Town of Estes Park, Colorado

Fall River Corridor Plan for Resiliency

Fall River Coalition

DRAFT January 2015

Prepared for:

Fall River Coalition

Town of Estes Park

Prepared by:

Walsh Environmental Scientists and Engineers, LLC

Robert Peccia & Associates

Flywater

Crane Associates

Anderson Consulting Engineers, Inc.

Great Outdoors Consultants

Round River Design

Table of Contents

Introduction

With its tight link to Rocky Mountain National Park, the Estes Valley is a treasure of our state, drawing over 3 million visitors annually. The Fall River corridor is a highly visible and important part of the experience, beginning its journey from headwaters in the Park, then flowing through Estes Park and joining the Big Thompson River in the heart of downtown. The Fall River Corridor is critically important to and well-loved by the many people who live, work, and play along it. With so much development located in the river corridor, reducing flood risk and improving stream health is essential for successful coexistence with the river.

Estes Park Condos Antlers Point Utility and Structure Damage

Fall River August 2014

Fall River is a typical mountain stream with coarse-grained bed materials (i.e, gravels, cobbles, and boulders) and relatively steep gradients that flatten as the stream moves farther down the valley. In Town, the most notable change in gradient occurs at the Elkhorn Lodge and this grade change contributed to the extensive sediment deposition on this property during the September 2013 flood event. Adequate stream corridor widths with low benches and terraces, for frequent floodplain access, are key requirements for stability and stream health in mountain streams like Fall River.

In September 2013, Fall River experienced a flood event. Damage due to floodwaters, erosion, and river location changes was rampant in the Fall River corridor. Estimates of peak flow for Fall River varied widely from 500 cubic feet per second (cfs) to 3,800 cfs (ICON, 2013; NRCS, 2013). Best consensus currently falls between 1,100 and 1,200 cfs, a peak flow range that falls between predicted values for the 50- and 100-year recurrence interval floods of 1,040 cfs and 1,670 cfs, respectively (CDOT, 2014). The primary reason for the damage, however, is the abundance of infrastructure, homes, and condos encroaching into the river corridor.

The flood of 2013 and subsequent scientific and planning efforts show that we still have much work to do in to achieve a healthy, resilient river system that protects both life and property during flood events.

With funding and technical support from the Colorado Water Conservation Board (CWCB) and the Office of Emergency Management (OEM), flood-affected communities were guided to create watershed coalitions and develop collaborative stream corridor master plans as the first critical step towards resiliency for our river systems, our economies, and our communities. The directive of the funding is to guide communities towards prioritization and implementation of flood recovery and stream restoration projects that protect life and property from hazards, while enhancing riparian ecosystems for wildlife and recreation.

In Estes Park, the **Fall River Corridor Plan for Resiliency** is the fruition of this directive and the first step in a decades-long journey of recovery and preparedness. The Plan is both a technical reference serving as a basis for final design, construction, and monitoring as well as a funding tool to support the grant writing process for flood recovery implementation funding.

The Fall River Plan is based on three base philosophies:

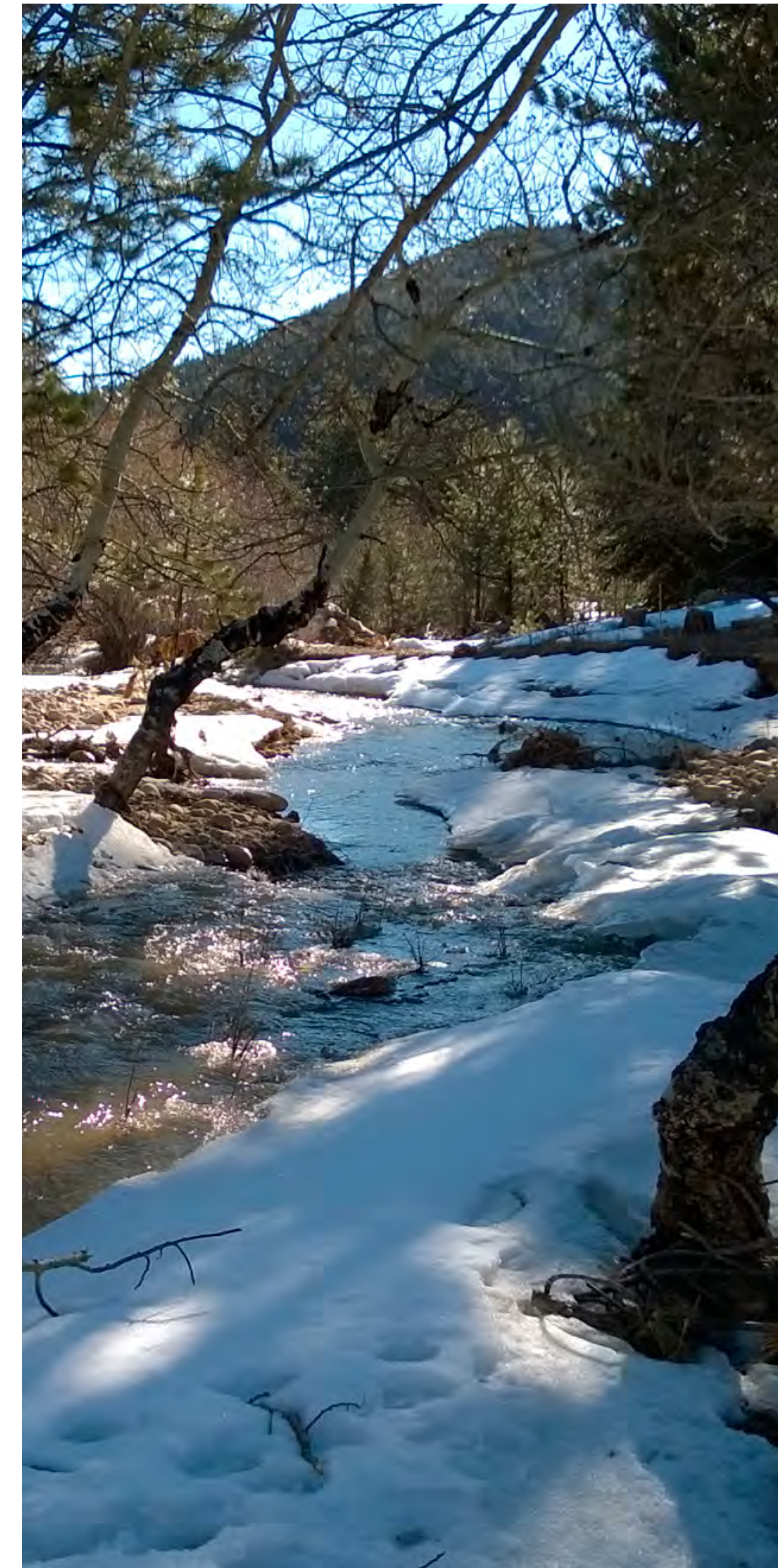
- Resiliency requires understanding the river and working with river processes, rather than forcing it into a mold of what we think it ought to be;
- A risk-based approach to planning is the only way to fully accommodate the complexities of river systems and inter-relationships with our roads, homes, and infrastructure; and
- With so many people impacted by the September flood, resiliency planning can only be successful by engaging a broad range of public, private, and non-profit stakeholders and through widespread outreach and education to garner public support.

The Plan defines the vision for resiliency and identifies goals to achieve the vision. Through education and outreach to date and critical ongoing education and outreach, the Plan fosters consensus driven and technically sound resiliency solutions that will be the foundation for project funding and implementation in both the short- and long-term.

Measures of success of the Fall River Plan include reduction of high risk areas (for both flood and geomorphic hazards), community understanding of the river corridor and associated risks, increased resiliency for long-term support of recreational, educational, and correlated economic opportunities, and healthy and functional fish and wildlife communities and native riparian plant communities.

With this Plan and the formation of the Fall River Coalition, which is transitioning to the broader and permanent Estes Valley Watershed Coalition, the Estes Park community embarks on the critical next step in flood recovery *to build permanent recovery work on a foundation of strong science and engineering, vetted through the communities it will benefit.*

We are on the path to resiliency for our river system, our economy, and our community.



Fall River Post Flood Infrastructure Damage

2 Introduction

2.1 Project Scope

The Master Plan report serves as a guide for ongoing flood recovery and river and watershed restoration planning, both in the short-term (1 to 2 years) and the long-term (2-20 year). The plan is built on a foundation of scientific assessments and engineering analysis and incorporates community values and ideas. The objectives of the Fall River Corridor Master Plan effort are to:

- Create a short-term (1-2 years) and long-term (2-20 year) implantable vision for recovery and restoration of identified priority areas on Fall River.
- Incorporate public input and guidance into the vision
- Focus on resilient solutions that consider hazards and stream health, including natural restoration, not just hard engineering
- Utilize qualitative and quantitative risk assessment tools that inform the short- and long-term planning decisions, considering flood and geomorphic risk
- Maximize funding opportunities through defensible prioritization of recovery and restoration projects and programs

The Fall River Corridor Master Plan effort is multi-disciplinary in nature, drawing on the expertise of engineers, fluvial geomorphologists, ecologists, fisheries biologists, and risk experts and informed by input from the community, including home and business owners.
The physical scope of the master plan is the Fall River Corridor from the Rocky Mountain National Park boundary to the confluence with the Big Thompson River in Estes Park, CO, and extending laterally through the valley bottom and up the valley walls. The technical scope addressed by the master plan is broad rather than detailed, and serves to best direct further work and funding on the Fall River to meet the community and stakeholder objectives. The ecological, geomorphic, and flood risk assessments are also large scale and were performed based on field assessments, existing data, and present-conditions model analysis. Cut-sheets were produced for the prioritized projects that provide an overview of objectives, benefits, implementation strategy, permitting requirements, cost estimates, and funding strategies. The cut-sheets do not provide designs for construction implementation but do serve as a basis to begin detailed engineering and design.

2.2 Community Process Approach

A watershed approach defines, analyzes, and addresses river and creek problems in a holistic manner and ensures that the stakeholders in the watershed are actively involved in selecting the management strategies that fit with their local and cultural values. This approach was used to shape the Fall River Plan for Resiliency, turning the focus of the plan away from localized problems and solutions and towards projects that fit within the context of the greater river system—both physical and social. One of the primary purposes of this approach was to improve resident and land owner awareness through education on the issues affecting

Fall River Stakeholder Collaboration

their river and watershed's resilience as well as the risks their property is exposed to.

Through the development of a common vision and over-arching goals for the river systems, the plan has suggestions for sequential and coordinated community actions in the years to come resulting from independent technical review and analysis and by involving a broad representation of stakeholders in the formation of the River Advisory Committee (RAC). Diverse interests were incorporated (including interests of NGOs and individuals) which worked to build participation and acceptance.

The partnerships formed in the development of the master plan established working relationships, improved communication, and allowed information to be shared all of which will allow the formation of the greater Estes Valley Coalition to succeed into the future. Furthermore, these partnerships encouraged conflict resolution, and promoted cooperation, while leveraging the talent and expertise, of the local individuals, organizations, and agencies, all of which collectively supports achievement of large-scale goals.

2.3 Risk Assessment Approach

Utilizing a risk based analysis is the best method to synthesize the massive extent of data, problems, and opportunities into scientifically defensible priority lists for funding and implementation. A risk-based approach has been utilized by the Dutch for over 30 years under their "Make Room for the River" program, as well as the states of Vermont and New York when dealing with post-hurricane recovery. Risk (R) is simply the probability (P) of occurrence multiplied by the consequence (C). For example, the National Flood Insurance Program (NFIP) maps floodplain boundaries for the 100-year and 500-year floods (which represents 1% and 0.2% probabilities (P) of occurrence), but risk (R) is not evaluated in this mapping because the consequences (C) of flood inundation in a given area are not considered. Furthermore, the flood mapping is based on one channel alignment and geomorphic hazards (e.g., mudslides, channel avulsions [channel takes new path]) are not considered. The damage incurred in the flood-affected corridors during the September 2013 flood has been approximated as greater than 60% of

The Evergreens on Fall River

Fall River Road Workshire Lodge

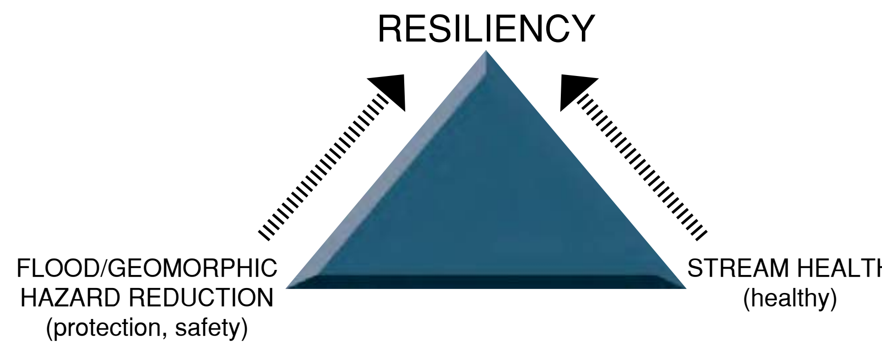
the damaged area occurred outside of the mapped 100-year floodplain boundaries. Therefore, the risk-based analysis adopted for this Master Plan effort addresses geomorphic risk along with flood risk.

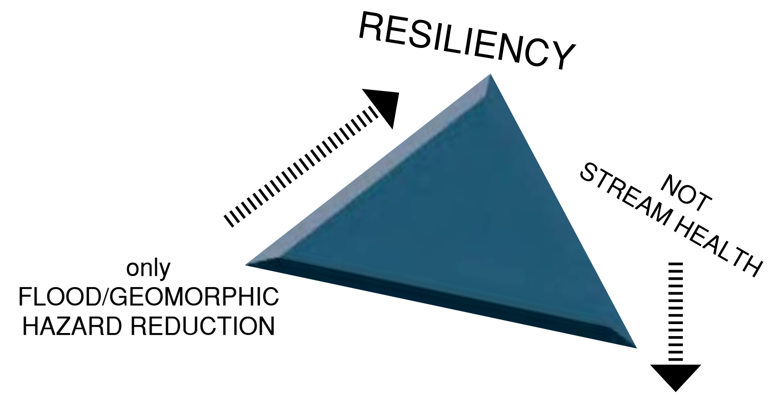
A successful risk reduction approach does not have a single answer. Multiple risk reduction goals are necessary to address myriad river conditions and land uses. Although there is always a residual risk, acquisition of high hazard properties is the closest to reducing risk to zero. Successful risk reduction also considers an acceptable percent of reduction. Changing from 2 pedestrian bridges to 1, for example, cuts the risk of debris jam in half locally.

2.4 Resilient Solution Approach

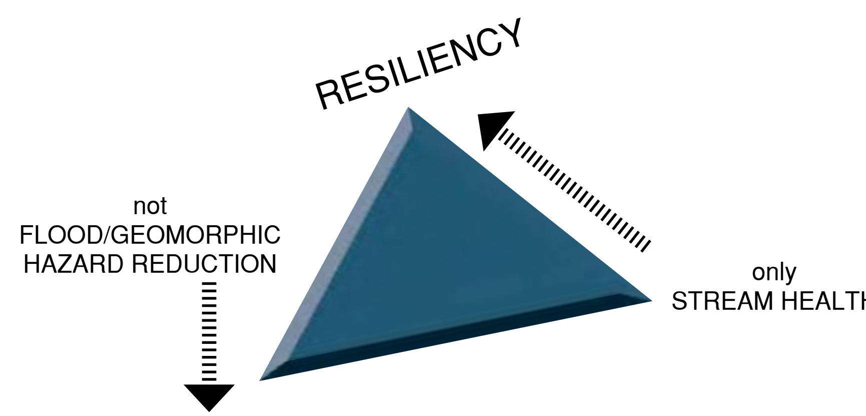
The Fall River Corridor Master Plan approach considers both hazard reduction and stream health to identify truly resilient solutions. Resiliency is not synonymous with safe or healthy or sustainable, it requires both hazard reduction for protection & public safety and healthy streams for the flexibility of the system to bounce back from the flood impacts.

Fall River August 2014





Resiliency NOT achieved by traditional approaches to flood mitigation, if stream health is ignored



Resiliency NOT achieved through stream health alone, assets must be protected and safety must be ensured

Fall River August 2014

Traditional flood mitigation approaches select a target streamflow (often 100-year), then design hard structures to resist the hydraulics of the target flow. This approach focuses only on safety – and only on conditions occurring for the few days the river is in flood stage. This design may be seen as successful at or below the target flow, but there is always a potential for a bigger flow, and with no flexibility, the stream is not able to adjust itself and catastrophic failure is a typical result. Moreover, this approach also sacrifices stream health (physical river processes of moving sediment and water, as well as the ecological complexity of the stream system) every day the river is not in flood stage.

Conversely, resiliency is not achieved by focusing only on stream health. When we have assets (homes, businesses, bridges, etc.) located along our stream corridors, protecting them and ensuring safety is a necessary part of resiliency.

Master Plan Goals

The Master Plan report will serve as a guide for future recovery and restoration planning, both in the short-term (1 to 2 years) and the long-term (decades).

Built on a foundation of strong science and engineering and vetted through the community.

It will create strategies to reduce the impact of future flooding and geomorphic hazards AND **create strategies** to restore ecological health, including wildlife habitat, fish passage, and wetland, riparian, and river improvements.

Maximize funding opportunities through defensible prioritization and project cut sheets.

Resilient Solutions

1st Tier: potential acquisition to remove an asset from a high hazard area should be considered first for maximum risk reduction.

2nd Tier: when acquisition is not an option, the owner makes an informed decision to stay.

3rd Tier: now engineering solutions, local scale and system-wide, can be considered to best protect the asset, the community, and to improve stream health for true resiliency.

Visit fallrivercoalition.org for examples of resilient versus static solutions.

New Master Plan Timelines

Work with your RAC Captain in August and watch for the draft master plan report in September and the final report in October

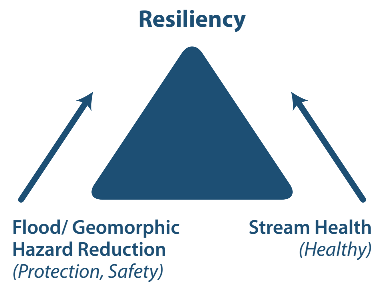
Fall River Coalition

Fall River Corridor Master Plan

River Master Planning for Resiliency

re•sil•ience

1. the ability of a substance or object to spring back into shape; elasticity.
2. the capacity to recover quickly from difficulties; toughness.



What is Fluvial Geomorphology?

The scientific study of landform development and change under processes associated with running water.

Why is it so important?

To make sound decisions for flood recovery and restoration, we must fully understand the geomorphic processes that drive stream behavior. Understanding river processes allows us to predict response to treatments and to work with Fish Creek, not accidentally against it, for solutions that will stand the test of time.

Contact Information

Website **fallrivercoalition.org**
Facebook **facebook.com/FallRiverCoalition**
Email **fallriver@estes.org**

Fall River Coalition

Fall River Corridor Master Plan

Fall River Corridor Mast

Our vision for resiliency is to work wit and the public to plan for safe, health resilient stream corridors

Be Involved!

Information on project dates, techn educational resources is available:

- through your **River Advisory Com Captain** (see inside!)
- **website:** *fallrivercoalition.org*
- **Facebook:** *facebook.com/FallRiver*
- **email:** *fallriver@estes.org*

fallrivercoalition.org facebook.com/FallRiverCoalition fallriver@estes.org

What are we Doing that's New?

Master Planning for Resiliency

The master plan considers both hazard reduction and stream health to identify truly resilient solutions, rather than static treatments that only harden the river.

Risk, R = P x C

Probability of occurrence X consequence.

We are taking a risk-based approach to planning and this is new in the U.S. The Dutch have 30 years under their "Make Room for the River" program. Post Hurricanes Sandy and Irene, VT and NY have started…and now Colorado.

Flood and Geomorphic Risk

Most of the damage caused by the September 2013 flooding occurred outside of our mapped 100-year floodplain areas. We were harmed by channel avulsions (new channel paths) and landslides. These are geomorphic hazards.

We need to plan based on both flood and geomorphic risk!

What is Successful Risk Reduction?

Not just one answer. We will need multiple risk reduction goals to address myriad river conditions and land uses.

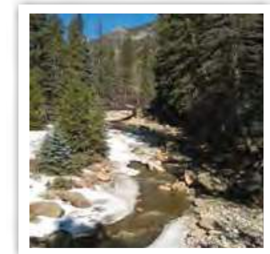
Reduce Risk to Zero. Although there is always residual risk, acquisition of high hazard properties is the closest to reducing to zero.

Reduce Risk by an Acceptable Percent. Changing from 2 pedestrian bridges to 1, for example, cuts the risk of debris jam in half locally.

Simply ensure safe access for all in next flood.

What is the River Advisory Committee?

The RAC is the heart of the master planning process.



A workgroup of citizens, the Town, and agencies that work directly with the master plan technical team to:

- define issues;
- evaluate projects and management strategies;
- foster ownership of the planning process; and
- provide input on the master plan.

System for 2-way communications:

- deliver information from the technical team to the community; and
- bring community issues and input to the team.

Tell your RAC captain what level of involvement is right for you for the remainder of the master planning process.

Fall River RAC Neighborhood Captains

Stream Reach	Description	Neighborhood Captain
Upper Reach	Park boundary downstream to Fish Hatchery Road (Antler's Point)	*Bill Oliver* *Warren Clinton*
Middle Reach	Fish Hatchery Road (Bugle Point) downstream to Deer Crest	*Ken Larson*
Lower Reach	Deer Crest to Silver Moon	*Frank Theis*
Downtown Reach	Silver Moon downstream to confluence with Big Thompson, including lower/ Downtown reach of Big Thompson	*Ron Wilcox*

Technical and Educational Resources

Field assessments are complete and results are available at fallrivercoalition.org:

Ecological Assessment: provides an initial evaluation of the overall condition of Fall River, its riparian zones and instream habitats, to understand trends in stream and riparian conditions through time.

Flood Risk Assessment: identifies assets (buildings, infrastructure) at risk of damage during flood event.

Geomorphic Risk Assessment: enables understanding of river processes to support appropriate solutions that will work with the river to provide the best long-term protection. Planning-level Channel Migration Zone (pCMZ) maps have been created to identify highest hazard areas where the channel may re-occupy historic areas that were not previously on our radar.

Also visit fallrivercoalition.org for past presentations and reporting, native revegetation guidance, and more.

Did you know?

With required permits, landowners may complete channel work on their property to protect it. The purpose of permits is to ensure no adverse effects. Please coordinate with the RAC and technical team for assistance.

We want to hear from you!

Values and Evaluation Criteria Ranking Form enclosed.

Please complete and return **BY AUGUST 22** to your RAC Captain or to

Estes Park Community Development
P.O. Box 1200, Estes Park, CO 80517
or *planning@estes.org*

Fall River Coalition flyers served as an overview reference on the RACs themselves, as well as what is driving the master planning work, why change is needed, and how we can go about making that change together. They also served as a quick reference to the coalition website and Facebook pages,.

The flyers were distributed door to door by Mountain Outreach and the RAC captains to keep the residents informed of the plan for resiliency activities.

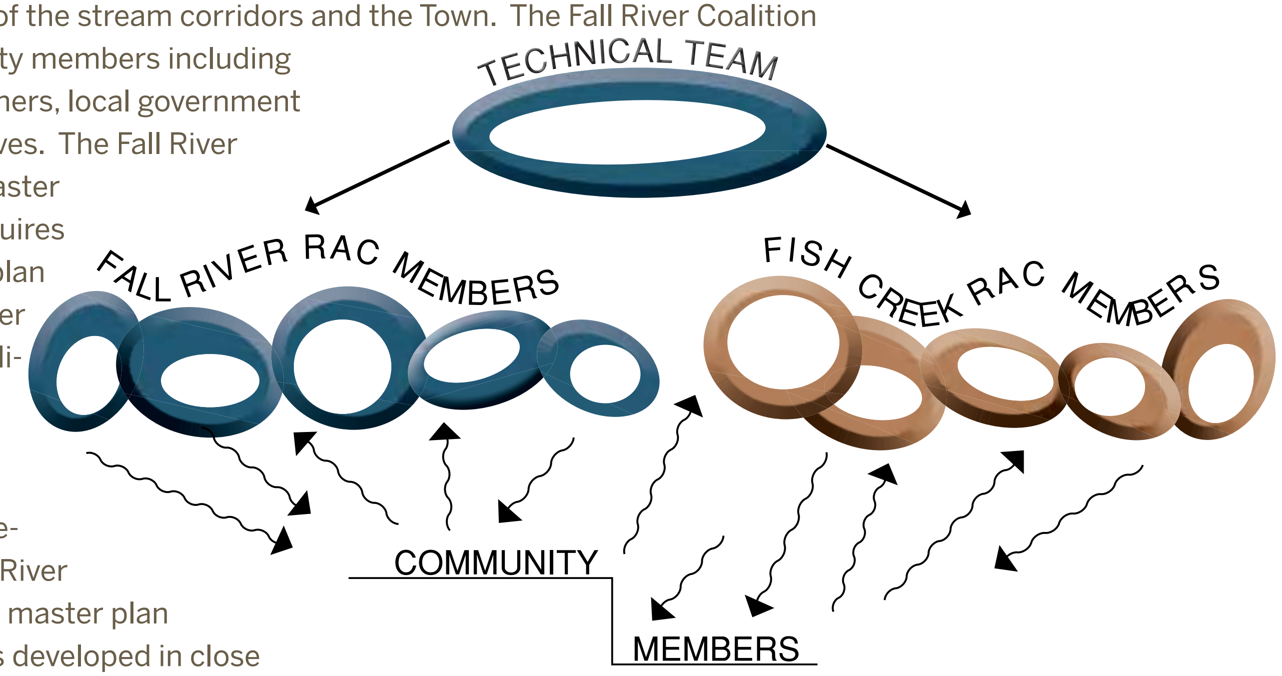
Public Meeting #2 April 2014

Estes Park Flood Expo August 2014

3.0 Community Outreach and Involvement

3.1 Objective

The preeminent objective guiding the development of the master plan was to set forth recommendations that were developed and vetted through a consensus based community process. To best accommodate the many different parties with interests in the Fall River corridor, the Town of Estes Park helped to assemble the Fall River Coalition to coordinate interested parties and most effectively advocate for health and resiliency of the stream corridors and the Town. The Fall River Coalition is comprised of representative community members including residents, business owners, property owners, local government agencies and Town of Estes representatives. The Fall River Coalition was built in the wake of the disaster upon the belief that the path forward requires a fundamental shift in how we view and plan for our rivers. While many think of the river as a problem that must be fixed, the Coalition sees the river as the linchpin in the solution.



To conduct flood recovery work a comprehensive approach, restoration of the Fall River corridor, will begin with the river corridor master plan development effort. The Master Plan was developed in close coordination with the Fall River Coalition in a series of public meetings, workshops, outreach, educational seminars and meetings, facilitated by the Master Plan Team and the Town of Estes Park.

A watershed approach defines, analyzes, and addresses river and creek problems in a holistic manner and ensures that the stakeholders in the watershed are actively involved in selecting the management strategies that fit with their local and cultural values. This approach was used to shape the Fall River Corridor Master Plan, turning the focus of the plan away from localized problems and solutions and towards projects that fit within the context of the greater river system—both physical and social. One of the primary purposes of this approach was to improve resident and land owner awareness through education on the issues affecting their river and watershed's resilience as well as the risks their property is exposed to.
Through the development of a common vision and over-arching goals for the river systems, the plan has suggestions for sequential and coordinated community actions in the years to come resulting from independent technical review and analysis and by involving a broad representation of stakeholders in the formation of the River Advisory Committee (RAC). Diverse interests were incorporated (including interests of NGOs and individuals) which worked to build participation and acceptance.

The partnerships formed in the development of the master plan established working relationships, improved communication, and

Fish CreekPublic Meeting #1

Larimer County Flood Open House March 2014

allowed information to be shared all of which will allow the formation of the greater Estes Valley Coalition to succeed into the future. Furthermore, these partnerships encouraged conflict resolution, and promoted cooperation, while leveraging the talent and expertise, of the local individuals, organizations, and agencies, all of which collectively supports achievement of large-scale goals.

3.2 Master Plan Team

3.2.1 Formation and member entities Includes:

- Fall River Coalition
- Town of Estes Park – Community Development Department
- Technical Team
- River Advisory Committee

The technical team for the Plan for Resiliency is composed of professionals in multiple disciplines including engineering, fluvial geomorphology, risk analysis, ecology, landscape architecture and fisheries. The technical team includes Walsh Environmental, Robert Peccia & Associates (RPA), Crane Associates, Anderson Consulting Engineers (ACE), Round River Design and FlyWater.

The heart of the Fall River master planning process is the River Advisory Committee (RAC) which is a means to foster ownership of the planning process in the community, create a constant stream of public engagement, promote understanding of the issues and process, and expedite the acceptance and implementation of a final plan. The RAC held monthly meetings (or conference calls) which informed and guided the planning process. It is a forum in which invested individuals and organizations have the opportunity to help define values and vision, define issues, proposing projects and management strategies, and provide input on the final plans. Having representatives from every reach of the river, and from all sectors of the community, encourages all members and the planning team to consider Fall River as system-keys for the plan's success.

3.3 Public engagement process

A number of public outreach activities were conducted to assist in the planning process. This section describes the various public engagement techniques that were conducted during the development of the Fall River Corridor Plan for Resiliency.

3.3.1 Stakeholders

Stakeholders and agencies helped direct the development of the Fall River Corridor Plan for Resiliency, and provided input via meetings, work sessions, and a Fall River coalition website and Facebook page comment tool. Monthly meetings with representatives from Estes Park, the Technical Team and the RAC's were conducted at various location in Estes Park throughout the duration of the project to share information.

The stakeholders included:

- Town of Estes Park – Public Works Department
- Estes Valley Recreation and Park Development
- Estes Valley Land Trust
- Larimer County
- Home and Business Owners
- Rocky Mountain National Park
- the Estes Area Lodging Association
- Upper Thompson Sanitation District
- Estes Valley Recreation and Parks District

3.3.2 Public Meetings

A series of public meetings were conducted for the for the Fall River plan. The meetings were intended to inform the public of Plan activities and solicit input for the project.

Public meeting dates;
March 14, 2014 Fall River - Public Meeting #1
April 21. 2014 Fall River Public Meeting #2
November 10, 2014 - Draft Master Plan Open House

3.3.3 River Advisory Committee (RAC)

The heart of The Fall River Plan for Resiliency planning processes was to create a River Advisory Committee (RAC) for the corridor. The RAC was a means to foster ownership of the planning process in the community, create a constant stream of public engagement, promote understanding of the issues and process, and expedite the acceptance and implementation of a final plan.

The RAC held monthly meetings which informed and guided the planning process. It was a forum in which invested individuals and organizations had the opportunity to help define values and vision, define issues, proposing projects and management strategies, and provide input on the Plan for Resiliency.

In addition RAC neighborhood captains were assigned to designated reaches of Fall River. These neighborhood captains helped the planning team facilitate contact and discussions with all property owners as well as hold organized individual meetings with specific homeowners.

RAC meeting dates;
Fall River RAC meeting #2 - Wednesday July 30, 2014
Fall River RAC meeting #3 - August 14, 2014
Fall River RAC Meeting #4 - August 27, 2014
Fall River RAC meeting #5 - September 24, 2014

Fall River RAC neighborhood captains

Stream Reach	Description	Neighborhood Captain
Upper Reach	Park boundary downstream to Fish Hatchery Road *(Antler's Point)*	Bill Oliver & Warren Clinton
Middle Reach	Fish Hatchery Road *(Bugle Point)* downstream to Deer Crest	Ken Larson,
Lower Reach	Deer Crest to Silver Moon	Frank Theis
Down-town Reach	Silver Moon downstream to confluence with Big Thompson, *including lower/ Downtown reach of Big Thompson*	Ron Wilcox & Bob Fixter

FALL RIVER and/or FISH CREEK please circle for which corridor you are completing this form

PART 1: PERSONAL VALUES

What do you and your family value in the Fall River and Fish Creek Corridors? Please check all that apply:

- ☐ Soothing natural aesthetic
- ☐ Important for wildlife habitat
- ☐ Bird watching, wildlife viewing
- ☐ Supports healthy, native plant communities
- ☐ Socializing, source of community pride (e.g., the annual duck race)
- ☐ Other:
- ☐ Important draw for business
- ☐ Hike along it, fish it, wade in it, skip rocks, build sandcastles, and more
- ☐ Important for water quality, air quality groundwater replenishment, soil stabilization
- ☐ Protection/ expect it to not threaten my property

PART 2: Evaluation Criteria

The Fish Creek and Fall River Corridor Master Plans rely on many criteria to evaluate, rank, and prioritize potential flood recovery and restoration projects. Listed below you will find a list of many of the characteristics, goals, objectives, and benefits of potential projects. **Please rank on a scale of 0 to 5, with 5 being the highest score possible, how important each of these statements is to you with regard to Fall River and Fish Creek recovery and restoration.**

— Address safety of the public and residents
— Restore public access and utility service without restricting access to private properties
— Provide access to recreational amenities, schools, and businesses
— Allow continued utility service during construction
— Reduces flood and geomorphic hazards to reduce future damage
— Increases river stability, reduces future erosion
— Improves stream health
— Complete projects in the shortest time possible
— Complete the reconstruction while lowering risk to permanent infrastructure and the public
— Create infrastructure investments that are reasonable to construct
— Projects with best value for their life cycle
— Meet Federal and Local standards for design
— Effectively uses undamaged infrastructure
— Incorporates new flood flow/ rainfall information
— Is innovative
— Provides neighborhood and reach scale solutions requiring multiple land owners to come to consensus
— Enhance tourist destinations
— Enhances access to tourist destinations
— Enhances access to community facilities, and neighborhoods
— Enhances access to neighborhoods
— Other:
— Enhances *local* natural outdoor recreational opportunities such as trails (hiking ,biking, and equestrian) and fishing
— Enhances *regional* natural outdoor recreational opportunities
— Enhances community supported recreation opportunities such as golf, camping and water based activities (canoeing, kayaking, stand up paddleboarding, motorboats, waterskiing etc.)
— Enhance neighborhood & community livability
— Enhance neighborhood & community aesthetics
— Preserve neighborhood & community culture & history
— Incorporate input from property owners
— Incorporate input from the community
— Incorporate input from conservation and environmental organizations
— Incorporate input from businesses and business leaders
— Protect and enhance fish habitat
— Protect and enhance avian habitat
— Protect and enhance beaver habitat
— Protect and enhance stream corridor vegetation
— Enhances water quality
— Provides the corridor with multiple benefits (e.g. flood mitigation, habitat enhancements, recreation and public access)
— Limits maintenance costs
— Uses locally available materials
— Uses environmentally friendly processes

Please return completed form by Oct 20, 2014 to the Town of Estes Park Community Development Department at planning@estes.org or PO Box 1200, Estes Park, CO 80517.

3.3.4 Values & Evaluation Criteria Survey

The Fall River Plan for Resiliency relies on many criteria to evaluate, rank, and prioritize potential flood recovery and restoration projects. A survey was created to evaluate and help define characteristics, goals, objectives, and benefits of potential projects for the Plan for Resiliency. They were ranked on a scale of 0 to 5, with 5 being the highest score possible, of importance the statements are to the residents for Fall River recovery and restoration.

Fall River Coalition Website

Fall River Coalition Facebook Page

3.3.5 Project Website and Facebook Page

A project website was created to assist in keeping the Fall River residents up to date on project milestones and progress. The website was a portal for information about Meetings/ events, comments, related efforts, flood resources, and weekly updates.

The Facebook page was used for meeting notifications, public comments, and notifications of other planning efforts.

this page intentionally blank

Before and After Baldplate Inn

4.0 Watershed Background and Description

4 Watershed Background and Description

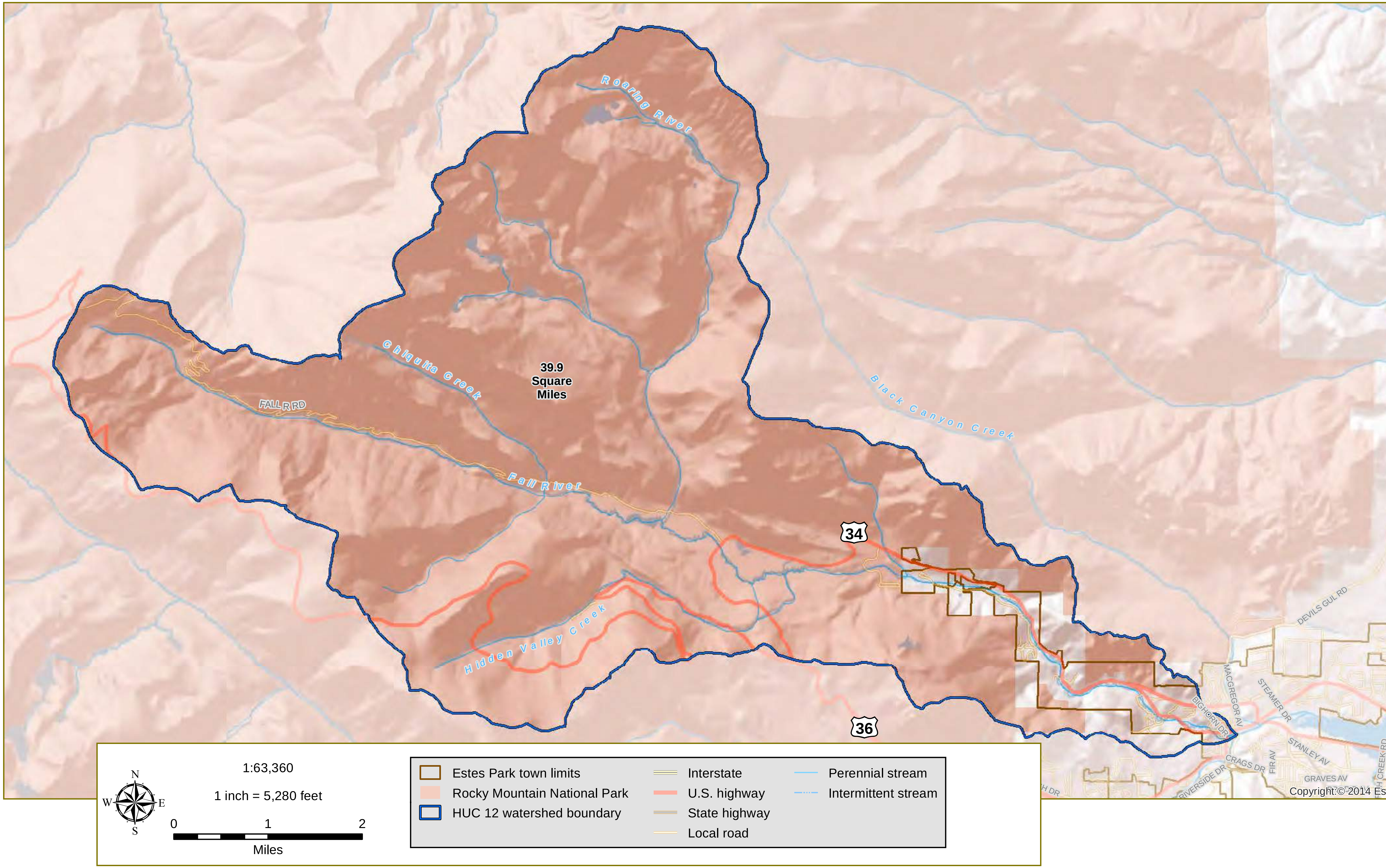
4.1 Location

The Fall River watershed is approximately 39.9 square miles located in the northeastern Rocky Mountains in Larimer County, CO. Fall River is approximately 17 miles long, and is a tributary of the Big Thompson River. The headwaters are in Rocky Mountain National Park, and Fall River flows directly out of the park east towards the Town of Estes Park along Fish Hatchery Road and Highway 34 – Fall River Road.

The elevation in the watershed ranges from 13,514 feet at Ypsilon Mountain and 7,530 feet at the confluence with the Big Thompson in Estes Park. The climate is defined by cold winters and warm summers with average temperature in Estes Park of 44F. In the past decade, Estes Park received an average of 13 inches of precipitation a year.

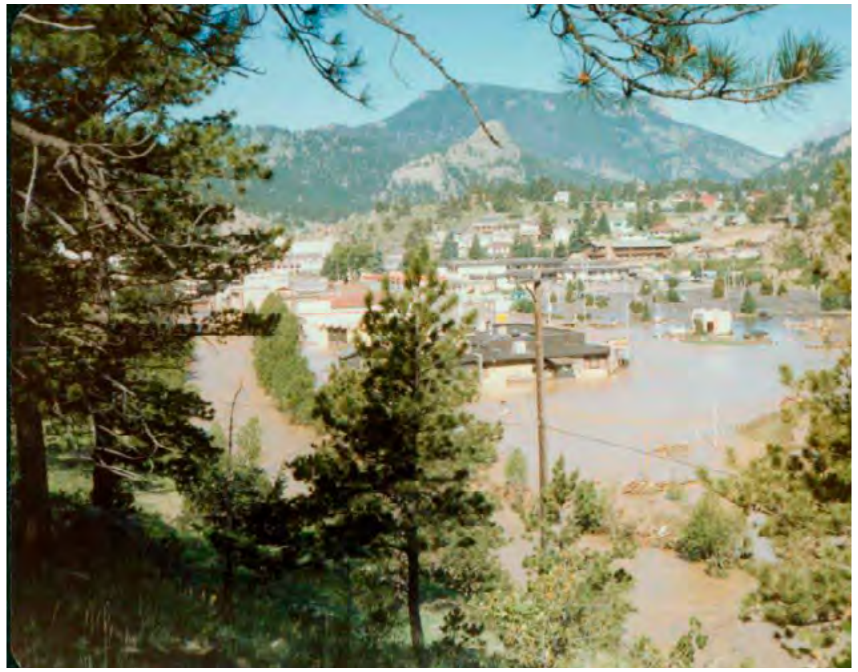
The upper portion of Fall River is within Rocky Mountain National Park and largely undeveloped and relatively pristine. The lower five miles of Fall River flows through a canyon with a developed zone where residences and businesses are located up to the river's edge. Within this lower zone, the last mile is in located in the heavily commercial downtown business district of Estes Park where the river is primarily contained between vertical concrete walls and building foundations. Through the four miles upstream of downtown, the river flows through medium density residential areas that are used for some year-round residences but are primarily vacation accommodations and seasonal condos. The residential population along Fall River is a combination of permanent and short-term tourist residents. The total population increases dramatically during the warmer tourist season in the summer.

The Fall River Corridor economy varies from the upper watershed to the residential and business sections of the lower watershed, though they are all interconnected. The upper watershed in Rocky Mountain Nation Park generates a destination for tourists that shapes the whole corridor. The residential section of the Fall River Corridor includes temporary accommodations including condominiums and hotels for these visitors. Businesses in downtown Estes Park at the confluence of Fall River and the Big Thompson River are primarily based around tourist economy with restaurants, candy stores, and souvenir shops. Fall River provides a draw to residents and visitors throughout the corridor. In addition to providing a strong aesthetic value, it also provides recreational opportunities for residents and visitors.

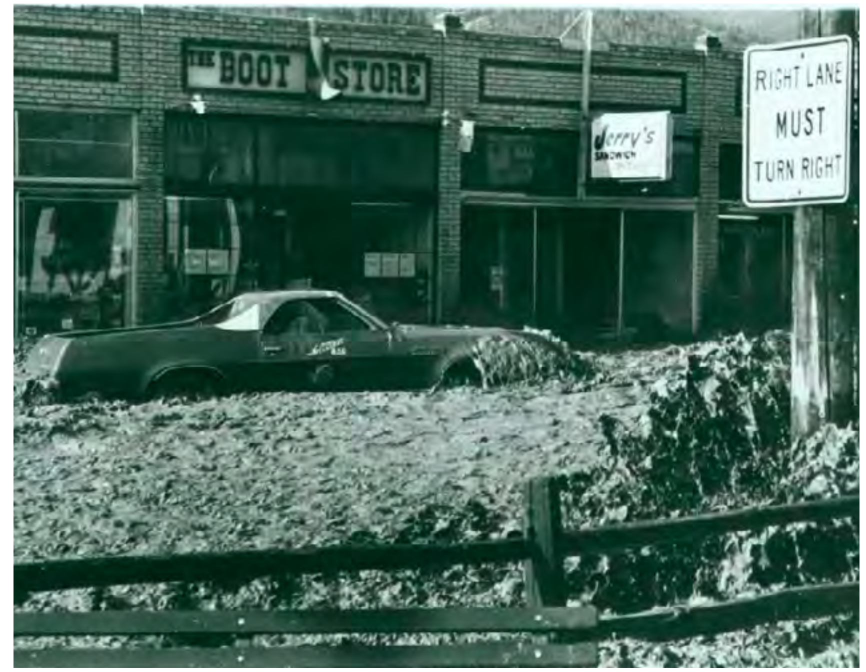

Roaring River
Chiquita Creek
39.9 Square Miles
FALL R RD
Fall River
Black Canyon Creek
34
Hidden Valley Creek
36
DEVILS GUL RD
MACGREGOR AV
STEAMER DR
BIGHORN DR
STANLEY AV
CRAGS DR
RIVERSIDE DR
GRAVES AV
Copyright:© 2014 Esri
1:63,360
1 inch = 5,280 feet
0
1
2
Miles
Estes Park town limits
Rocky Mountain National Park
HUC 12 watershed boundary
Interstate
U.S. highway
State highway
Local road
Perennial stream
Intermittent stream

4.2 Flood History

4.2.1 Historic



1982 Flood waters through Estes Park During the Lawn Lake Flood. Photo Courtesy of the Estes Park Museum.



Rushing water on Elkhorn Ave. during the 1989 Lawn Lake Flood. Photo Courtesy of the Estes Park Museum.

Elkhorn Ave. during the 1989 Lawn Lake Flood . Photo Courtesy of the Estes Park Museum.

1982 Lawn Lake Flood at Ponderosa Lodge on Fall River. Photo Courtesy of the Estes Park Museum.

4.2.2 September 2013 flood

The floodwaters of the September 2013 storm event carried extremely large volumes of fine and coarse grained sediments through and into the Town of Estes Park. The type of storm created a sediment supply that was in excess of the transport capacity to convey the material, resulting in significant deposition in both the channels and overbanks. The deposited materials are now available for transport during the spring runoff, which will not likely flush it entirely from the system. Rather, sediments will move episodically downstream and redeposit, eventually moving through over the course of several runoff events.

In the cobble bed system of Fall River, fine grained sediments were deposited along the tops of banks where flows overtopped the streambanks and accessed adjacent floodplain areas. The overtopping and associated energy loss is evidenced by extensive sand deposition paralleling streambanks in these areas. Coarser grained materials, cobbles and gravels, were carried in-channel by the rivers until similar energy losses occurred within the main channel. Most typically in Fall River and Big Thompson, coarse grained sediments were deposited upstream of bridges and culverts, where the constrictions caused sufficient backwater for deposition. More abrupt changes from steeper to milder gradients increased the energy loss and corresponding deposition in some areas. In some cases, utility line or similar crossings include notable raises in channel invert, which would flatten the upstream gradient and effect an abrupt gradient change for the area.
Several sites on Fall River have been identified as ‘high threat’ as a result of the changes incurred by the 2013 flood.

Elkhorn Lodge to Confluence

The threat at this site is tied to the large-scale deposition of cobbles and gravels and significant aggradation of the channel bed, based on relative elevation against the adjacent Fall River Road. Deposition in this reach exceeds 200 feet in lateral extent and over 600 feet in length. In September 2013, floodwaters overtopped the road in this reach and were captured by the road, which prevented them from re-accessing the road before reaching the downtown area.

With the impending high flows of annual spring runoff, this location of substantial aggradation poses an imminent threat to buildings and infrastructure in the immediate vicinity due to higher water surface elevations. If elevated bed elevations hold during runoff, the main channel will have reduced capacity and more out of bank flow. This overflow condition was a major contributor to damage to Town buildings and infrastructure during the September flood. Threatened buildings and infrastructure in the immediate vicinity include two historic barns slated for renovation, a restaurant, Fall River Road, and a sewer main that crosses the channel above the culvert, as well as 10 buildings at lower elevation on the north side of Fall River Road. The threat at this site includes an additional 50 businesses located downvalley in the downtown area because, as evidenced in September, once flows are captured by the road, they are not quickly returned to the channel and cause extensive damage as they continue downvalley before eventually reconnecting with the river.

The close proximity of the channel to the road in this reach additionally presents the threat of a washout to the road. Streambanks along Fall River Road are destabilized post-flood, including a loss of stabilizing vegetation. Instabilities in this reach pose a threat to the culvert on Fall River Road located just downstream.

The threat at the Water Wheel site, located within this reach, is tied to insufficient channel capacity that is potentially aggravated by aggradation of the channel bed during the September 2013 floods. Floodwaters overtopped the road in this reach during the September floods, joining the out of bank flow from the Elkhorn Lodge reach located upstream. With the impending high flows of annual spring runoff, this location of insufficient channel capacity poses an imminent threat to buildings and infrastructure in the immediate vicinity due to higher water surface elevations. Threatened buildings and infrastructure in the immediate vicinity include 50 businesses located downvalley in the downtown area. Additionally, the culvert under Fall River Road is at threat of increased potential for blockage by current conditions.

Elkhorn Lodge to Confluence

Elkhorn Lodge to Confluence

Town Bridge at Fall River Court

The threat at this site is tied to insufficient channel capacity that is potentially aggravated by aggradation of the channel bed during the September 2013 floods. Aggradation is expected at a minimum of 4 feet of cobble and woody debris deposition. With the impending high flows of annual spring runoff, this location of insufficient channel capacity poses an imminent threat to the Town Bridge, as well as additional buildings in the immediate vicinity, due to higher water surface elevations. The obstructed bridge is also at threat of increased potential for blockage by current conditions. Utilities on and around this bridge include sewer, water, and electric lines. This bridge provides the primary access to entire subdivision.

Town Bridge at Fall River Court

5 Data Collection

5.1 GIS Data and Mapping

GIS data and mapping was employed in the risk analysis and project recommendation phases of the master plan. The data employed includes publicly available data and GIS data generated by the technical team in the process of various risk assessment tasks. The following table summarizes the public data utilized in the master planning effort

In the process of completing the risk assessments GIS boundaries were developed for the ecosystem quality, planning-level Channel Migration Zone, and floodplain extents for the post-flood condition.

Data Type	Source	Date
Post-flood Aerial imagery	Larimer Emergency Telephone Authority (LETA)/Digital Globe	2013
Pre-flood Aerial imagery	Bing/ESRI	2011
Pre-September 2013 River Alignment	LiDAR - NEON/NSF Grant No. DBI-0752017	2011
Post-September 2013 River Alignment	Preliminary LiDAR - FEMA/Photo Science Geospatial Solutions	Feb 2014
Parcels	Larimer County	July 10, 2014
Utilities (Potable water and Sanitary Sewer)	Town of Estes Park	June 3, 2014
Pre-September 2013 Trail Alignment	Town of Estes Park	Mar 2013
Estes Park Town Limits	Town of Estes Park	No metadata
Rocky Mountain NP Limits	Town of Estes Park	No metadata
Road Alignments	Town of Estes Park	Mar 2013
Floodplains (FIRM)	FEMA	Mar 2013
Post-Awareness Floodplains	Colorado Water Conservation Board (CWCB)	Sep 2014

Post Flood Imagery

5.2 Identified Reaches

As a first step in the rapid geomorphic assessment, Walsh scientists and engineers identified geomorphic reaches, or sections of the Fall River, with roughly homogenous physical and dynamic characteristics. The purpose of delineating reaches is to "break down" river networks into physically homogenous sections for planning purposes. These reach characteristics can then be used to "build-up" an understanding of the systemic interactions within the watershed. Geomorphic reaches were identified based on one or more of the following criteria:

- Changes in gradient (proportional to sediment transport capacity)
- Changes in valley width and channel confinement
- Tributary junctions (changes in the ratio of sediment transport capacity to sediment supply)
- Changes in channel pattern (sinuosity)
- Changes in infrastructure that control lateral erosion and migration
- Changes in geology/ erodibility of adjacent valley slopes
- Changes in land use

In total, 17 geomorphic reaches were identified within the Fall River study area (Table XX and Figure XX).

Biological assessment protocols (SVAP2) call for ecological "reaches" that are frequently shorter than the geomorphic reaches described above. The rapid ecological assessment of the Fall River corridor conducted by Walsh scientists identified 22 reaches during the ecological assessment. The additional reaches identified were frequently a subdivision of the geomorphic reaches based on changes in streamside development or vegetation.

Table 2 Fall River Reach Break Descriptors

Reach Name	Downstream End	Upstream End
1	Confluence with Big Thompson River	Park Theatre
2	Park Theatre	W Elkhorn Ave. bridge
3	W Elkhorn Ave. bridge	Sunny Acres Ct. bridge
4	Sunny Acres Ct. bridge	Old Ranger Dr. bridge
5	Old Ranger Dr. bridge	Fall River Ln. bridge
6	Fall River Ln. bridge	4 Seasons Inn
7	4 Seasons Inn	Pedestrian bridge
8	Pedestrian bridge	Nicky's Restaurant
9	Nicky's Restaurant	Castle Mountain Lodge
10	Castle Mountain Lodge	James McIntyre Rd. bridge
11	James McIntyre Rd. bridge	Homestead Ln. bridge
12	Homestead Ln. bridge	Boulder Brook bridge
13	Boulder Brook bridge	Diversion dam downstream from Fall River Ct.
14	Diversion dam downstream from Fall River Ct.	River Stone/Bear Paw bridge
15	River Stone/Bear Paw bridge	Pedestrian bridge upstream from David Dr.
16	Pedestrian bridge upstream from David Dr.	Fish Hatchery Rd. bridge
17	Fish Hatchery Rd. bridge	100 feet downstream of Fawn Valley Inn
18	100 feet downstream of Fawn Valley Inn	100 feet upstream of Fawn Valley Inn
19	100 feet upstream of Fawn Valley Inn	Fish Hatchery Rd.
20	Fish Hatchery Rd.	Bridge at Fall River Hydroplant/Confluence with Bighorn Creek
21	Bridge at Fall River Hydroplant/Confluence with Bighorn Creek	700ft downstream of Cascade Cottages Bridge
22	Bighorn Creek Confluence	Bighorn Creek at HWY 34

5.3 Field Work

Fall River field work consisted of a Rapid Geomorphic and Rapid Ecological assessment. The field technical team conducted this work in March and April of 2014 by observing the Fall River at strategic access points from confluence with the Big Thompson River up to the National Park Boundary[1]. Aerial photographs printed at large scale were used as base maps and were marked up with notes during the assessment. Photographs were taken at each reach to document existing conditions. Sites of particular geomorphic or biologic interest were also photographed – specifically as project development ideas were being discussed. The team completed the SVAP2 field data sheets collectively and discussed geomorphic conditions, processes, and stressors. Follow up field visits were conducted in June and July to confirm existing, reference, and potential geomorphic conditions.

1 The field team drove into the National Park along Fall River Road to explore the upper watershed, the Lawn Lake alluvial fan, and other features but did not conduct assessments within the Park.

Technical Team Conducting Corridor Evaluations

Fall River Key Map

5.4 Values & Evaluation Criteria Survey

A public survey of personal values and evaluation criteria was used to guide and compare the recommended projects. To improve continuity with other organizations working on flood recovery, the survey used for the master plan was based on the survey developed for the Fish Creek Infrastructure Re-Build project funded by the FEMA Public Assistance program and administered through Larimer County. The survey asked the participant to mark which of nine values they personally held for the river, and then to give each of 39 evaluation criteria a rank between 0 and 5 for importance to them. Both the personal values and evaluation criteria sections had spots to write-in other responses. Public surveys were distributed at the public meetings, through the coalition website, through the coalition's facebook account, by email, and by US mail to local residents. A total of 23 survey responses were received, and the results of the survey are summarized below.

5.5 Related Plans and Documents

Numerous other studies and planning efforts were used to support the development of the Fall River Corridor Master Plan. These documents provide scientific, social, and political basis for this plan.

- Fish Creek Corridor Master Plan (November 2014)
- Estes Valley Comprehensive Plan (December 16, 1996, revised 2014)
- Big Thompson River Master Plan
- Left Hand Creek Watershed Master Plan
- St. Vrain Creek Watershed Master Plan
- Coal Creek Watershed Master Plans (Upper and Lower Reaches)
- Boulder Creek Watershed Master Plan (Lower Reaches)
- Fourmile Creek Watershed Master Plan

ID	**PERSONAL VALUES** *Ranked from survey response*	Ranking
2	Important for wildlife habitat	7
1	Soothing natural aesthetic	6
4	Supports healthy, native plant communities	5
8	Important for water quality, air quality, groundwater replenishment, soil stabilization	5
3	Bird watching, wildlife viewing	4
7	Hike along it, fish it, wade in it, skip rocks, build sandcastles, and more	4
5	Socializing, source of community pride (e.g., the annual duck race	3
9	Protection/ expect it to not threaten my property	3
6	Important draw for business	1
ID	**EVALUATION CRITERIA** *Ranked from survey response*	**Ranking**
1	Address safety of the public and residents	96
6	Increases river stability, reduces future erosion	94
5	Reduces flood and geomorphic hazards to reduce future damage	89
27	Incorporate input from property owners	89
36	Provides the corridor with multiple benefits (e.g. flood mitigation, habitat enhancements, recreation and public access)	88
7	Improve stream health	85
4	Allow continued utility service during construction	79
34	Protect and enhance stream corridor vegetation	79
38	Uses locally available materials	79
31	Protect and enhance fish habitat	77
10	Create infrastructure investments that are reasonable to construct	76
21	Enhances *local* natural outdoor recreational opportunities such as trails (hiking ,biking, and equestrian) and fishing	76
11	Projects with the best value for their life cycle	75
35	Enhances water quality	75
2	Restore public access and utility service without restricting access to private properties	73
3	Provide access to recreational amenities, schools, and businesses	73
14	Incorporates new flood flow/ rainfall information	72
28	Incorporate input from the community	72
22	Enhances *regional* natural outdoor recreational opportunities	71
32	Protect and enhance avian habitat	70
30	Incorporate input from businesses and business leaders	69
16	Provides neighborhood and reach scale solutions requiring multiple land owners to come to consensus	66
39	Uses environmentally friendly processes	66
13	Effectively uses undamaged infrastructure	65
37	Limits maintenance costs	65
9	Complete the reconstruction while lowering risk to permanent infrastructure and the public	64
29	Incorporate input from conservation and environmental organizations	63
20	Enhances access to neighborhoods	62
24	Enhance neighborhood & community livability	62
17	Enhance tourist destinations	61
19	Enhances access to community facilities, and neighborhoods	61
12	Meet Federal and Local standards for design	60
8	Complete the projects in the shortest time possible	57
25	Enhance neighborhood & community aesthetics	57
23	Enhances community supported recreation opportunities such as golf, camping and water based activities (canoeing, kayaking, stand up paddleboarding, motorboats, waterskiing etc.)	55
26	Preserve neighborhood & community culture & history	52
18	Enhances access to tourist destinations	51
15	Is innovative	50
33	Protect and enhance beaver habitat	48

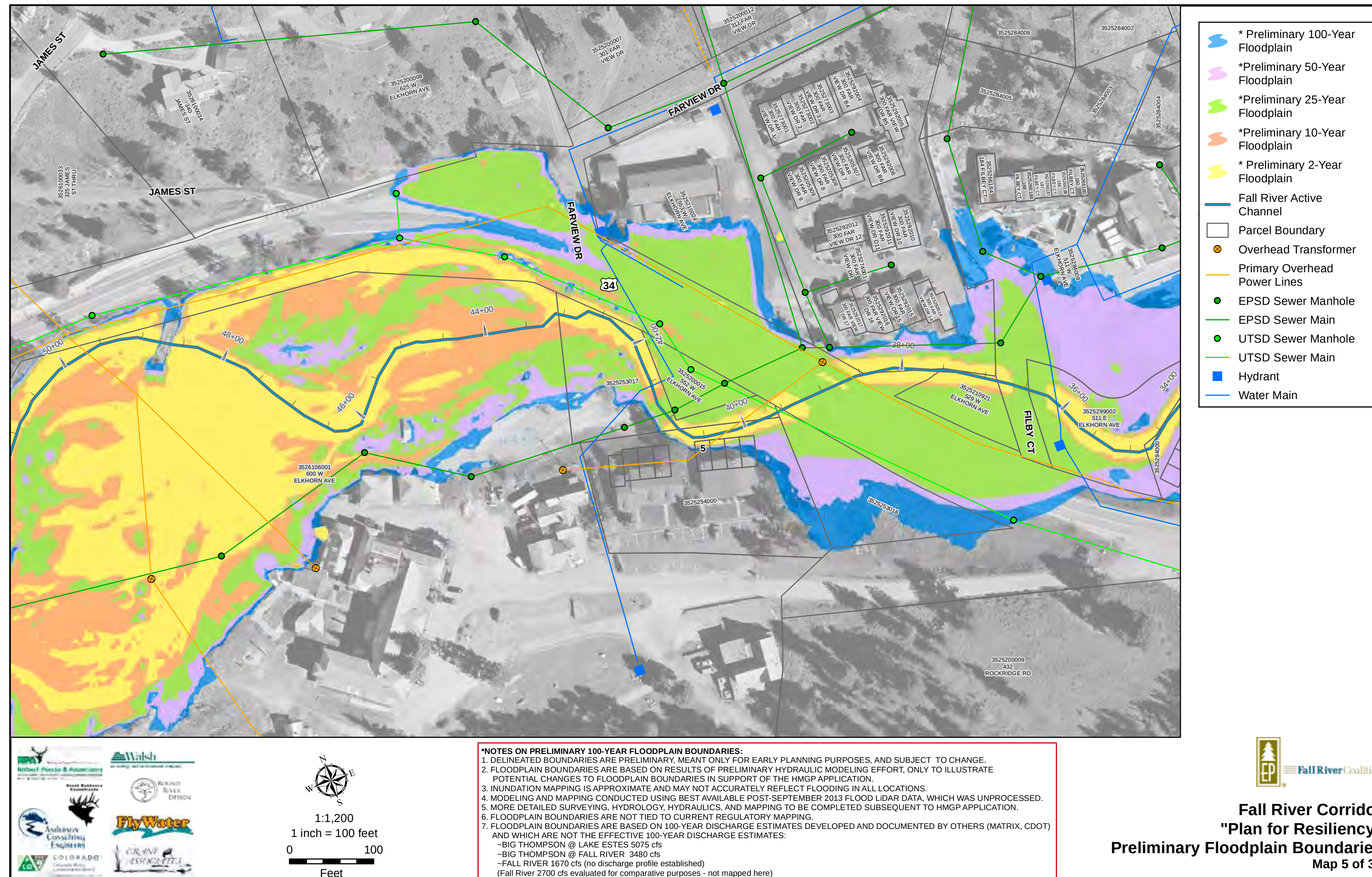
- Little Thompson River Master Plan
- Exceedance of Probability Analysis for the Colorado Flood Event, September 9-16, 2013
- CDOT/CWCB Hydrology Investigation Phase One – 2013 Flood Peak Flow Determinations
- Larimer County Flood Insurance Study (FIS)

Future planning and development efforts should refer to these documents in their own efforts. Coordinating with other coalitions and planning efforts could be advantageous for funding opportunities and long-term success of the projects. Further references for these documents are provided in the References section.

5.6 Regulatory Foodplains

FEMA 100-yr regulatory floodplain maps were collected by the technical team for the master planning; however they were not prioritized in the master planning risk assessments. The current regulatory floodplain extents are known to be underestimated on account of an unrealistically low 100-year discharge being employed in the analysis. Additionally, changes in the local topography as a result of the September 2013 floods render the current maps inaccurate. As a result, the technical team focused on updating the flood discharge estimates to more realistic values, and incorporated the new topography and changes in river crossings to best represent the current state of floodplain extents. This work is summarized with more detail in Section 6.4.

The last major study of the watershed in terms of characterizing channel conveyance, structure capacity and erosion potential occurred over 30 years ago, utilizing hydrology which had been developed a number of years before that. A patchwork of LOMRs have been incorporated into the mapping in the subsequent years. Repairs to infrastructure along Fall River have altered the shape and capacity of the channel and numerous private crossings have been either repaired or replaced. In order to have the most comprehensive and complete special flood hazard area maps for regulatory purposes, as well as maps that incorporate the cumulative effects of the 2013 floods and the subsequent floodplain, crossing, it is recommended that a new Flood Insurance Study (FIS) be undertaken for the entirety of Fall River System. It is likely that a new study will be faster and less expensive than reach-scale or property-scale LOMRs.



Preliminary Floodplain Boundaries Maps - See Appendix Section 10.3

this page intentionally blank

6 River Corridor Risk Assessment

6.1 Overview

A solid understanding of the river corridor underpins the risk-based planning process. Flood mitigation, safety, hydrologic and structural function, biology and environment, and resiliency were assessed using semi-quantitative methods in order to evaluate relative risk throughout the Fall River corridor. The following assessments were used to rank stream reaches and specific community assets for potential of flood, geomorphic or ecological damage.

1. Hydrologic data
2. Community asset inventory
3. Ecologic assessment using the SVAP2 protocol
4. Geomorphic risk assessment, including an assessment of sediment transport
5. Erosion hazard assessment, including reach-wide geomorphic hazards of debris flows, slope failures and bank erosion, alluvial fans, headcuts, and avulsions
6. Flood risk assessment, including updating existing hydrologic data, development of hydraulic model for 2-, 10-, 25-, 50-, and 100-, and 500-year flows (calibration to recent flows), and floodplain mapping (2- to 100-year).

The Fall River Corridor is diverse, from its headwaters in Rocky Mountain National Park to heavily developed reaches through Town. With approximately 1,100 parcels that include approximately 304 residences and 90 commercial properties. Structures and infrastructure at risk were noted during the SVAP2 field assessments.

6.2 Ecosystem Rish Assessment

A healthy, resilient stream ecosystem is one that maintains key ecological and physical functions though varied hydrologic conditions, though space and through time. Many factors influence the health of a stream system including: physical structures, energy sources, biotic elements, chemical variables and flow regime. The physical structure of a healthy stream corridor displays a complex and diverse set of features, including channel form (meanders, pools, riffles, backwaters, wetlands), channel profile (stream gradient, width, and depth), materials that have fallen into the channel (trees and bank material), overhanging vegetation, roots extending into the flow, and streambed materials (sand, gravel, rocks, and boulders). This complexity influences the physical function of the stream (i.e., increases channel roughness, which in turn dissipates the energy of water and reduces its erosive power) and increases the potential for higher diversity of aquatic species.

As part of the Fall River Corridor Master Plan effort, scientists and engineers from Walsh Environmental completed a rapid ecologic stream assessment of Fall River. The ecological stream assessment was completed using the Stream Visual Assessment Protocol (SVAP2), developed by the US Natural Resources Conservation Service (NRCS, 2009). The SVAP2 is a national protocol that provides an initial evaluation of the overall condition of streams, their riparian zones, and their in-stream habitats. It is often used as a tool for conservation planning, identifying restoration goals and objectives, and assessing trends in stream and riparian conditions through time. For the purposes of this analysis the results were used to identify critical riparian ecosystem elements that are damaged or absent from the river system, as well as to identify highly degraded areas. The evaluations are intended to supplement an overall understanding of the vulnerabilities that certain key species may have in the Fall River and assist with focusing appropriate restoration strategies.

The application of the SVAP2 protocol includes the evaluation of features in the stream system that affect overall stream conditions and generally encompass the following categories:

1) Channel stability (channel condition, bank condition)
2) Water quantity (hydrologic alteration)
3) Water quality (nutrient enrichment and manure/human waste)
4) Vegetation (riparian area quantity/quality and canopy cover)
5) Instream habitat (pools, habitat complexity, embeddedness)

A description of the specific elements evaluated as part of the SVAP2 protocol is presented in Table 1: SVAP2 Ecologic Stream Assessment – Ecosystem Elements. At completion of the SVAP2 protocol stream reaches are classified into one of the following categories:

Severely Degraded: Channel and banks are highly unstable and/or covered with rip-rap or concrete; homogenous channel bed lacking in habitat complexity; natural flow regime is significantly altered; limited floodplain access; and there is little to no riparian vegetation.

Poor: Channel is unstable with fairly homogenous channel bed lacking in habitat complexity; inadequate riparian corridor with large gaps of vegetation along the reach; developments in floodplain, or inaccessible floodplain, with diverted flow altering the natural flow regime.

Fair: Channel may be displaying some instability, with marginal connections between the active channel and floodplain; narrow riparian corridor with large gaps of vegetation along the reach and limited canopy cover; limited habitat complexity. Good: Channel may be displaying some instability, but the active channel and floodplain are connected in most areas; some development in floodplain, but does not significantly alter natural flow regime; adequate riparian corridor is present, but may have gaps along reach; moderate habitat complexity. Excellent: Channel is stable with continuous floodplain access, complex fish habitat including numerous shallow and deep pools; extensive and diverse riparian corridor; natural flow regime prevails.

6.2.1 Methodology

The first task in the ecologic stream assessment was to divide the Fall River into reaches of similar geomorphic form. Aerial imagery and high-resolution topography were evaluated to identify changes in geomorphic conditions (gradient, channel form, tributary confluences, etc.) which dictated locations of reach breaks. The reach breaks were adjusted, if necessary, during the initial field investigation. Ultimately, Fall River was divided into 22 ecosystem reaches, including the tributary Bighorn Creek (Table 2). Each reach was evaluated using the SVAP2 protocol. Table 1 describes the elements assessed as part of the SVAP2 protocol. Each element is scored with a value of zero to 10, where a higher score indicates a more ecologically healthy system. An overall score was assigned to each reach, based on the average of the scores for the 12 elements.

6.2.2 Results (Figure Maps in Appendix)

The resulting SVAP2 scores are presented in Table 3 and the overall score is mapped by reach in Appendix x. The overall ecological score for each reach were classified using the following categories:

- Score of 1 to 2.9: Severely Degraded
- Score of 3 to 4.9: Poor
- Score of 5 to 6.9: Fair
- Score of 7 to 8.9: Good
- Score of 9 to 10: Excellent

The majority of Fall River received “fair” to “poor” overall ecosystem scores. The downtown reach between Elkhorn Ave and Park Theatre is the only “severely degraded” area, due to lack of riparian vegetation and canopy cover, an unnatural barrier to fish movement, and homogenous streambed with little to no habitat complexity or pools.

The “fair” and “poor” reaches tend to lack pools, as well as appropriate riparian zone width, due to encroaching development. Several “good” reaches were identified throughout the Fall River corridor, including Big Horn Creek (Reach 22, in the upper watershed), given the larger riparian zones and more vegetation diversity and canopy cover, as well as numerous deep and shallow pools, which leads to higher quality, more complex fish and invertebrate habitat.

6.2.2.1 Channel Stability

Channel stability is specifically addressed in Section 6.3 Geomorphic Risk. The channel stability as measured through the SVAP2 protocol was included in the ecosystem scores.

6.2.2.2 Water Quantity

Water quantity and flow timing in Fall River is altered by a diversion in Reach 13 and floodplain development throughout the corridor, but for the majority of the system the natural flow regime prevails. In the recent past, there were two dams in the upper reaches of Fall River, both these dams have failed and no long have an effect on the amount of flow or the timing of flow through the reach.

6.2.2.3 Water Quality

General water quality related to the presence of manure and/or septic was visually assessed along the Fall River corridor. A leaking septic system was noted in an upper reach (Reach 20: between Fish Hatchery bridge and the Fall River Hydroplant) and manure was noted in a lower reach (Reach 4 between Sunny Acres Ct. bridge and Old Ranger Dr. bridge) causing notable algae in the creek.

6.2.2.4 Vegetation

The scores for vegetation quantity and quality and canopy cover along the Fall River corridor were averaged into one score as presented in Figure 2. Only four reaches along the Fall River corridor displayed adequate riparian vegetation, corridor width, and canopy cover. The lower reaches downstream of Sunny Acres Ct. (Reaches 1-4) and two reaches in the mid and upper river corridor (Reaches 12 and 18) displayed severely degraded riparian corridor and canopy cover.

6.2.2.5 Instream Habitat

An assessment of instream habitat, including pool presence, barriers to fish movement, fish and aquatic invertebrate habitat complexity, and riffle embeddedness, for the Fall River corridor is presented in Table 3. The scores representing fish habitat complexity and pool presence are displayed in Figure 3 and Figure 4, respectively. Nine reaches lack adequate fish and aquatic invertebrate habitat complexity, mostly in the lower reaches. Four reaches display good or excellent habitat complexity. When specifically looking at the presence of shallow and deep pools, five reaches were completely absent of pools and only six reaches displayed adequate deep and shallow pool presence.

Riffle embeddedness is a prominent issue for Fall River; eight reaches (all below the Boulder Brook bridge) displayed riffles with gravel and cobbles buried by fine sediment greater than 40%. Out of the remaining reaches, only three (uppermost reaches) had riffles buried by less than 10 percent. Additionally, Fall River has several barriers to fish movement including three exposed sewer and water lines causing substantial drops (Reaches 7, 8, and 17), scour at the Elkhorn Ave. Bridge (Reach 2), and a 6-foot-tall concrete diversion dam (Reach 13).

Pre September Flood - 2007

Post September Flood

Table 1 SVAP2 Ecologic Stream Assessment – Ecosystem Elements

Element	Description	Scoring
1. Channel Condition	Evaluates the relative geomorphic stability of the channel. The shape of a stream channel changes constantly depending on the flow and sediment conditions in the channel. This element is a description of the geomorphic condition and the relative relationship between the channel and its floodplain.	High Score: The active channel and floodplain are connected throughout the reach, no signs of incision or aggradation. Low Score: Headcuts or massive incision present, no floodplain access, or severe lateral migration/avulsions.
2. Hydrologic Alteration	Hydrologic Alteration is the degree to which streamflow conditions differ from normal, unregulated conditions and patterns. Naturally occurring daily and annual flow variations provide ecological benefits to floodplain and riparian ecosystems. For example, variations in flow provide cues to fish for spawning, egg hatching, rearing, feeding locations, and migration (Junk, et al., 1989).	High Score: The river, creek, or stream has an unaltered hydrologic regime, there are no dams, impoundments, levees, withdrawls, diversions, or flow additions. Low Score: The river, creek, or stream has significantly less or more water during parts or all of the daily or annual cycle.
3. Bank Condition	Stable stream banks are essential to healthy stream systems. Failing banks provide an influx of fine sediments which have detrimental ecosystem, water quality, and economic consequences. As much as 85% of a stream's sediment load can come from failing banks. Healthy vegetation on streambanks promotes bank stability and reduces the impact of high flows.	High Score: Banks are stable, protected by vegetation, wood, or natural rock. Low Score: Banks are unstable with no protection, numerous active bank failures, and/or dominated by riprap or other fabricated structures.
4. Riparian Area Quantity	Riparian areas function as transitional areas between the stream and uplands. They may include wetlands or floodplains, depending on the valley form and stream corridor. They are important habitat and travel corridors for numerous plants, insects, amphibians, birds, and mammals.	High Score: Riparian corridor width is at least two bankfull widths or more than the active floodplain and is contiguous across and down the corridor. Low Score: Riparian corridor is less than 25% of the active floodplain or vegetation gaps exceed 30% of the property.
5. Riparian Area Quality	The quality of the riparian area increases with the width, complexity, and linear extent of the vegetation along the stream. A complex community consists of diverse plant species native to the area with varying age classes.	High Score: Natural and diverse vegetation with varied age classes. No invasive species. Low Score: Little to no native vegetation, invasive species widespread.
6. Canopy Cover	In forested riparian areas, shading of the stream is important as it helps maintain cool water temperatures. Loss of shading vegetation can cause a decline in certain species of fish (including trout), insects, and some aquatic plants. Additionally, cool water can hold more dissolved oxygen.	High Score: Greater than 75% of water surface shaded. Low Score: Less than 20% of water surface shaded.
7. Manure or Septic Present	Manure or human waste increases nutrients and oxygen demand in streams. This alters food webs, nutrient cycling, algal growth, and could cause bacterial or viral contamination.	High Score: No livestock access and no leaking septics, sewers, and/or untreated waste discharges. Low Score: Livestock have unlimited access to stream and manure is noticeable and/or there is visible septic, sewer, or untreated wastewater discharges.
8. Pools	Pools are important resting, hiding, winter habitat and feeding locations for fish. Streams with a mix of shallow and deep pools offer diverse habitat for diverse species and age-classes of fish and other aquatic species.	High Score: More than three deep pools separated by riffles or boulders; shallow pools also present. Low Score: Pools absent.
9. Barriers to movement	Most aquatic organisms move around their habitat or take daily or seasonal migrations. Some species use headwater streams for spawning and move downstream to lakes and larger creeks for feeding as they mature. Barriers that block the movement of fish or other aquatic organisms interrupt these natural cycles.	High Score: No artificial barriers that prohibit movement during any time of the year. Low Score: Physical structures, water withdrawals, and or water quality prohibit movement.
10. Fish Habitat Complexity	Quality fish habitat is a mosaic of different types of habitat created by different combinations of water depth, velocity, wood, boulders, riparian vegetation, and species. Fish require these complex habitats and the dynamic nature of instream habitat features assures that fish are able to find suitable areas to rear, feed, grow, hide, and reproduce. The greater the variety of habitat features the more likely it is to support a diverse aquatic ecosystem.	High Score: Ten or more habitat features available, including logs or large wood, small wood accumulations, deep pools, shallow pools, overhanging vegetation, large boulders, small boulder clusters, riffles, undercut banks, and side channels or floodplains. Low Score: Less than four habitat features available.
11. Aquatic Invertebrate Complexity	In a healthy stream, substrates are varied, free of fine sediment, abundant, and in place long enough to allow for colonization of aquatic invertebrates. High stream velocities, high sediment loads, and frequent flooding may cause reaches to be unsuitable for these organisms. Wood and riffle areas with boulders and cobbles support the bulk of the invertebrate community. Reaches with wood tend to support a more diverse aquatic invertebrate community.	High Score: Nine or more habitat features available, including logs or large wood, small wood accumulations, deep pools, shallow pools, overhanging vegetation, large boulders, small boulder clusters, riffles, undercut banks, and side channels or floodplains, and must include at least one wood/riffle combination. Low Score: No habitat features available.
12. Riffle Embeddedness	Embeddedness measures the degree to which gravel and cobble substrates in riffles are surrounded by fine sediments. It is a measure of the suitability of the stream for macroinvertebrates, fish spawning, and fish egg incubation as reaches with high embeddedness suffocate eggs and macroinvertebrates.	High Score: Gravel or cobble substrates are less than 10 percent embedded. Low Score: Gravel or cobble substrates are greater than 40 percent embedded.

Table 3 SVAP2 Results for Fall River

Reach	Stream Slope (%)	Channel Condition	Hydrologic Alteration	Bank Condition	Riparian Quantity	Riparian Quality	Canopy Cover	Vegetation Composite	Manure or Septic	Pools	Barriers to Movement	Fish Habitat Complexity	Aquatic Invertebrate Habitat	Embeddedness	Overall Ecosystem Score	Reach
1	2.23	1	9	1	2	2	1	1.7	10	6	10	1	0	1	3.7	1
2	2.19	1	9	1	0.5	1	1	0.8	10	1	5	1	0	2	2.7	2
3	1.32	2	9	2	2	2	2	2.0	10	6	10	2	1	0	4.0	3
4	1.40	9	9	8	2	2	1	1.7	6	1	10	3	2	5	4.8	4
5	1.66	8	9	6.5	6	7	5	6.0	10	9	10	8	9	5	7.7	5
6	4.36	4	9	5	4.5	7	4	5.2	10	2	10	4	5	2	5.5	6
7	2.27	6	9	3	3	4	2	3.0	10	5	8	2	3	2	4.8	7
8	1.95	2	9	2	5	4	4	4.3	10	3	4	3	4	4	4.5	8
9	2.13	7	9	6	7.5	8	6	7.2	10	6	10	4	5	1	6.6	9
10	2.33	9	9	7	6	9	8	7.7	10	6	10	5	6	3	7.3	10
11	1.88	4	9	2	3.5	6.5	4	4.7	10	3	10	5	6	1	5.3	11
12	2.27	4	9	2	1.5	3.5	1	2.0	10	6	10	5	6	2	5.0	12
13	2.69	9	7	8	9	9	9	9.0	10	4	0	7	8	4	7.0	13
14	2.22	9	9	7.5	5	5.5	4	4.8	10	4	10	5	6	3	6.5	14
15	2.25	2	9	4	3	6	1	3.3	10	2	10	2	3	5	4.8	15
16	2.33	5	9	3	5	6	3	4.7	10	7	10	7	8	5	6.5	16
17	2.30	5	9	2.5	3.5	4	2	3.2	10	8	2	5	6	5	5.2	17
18	2.07	3	9	2.5	2	3.5	2	2.5	10	2	10	2	3	5	4.5	18
19	2.65	5	9	3	5	5	2	4.0	10	5	10	5	6	8	6.1	19
20	3.73	6	9	2	5.5	6	4	5.2	5	7	3	4	5	9.5	5.5	20
21	5.79	2	9	0.5	9.5	9.5	2	7.0	10	7	10	7	8	10	7.0	21
22	-	10	9	9	8	8	7	7.7	10	8	8	6	7	9	8.3	22

6.3 Geomorphic Risk Assessment

As part of the Fall River Corridor Master Planning project, the technical team completed a geomorphic assessment of the Fall River system, consisting of a rapid geomorphic assessment and the mapping of a planning-level channel migration zone (pCMZ). The rapid assessment and pCMZ mapping covers the Fall River from the Rocky Mountain Park boundary downstream to the confluence with the Big Thompson River, including Big Horn Creek (from the National Park boundary downstream). Finally a community asset inventory was used to characterize risk associated with the geomorphic hazards identified through the rapid assessment and pCMZ mapping.

The geomorphic assessment began with a remote sensing evaluation of geomorphic reaches followed by several field days of field evaluations to observe and record field data related to stream channel type, stream channel and floodplain alteration, bed material and bedform, and active channel erosion and sedimentation processes. This initial fieldwork was followed by supplemental analysis of alluvial landforms using available GIS data and aerial imagery. Final evaluation and quality checks and assurances were obtained during a follow-up field day.

There are three objectives for these data and analysis:

1) System Understanding via Rapid Geomorphic Assessments: Define post-flood geomorphic conditions in the Fall River system to supplement an overall understanding of the dynamics of Fall River and assist with focusing on geomorphically appropriate flood risk reduction and restoration strategies. Rapid assessments do not include comprehensive evaluations of berms, crossing structures, floodplain fills, and other features that contribute to instability. Further analysis of these channel stressors may be warranted on a reach or watershed level.

2) Mapping of a Planning-Level Channel Migration Zone (pCMZ) : A channel migration zone (CMZ) refers to the area a stream has occupied in recent history and may migrate through again as it moves, stores, and reworks its sediment load on its path down the valley. Identification and management of these channel migration zones is intended to reduce flood damage to community and private infra-

structure – all of which may be in jeopardy when and if the channel does re-occupy this area. A CMZ can also be thought of as the "river corridor" where dynamic system processes, under a broad range of flow conditions, can occur providing for long-term geophysical and biological stability. The pCMZ is intended to offer local governments insight into the potential behavior of a stream during a flood and to aid their efforts to reduce future flood and erosion damage and improve riparian and aquatic habitat through the management of a river corridor.

3) Evaluation of geomorphic risk by combining the pCMZ analysis with a community asset inventory: An assessment of risk includes an evaluation of probability with costs. The community asset inventory is used as a tool to estimate some of the costs associated with the geomorphic instability of the river corridor. The community asset inventory assessment overlays property, structure, and utility costs with the elements of the pCMZ to get an estimate of risk. The assessment does not include many other costs and is intended as a long-term planning tool for local coalitions and governments.

6.3.1 Methodology

6.3.1.1 Rapid Geomorphic Assessments

As a first step in the rapid geomorphic assessment, Walsh scientists and engineers identified geomorphic reaches, or sections of the Fall River, with roughly homogenous physical and dynamic characteristics. For planning purposes it is important to delineate zones with similar migration potential, river planform patterns, and/or valley characteristics. Possible geomorphic reach-break criteria included:

- Changes in gradient (proportional to sediment transport capacity)
- Changes in valley width and channel confinement
- Tributary junctions (changes in the ratio of sediment transport capacity to sediment supply)
- Changes in channel pattern
- Changes in infrastructure that control lateral erosion and migration
- Changes in geology/ erodibility of adjacent valley slopes
- Changes in land use

In total, 22 geomorphic reaches were identified within the study area, see Figure 1.

While the channel evolution phase is presented for representative reaches in the Fall River system as it exists in June of 2013, during future design-level analyses, it will be important to assess the current channel evolution phase for the smaller and more specific design reaches as well as changes in disturbance and function in associated upstream and downstream reaches. A weakness of the Schumm Channel Evolution Model is that it implies a linear process from Stage I to Stage V, whereas if disturbances continue or upstream sediment supply changes the reach may cycle through the middle stages without establishing an interim quasi-equilibrium state. Similarly, for aggrading reaches, such as that found at the Elkhorn Lodge reach, the Schumm model cannot be applied. Despite these limitations, the CEM model can still potentially aid in the prediction of how the channel will adjust in the future as it attempts to reach a dynamic-equilibrium condition after the flood.

Walsh scientists and engineers conducted a rapid survey of existing geomorphic conditions by walking the river corridor to the extent practical. Qualitative assessments of the geomorphic conditions for each reach were recorded at representative locations within each reach. While it is our best professional judgment that the qualitative assessments represent general conditions in the reach, they are a generalization of the most dominant characteristics in the corridor and do not exclude the possibility that other conditions are or could be present. This study was scoped to be a rapid visual assessment and as such, no quantitative measures of channel or valley width, width to depth ratios, grain size, or other widely accepted geomorphic characteristics were determined.

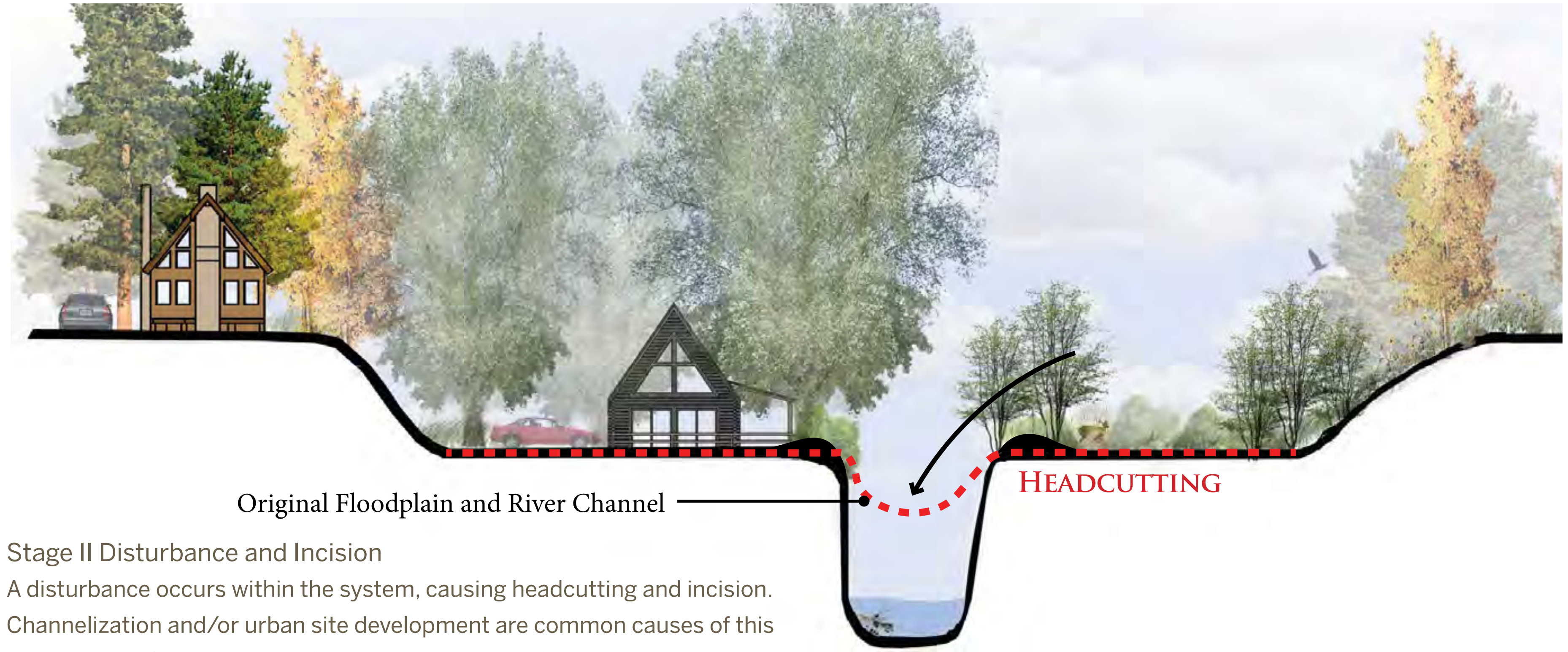
Stage I Stable
River channel is stable (at equilibrium) with considerable bank vegetation and is in frequent contact with the original floodplain.

Based on visual assessments, estimates of existing and reference stream channel type and form, dominant bed material, channel evolution stage, and dominant sediment transport processes were made for each reach. These generalizations are further described below.

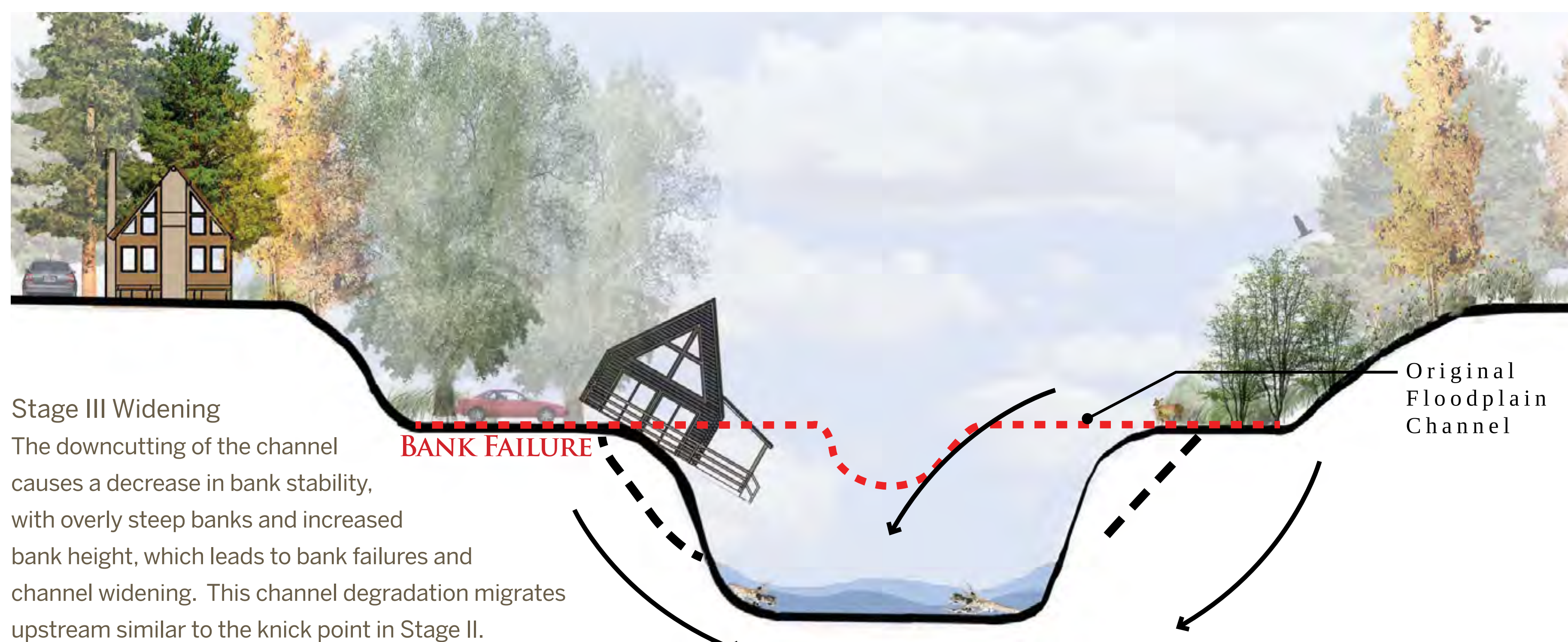
- Existing and reference stream channel type and form—Stream channel type, using Rosgen (1994) and Montgomery-Buffington (1997) stream type classifications, were assessed for existing conditions as well as reference conditions (i.e., equilibrium conditions). Rosgen classification uses numerous discrete classes represented by a suit of morphologic parameters used to categorize a stream reach (e.g., B2, C3b). Montgomery-Buffington (primarily used in mountain stream systems) uses seven categories represented by channel substrate or bed form (e.g., cascade, step pool, pool riffle, plane bed).

- Dominant bed material—Dominant bed material (D50) was visually and qualitatively identified for each reach as either bedrock, boulder, cobble, gravel, or sand. An assessment was also made as to whether the existing dominant material would be part of the reference conditions.

- Channel evolution stage—The channel evolution model described by Schumm, et. al. (1984) was used to assess the current channel condition and active processes in terms of streambed adjustment. As shown in Figure 2, the model includes five stages that describe the adjustment of a streambed starting with incision, the detachment from the existing floodplain, and eventually the formation of a new floodplain at a lower elevation. Based on evidence of bank stability, floodplain connectivity, and meander migration, each reach was assigned a channel evolution stage. While these stages are provided for instructional purpose and to aid in predicting future adjustments (and indeed strong on-the-ground correlations do frequently exist) it should be noted that the Schumm model does not account for aggrading channels, stable multi-thread channels, and non-linear



Stage II Disturbance and Incision
A disturbance occurs within the system, causing headcutting and incision. Channelization and/or urban site development are common causes of this disturbance. Channelization (channel straightening) creates a system with a steeper slope with more stream power. Urban development increases stormwater flows due to the increase in impervious surfaces, which also increases stream power. With the increase in stream power the stream system begins to incise in an attempt to adjust to a lower channel slope. This incision progresses as a knick point upstream. The stream and floodplain have less frequent interaction. [Diversions are another disturbance that can disrupt the equilibrium of a stream system by decreasing base flows which may cause aggradation, moving the system into Stage IV.]



Stage III Widening
The downcutting of the channel causes a decrease in bank stability, with overly steep banks and increased bank height, which leads to bank failures and channel widening. This channel degradation migrates upstream similar to the knick point in Stage II.

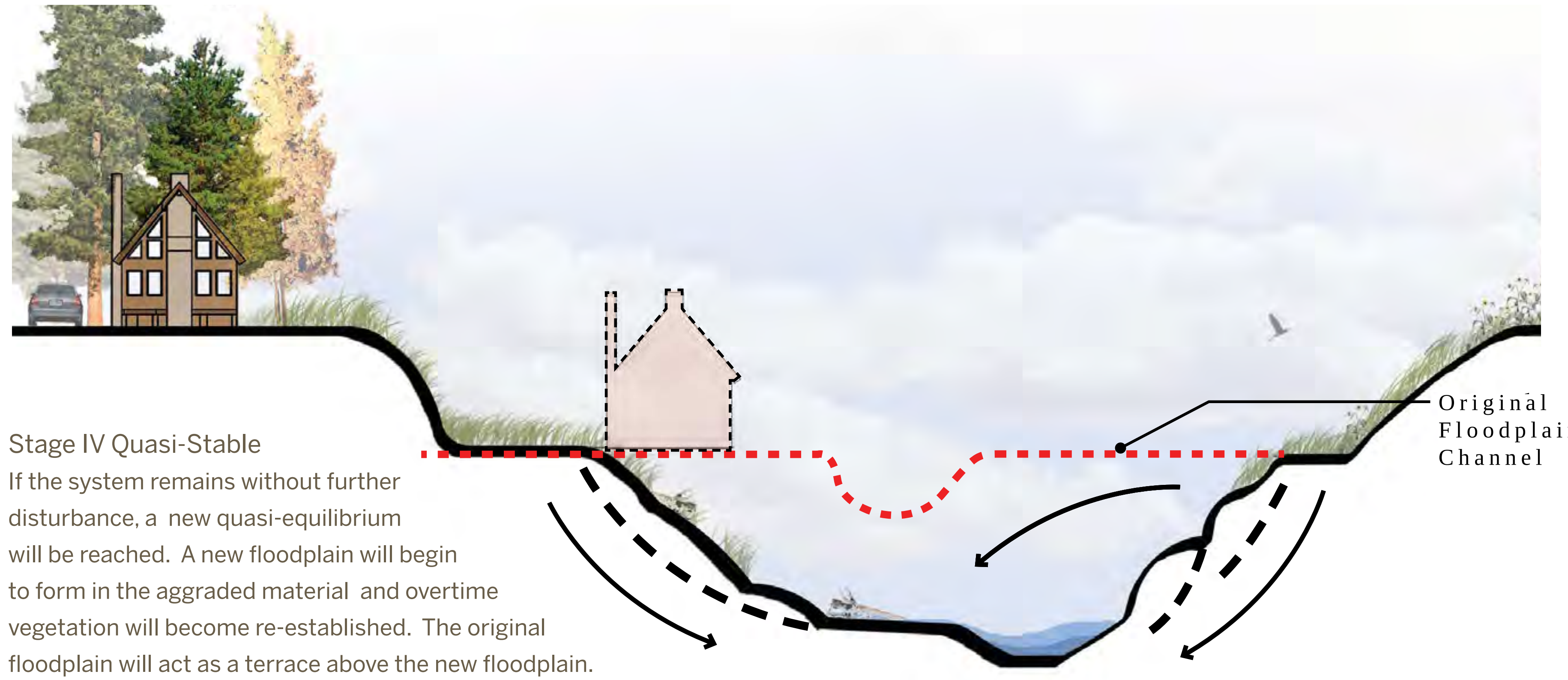
processes, all of which may be observed over varying temporal and spatial scales within the Fall River system. New models are being developed to describe these conditions, such as the Stream Evolution Model (Cluer & Thorne, 2013), however, for the purposes of this rapid geomorphic assessment, the widely adopted and current industry standard Schumm model was utilized.

- Dominant sediment regime type—Dominant sediment regimes were evaluated for each reach, using guidelines presented in Kline (2010). Sediment regime mapping attempts to characterize the source and fate of both fine and course sediment loads (i.e., wash and bed loads) which can be a useful exercise in project development and attempting to restore equilibrium conditions to a watershed. Based on existing stream type and condition, channel evolution stage, degree of incision and width, and channel alterations, each reach is categorized singularly or as a combination of a "source", "transport", or "deposition" reach.

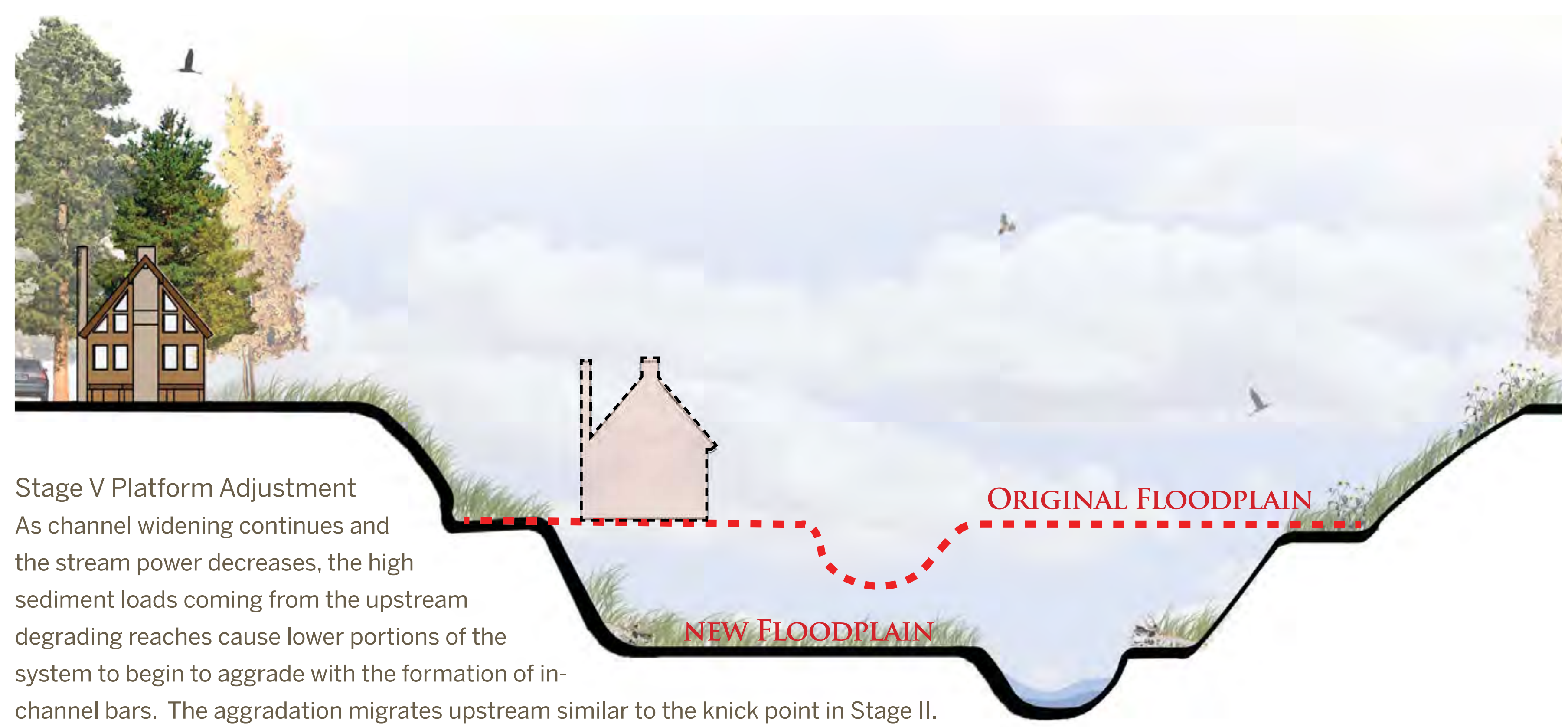
6.3.1.2 Planning-Level Channel Migration Zone Mapping

Channel migration is the lateral movement of a channel, including processes such as channel widening, bend migration, and/or abrupt channel shifts, and vertical movement of a channel through incision or aggradation. A channel migration zone (CMZ) refers to the area a stream has occupied in recent history and may migrate through again as it moves, stores, and reworks its sediment load on its path down the valley. Identification and management of these channel migration zones is intended to reduce flood damage to community and private infrastructure – all of which may be in jeopardy when and if the channel does re-occupy this area. A CMZ can also be thought of as the "river corridor" where dynamic system processes, under a broad range of flow conditions, can occur, posing a hazard to infrastructure and communities, but also providing for long-term topographic stability and biological complexity.

There are several scientifically vetted protocols in states with similar physiographic characteristics that provide guidance on the mapping of channel migration zones. For this assessment, Washington State's planning-level channel migration zone (pCMZ)



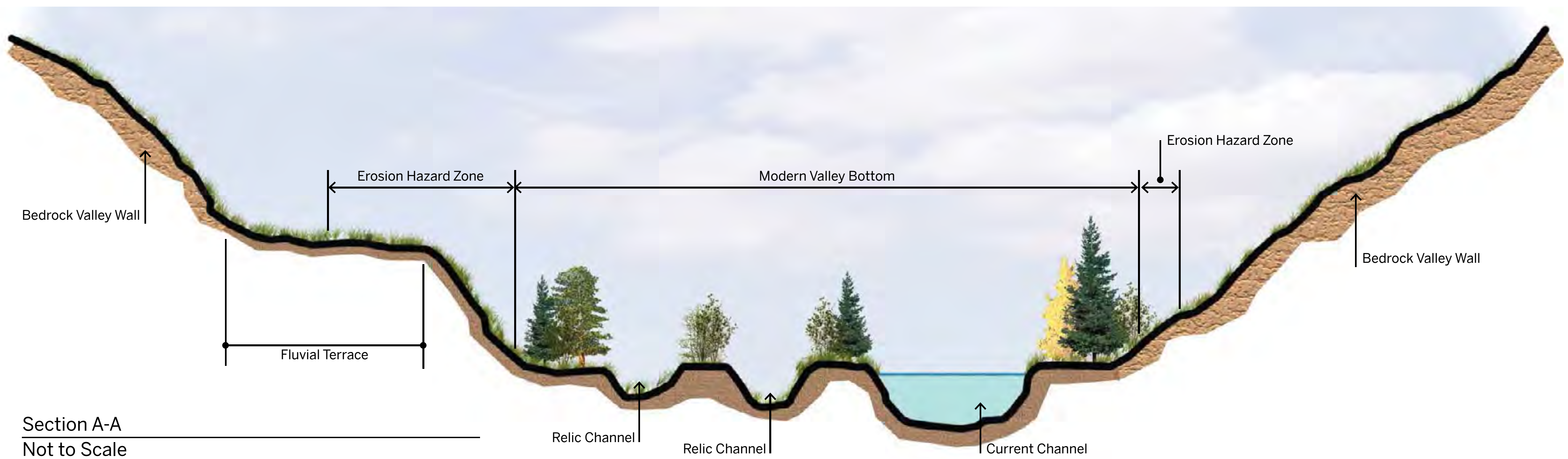
Stage IV Quasi-Stable
If the system remains without further disturbance, a new quasi-equilibrium will be reached. A new floodplain will begin to form in the aggraded material and overtime vegetation will become re-established. The original floodplain will act as a terrace above the new floodplain.



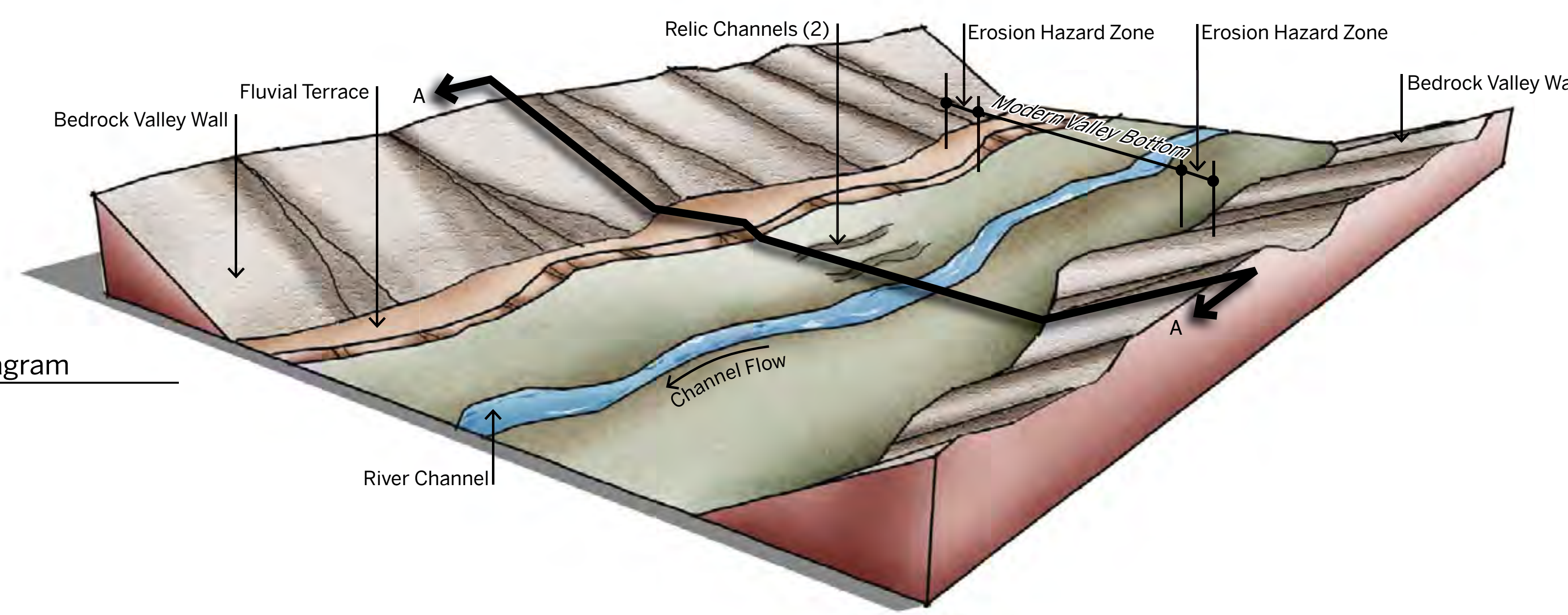
Stage V Platform Adjustment
As channel widening continues and the stream power decreases, the high sediment loads coming from the upstream degrading reaches cause lower portions of the system to begin to aggrade with the formation of in-channel bars. The aggradation migrates upstream similar to the knick point in Stage II.

method was selected, based on Washington State Department of Ecology's A Methodology for Delineating Planning-Level Channel Migration Zones (2014).

The pCMZ method utilizes channel migration records preserved in landforms, soils and geology to describe the spatial influence of channel migration. The pCMZ is intended to offer local governments insight into the likely long-term behavior of their streams and to aid their efforts to reduce future flood and erosion damage and improve riparian and aquatic habitat through the management of a river corridor. The following components were mapped for the Fall River system as part of defining the pCMZ, using digital elevation models (DEMs) derived from the 2013 post-flood LiDAR and 2013 post-flood aerial photography:



Section A-A
Not to Scale



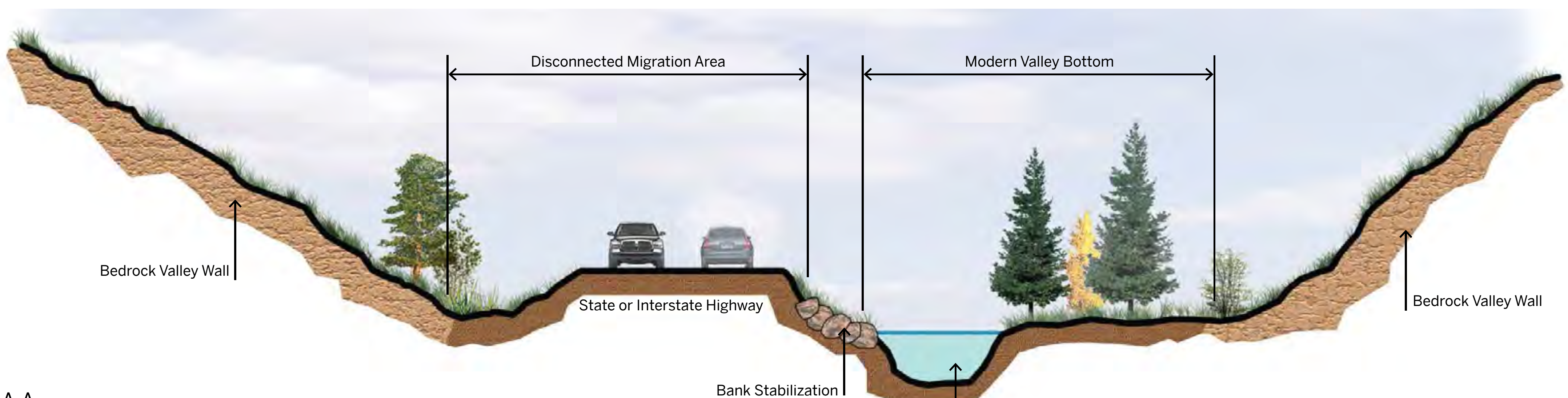
Axonometric Diagram
Not to Scale

a. Modern Valley Bottom (MVB): The MVB is the fundamental component of the pCMZ, it represents the area where channel migration has occurred in the past few thousand years. Reoccupation of this area by the river during a flood event is likely, considering the ease of accessibility during a flood event and the nature of the surficial geology (alluvium), therefore the MVB is an area of very high hazard.

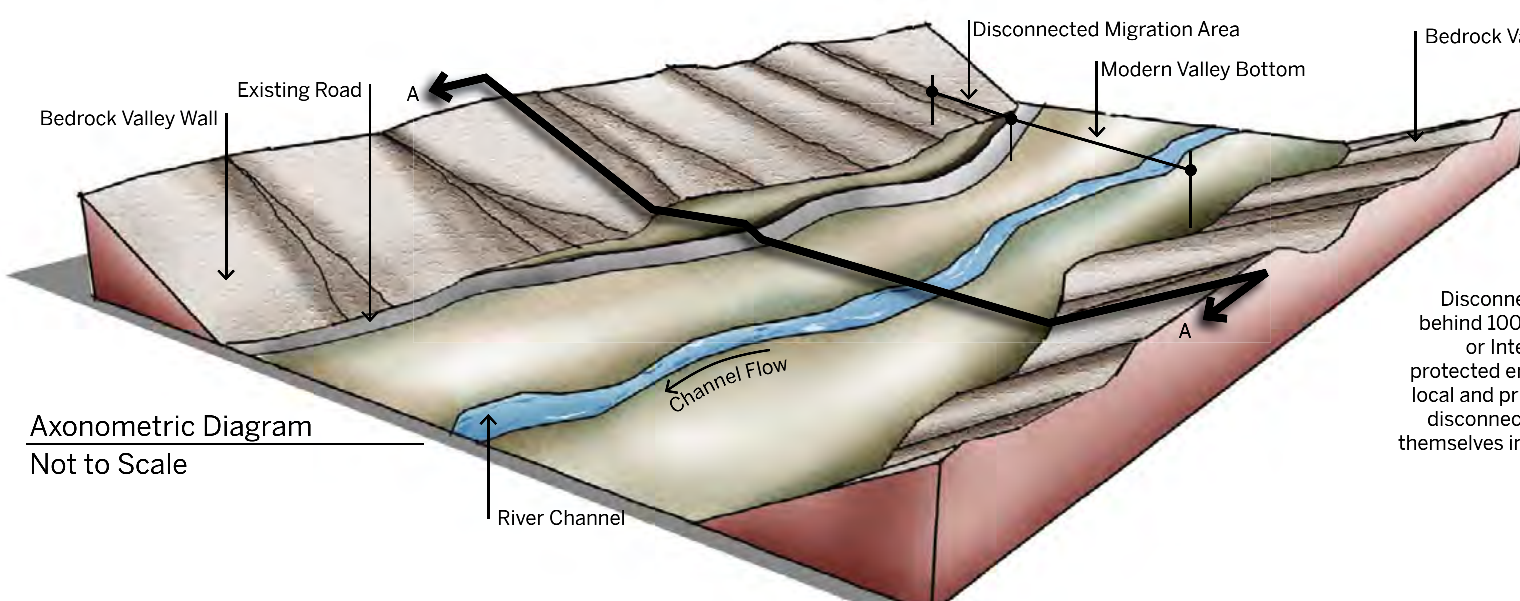
b. Avulsion Hazard Zones (AVZ): AVZs are mapped within the MVB, where there are low areas with abandoned or relict channels connecting to the main active channel, or low portions of the valley connected to the active channel with gradients steeper than the active channel gradient. AVZs are areas where abrupt shifts (avulsions) in channel location have the possibility to occur at moderate to high flows and may have catastrophic consequences for adjacent property and infrastructure. These are extreme hazard areas.

c. Erosion Hazard Area (EHA): The EHAs are mapped outside the MVB to account for potential valley widening caused by future channel migration. The extent of the EHA is related to the erodibility of the valley walls as well as the likelihood that the stream channel will come into contact with these features. These are areas of high hazard.

d. Alluvial fans (AF): Alluvial fans are fan-shaped accumulations of sediment that form along the margins of valleys at the mouths of tributary channels. The natural tendency of the tributary streams



Section A-A
Not to Scale



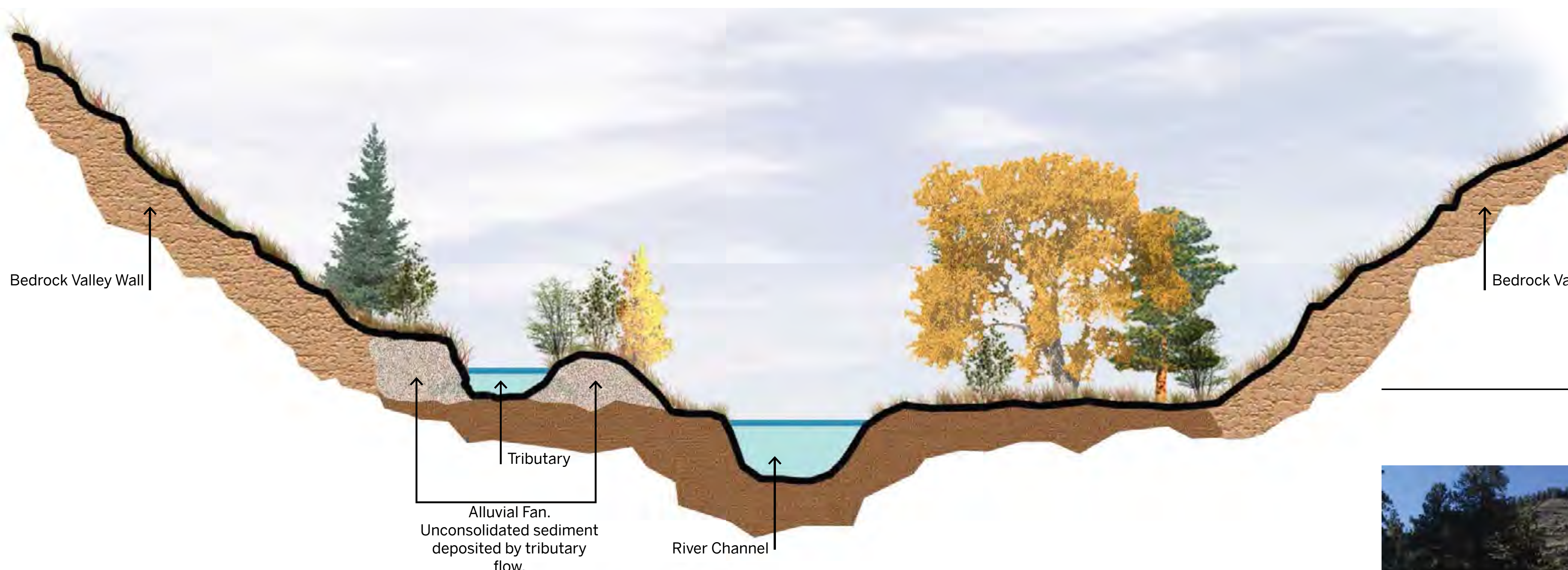
Axonometric Diagram
Not to Scale

Disconnected Migration Zones occur behind 100-year levees or behind State or Interstate Highways with highly protected embankments. County, town, local and private roads DO NOT result in disconnected migration zones and are themselves included in the modern valley bottom

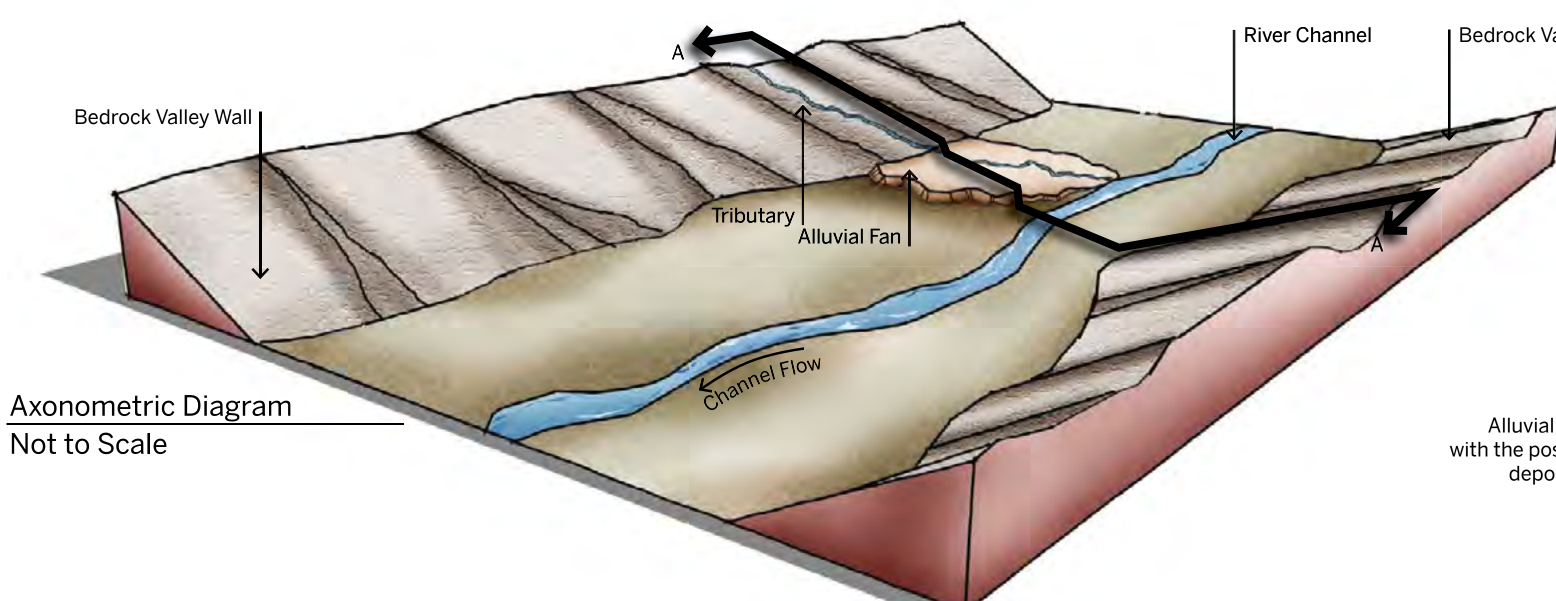
to drop their sediment loads and avulse on AF surfaces makes them potentially hazardous areas for development. These are areas of very high hazard.

e. Disconnected Migration Area (DMA): DMA are low-lying areas that would naturally be mapped within the MVB of a stream channel, but are disconnected from channel migration processes by man-made structures such as levees, railroads, and major roads. When observed, these areas were mapped outside of the pCMZ though still have the potential to capture flow if the infrastructure fails. Their mapping may indicate areas where future floodplain reconnection projects could occur. These are areas of high hazard.

The complete methodology for the pCMZ method can be found in Washington State's A Methodology for Delineating Planning-Level Channel Migration Zones (2014).



Section A-A
Not to Scale



Axonometric Diagram
Not to Scale

Alluvial fans are very dynamic areas with the possibility of massive sediment deposition happening at any time

6.3.1.3 Community Asset Inventory

The community asset inventory accounted for the monetary consequences of property, structures, and utilities within the pCMZ extents. The community asset inventory analysis was performed using ArcGIS (2013) software package for parcels (properties and structures), and utilities separately. Parcel location, extents, estimated property dollar value, and estimated property improvement (structure) dollar value were gathered from publically available Larimer County data (June 3, 2013). The estimated dollar values are not assessed values for properties. Utility locations were provided by the Town of Estes Park for potable, lateral and sewer main categories. Potable utilities include water supply mains, laterals are secondary the water main, such as hydrants, bleeders, and service. Utility cost per foot were estimated from Larimer County values and are summarized in Table xx.

To calculate the geomorphic risk for parcels, total land and improvement values were multiplied by the fraction of the parcel within the extents of the pCMZ as derived from a GIS analysis of the union of delineated pCMZ areas and Larimer County parcel data. This is not a detailed account of whether or not the structures themselves would be damaged or destroyed. For example, if 50% of the land acreage falls within the pCMZ area, a $10,000 plot with $50,000 improved structures is reported as $5,000 and $25,000 asset loss respectively regardless of whether or not structures fall within the pCMZ area. The recalibrated square footage and dollar values were then summarized by parcel category for each area/zone using excel pivot tables.

To calculate the geomorphic risk for utilities, a GIS analysis of affected utilities was derived by clipping the linear utility data provided by the City to the extent of delineated pCMZ area and summing the recalibrated footage of each utility category using excel pivot tables. The pCMZ extents were separated into four categories for analysis: avulsion hazard areas, disconnected migration areas, erosion hazard areas, and the modern valley bottom.

The community asset inventory does not account all forms of loss caused by a geomorphic risk by any means. Due to a lack of data many things such as loss of life, injury, loss of personal property inside of structures, or loss of non-structural assets on properties cannot be analyzed. However this analysis does give a starting point for understanding geomorphic risk in the river corridor.

6.3.2 Geomorphic Risk Assessment Results

The results the geomorphic risk assessment should be used exclusively for planning purposes and only within the context of the Fall River Corridor Master Planning project. Any follow-up programmatic or engineering design work must be accompanied by a thorough and complete design-level analysis on a site specific or reach specific basis. Results represent conditions found in the Fall River system during the months of March and April 2013. Due to the natural, constantly evolving characteristics of streams, as well as the large investment that towns, counties, state and federal agencies, and local property owners are currently making to change the physical condition of the streams, all results, recommendations, and project development require field verification and supplemental investigations before design-level analysis. Verifications and investigations should be completed by qualified fluvial geomorphologist(s) and/or river engineer(s) on the reach in question, as well as the reaches upstream and downstream that could affect sediment sources and storage areas, sediment transport characteristics, and stream power.

6.3.2.1 Rapid Geomorphic Assessment

Reach-scale rapid geomorphic summaries are documented in the Appendix as well as in Table 1. The following descriptions are provided as an overview, not comprehensive assessment, of the dominant forces and processes observed in the reaches that were surveyed.

6.3.2.1.1 Rocky Mountain National Park Headwaters to Park Boundary

The Fall River starts as a small stream gathering waters and sediment off of the Trail Ridge and Fall River Pass, over Chasm Falls following the Old Fall River Road valley. It is not until it reaches the broad meadows of Horseshoe Park, however, that it really takes the form of a "river". Excellent floodplain access and channel stability and flat slopes attenuate sediments in the vicinity of Horseshoe Park. Lawn Lake's dam breach into the Roaring River has left a significant geological mark at the Lawn Lake alluvial fan but due to the meadow stream condition coarse sediments do not travel far beyond the fan and fine sediments are largely being stored in the meadows around Sheep Lakes. Downstream in the vicinity of Cascade Cottages and Aspenglen Campground the Fall River passes through a former glacial moraine and steepens dramatically. Here as in the section downstream, steep slopes combined with erodible materials has created a highly dynamic stream channel with the ability to mobilize and transport large quantities of sediment.

RMNP Headwaters to Park Boundary Image

RMNP Boundary to Upper Fish Hatchery Road Crossing

Upper Fish Hatchery Rd. to Lower Fish Hatchery Rd. Crossing

6.3.2.1.2 Rocky Mountain National Park Boundary to Upper Fish Hatchery Road Crossing

A steep valley slope (~5%) running through a terminal moraine deposit defines this reach of the Fall River. The surficial geology, comprised of unconsolidated boulders, cobbles, gravels, and sands, has down-cut and widened in the erodible material. Lateral migration during the 2013 flood eroded large embankments, as the river's energy had no floodplain upon which to release. Continued mobilization and transport of moraine sediments during flood events should be expected for this reach into the future as a result of its surficial geology. Scour forces have limited the formation and maintenance of complete step-pool sequences.

6.3.2.1.3 Upper Fish Hatchery Road Crossing to Lower Fish Hatchery Road Crossing

Valley slopes flatten in between the Fish Hatchery Road Crossings (~2-3%). While still steep overall, the slope does not support the transport of massive amounts of material (potentially) eroded from the moraine reach above. Aggradation and planform adjustment are dominant processes in this reach. A short section of semi-confined valley has little room to meander and is more apt to transport materials but overall the valley is wider here and the channel's floodplain more accessible. Abundant material should support riffle-pool bedform formations however channel and floodplain alterations may work against these processes.

6.3.2.1.4 Lower Fish Hatchery Road Crossing to Old Ranger Road

This is a long section with numerous geomorphic and habitat reaches that have been grouped together for the summary purposes of this memo. In general this section consists of a cobble/gravel dominated alluvial channel that flows through a narrow valley. Erosive energies are limited to minor scour by rip rap and vegetation but occasionally have the ability to become active and create large bank failures. Sediments are generally transported through the system with pockets of aggradation and erosion at the micro-reach scale. Floodplain encroachment by roads and development, historic channel straightening, and recent post-flood dredging have generally limited regular floodplain interactions. The river is generally incised and somewhat entrenched through this section with a weak riffle-pool bedform. Numerous undersized bridge crossings have led to localized instability.

Lower Fish Hatchery Rd. Crossing to Old Ranger Rd.

6.3.2.1.5 Old Ranger Road to West Elkhorn Ave.

Old Ranger Road marks a change in valley slope (to <2%) and confinement that yields a depositional reach at the Elkhorn Lodge/Ranch. Sediments mobilized and transported through the prior reaches (typically smaller gravels and sands) fall out of the bedload here causing aggradation and braiding during a flood event.

Old Ranger Rd. to West Elkhorn Ave.

6.3.2.1.6 West Elkhorn Ave. to Big Thompson River

Downstream of the West Elkhorn Road Bridge the Fall River enters the highly developed corridor of downtown Estes Park. Extensive historic armoring and straightening has essentially locked the channel in place leaving little room for natural channel adjustments. Channel habitat has been altered as typical riffle-pool sequences and riparian vegetation are not maintained. Sediments are generally transported through the reach as in-channel and floodplain storage is limited.

West Elkhorn Ave. to Big Thompson River

6.3.2.2 Planning-Level Channel Migration Zone Mapping

Appendix X displays the Planning-Level Channel Migration Zone mapping results and associated draft erosion hazard zones. These maps are provided for planning purposes and while much attention was given to accuracy, there may be locations along the boundaries that warrant additional refinement as part of future, detailed investigations.

6.3.2.2.1 Interpreting the pCMZ maps and pCMZ Applications

The pCMZ methodology tends to be a conservative assessment that uses LiDAR data as a basis for delineating areas of past and potential future channel migration. The planning-level method does not analyze historical channel occupation or migration rates, and therefore does not allow for assignment of a CMZ design life (effective time period), associated probabilities for migration or erosion, or migration or erosion rates. The pCMZ boundary line is a conservative approximation of areas reasonably succeptible to impact from channel migration. While channel migration should be considered unlikely outside of the CMZ boundary, extreme events where channel migration occurs outside of CMZ boundaries are nonetheless possible. Where a perceived threat to critical infrastructure or life is present, a detailed-level assessment should be undertaken to quantify channel migration rates and processes.

The boundaries of the CMZ and FEMA floodplain generally will not coincide, and should be considered independent of one another. FEMA floodplains will commonly exceed the CMZ in channelized streams such as downtown Estes Park. Conversely, CMZs may exceed the FEMA floodplain in actively migrating streams and depositional areas.

While we present the pCMZ as a valuable planning tool with hopes of minimizing future flood damage, it is certainly not all-inclusive and should be utilized with other tools such as FEMA-derived inundation maps. In addition, the pCMZ does not capture extreme landscape disturbances such as dam failures, debris flows, landslides, earthquakes, etc., and this pCMZ analysis did not examine the potential for geotechnical slope failures. In addition to endangering life and property within these landscape disturbance areas, resulting debris, sediment, or fractures may alter the course of the Fall River into areas not identified in the pCMZ. Likewise, the possibility of diversion ditches capturing the main stem of the river is not considered in the pCMZ mapping.

The pCMZ maps are presented to support coalition efforts to work with local governments and state agencies to develop programs and codes that limit investment and asset development within the mapped pCMZ hazard areas. Erosion hazards and channel avulsions present extreme risks during high flow events in all watersheds along the Front Range and having a robust data set that assesses multiple hazards is critical to long term planning and community resilience. Avulsion hazard areas and mapped alluvial fans are priority locations for buyouts, especially, though not limited to, where they overlap with mapped FEMA floodplains. The modern valley bottom, erosion hazard area, and disconnected migration zones should similarly be examined for opportunities to remove critical infrastructure and homes in favor of greenways or open space corridors, or at the very least, provide education for those citizens, businesses, and government agencies that invest in high risk areas. Additionally, in some locations, mapped disconnected migration zones can be used to identify locations for floodplain reconnection projects.

6.3.2.2.2 Rocky Mountain National Park Boundary to Upper Fish Hatchery Road Crossing

CMZ mapping from the Park Boundary follows the recent channel which has incised into a glacial moraine. While high terraces keep the channel locked into a narrow course under normal flows these non-cohesive materials are susceptible to erosion during a flood event. Due to the unconsolidated nature of the moraine deposit an erosion hazard area (EHA) of one have meander belt width was identified.

6.3.2.2.3 Upper Fish Hatchery Road Crossing to Lower Fish Hatchery Road Crossing

The MVB below Fish Hatchery Road broadens as the valley slope lessens and the stream becomes more depositional. The combination of large materials coming out of the moraine area and a widening flatter river may to extreme erosion and deposition (as was the case during the September 2013 flood).

For these reasons most of this segment was also designated as an avulsion hazard zone (AVZ).

6.3.2.2.4 Lower Fish Hatchery Road Crossing to Old Ranger Road

The MVB that runs along the majority of the study area of the Fall River is a combination of the active channel and nearby floodplain as well as low floodplain terraces that may only be accessed during larger events but nonetheless are composed of alluvium and susceptible to fluvial erosion. The EHA is kept to 50' throughout this reach – the average ½ meander belt width. Where Fall River Road historically cut off meander bends DMA's were delineated. A special consideration AVZ' was also delineated where under the right circumstances there may be a chance for the Fall River to make an unexpected jump due to a diversion structure.

6.3.2.2.5 Old Ranger Road to West Elkhorn Ave.

The MVB broadens at the Elkhorn Ranch as the channel becomes highly depositional. The whole MVB was designated as an AVZ as the river is susceptible to braiding and avulsions in this reach. A DMA was delineated the north side of Elkhorn Avenue where floodplain likely existed prior to the construction of the road.

6.3.2.2.6 West Elkhorn Ave. to Big Thompson River

Below West Elkhorn Ave. the MVB was delineated based on elevation?? As significant channel erosion is unlikely here and the valley side slopes are comprised of bedrock it was decided that an EHA would not be delineated.

6.3.2.3 Community Asset Inventory

The results of the community asset inventory for geomorphic hazards are summarized in Tables x for parcels in the Fall River corridor for avulsion hazard areas, disconnected migration areas, erosion hazard areas, and the modern valley bottom. The results of the asset inventory for utilities is presented in Tables x.

pCMZ Zone (Parcel type)	Number of Parcels	Number of Buildings	Value of pCMZ Property	Value of pCMZ Structures	Total Property Value	Total Structure Value
Avulsion Hazard	**72**	**128**	**$3,579,771**	**$5,929,190**	**$9,024,102**	**$10,663,566**
Commercial	3	50	$139,976	$170,089	$700,012	$746,814
Exempt	3	20	$110,272	$131,490	$1,473,990	$1,568,104
Residential	61	58	$3,329,523	$5,627,611	$6,850,100	$8,348,648
(blank)	5	0	$0	$0	$0	$0
Disconnected Migration	**6**	**4**	**$64,789**	**$150,502**	**$717,508**	**$1,469,752**
Commercial	2	2	$55,024	$135,544	$410,008	$1,010,000
Residential	2	2	$9,765	$14,959	$307,500	$459,752
(blank)	2	0	$0	$0	$0	$0
Erosion Hazard	**320**	**513**	**$10,144,859**	**$19,412,064**	**$38,125,501**	**$62,311,115**
Commercial	44	261	$1,674,921	$3,320,385	$13,183,089	$24,124,573
Exempt	8	21	$95,748	$155,827	$1,681,912	$2,445,253
Multiple Unit	1	2	$33,091	$30,154	$202,800	$184,800
Residential	237	229	$8,341,098	$15,905,698	$23,057,700	$35,556,489
(blank)	30	0	$0	$0	$0	$0
Modern Valley Bottom	**345**	**406**	**$17,002,314**	**$34,581,106**	**$43,994,725**	**$77,702,563**
Commercial	115	214	$7,881,016	$16,212,583	$23,680,038	$44,056,652
Exempt	21	0	$1,483,327	$0	$1,847,787	$0
Multiple Unit	3	4	$188,128	$747,850	$387,800	$929,800
Residential	176	188	$7,449,843	$17,620,673	$18,079,100	$32,716,111
(blank)	30	0	$0	$0	$0	$0
Grand Total	**743**	**1051**	**$30,791,733**	**$60,072,862**	**$91,861,836**	**$152,146,996**

pCMZ Zone (Utility type)	Length of impacted utilities (ft)
Avulsion Hazard	**3,555**
Lateral	159
Potable	679
SewerMain_EPSD	1,001
SewerMain_UTSD	1,716
Disconnected Migration	**392**
Lateral	4
Potable	187
SewerMain_EPSD	169
SewerMain_UTSD	32
Erosion Hazard	**15,595**
Lateral	1,792
Potable	5,887
SewerMain_EPSD	679
SewerMain_UTSD	7,237
Modern Valley Bottom	**20,337**
Lateral	2,479
Potable	5,328
SewerMain_EPSD	6,400
SewerMain_UTSD	6,130
Grand Total	**39,879**

6.4 Flood Risk Assessment

A flood risk analysis was employed to update the current understanding of potential flood impacts on Fall River. This analysis is a preliminary post-flood assessment and cannot replace FEMA flood mapping. A detailed local hydraulic assessment will be required for design at any site. FEMA inundation maps provide an estimate of 100 year inundation extents; however they do not provide an understanding of the uncertainty in this assessment. The inundation maps also fail to extrapolate the location of inundation to an understanding of risk to assets in the river corridor. By definition, risk is the product of probability and consequence. This assessment accounts for both components of risk by performing a hydraulic analysis to update flood inundation extents, and coupling this with a community asset analysis.

The hydraulic analysis was performed to account to changes in topography caused by the 2013 flooding, and updates to the estimated flood discharge values. This analysis produced updated inundation extents for the 2-, 10-, 50-, and 100-year events. The limitations of this modeling are described in detail in the results section. This information was overlaid with known property, structure, and utility values to get an estimate of risk due to flooding.

6.4.1 Methodology

6.4.1.1 Hydraulic Modeling

Hydraulic modeling was conducted using the U.S. Army Corps of Engineers' River Analysis System (HEC-RAS), Version 4.1.0. Models were originally developed by the Colorado Water Conservation (CWCB) as part of the 2013 flood response, recovery, and post-flood mitigation efforts. The CWCB HEC-RAS model was slightly modified by the technical team for master planning activities.

6.4.1.1.1 CWCB 2013 Post-Flood Hydraulic Modeling

Hydraulic models were developed by CWCB along river reaches affected by the September 2013 flood. Models were generated using HEC-GeoRAS, an automated program that utilizes GIS, and 2013 post-flood LiDAR data. The 2013 post-flood LiDAR data references the horizontal datum of NAD 83 and the NAVD 1988 vertical datum. It should be noted that the 2013 post-flood LiDAR was raw or unprocessed along most river reaches at the time of model development. The Fall River CWCB model was obtained directly from CWCB. The Fall River hydraulic model provided by CWCB included two separate models which cover approximately 6 miles of river. The first model includes the lower 20,000 feet (3.8 miles) of the Fall River, upstream of the Big Thompson confluence. The second Fall River model includes an upper reach extending from station 20,000 up to 31,800 feet, with a reach length of 11,800 feet (2.2 miles). Cross sections were cut every 100 feet along the lower reach and every 200 feet through the upper reach. Bank stations were not established at any cross sections. A manning's n value of 0.04 was applied to all cross sections uniformly. There are approximately 42 road or pedestrian bridges/culvert crossings located on the Fall River within the 6-mile model reach. The lower reach model includes geometry of four bridges and one culvert crossing (3 pedestrian bridges, shopping center culvert, and Weist Drive Bridge) all located through the downtown area. The source of the bridge/culvert geometry in the lower model is unknown. The upper model does not include any bridge or culvert crossings. Critical depth was applied as the downstream boundary condition and the FEMA effective 100-year discharge of 680 cfs was included in the model. FEMA effective discharge values from the Larimer County FIS are provided in Appendix (x)

6.4.1.1.2 Modified CWCB 2013 Post-Flood Hydraulic Modeling

The Fish Creek CWCB 2013 post-flood hydraulic model was slightly modified by the technical team for use in the Master Planning process.

Modifications made to the Fall River model include the following:

- Downstream Boundary Conditions – The downstream boundary conditions were modified from critical depth to normal depth. Coincident flood levels on the Big Thompson were considered by comparing the water surface elevation on the Big Thompson with the 100-year normal depth computed on the Fall River. The Fall River 100-year normal depth water surface was found to be higher than the 10-year water surface elevation on the Big Thompson River.

- Discharge Profiles – Per guidance from FEMA estimated 10-, 25-, 50-, 100-, and 500-year discharge values from a 2013 post-flood study entitled "Hydrologic Evaluation of the Big Thompson Watershed, Post September 2013 Flood Event" and prepared by Jacobs for the Colorado Department of Transportation (CDOT) and CWCB were included in the hydraulic model. Estimated flood discharge values entered into the HEC-RAS model are shown in Table 1. A 2-year discharge was estimated using regression analysis. Due to uncertainty associated with the flood discharge estimates and current lack of an updated detailed hydrologic study an additional discharge of 2,700 cfs, representing an upper bound of an estimated 100-year discharge, was also included in the modeling. No discharge profile that varies along the reach was produced; hence this values for each simulation did not vary from the uppermost reach to the most downstream reach of the channel

Table 1 Fall River Flood Discharges (cfs)

(Hydrologic Evaluation of the Big Thompson Watershed, Post September Flood Event, Jacobs)

2-Year	10-Year	25-Year	50-Year	100-Year	500-Year
65*	248	593	1,039	1,669	3,990

*Estimated using regression.

- Ineffective Flow Encroachments – Ineffective flow encroachments were added to the model through the downtown area where buildings are located.
- Bridge/Culvert Crossings – The bridge/culvert crossings listed below were added to the model using geometry estimated from field measurements. Survey data was not collected at these structures.
    - Moraine Avenue Culverts
    - Lower West Elkhorn Drive Bridge (includes Wagon Wheel Bridge)
    - Spruce Drive Bridge
    - Pedestrian Bridge
    - Sunny Acres Ct Bridge
    - Upper West Elkhorn Drive Bridge
    - Old Ranger Road Bridge

Bridge and Utility Damage

6.4.1.2 Community Asset Inventory

The community asset inventory accounted for the monetary consequences of property, structures, and utilities within the predicted inundation extents. The community asset inventory analysis was performed using ArcGIS (2013) software package for parcels (properties and structures), and utilities separately. Parcel location, extents, estimated property dollar value, and estimated property improvement (structure) dollar value were gathered from publically available Larimer County data (June 3, 2013). The estimated dollar values are not assessed values for properties. Utility locations were provided by the Town of Estes Park for potable, lateral and sewer main categories. Potable utilities include water supply mains, laterals are secondary the water main, such as hydrants, bleeders, and service. Utility cost per foot were estimated from Larimer County values and are summarized in Table xx.
To calculate the flood consequences for parcels, total land and improvement values were multiplied by the fraction of the parcel inundated as derived from a GIS analysis of the union of delineated inundation areas/CMZ zones and Larimer County parcel data. This is not a detailed account of whether or not the structures themselves were inundated. For example, if 50% of the land acreage falls within the inundation area, a $10,000 plot with $50,000 improved structures is reported as $5,000 and $25,000 asset loss respectively regardless of whether or not structures fall within the inundation area. The recalibrated square footage and dollar values were then summarized by parcel category for each area/zone using excel pivot tables.
To calculate the flood consequences for utilities, a GIS analysis of affected utilities was derived by clipping the linear utility data provided by the City to the extent of delineated inundation areas/CMZ zones and summing the recalibrated footage of each utility category using excel pivot tables.

The community asset inventory does not account all forms of loss caused by a flood by any means. Due to a lack of data many things such as loss of life, injury, loss of personal property inside of structures, or loss of non-structural assets on properties cannot be analyzed. However this analysis does give a starting point for understanding flood risk in the river corridor.

6.4.2 Results

6.4.2.1 Hydraulic Modeling

Results of the Fall River hydraulic modeling were used to determine estimated 2-, 10-, 25-, 50-, and 100-year water surface elevations. Mapping of 2-, 10-, 50-, and 100-year inundation was conducted using HEC-RAS model results and the 2013 post-flood LiDAR data. The results are presented as a map book in Appendix X that shows the extents of the modeled inundation.

6.4.2.1.1 Hydraulic modeling limitations and assumptions

The hydraulic model and inundation mapping developed for Fall River are considered to be approximate and do not meet standards of a detailed analysis. Model results and inundation mapping should be used with the following caveats/limitations in mind:

- Fall River flood discharge values are estimates and not based upon detailed hydrologic modeling. In addition, flood discharge values in the Fall River are assumed to be static throughout the study reach and are not reflective of a more realistic discharge profile that should likely be reduced as you proceed up the channel.
- Fall River hydraulic model geometry and inundation mapping was developed using un-processed LiDAR data.
- Fall River hydraulic model geometry does not include in-channel bathymetric survey data. (Note that LiDAR data does not include data below water.)
- The origin of bridge/culvert model geometry from CWCB is unknown.
- Bridge/culvert model geometry added to CWCB models was estimated and is not based upon field survey data.
- A majority of bridges/culverts are not represented in the modeling. The absence of crossing structures in the model will result in underestimation of water surface elevations in the vicinity of bridges or culverts.
- The Fall River hydraulic model includes ineffective encroachments through the downtown area where buildings are present. In this location there are split flows likely occurring where flow spills from the channel and moves through the downtown area, mostly along streets, and then returns back to the river channel. Possible split flows were not modeled.

The level of detail provided in the Fall River hydraulic modeling was considered sufficient for the purposes of conceptual level activities associated with Master Planning efforts. However, more detailed hydrologic and hydraulic studies will need to be completed subsequent to Master Planning efforts.

6.4.2.2 Community Asset Inventory

The results of the community asset inventory for flood hazards are summarized in Tables x through x for parcels in the Fall River corridor for 2-, 10-, 25-, 50-, and 100-year inundation levels. The results of the asset inventory for utilities is presented in Tables x through x for 2-, 10-, 25-, 50-, and 100-year inundation levels respectively.
Table x

Utility and Structure Damage

Fall River 2-Year Floodplain Parcel Assets						
Parcel Type	Number of Parcels	Number of Structures	Inundated Property Value	Inundated Structure Value	Total Property Value	Total Structure Value
Commercial	50	167	$718,665	$1,591,253	$10,860,859	$20,937,651
Exempt	16	10	$162,251	$17,621	$2,167,746	$784,052
Residential	57	63	$976,636	$962,460	$11,562,500	$14,535,781
(blank)	17	0	$0	$0	$0	$0
Grand Total	**140**	**240**	**$1,857,552**	**$2,571,334**	**$24,591,105**	**$36,257,484**

Fall River 10-Year Floodplain Parcel Assets						
Parcel Type	Number of Parcels	Number of Buildings	Inundated Property Value	Inundated Structure Value	Total Property Value	Total Structure Value
Commercial	54	170	$1,047,254	$2,400,081	$11,565,485	$22,137,651
Exempt	17	10	$217,119	$24,604	$2,281,002	$784,052
Residential	71	75	$1,313,483	$1,332,145	$13,489,500	$17,597,366
(blank)	20	0	$0	$0	$0	$0
Grand Total	**162**	**255**	**$2,577,856**	**$3,756,831**	**$27,335,987**	**$40,519,069**

Fall River 25-Year Floodplain Parcel Assets						
Parcel Type	Number of Parcels	Number of Buildings	Inundated Property Value	Inundated Structure Value	Total Property Value	Total Structure Value
Commercial	71	189	$3,368,789	$8,732,060	$14,806,036	$26,315,267
Exempt	18	10	$646,426	$32,261	$2,281,502	$784,052
Multiple Unit	2	2	$185,000	$745,000	$185,000	$745,000
Residential	91	97	$2,348,070	$3,231,191	$15,254,500	$20,374,293
(blank)	22	0	$0	$0	$0	$0
Grand Total	**204**	**298**	**$6,548,285**	**$12,740,513**	**$32,527,038**	**$48,218,612**

Fall River 50-Year Floodplain Parcel Assets						
Parcel Type	Number of Parcels	Number of Buildings	Inundated Property Value	Inundated Structure Value	Total Property Value	Total Structure Value
Commercial	113	232	$8,300,436	$15,284,481	$21,768,825	$32,947,039
Exempt	20	11	$980,349	$41,868	$2,373,302	$1,661,201
Multiple Unit	2	2	$185,000	$745,000	$185,000	$745,000
Residential	137	142	$4,440,906	$7,262,670	$17,496,900	$26,084,133
(blank)	24	0	$0	$0	$0	$0
Grand Total	**296**	**387**	**$13,906,691**	**$23,334,019**	**$41,824,027**	**$61,437,373**

Fall River 100-Year Floodplain Parcel Assets						
Parcel Type	Number of Parcels	Number of Buildings	Inundated Property Value	Inundated Structure Value	Total Property Value	Total Structure Value
Commercial	127	247	$11,422,869	$18,772,340	$22,378,705	$33,973,359
Exempt	20	11	$962,244	$54,578	$2,309,502	$1,661,201
Multiple Unit	3	4	$184,935	$744,341	$387,800	$929,800
Residential	178	183	$6,666,583	$12,299,813	$19,591,600	$31,829,106
(blank)	26	0	$0	$0	$0	$0
Grand Total	**354**	**445**	**$19,236,631**	**$31,871,072**	**$44,667,607**	**$68,393,466**

Infrastructure Damage

Fall River 2-Year Floodplain Utilities	
Utility Type	Length of Impacted Utility (ft)
Lateral	187
Potable	439
SewerMain_EPSD	357
SewerMain_UTSD	355
Grand Total	1,338

Fall River 10-Year Floodplain Utilities	
Utility Type	Length of Impacted Utility (ft)
Lateral	278
Potable	594
SewerMain_EPSD	786
SewerMain_UTSD	634
Grand Total	2,292

Fall River 25-Year Floodplain Utilities	
Utility Type	Length of Impacted Utility (ft)
Lateral	898
Potable	1,941
SewerMain_EPSD	2,959
SewerMain_UTSD	2,208
Grand Total	8,006

Fall River 50-Year Floodplain Utilities	
Utility Type	Length of Impacted Utility (ft)
Lateral	1,949
Potable	4,256
SewerMain_EPSD	5,051
SewerMain_UTSD	4,503
Grand Total	15,759

Fall River 100-Year Floodplain Utilities	
Utility Type	Length of Impacted Utility (ft)
Lateral	2,633
Potable	5,009
SewerMain_EPSD	6,211
SewerMain_UTSD	6,109
Grand Total	19,962


Infrastructure Damage


Bridge Damage


Infrastructure Damage

this page intentionally blank

Fall River Post Flood Damage

7 Recovery and Restoration Project Recommendations

7.1 Overview

Recommended projects were generated by the technical team, with the help of the River Advisory Committee, and public feedback. The recommended projects represent the best alternatives to reduce flood and geomorphic risk for homeowners, business owners, and the public as well and increase the ecological quality of Fall River. The projects were summarized in a matrix and evaluated for their ability to reduce risk and meet community values, and evaluation criteria relative to all the other potential projects. After going through a public review and editing process, the top five projects were chosen based on their matrix rankings. The purpose of the prioritization is to direct community organizers to projects that best meet the goals of reduced flood and geomorphic risk, and increased ecological function, as well as meeting the community values and criteria. The prioritized projects also take into account their relative cost and funding potential. The prioritization of the five projects does not guarantee that they will be constructed or even funded. The prioritized projects are described in greater detail in individual cut sheets.

Three tiers of projects were recommended for the resiliency plan. The different tiers reflect the range of hazards and risks in the Fall River corridor. The following are descriptions of the three types of projects:

1st Tier: acquisition and removal of an asset (e.g., home, business, or other infrastructure, such as road or bridge) from a high hazard area should be considered first for maximum risk reduction.

2nd Tier: when acquisition is not an option, the owner(s) in the high hazard area make an informed decision to stay despite the risks. Similarly, when relating a road or removing a bridge from a high hazard area is not an option, agencies and affected landowners make an informed decision on how to proceed. Then, to best protect assets, the stakeholders make physical changes to improve channel stability, reduce flood surface elevations and restore stream health. Multiple project partners can collaborate on larger project(s) with system-wide engineering solutions that move towards resiliency.

3rd Tier: when a larger project is not feasible, affected parties can consider localized solutions to protect the individual assets, including flood-proofing structures, specialized foundations, revetments, retrofits, etc.

7.1.1 How to use this document

The information in the recommended project section of the master plan is meant to be used as a planning tool for the community and the future leadership of the river coalition. The results of the project recommendation process resulted in:

- The Concept Drawings showing specific conceptual project recommendations
- The Project Matrix which compares all of the recommended projects
- The Top 5 Prioritized Projects with cut-sheets show these projects in more detail

Each recommended project is a reach on Fall River where specific project elements are laid out to best reduce flood and geomorphic risk, increase ecological function, and meet the community values. The specific recommendations are shown on the Concept Drawings in Appendix X. The recommended projects are summarized and evaluated in the project matrix, which can be used for comparison of benefits between projects. The recommended project matrix should be used as a comparison tool and guide for the pursuit of funding for different projects. It is not the final decision about what projects to pursue for implementation. For example, several projects address the specific needs of local structures to reduce high geomorphic or flood risk, but due to the highly developed and confined nature of the reach, the project provides little other benefit outside of risk reduction. These projects do not compare as favorably to projects that provide multiple benefits, but they are still necessary to the safety of the local residents and public.

While the technical team recommends completing all of the projects to reduce risk and improve stream function, five projects were prioritized because of significant multiple benefits to the river. The prioritized project cut sheets describe in greater detail the project objectives and strategy. They provide information on potential funding sources, implementation guides, construction considerations, and projects costs which can be used to help pursue funding, and guide the design and implementation.

The projects recommended by the technical team represent the best alternatives for reducing risk in the Fall River Corridor. They provide a long-term vision for the river that groups can use to guide future projects and development. As projects are funded and moved into design and implementation phases there is room for further change and refinement to meet the needs of residents and specific site limitations.

Fall River Pedestrian Bridge Damage

Fall River Structure Damage

7.2 System-wide Recommendations

There are several strategies and approaches that are either programmatic, regulatory in nature, or thematic that could be applied wholesale throughout the Fall River system. This section outlines these recommendations.

Strategies to benefit Fall River include:

- Channel Design and Rehabilitation
    - Create compound channels
    - Create complex channels
- Reduce Channelization, Armoring, and Floodplain Disconnections
- Improvements to and Relocation of Road Infrastructure
- Improvements to Public and Private Crossings
    - Increase Conveyance--Adjustments to Bridge Geometry Standards
    - Maintain and Restore Sediment Transport Capacity
    - Compound Channels through the Crossing
    - Additional Floodplain Conveyance
    - Break-Away Bridges and Designed-to-Fail Approaches
    - Shared Crossings
    - Temporary Crossings

- Diversion Structure Strategies
- Utility Relocation

Programs and Regulations to benefit Fall River include:

- Create a Protected "River Corridor"
    - Conservation Easements
    - Transfer of Development Rights
    - Voluntary Fee and Title Transfer and Acquisitions
    - Deliberate building envelope placement
- Finalize and Adopt Channel Migration Zone Delineations and Policy
- New Flood Insurance Study (FIS)
- Reducing Risk and Enhancing Ecosystems via Land Use and Zoning
- Watershed Management Plans
- Flood Warning System
- Public Education Campaigns
- Join the National Flood Insurance Program (NFIP) Community Rating System (CRS)
- Stormwater Management and Accounting for Altered Hydrologic Regimes
- Regulatory Frameworks and Funding Strategies

A "conservation easement" is a legal agreement between a landowner and a land trust or government agency that permanently limits uses of the land in order to protect its conservation values. It allows landowners to continue to own and use their land, and they can also sell it or pass it on to heirs. Conservation easements offer great flexibility. An easement may apply to all or a portion of the property, and need not require public access.

When you donate a conservation easement to a land trust, you give up some of the rights associated with the land. For example, you might give up the right to build additional structures, while retaining the right to recreate on the land. The easement is in perpetuity--future owners also will be bound by the easement's terms. The land trust is responsible for making sure the easement's terms are followed. This is managed through "stewardship" by the land trust which includes annual (or more frequent) site visits to assure that easement terms are being upheld, and corrective actions which can include litigation if violations are detected.

Estes Valley Land Trust is a nationally accredited land trust with over 27 years of experience "preserving and protecting open space, valleys, wetlands, streams, ranch lands, and wildlife habitat in the Estes Valley." The proposed conservation easement lands that are included in these Master Plans are well within the mission of the Land Trust. As detail plans and implementation projects are developed, EVLT welcomes the opportunity to work with the implementation teams to protect the critical conservation values of the Estes Valley watersheds.

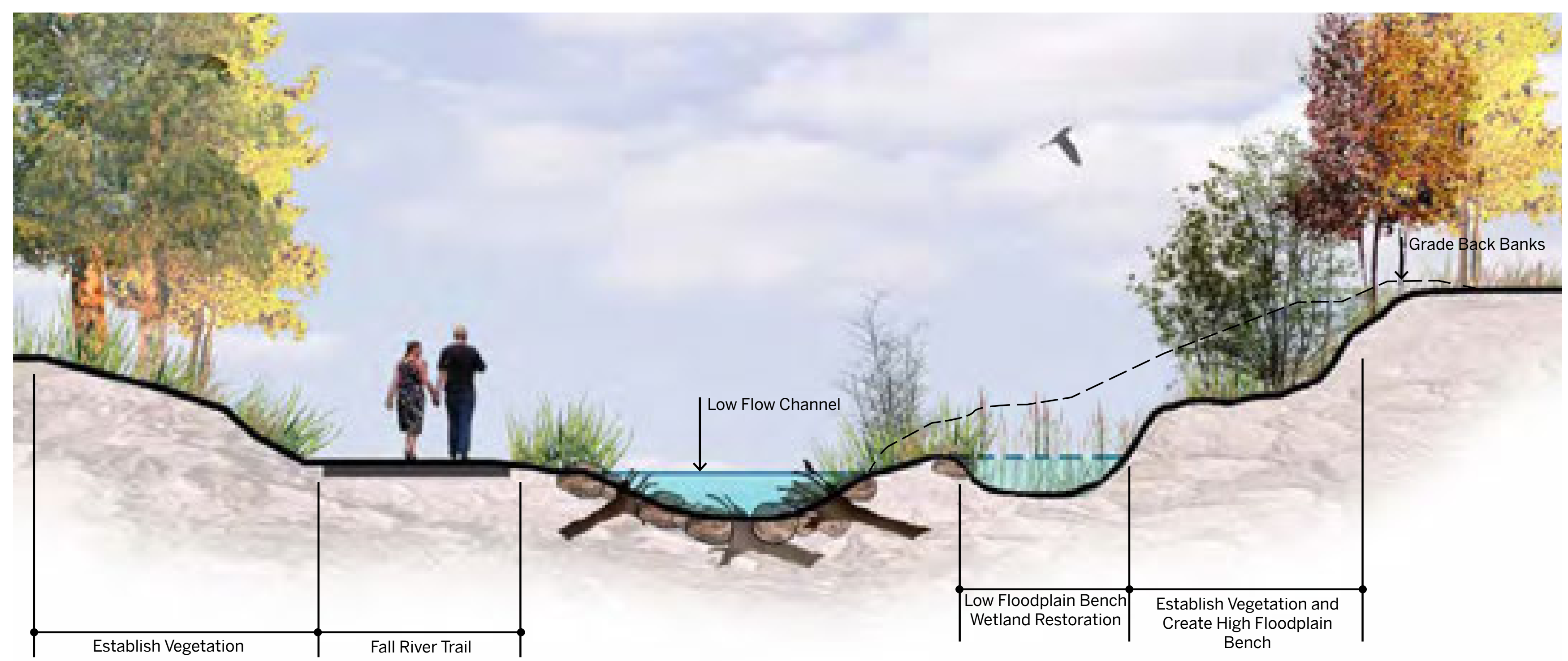


Figure 1. Compound channel for connected and variable floodplains. Compound or nested channels with floodplain benches below, at, and above the top of bank reduce flood surface elevations, maintain sediment transport while also providing refuge for fish and niches for diverse riparian plant communities.

7.2.1 Strategies

7.2.1.1 Improve Channel Complexity and Function

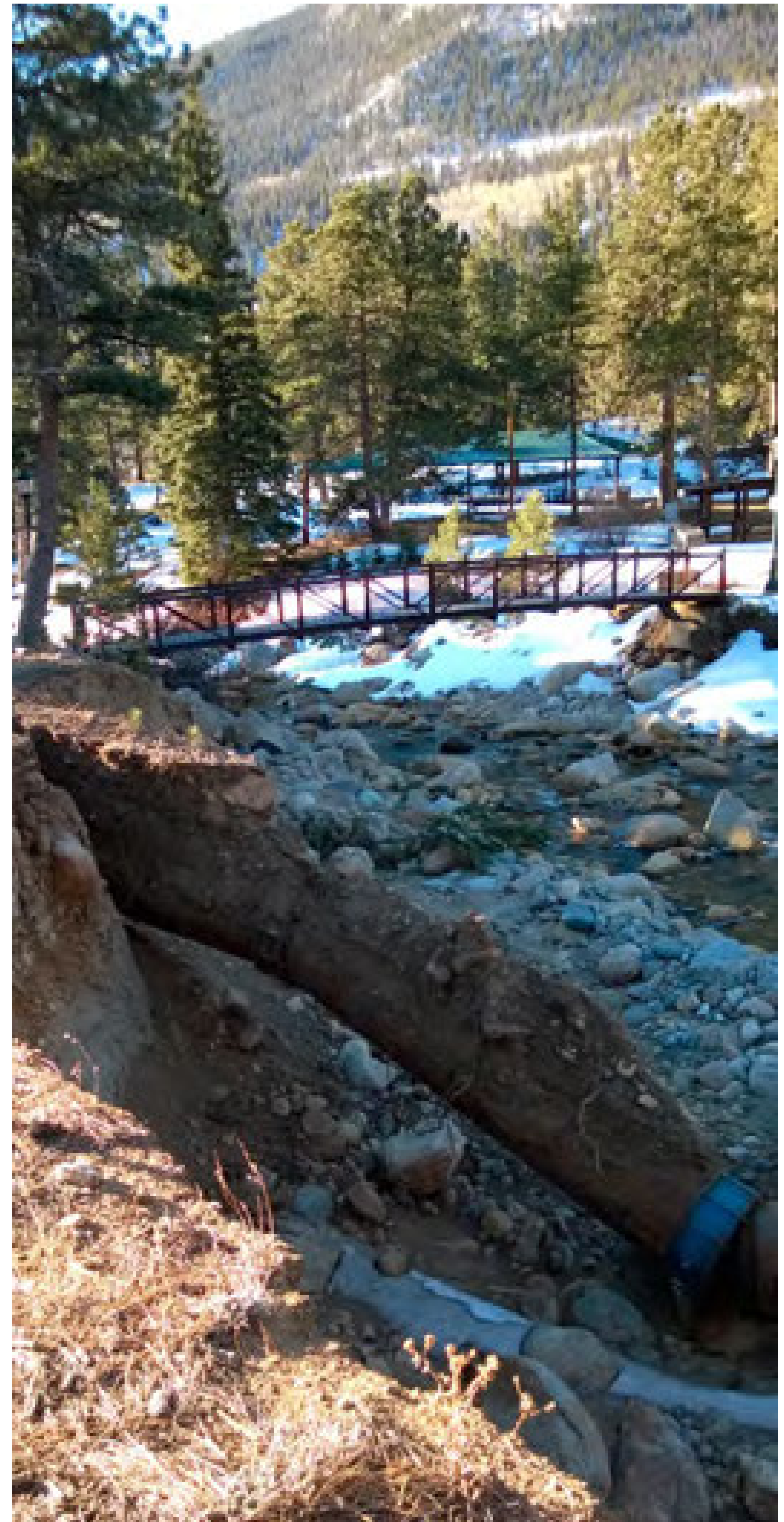
In-channel restoration projects typically result in significant public attention and stakeholder involvement. They are the 'sexy' aspect of watershed restoration – heavy machinery working in the river to recreate a natural looking channel, bank, and floodplain with promises that trout and other wildlife will move in afterwards. While undeniably in-channel work has resulted in some excellent results it also has a mixed track record and the cost-benefit has not always added up. In order to increase the likelihood of success, we strongly encourage that in-channel projects emphasize restoration of stream processes over aesthetic form, regulatory target, and/or unreasonable expectation

Rivers, given enough time, space, and water moving through them (in the right quantities and timing - including seasonal flooding) are inherently self-healing. Flood altered streams will find their equilibrium and reestablish habitat features and floodplains given enough time and (clean) water moving through them. Time, however, for a river, can be much longer than a community is willing to wait – especially in Colorado's mountains where natural systems are brittle and ecosystem recovery can be very slow. Projects that allow for and even encourage natural channel forming processes to take place can hasten a streams rehabilitation and increase the likelihood of establishing a self-maintaining system. These processes include the ability to meander; generate, transport, and store sediments and organic debris; access and dissipate energy onto floodplains; interact with riparian vegetation; and experience seasonally variable flows.

Specifically, the concept of process based restoration for the Fall River should emphasize in-channel variation and connectivity and movement as described in the following two subsections:

7.2.1.1.1 Create compound channels (Figure 1)

The early study of river systems may have inadvertently led to the proliferation of trapezoidal channel design being considered a "stable" river shape and optimum for flood control. For ease of graphic description and mathematical calculation a trapezoid is a straightforward way to think of a river channel. Trapezoid channels also move water quickly and efficiently – a trait that can be of great benefit, but also great detriment during a flood. The wide-bottomed, steep banked trapezoid, however, hinders sediment storage and transport, promotes excessively shallow low water flows and extremely high powered flood flows, does not dissipate energy, and ignores important biogeochemical processes necessary for maintaining water quality and aquatic health.


Hydroplant Damage

Natural stream channels and their floodplains are complex. This complexity is both created and derived from rivers occupying different areas of the channel and floodplain at different flow stages. One often overlooked channel is the low-flow channel or base flow channel which sits within the bankfull channel, has a higher sinuosity than the larger bankfull channel, and provides refuge and shade for aquatic biota during the low flow periods of the summer, fall, and winter. Bank and floodplain benches below, at, and above the top of bank provide stepped relief for the stream channel maintaining sediment conveyance at crucial times while also providing refuge for fish and niches for plant diversity.

The complexity in channel shape carries over into the floodplain where overflow channels and flood chutes provide opportunities for floodplain access and backwater refuge at varying flows (sometimes a low floodplain bench is not directly adjacent to the main channel but rather exists as a flood-chute separated from the main channel). Too frequently following the September 2013 flood these areas have been filled back in and the stream channel bulldozed back into a "bad trapezoid". It is recommended that the Fall River Coalition prioritize protecting and restoring secondary channel locations and natural floodplains from the impacts of development, and remove fill when appropriate to re-create or preserve access to floodplain benches and overflow channels.

7.2.1.1.2 Create complex "messy" channels

Prevailing public perception of "natural" river channels being

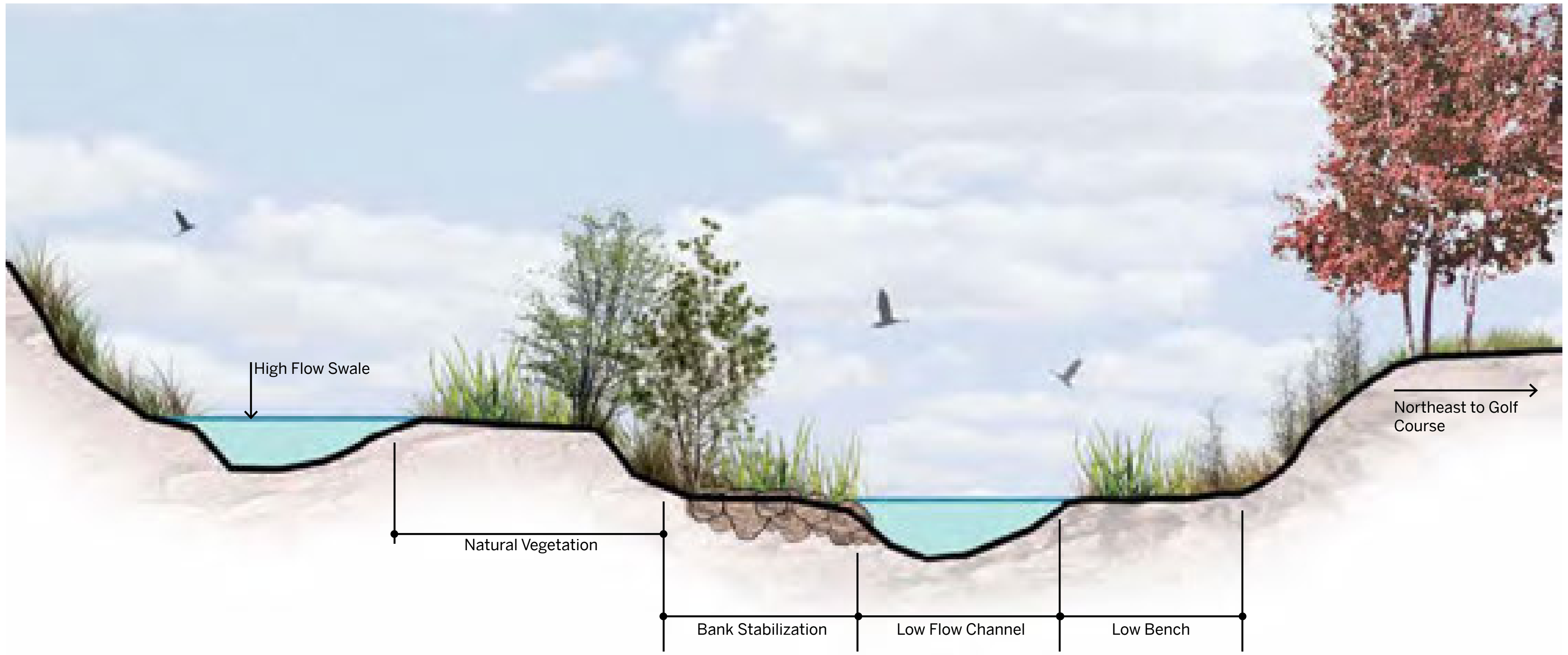


Figure 2. Overflow channels. Where corridor width allows, establishing designated high flow paths to relieve the flow in the main channel provide the safest and most reliable means of dealing with overbank flow and potential damaging floodwaters.

"messy" has led to several pervasive problems in Colorado mountain streams. Where once beaver dams and log jams choked stream channels allowing water to access numerous side channels and create complex habitats and healthy riparian zonestoday's Fall River is largely a "clean" single-thread channel running from its headwaters to its confluence. This metamorphosis from an anabranched wandering channel with excellent and frequent floodplain connection to a simplified single thread channel has limited the retention of organic matter (carbon), nutrients, and flood waters and reduced the ecological diversity it once held. The lack of large wood and beaver dams in the channel is of particular concern as fallen trees provide excellent fish habitat, promote local scour and create natural pools, and provide cohesive structure to the channel bed and banks. Although relatively stable due to its large bed substrates the existing Fall River channel provides limited fish and riparian habitats because the system has been so constrained by development and historic floodplain alterations. Localized complexity and system-wide variability in width, depth, land cover, vegetation, and bed materials should be long term goals for the Fall River.

The concept of "clean" has also been applied to riparian areas and floodplain wetlands where lawns and riprap have replaced natural vegetation along much of the Fall River. While these altered floodplains may provide an easier place to backcast a trout fly, lawns and rip-rap offer little to the stream ecosystem. They also provide a false sense of stability and flood protection. To the extent possible efforts to reintroduce complexity into the channel and its floodplain should be embraced and efforts to treat the river as a manicured landscape should be resisted.

7.2.1.2 Reduce Channelization, Armoring, and Floodplain Disconnections (Figure 3)

For decades, the prevailing flood control theory was that river channelization (straightening) resulted in perpetually scouring, stable, and high conveyance channels. As a result, river systems have been cut off from their floodplains by berms and aggressive channelization, yet successful flood control was never achieved from these efforts. Over the last two decades, this channelization for flood control theory has been largely abandoned and prevailing philosophies on efficient (for both sediment and water) river systems have trended towards floodplain reconnections with multi-stage channels. Floodplains and natural banks play an important role in dissipating stream energy and provide low-risk locations for natural sediment deposition in addition to providing ecological complexity and good riparian habitat. Channelization occurs throughout the Fall River system. The response of the stream system to these modifications typically occurs within and well beyond the modified reach and frequently begins with a bed incision process. As channels incise (or berms are constructed), channels are disconnected from their floodplains, and in turn, the excess energy in the system causes an increase in erosion laterally and/or vertically. The increased erosion leads to an increase in sediment load transferred downstream of the channelized reach, where the channel may not have the capacity to continue to move the sediment, ultimately leading to bed aggradation and possible avulsion. Above the site of impact, the incision process may migrate upstream undermining existing structures, bank protection, and erasing habitat features such as pools and riffles.

Armoring and rip-rap, also prevalent in the Fall River system, similarly, do not typically eliminate erosion problems. Instead energy is transferred shifting the problem further downstream or to the opposite bank with potentially impacting neighboring properties. Fundamentally, both channelization and armoring are outdated means of addressing a local imbalance between the river energy and the means to dissipate or transport it in a way that is commiserate with human uses.

When possible, the Fall River Coalition should seek to remove barriers to channel migration and provide frequent opportunities for floodplain access. When necessary bank protection should be comprised of natural materials such as large woody debris and living shrubs and trees.

7.2.1.3 Improve and Relocate Road Infrastructure

At the watershed scale road networks can have significant impacts to the hydrologic regime and floodplain of the Fall River. Excessive road networks may decrease water storage capacity of the landscape as water is quickly and effectively transferred into conveyance ditches. These land use changes decrease the time it takes water to enter the channel and may increase the peak volume of water. Changes in runoff volume and timing can disrupt the water/sediment balance in creek systems. Erosion, incision, and channel widening are often associated with increased stormwater resulting from development.

Elkhorn Avenue, Fall River Road, Fish Hatchery Road and a number of other local roads have encroached on the stream corridor. In turn, flow depths, shear stresses, and sediment transport capacities may become higher than they would be in a more natural condition. This corridor alteration has likely transformed some reaches from sediment storage areas to sediment transport reaches, which potentially impacts downstream reaches where the excess sediment then deposits. When these roads are repaired, coordination with qualified fluvial geomorphologist(s) and/or river engineer(s) is highly recommended to limit constrictions, maintain sediment transport, reduce sheer stress against the road embankments, and maintain floodplain and in-channel habitat.

In addition, where roads border the river, vegetation tends to be disturbed and not as robust as if the stream were meeting an unaltered floodplain forest. Berming, straightening and armoring associated with the building of the road along a stream corridor effectively raises the bank height, increasing channel erosive energy and disconnects the river from its floodplain (as described in the previous section). These road protection efforts have proven to be temporary fixes at best,

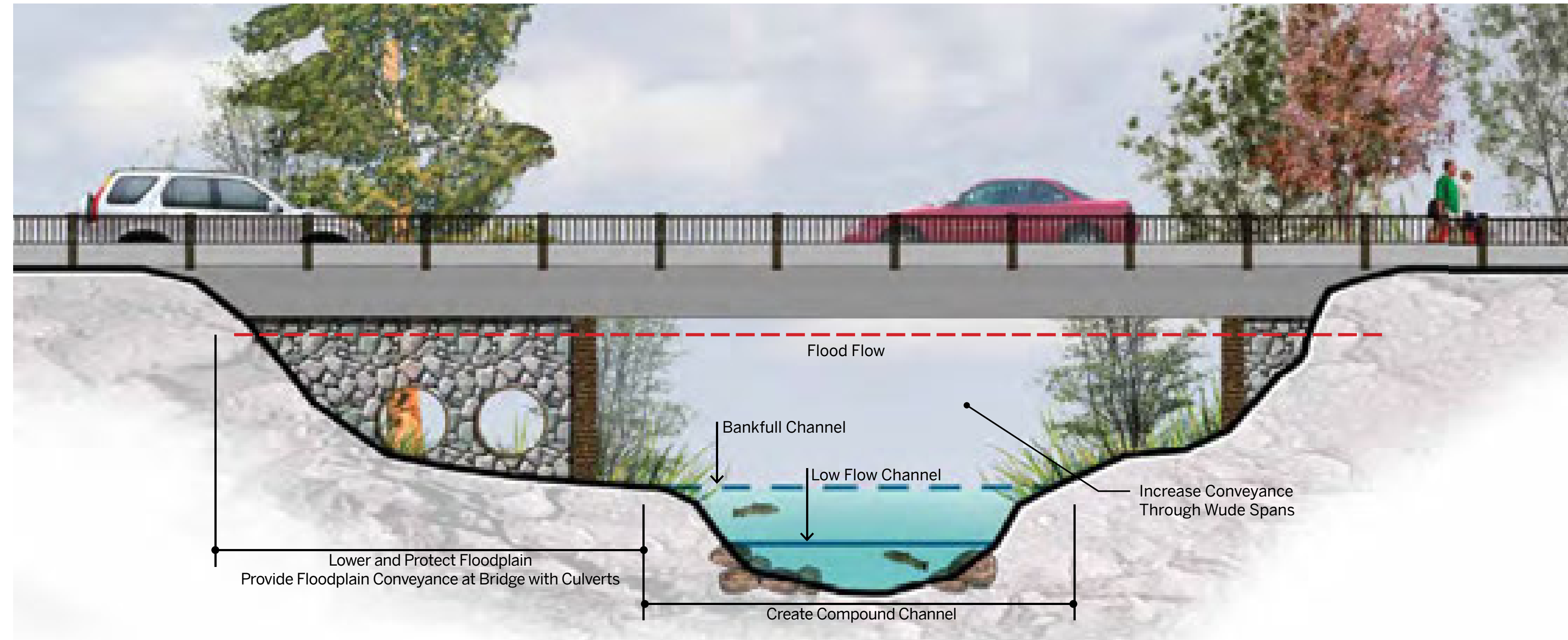


Figure 3. Improvements and retrofits to bridges. Bridge and culverts embankments block floodplain flow and increase the risk of debris jams and flanking. Bridge removal, replacements, and retrofits can help to convey flood flows and sediment reducing risk to adjacent properties and the infrastructure itself.

and in some cases have led to disastrous property losses and natural resource degradation.

A comprehensive road maintenance manual should be developed for the Town of Estes Park to include recommendations on post-disaster emergency road rebuilding and permanent solutions for building roads and crossings that are compatible with the river. As roads and embankments need rebuilding after this most recent event and after future events, identification of reroute and realignment options that remove roadways from the river corridor and it's channel migration zone should be considered as primary alternatives. Re-routing traffic downtown (Project A, in this section) is a perfect example of how slight changes in operations and management of existing infrastructure can result in significant increases in safety.

7.2.1.4 Improve Public and Private Crossings

Improperly designed crossings (e.g., bridges and culverts) remain vulnerable and pose severe hazard to adjacent land and residences in future flood events. These structures may exacerbate channel migration or bank erosion when the structure fails to pass adequate quantities of sediment and debris. Throughout the Front Range, there were numerous examples of undersized crossings that racked debris (dislodged sheds and decks, propane tanks, cars and trees) causing the creek to back up and eventually flank the blocked bridge or culvert. Additionally, CDOT officials recently presented findings from their investigation of failure modes for the transportation network during the flooding and it was noted that while most crossings stayed intact during the event, many bridge approaches were washed away as debris blocked bridge openings. Crossings, while necessary for vehicular traffic, fundamentally create flow constrictions which will, by definition, back up water and debris during large flood events.

Bridge planning for flood resilience should be based around a comprehensive analysis of the location of a bridge in relation to the stream channel and its propensity for lateral adjustment, streambank erosion, and/or aggradation (this goes hand in hand with road layout and design). For example, critical bridge structures should avoid being situated at the mouths of canyons, on alluvial fans, and in avulsion hazard areas. When these locations are unavoidable structures should be designed to fail quickly and be replaced cheaply.

Because each bridge crossing drastically increases the risk to the properties around it, and each design should be a thoughtful endeavor, in terms of bridges, less is often more – opportunities to reduce the number of crossings by rerouting or sharing major road arteries or by sharing driveways will have numerous benefits.

Despite these considerations, the design team recognizes that the magnitude and duration of the September 2013 flood was such that designing crossings to handle the water and debris load of a flood of that magnitude is likely not realistic or practical. It is recommended that the Fall River Coalition consider road crossing designs that allow for appropriate sediment transport at low, medium, and high flows (including the overflow areas), as well as the capability to pass debris and/or design crossings that break away if debris racks and upstream pressure becomes too great. However, improvements to the conveyance and sediment transport capacities of nearly all bridges crossing the Fall River will result in measurable improvements to the safety and resiliency of the system.

The pCMZ mapping included in this report does not attempt to predict debris jams at man-made structures or the most likely location of new channels should infrastructure jam or fail.

7.2.1.4.1 Increase Conveyance--Adjustments to Bridge Geometry Standards

The narrowing of the river from bridge abutments becomes problematic when, during high flows, floodwaters back up due to the constriction thus causing flooding upstream and sometimes outflanking of the bridge. This is worsened by debris and sediment that can accumulate at a constriction which typically further exacerbates upstream instability. It is important to understand that this is most often a structure problem not a sediment/ debris problem and as such, it can often be ameliorated through improved design and/or structure retrofit.

During flood conditions, stream power is increased on the downstream side of the constriction (like putting

Fall River Flood

your thumb on the end of a garden hose). The extra energy causes erosion and typically leaves a wide scoured area downstream of an undersized bridge. In additional, physical changes to the river channel such as straightening/dredging and armoring of the banks in order to protect narrow bridge abutments may further keep a river from achieving functional stability.

Long-term crossing resilience relies heavily on a number of factors including: bridge width and height, flood conveyance planning, reach location (in relation to channel geomorphology), aquatic organism passage and intelligent planning for additional features. Removing channel constrictions by significantly expanding the width and height of stream crossings will improve the Fall River's ability to transport water, sediment, and debris in equilibrium.

7.2.1.4.2 Maintain and Restore Sediment Transport Capacity

Sediment will continue to be an issue while the system adjusts to the disturbance caused by the flood and the disturbances caused by construction following the event. In the short term, to account for these variations, all crossings should be monitored several times a year and cleaned out as necessary to maintain flood flow conveyance. Many of the crossings that survived the flood or that have been rebuilt within the last year are large enough to accommodate flood flows but are constructed with flat floors or bottoms. This has the effect of reducing or eliminating the sediment transport capacity of lower magnitude, more frequent flows (i.e., base flows), that the creek uses to move fine sediments through the system. As a result, directly upstream of the crossings, and often times even within the crossings themselves, the channel tends to aggrade, or accumulate material. Many of the crossings have aggraded significantly due to flat-bottom designs, with inches to feet of sediment accumulated under and adjacent to the crossing.

7.4.1.4.3 Compound Channels through the Crossing

Moving forward, it is prudent to consider crossing designs that maintain sediment transport and aquatic organism passage through the crossing. The long-term strategy to addressing this issue is to establish a compound channel, which includes a low-flow channel that can continuously transport fine material though the river system as well as through the crossings. Ecological impacts from bridge and culvert crossings are most severe when artificial bottoms, high velocities, or otherwise impassable barriers are created due to the dimension, slope, and material of a bridge or culvert. Design for aquatic organism passage frequently entails natural channel bottoms, velocity dissipation, and/or grade control structures in the vicinity of the structure. Resources commonly used to design crossings that facilitate the transport of debris and aquatic organisms include the USFS Stream Simulation (Forest Service Stream-Simulation Working Group, 2008) or FHWA (Federal Highway Administration) HEC-26 methodologies (FHWA, 2010). If implemented, these tools should help manage the sediment and debris load for more frequent flows and lower magnitude flood flows.

In the near term, a correctly sized compound channel will facilitate sediment transport for a range of flows, but is still likely to require maintenance until the channel's transport capacity adjusts to the culmination of all the recent changes.

7.2.1.4.4 Additional Floodplain Conveyance

When and where design and surrounding land use allow, retrofitting existing structures with high flow crossings or culverts to aid passing water over/under a road may be an option. Adding small culverts in the embankments, at higher elevation than the main opening(s), allows conveyance of floodwaters moving outside of the main channel, reduces the backwater condition and reduces the concentration of flows and subsequent scour that can result along the road approaches. A similar strategy would be to design roadway approaches so that water can pass over them– the channel may cut into these areas but would leave the bridge, its abutments, and decking in place for easier repair. The target is to imitate the geometry of the compound channel upstream of the crossing, such that the constriction is as unnoticeable as possible to flows passing through. The benefit is not conveyance based (i.e., there will not necessarily be a significant increase in flow capacity), rather it is sediment transport-based where the reduction in abrupt constriction reduces problematic deposition at the crossing.

7.2.1.4.5 Break-Away Bridges and Designed-to-Fail Approaches

Breakaway designs where the decking swings on a hinge downstream (so as to prevent a washout from becoming flood debris) may be an acceptable solution for some structures. These "design-to-fail" solutions provide temporary inconvenience but ideally promote long-term channel stability and protect other more vital infrastructure.

Riverstone Bridge

7.2.1.4.6 Shared Crossings

More relevant in Fish Creek, in terms of bridges, less is often more – opportunities to reduce the number of crossings by rerouting or sharing major road arteries or by sharing driveways may not be perceived as convenient but will have numerous benefits.

7.2.1.4.7 Temporary Crossings

Temporary crossings, while a necessary post-flood endeavor, are subject to become permanent as interest, funding and oversight wane. Because of the persistent and acute problems bad bridge design inflicts on stream corridors these temporary crossings need to be replaced with long-term resilient designs – complete removal being one of those options.

7.2.1.5 Diversion/Utility Structure Strategies

The Planning Team recommends that the Fall River Coalition investigate reconstructing low-head diversion dams and utility crossings. Currently several structures currently exist that divert water and/or create a low dam across the stream channel. These structures may impede aquatic organism passage and create localized erosion and sediment transport issues. Numerous examples now exist in Colorado where boulder-weir structures have replaced concrete dams and gradually step down a river. These types of low-head structures allow for fish and aquatic organism passage, divert water as needed, and reduce the sediment load (and therefore maintenance) into ditches.

7.2.1.6 Relocate Utilities out of the River Corridor

Natural river channel movement during the September 2013 resulted in the exposure of several buried utility lines in the Fall River corridor. Because of the inevitability of river channel movement within the modern valley bottom and because of the public health and safety aspects associated with water, electric, gas, and sanitary lines, it is strongly recommended that the Fall River Coalition advocate for relocating utilities out of the river corridor as a long-term solution.

7.2.1.7 (Figure 4)

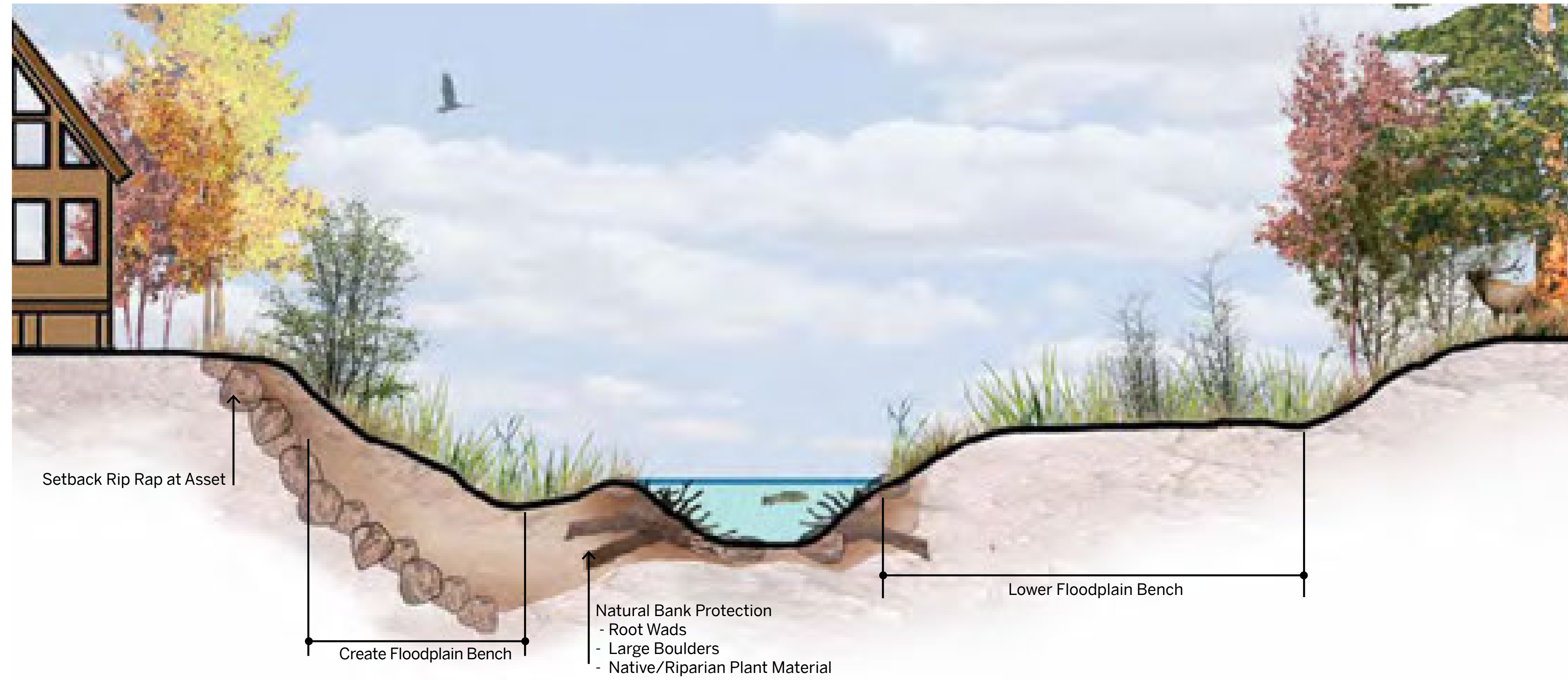
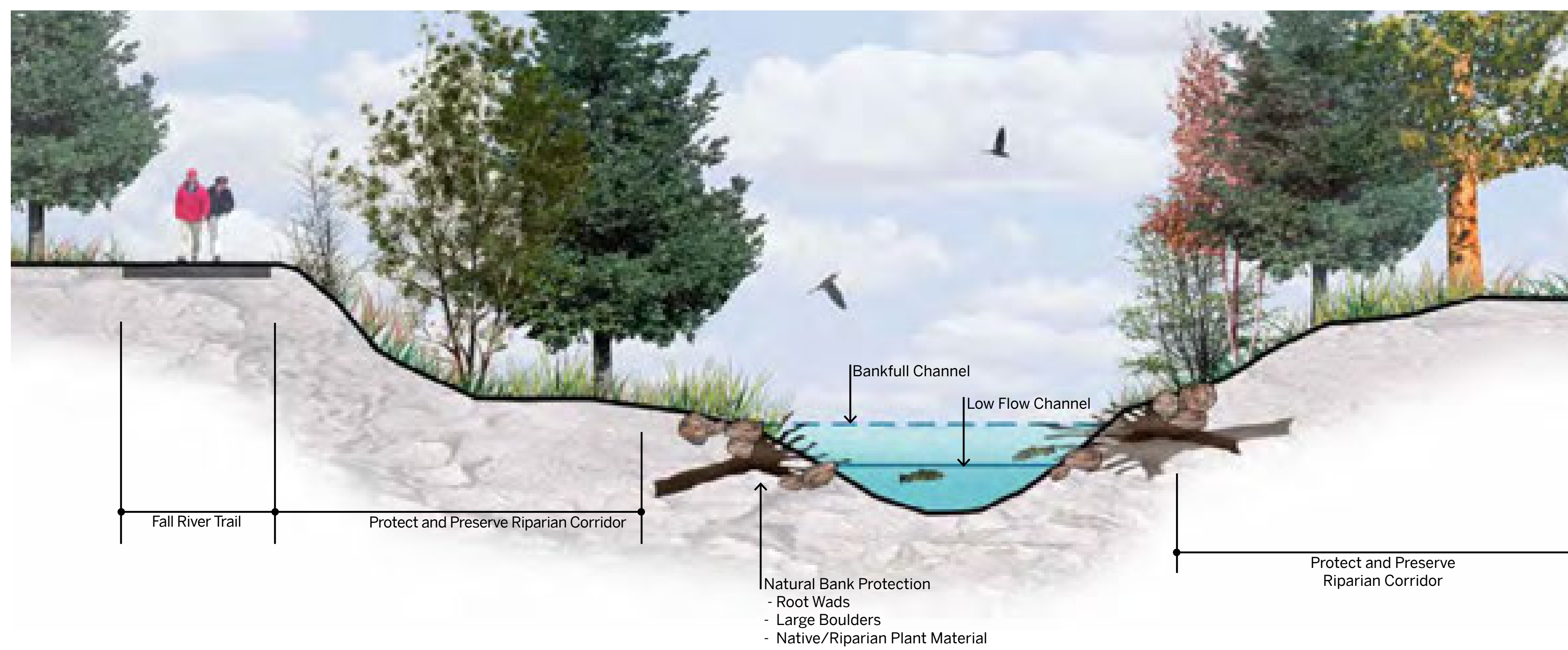


Figure 4. Multiple lines of defense. Streams are dynamic and need flexibility to respond to a range of flows. Hard protection in the form of rip rap or retaining walls should occur at the outer most boundaries of the river corridor and directly adjacent to the asset at risk and should be the last line of defense, not the first. Closer to the active stream channel natural bank protection (large wood, boulders, and woody vegetation) should be used to stabilize banks and dissipate stream energy.



New Figure 5. Establish and preserve a river corridor. Any new development within the river corridor will increase risk and future damage. Where the floodplain and riparian corridor is undeveloped, preservation of this space should be the top priority. Where there is encroachment, slow and systematic restoration of the land and removal of assets will have the largest effect on reducing the community's risk. development in recommended preservation areas will increase risk to assets. Where floodplain is intact, preserve this natural buffer to best protect assets. Enhance floodplain connectivity and presence of woody materials

7.2.2 Programs and Regulations

7.2.2.1 Create a Protected "River Corridor" (Figure 5)

Because their change is often slow and because we have been largely successful at removing and taming those things that make them wild and unruly (beavers,fallen trees, and floods particularly) we tend to think of rivers as being locked into one location. This thinking along with the common reaction to flooding - straightening, dredging, armoring, and berming – has aided a false sense of security and allowed development to encroach further and further into river corridors. As recent events in September of 2013 demonstrated, however, our current methods of relying solely on flood elevation maps to reduce flood risk offers limited protection as even properties located high above creeks were affected due to erosion.
As a matter of physics, streams can become highly energetic during a flood event and as a general rule materials that were laid down by a river are subject to removal by the river at some future event (i.e., what the river builds the river will take away). Sudden changes to a river's course are an inevitability not an anomaly. Geomorphologists read these changes in the landscape by looking at old scars left behind by the moving channel.
Long term resilience therefore looks at a river as not only the place where we see it today but also as the place where we may see it tomorrow. It recognizes that the water in the channel is bounded by water under the banks and floodplain. It recognizes that there are physical and ecological processes occurring on the land around the river that are integral to the health and behavior of the river itself (and vice a versa). These notions are summarized in the term "river corridor" which accounts for the area of land adjacent to and including the river that is required to accommodate the dimensions, slope, planform, floodplain and riparian habitat of the naturally stable channel, and necessary to maintain or restore stable conditions and minimize erosion hazards. For more information on river corridors visit:

http://cwcb.state.co.us/environment/watershed-protection-restoration/documents/co_rivercorridorprotectionfs.pdf and


Evergreens Pedestrian Bridge


Existing Bridge on Fall River

http://www.floods.org/PDF/ASFPM_TNC_Active_River_%20Area.pdf

Strategies for the establishment and long term protection of a river corridor can be multi-faceted and creative. They can include any or all of the following incentives and programmatic methods to achieve a protected river corridor.

7.2.2.1.1 Conservation Easements
7.2.2.1.2 Transfer of Development Rights
7.2.2.1.3 Voluntary Fee and Title Transfer
7.2.2.1.4 Deliberate building envelope placement
7.2.2.1.5 Finalize and Adopt Channel Migration Zone

7.2.2.2 Finalize and Adopt Channel Migration Zone Delineations and Policy

Debris flow and sediment had a major impact on the flood behavior in the Fall River system during the September 2013 flood. For much of the watershed, channel changes (e.g., migrations, avulsions) posed a much greater hazard to residents than overbank flows. As a part of the master planning process, preliminary CMZ maps were developed to identify areas at risk for large scale geomorphic changes.

It is recommended that the Fall River Coalition and the Town of Estes Park finalize and implement a regulatory Channel Migration Zone that can then be used to guide the alignment of roads and the planning of future development within the watershed. Implementation of such a model could work in tandem with the existing FEMA regulatory model by potentially offering incentives to communities that use channel migration zone analyses to inform local zoning regulations. Since the methods were developed for Pacific Northwest rivers, some additional study and application discussions may be required to tailor and finalize the methods for the Estes Valley rivers as the adoption process begins. CWCB has expressed interest in assisting Estes Park with the implementation of a pilot program to use CMZ and fluvial hazard zone maps as regulatory tools.

The potential savings in damage, something FEMA is currently assessing on the St. Vrain System, could easily outweigh the cost of identifying and regulating geomorphic hazards due to fluvial migration. These maps also serve as a tremendous educational tool for informing land owners and residents of their risk both for the purposes of insurance as well as evacuation and life safety.

7.2.2.3 New Flood Insurance Study (FIS)

The last major study of the watershed in terms of characterizing channel conveyance, structure capacity and erosion potential occurred over 30 years ago, utilizing hydrology which had been developed a number of years before that.

The Town of Estes Park and FEMA anticipate that the 100-year regulatory hydrology will be redefined to a significantly higher value in light of the last 30 years of data and records. It is recommended that a hydrologic evaluation be prepared for the entire Fall River watershed using modern techniques that include GIS and radar rainfall data.

A patchwork of LOMRs have been incorporated into the mapping near urban areas of the watershed, and in the near future, without a new FIS it is anticipated that new CLOMRs and LOMRs will need to be developed for nearly all projects related to the 2013 flood event. Repairs to infrastructure as well as the flood waters themselves have altered the shape and capacity of the channel throughout the watershed, and numerous private crossings have been either repaired or replaced altering the predicted 100-year regulatory flood surface elevations. In order to have the most comprehensive and complete special flood hazard area maps for regulatory purposes, as well as maps that incorporate the cumulative effects of the 2013 floods and the subsequent floodplain, crossing, and roadway construction, it is recommended that a new Flood Insurance Study (FIS) be undertaken for the entirety of Fall River. It is likely that a new study will be faster and less expensive than reach-scale or property-scale LOMRs.

7.2.2.4 Reducing Risk and Enhancing Ecosystems via Land Use and Zoning

Several reaches in the upper most parts of the Fall River system have limited threats to life and property simply because little infrastructure and few buildings exist in those areas (i.e. Town Park at Hydro Museum and Fish Hatchery). It is in these reaches that we also find the most functional riparian ecosystems with the best in-stream habitat, lateral connectivity, and vegetation quantity and quality. The most effective means to reduce future flood and geomorphic risk in the upper reaches of Fall River, as well as in areas lower in the watershed that remain undeveloped (e.g., Elkhorn Lodge), is to discourage or severely limit infrastructure construction and residential development on these properties. Overflow channels and flood chutes carved though the floodplains during the 2013 flood provide opportunities for seasonal floodplain access. It is recommended that the Fall River Coalition prioritize protecting and restoring these locations as well as the wider channel corridor from the impacts of development, in order to reap the multiple benefits of increased flood protection and improved stream health provided by floodplain access and seasonal side channels.

As the new FIS is completed and Channel Migration Zones maps finalized, it is recommended that Estes Park adopt these changes into their Land Use and Zoning Plans and Codes and provide guidance on and limits to development in these areas.

7.2.2.5 Watershed Management Plans

First is the theme of watershed management. Stream systems, because they receive from the surrounding landscape, are an indicator of the condition of the land that drain into them. Treating an in-channel symptom without concern/attention to the health of the surrounding land may result in a failed project. It makes sense then that an in-channel restoration goal may start with (or at least be done in conjunction with) an out of channel restoration project (e.g. manage overgrazing of elk in order to establish riparian vegetation that then supports beaver recolonization in order to reconnect floodplains).

7.2.2.6 Long Term River Monitoring

The establishment of long-term monitoring sites to track changes to the chemical, biological, and physical condition of the Fall River is recommended. Collecting baseline data and strategic sampling to further understand and pinpoint problem areas will inform and support future Coalition efforts. Monitoring guidance can be found through the Colorado Measurable Results Project.

7.2.2.7 Flood Warning System

It is recommended that an early warning network be expanded and incorporated into this update in order to reduce life hazard issues, especially in debris-flow and erosion-prone areas. The Town of Jamestown is currently in the process of implementing a basic flood warning system and this could serve as a template for a system installation along Fall River. Specifics of the system (e.g., locations of new instruments and inclusion of existing instruments) would require further study, but would start with basic monitoring river stage and precipitation. Additional data points could include nearby SNOTEL stations and/or National Weather Service point forecasts, and the recent hydrologic study commissioned by CWCB should be incorporated into the river forecast mode when complete. The optimal configuration of new and existing data points, as well as the specifics of warning dissemination should be explored with further study.

The early warning system should also be integrated with the existing HAM radio and emergency services network (fire departments, Rocky Mountain Search and Rescue, Sherriff and local police) already in place for the mountain communities. Funding, organizational support, and training should be provided for these groups as the first responders and communication pathways in rural and mountainous Larimer County.

7.2.2.8 Public Education Campaigns

7.2.2.9 Join the National Flood Insurance Program (NFIP) Community Rating System (CRS)

Another framework that could be used to assist the Fall River community is the National Flood Insurance Program's (NFIP) Community Rating System (CRS). CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the goals of reducing flood damage to insurable property; strengthening and supporting the insurance aspects of the NFIP, and encouraging a comprehensive approach to floodplain management. Additional rate discounts may be obtained by projects that aim to reduce flood losses, promote flood risk awareness and flood insurance, and protect natural floodplain functions. In the future, rate discounts may also become available for communities that adopt a channel migration zone or erosion hazard zone map as part of their planning efforts.

7.2.2.10 Stormwater Management and Accounting for Altered Hydrologic Regimes

Changes in hydrologic regimes disrupt the water/sediment balance in creek systems. Stormwater runoff from development within the river corridor may have some minor effects on the Fall River hydrograph by increasing the volume of runoff and accelerating its delivery into the channel. Erosion, incision, and channel widening are often associated with increased stormwater resulting from development. Practicing soil conservation and erosion control practices (BMP's) on all construction and other sites where soil is disturbed should be encouraged. In addition, on-site stormwater management retrofitting for all existing residential and commercial building sites and implementation of low-impact design (LID) techniques for all future development.

7.2.2.11 Regulatory Frameworks and Funding Strategies

The invisible structures that support many watershed efforts are those of regulatory and funding nature. From the Federal Clean Water Act of 1972 to recent legislative appropriations to continue the Colorado floodplain map modernization program, old frameworks are being enhanced and new regulations are being put in place to promote long term river resiliency.

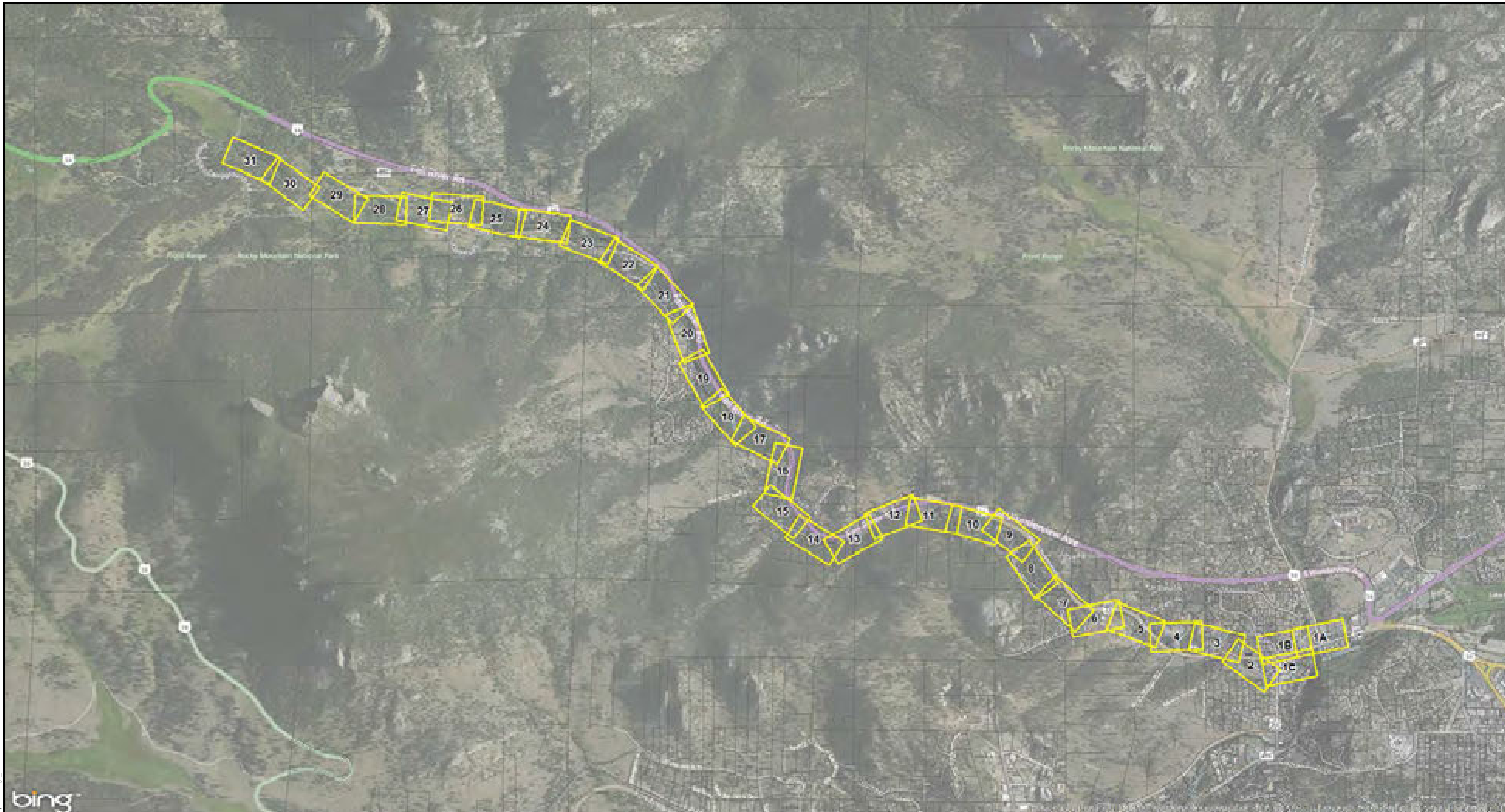
Where existing frameworks support flood recovery and resiliency some minor tweaks could promote better long term solutions. One such idea is the restructuring of how disaster recovery funding is allocated. Currently much federal funding post-disaster goes directly towards band-aid fixes (e.g., NRCS exigent sites that receive "temporary" rip-rap) particularly at assets identified in high hazard zones (A1, A2, B1, B2 lists). Alternatively these funds could have been provided to buyout critical (prioritized and willing) sellers that instead received these emergency funds and are now more inclined to feel safe and stay.

7.3 Recommended Projects

Each recommended project represents a reach of the river where recommendations were made to best reduce flood and geomorphic risk, increase ecological function, and meet the community values. A project can include multiple elements such as bridge improvements, floodplain reconnection, or grade control that addresses the specific needs identified in that reach by the technical team with the input of the public. The project reach extents do not always match the reach extents used for evaluating risk.
The recommended projects are summarized in the Concept Drawings in this section. The project matrix evaluates the recommended projects and allows for comparison between the other projects on Fall River.

7.3.1 Recommended Project Development

The recommended projects were developed by the technical team as a direct result of the flood, geomorphic, and ecological assessments. The technical team brainstormed potential projects, and recommended those that best reduce risk and meet the overall values of the community. The draft recommended projects were brought to the River Advisory Committee to be vetted. The RAC provided feedback for honing and improving the recommended projects. The draft recommended projects were then updated and presented for public review. The feedback received during this process was used to further refine the recommended projects, and the final version is presented in this section Concept Drawings.



N
W E
S

0 1,000 2,000
Feet

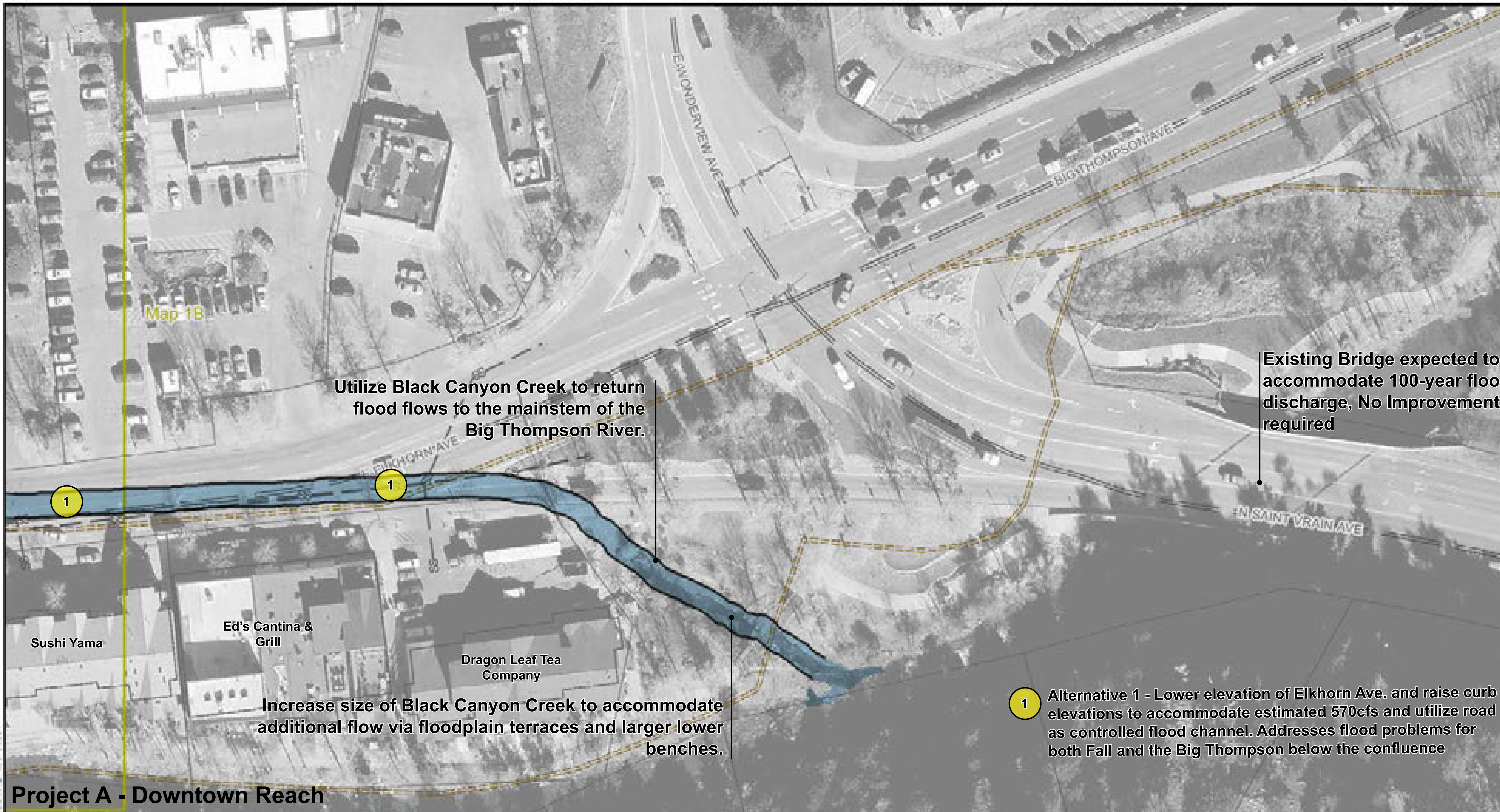
NOTES APPLICABLE TO ALL MAP SHEETS:

1) PROPERTY BOUNDARIES SHOWN HEREON ARE ESTIMATED AND SHALL BE USED FOR INFORMATIONAL PURPOSES ONLY.
2) PRELIMINARY POST-FLOOD GEOMORPHIC ND FLOOD HAZARD BOUNDARIES AND POST-SEPTEMBER 2013 (CURRENT) ALIGNMENTS ARE BASED ON LIDAR DATA PROVIDED BY FEMA AND COLLECTED IN OCTOBER 2013.
3) HIGH RESOLUTION BACKGROUND IMAGERY (WHERE AVAILABLE) IS POST-FLOOD AND PROVIDED BY LARIMER EMERGENCY TELEPHONE AUTHORITY (FALL 2013).
4) LOW RESOLUTION BACKGROUND IMAGERY FROM NAIP (OCTOBER 2013).

Fall River Coalition

Fall River Corridor
"Plan for Resiliency"
Resiliency Ideas, Floodplain and CMZ Mapbooks
Index Map

U:\Projects\WA002304_FallRiver\GIS\FALL_RIVER_ConceptDrawings_INDEX.mxd 12 Nov 2014



Robert Peccia & Associates

Walsh

Round River Design

FlyWater

Anderson Consulting Engineers

N
W E
S
1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
SS Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

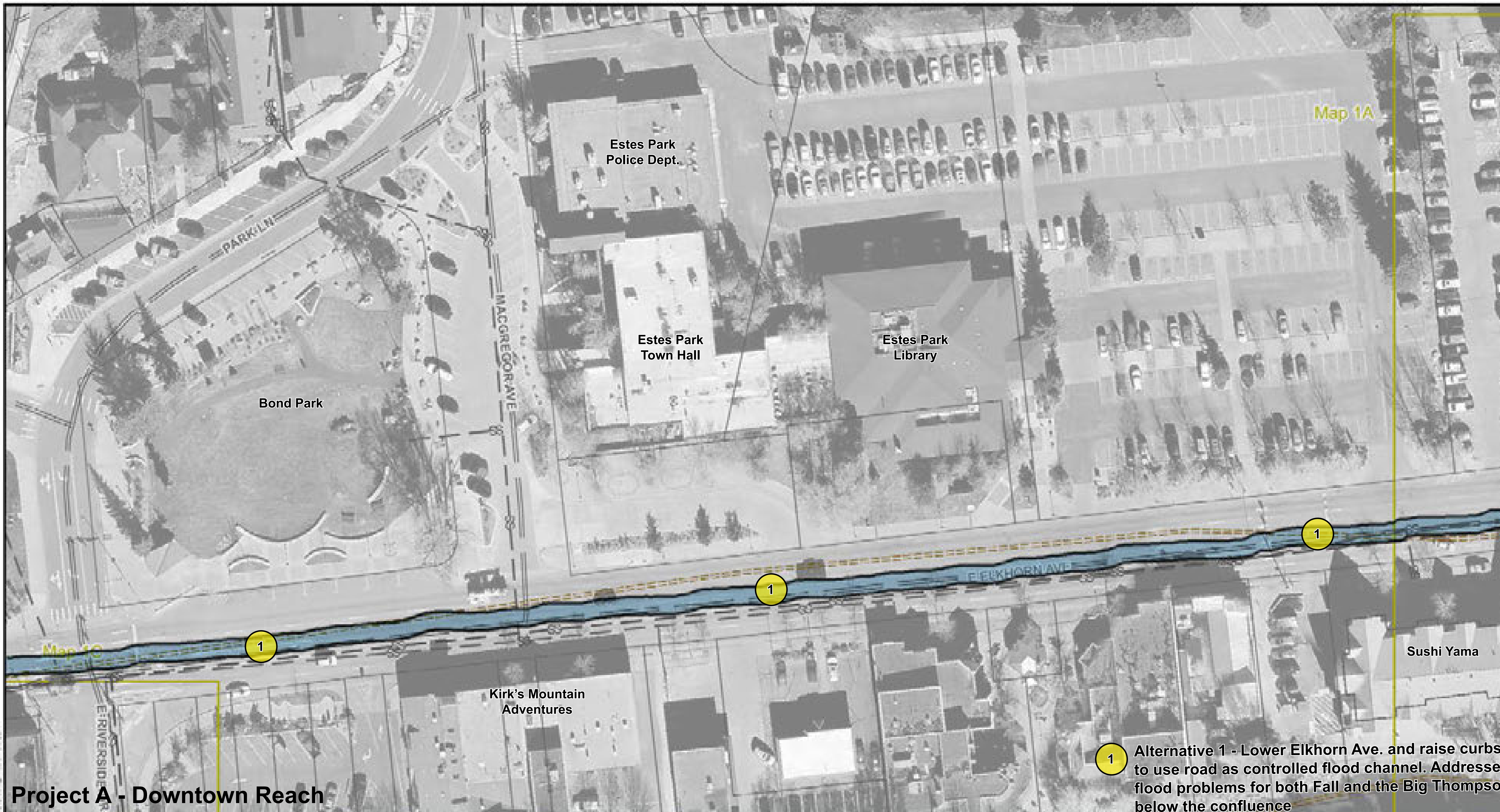
* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

EP Fall River Coalition

Fall River Corridor
"Plan for Resiliency"
Resiliency Ideas
Map 1A of 31



N
W E
S
1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

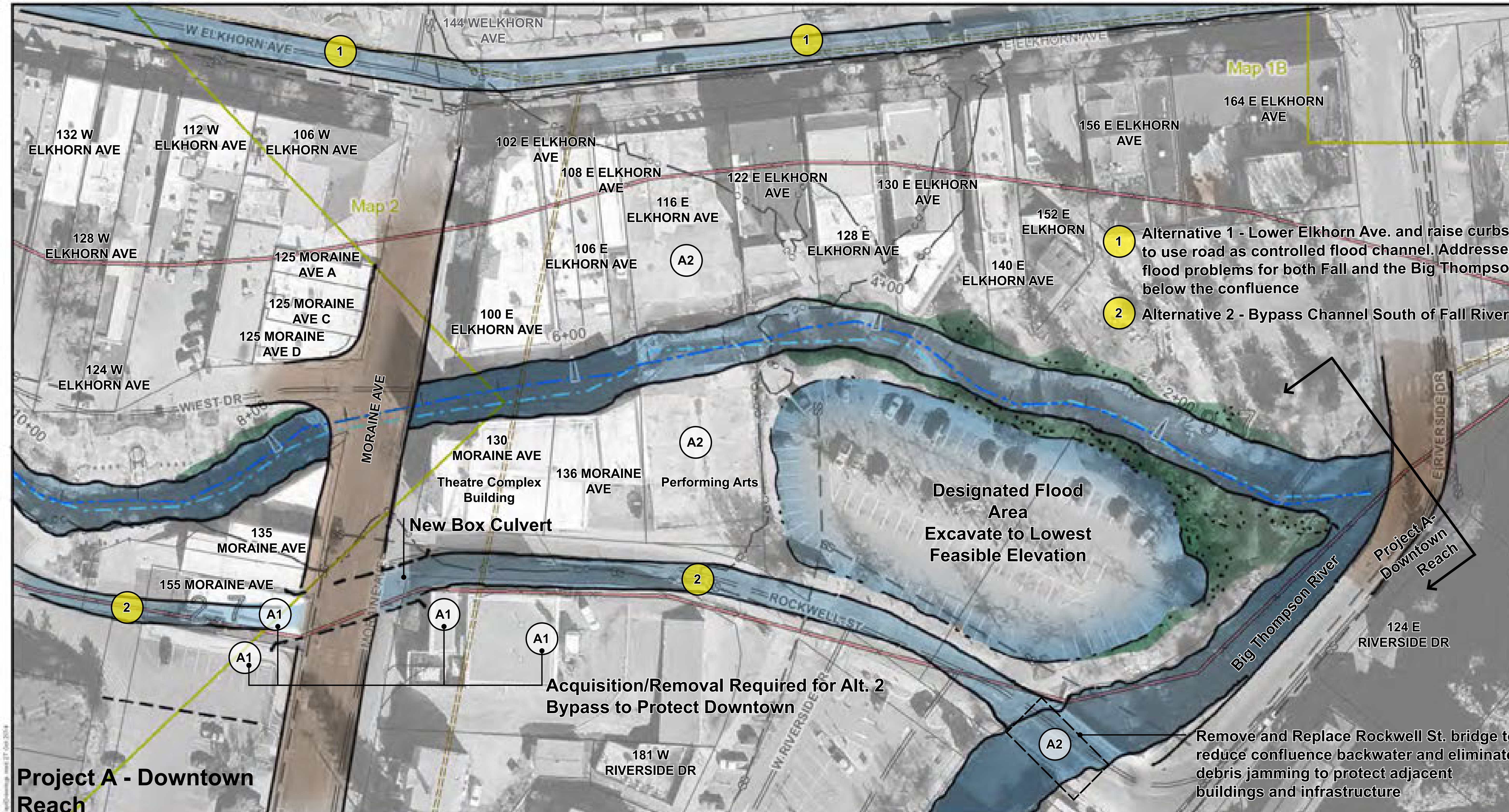
* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor
"Plan for Resiliency"
Resiliency Ideas
Map 1B of 31



1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
SS Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)

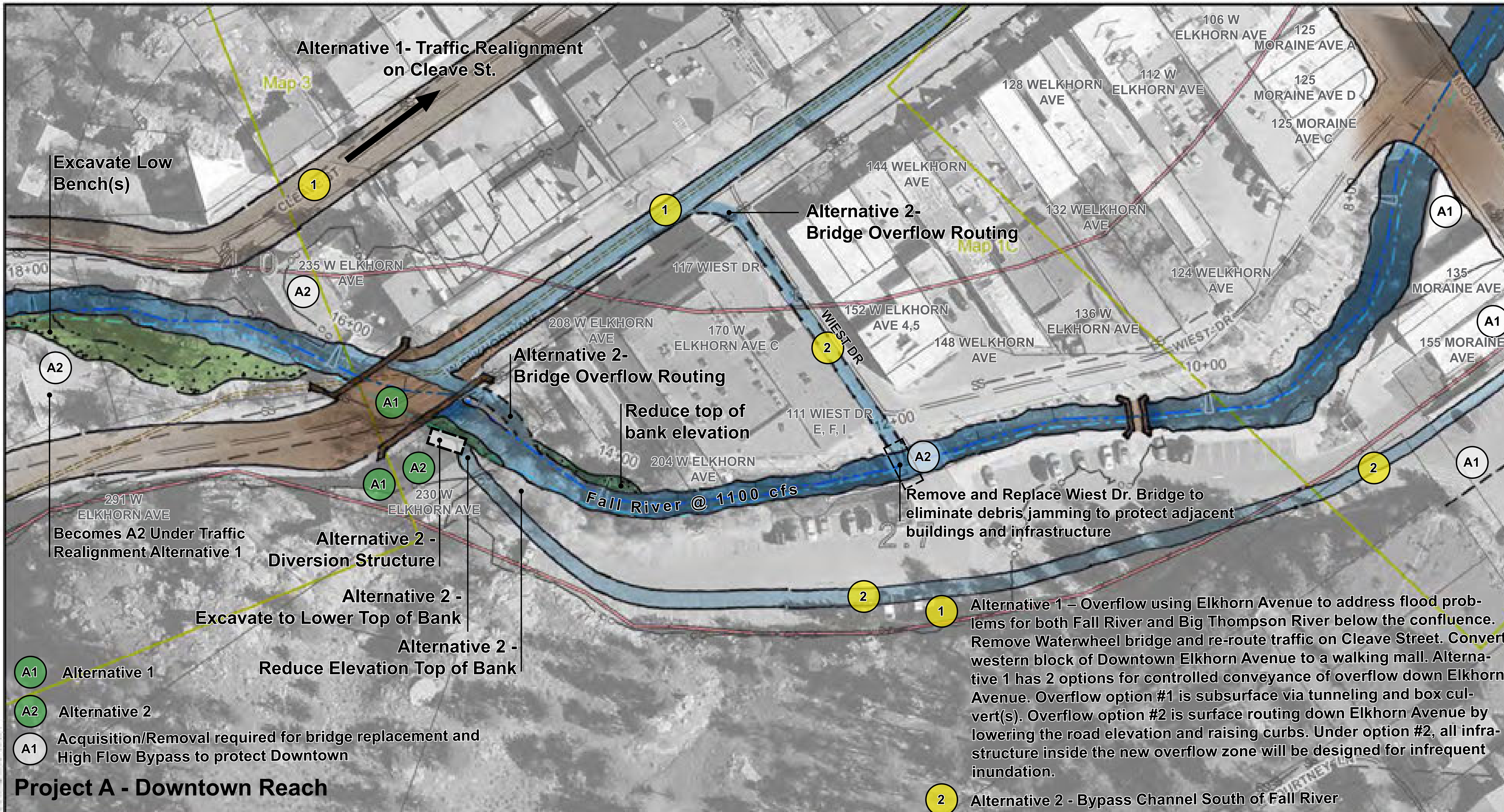
Highest Hazard Area

Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



1:720
1 inch = 60 feet
0 60
Feet

=====	Pre-Sep 2013 Trail Alignment
═══	Pre-Sep 2013 Road Alignment
SS —	Pre-Sep 2013 Sanitary Sewer Alignment
☐	Estimated Parcel Boundary (See Notes)
☐	Adjacent Map
- - -	Post-Sep 2013 (ca. Nov. 2013) River Alignment
- · -	Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)

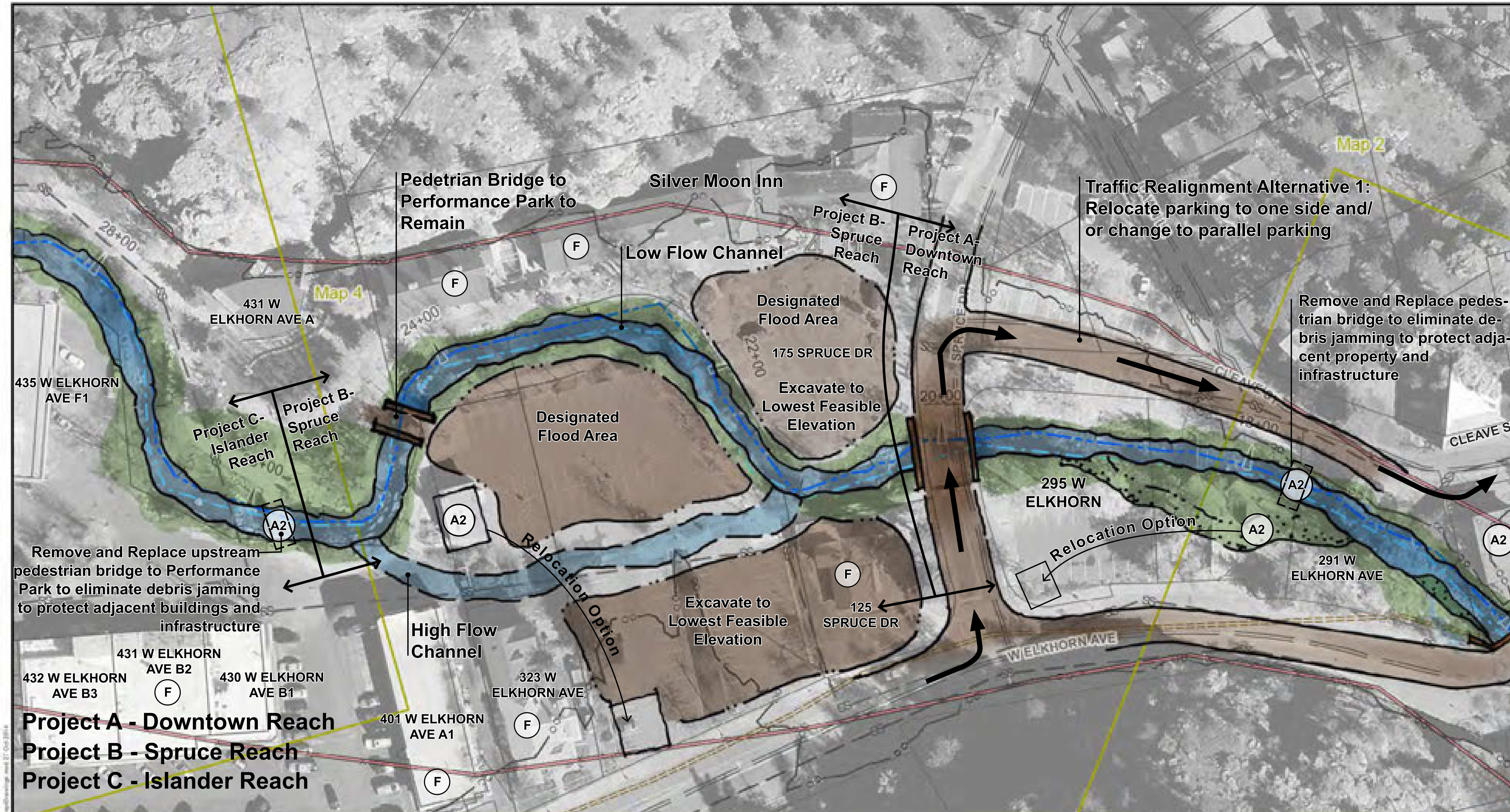
Highest Hazard Area

Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor
"Plan for Resiliency"
Resiliency Ideas



1:720
1 inch = 60 feet
0 60
Feet

=====	Pre-Sep 2013 Trail Alignment
=====	Pre-Sep 2013 Road Alignment
SS— —	Pre-Sep 2013 Sanitary Sewer Alignment
☐	Estimated Parcel Boundary (See Notes)
☐	Adjacent Map
— · —	Post-Sep 2013 (ca. Nov. 2013) River Alignment
— · —	Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

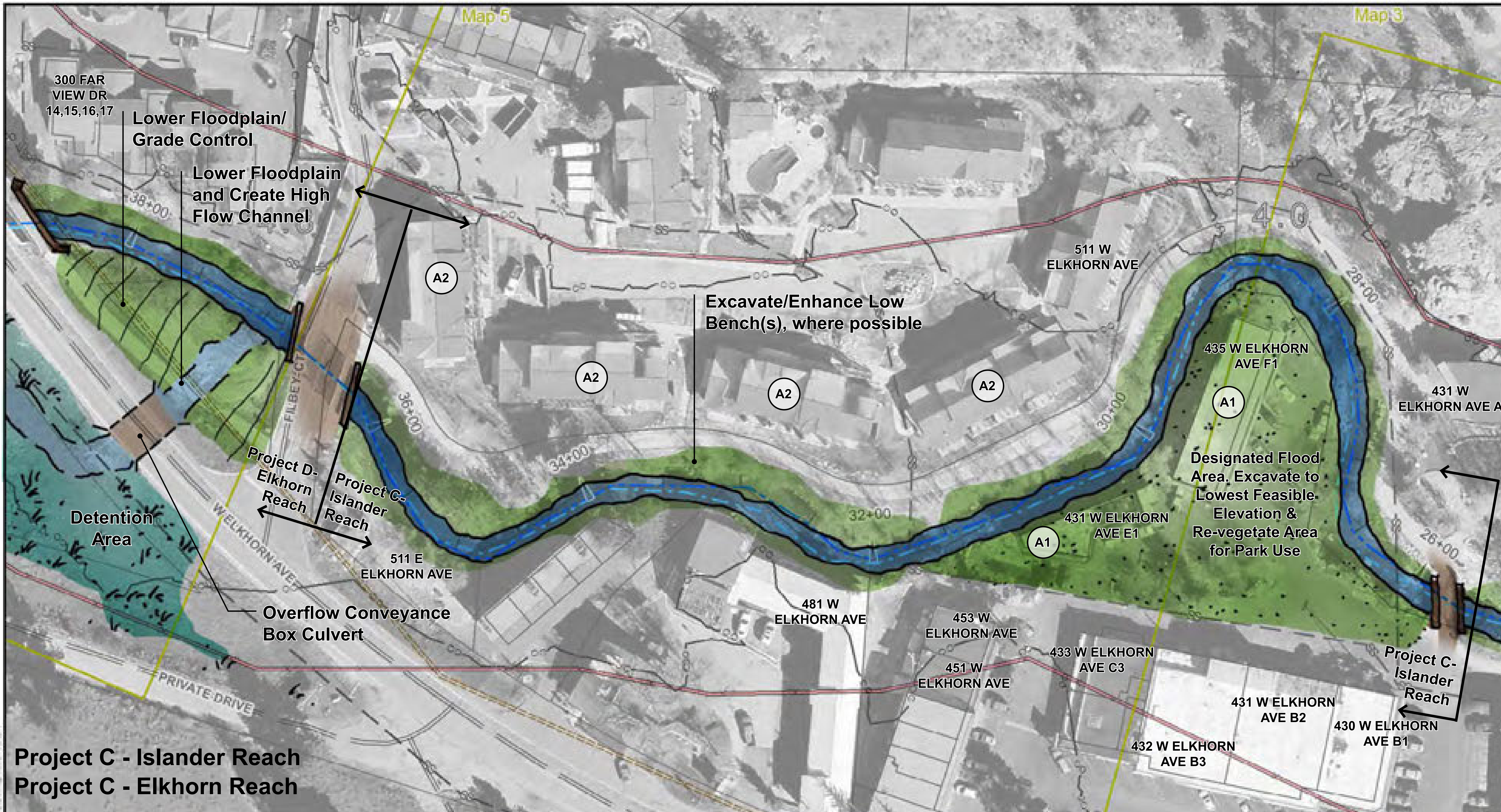
* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor
"Plan for Resiliency"
Resiliency Ideas
Map 3 of 31



N
W E
S
1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
SS Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

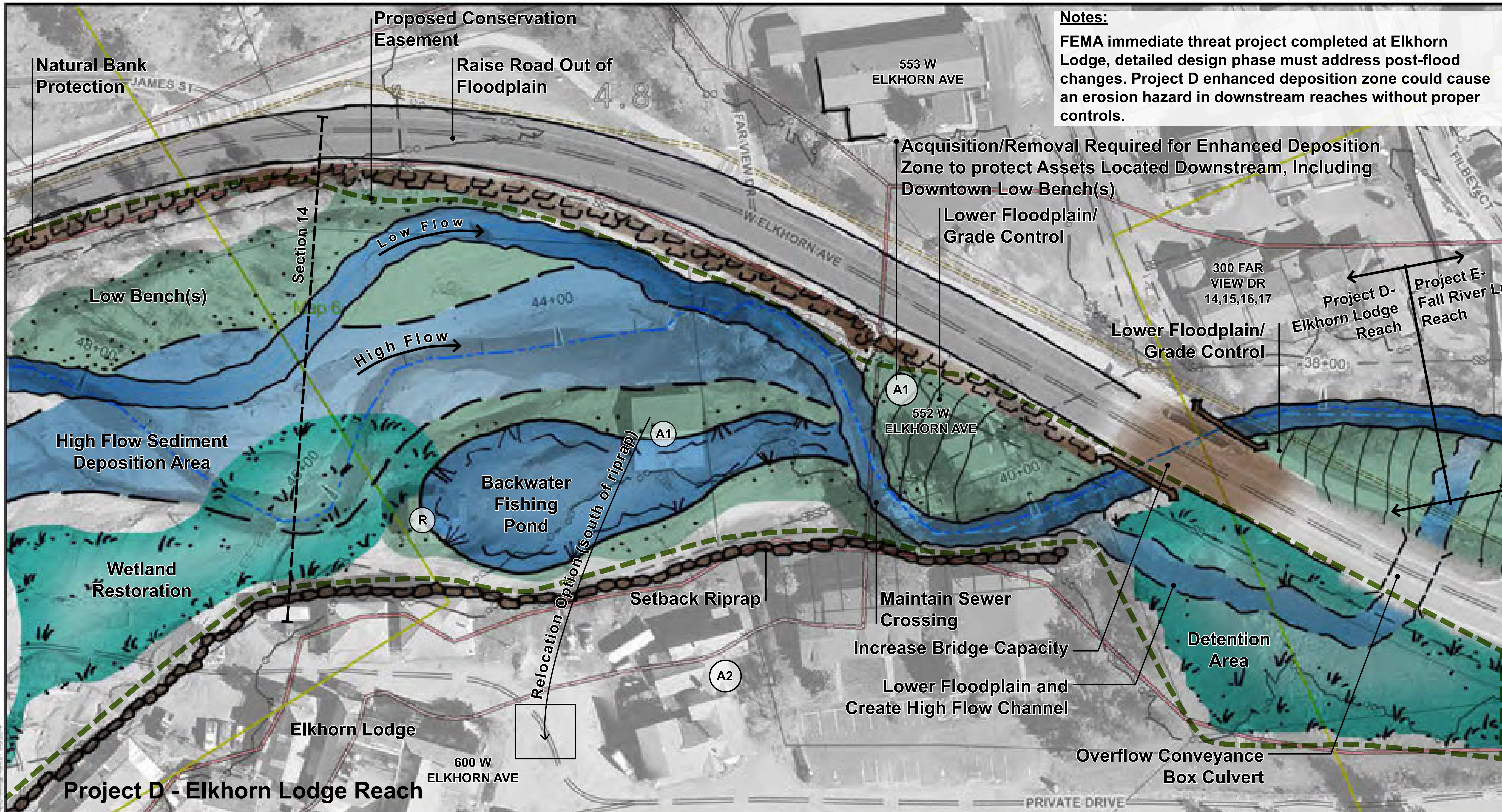
* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



1:720
1 inch = 60 feet
0 60
Feet

- Pre-Sep 2013 Trail Alignment
- Pre-Sep 2013 Road Alignment
- SS Pre-Sep 2013 Sanitary Sewer Alignment
- Estimated Parcel Boundary (See Notes)
- Adjacent Map
- Post-Sep 2013 (ca. Nov. 2013) River Alignment
- Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

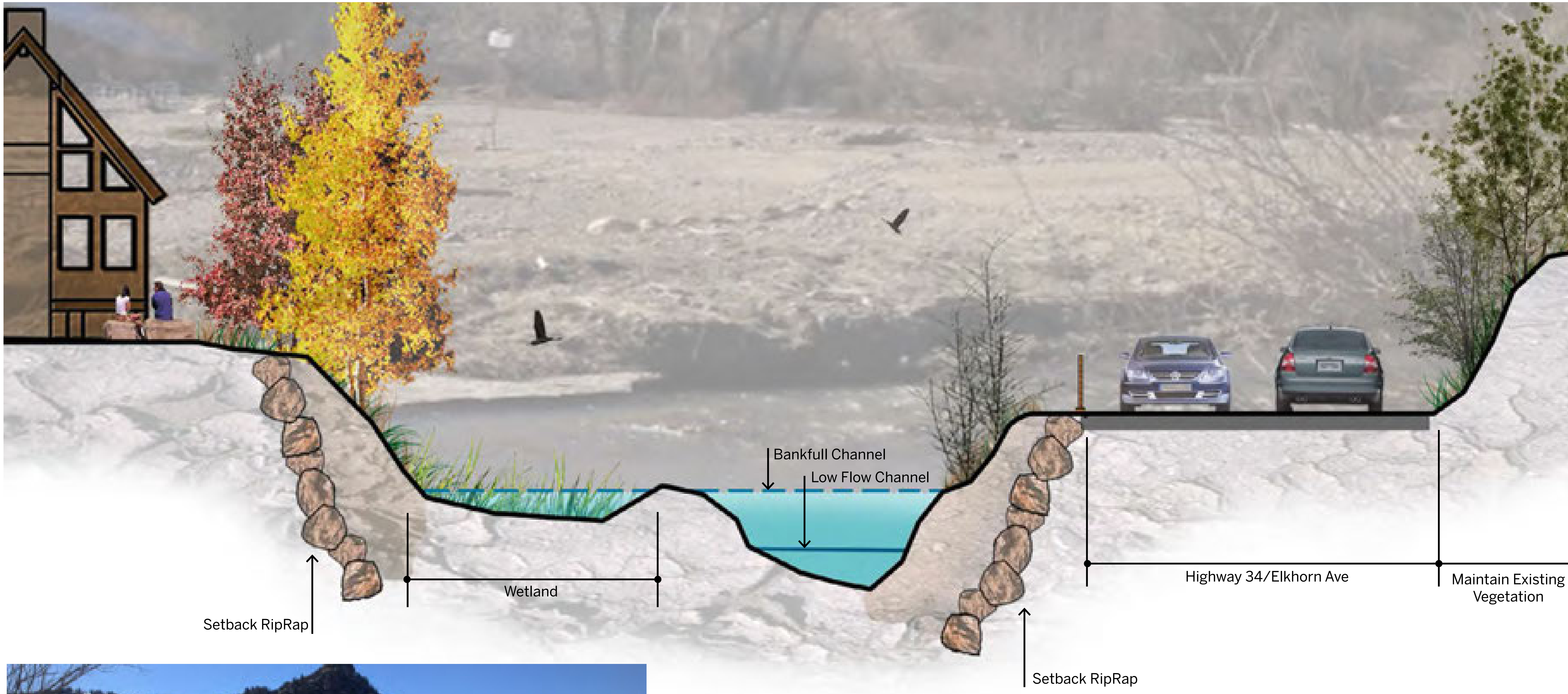
A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
- Highest Hazard Area
- Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



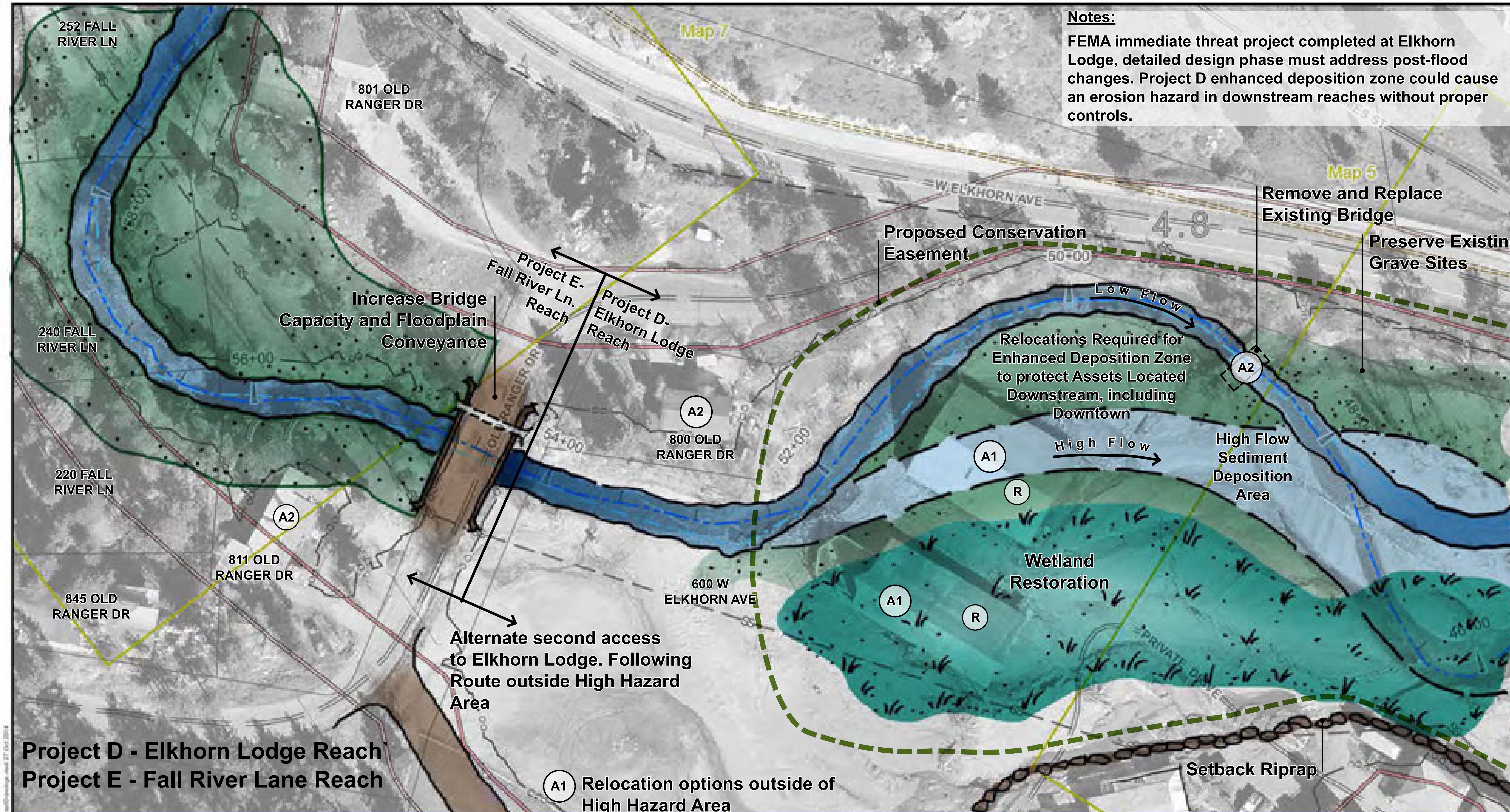
Post Flood Image
Looking Upstream

Section 14
Elkhorn Lodge
Looking Upstream
Not to Scale

Project D - Elkhorn Lodge Reach
Project E - Fall River Lane Reach

Notes:

FEMA immediate threat project completed at Elkhorn Lodge, detailed design phase must address post-flood changes. Project D enhanced deposition zone could cause an erosion hazard in downstream reaches without proper controls.



1:720
1 inch = 60 feet
0 60
Feet

=====	Pre-Sep 2013 Trail Alignment
	Pre-Sep 2013 Road Alignment
SS	Pre-Sep 2013 Sanitary Sewer Alignment
	Estimated Parcel Boundary (See Notes)
	Adjacent Map
	Post-Sep 2013 (ca. Nov. 2013) River Alignment
	Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

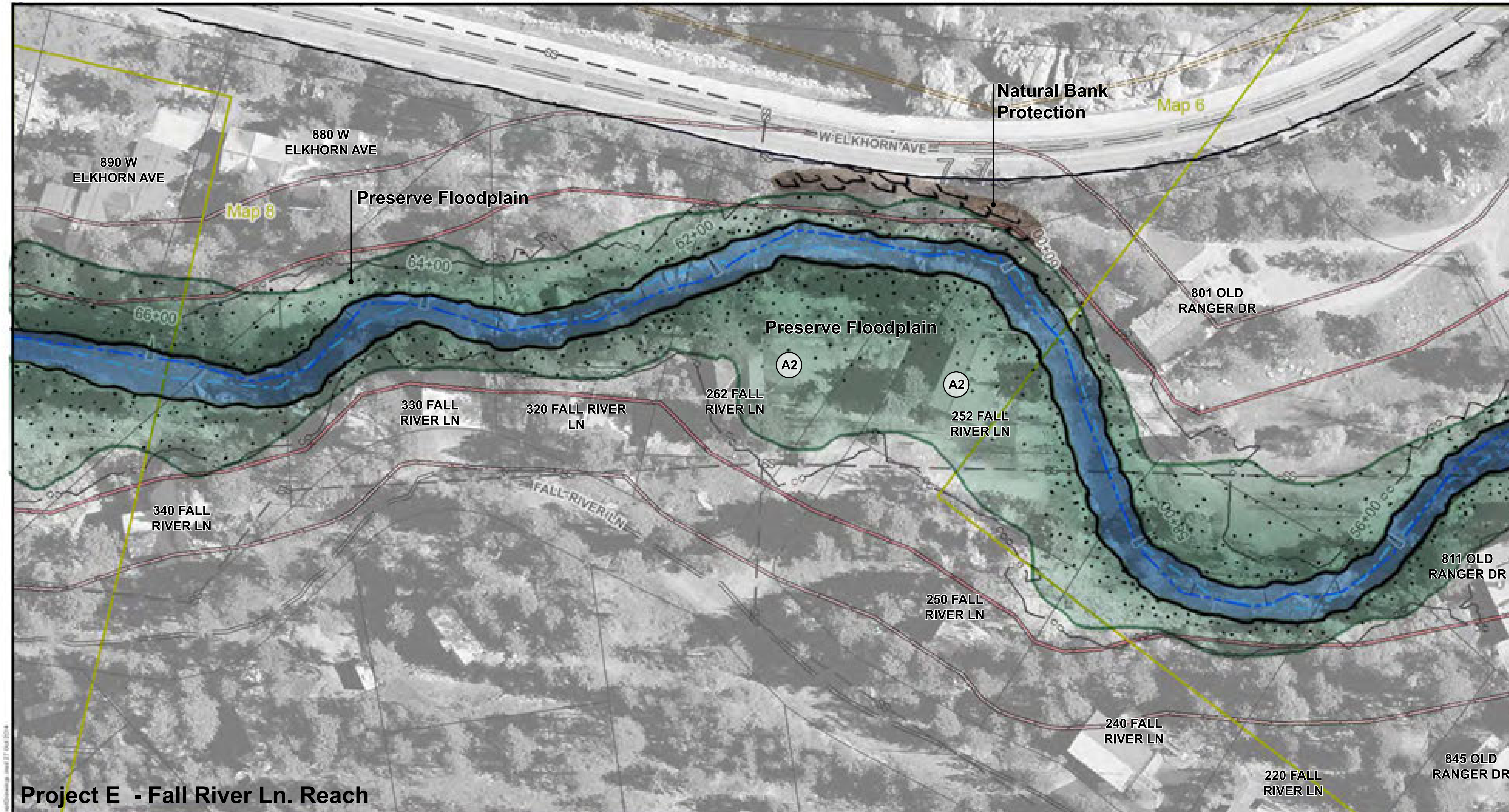
* Planning-Level Channel Migration Zone (pCMZ)

- Highest Hazard Area
- Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



Project E - Fall River Ln. Reach

1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

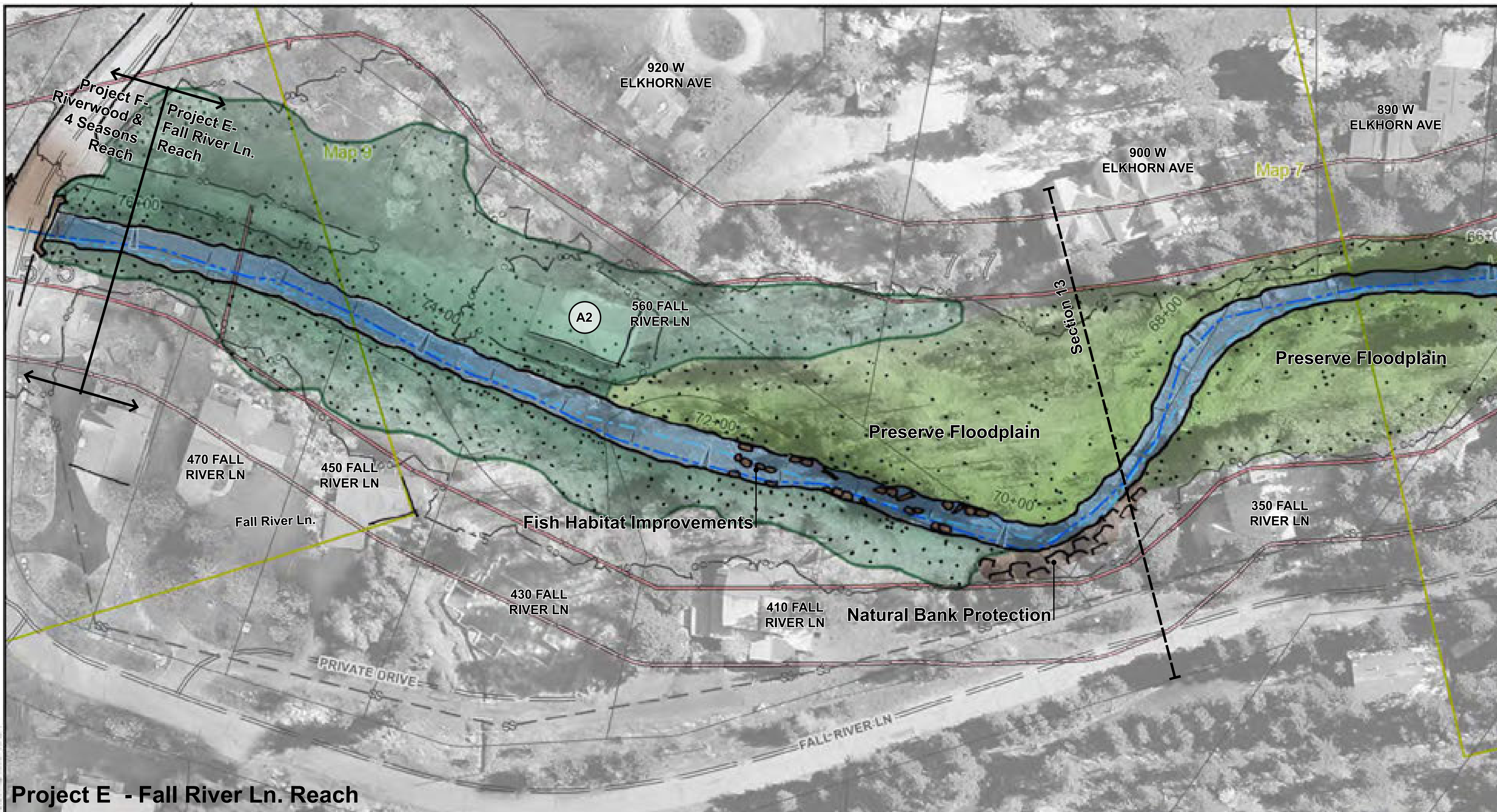
* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



1:720
1 inch = 60 feet
0 60
Feet

=====	Pre-Sep 2013 Trail Alignment
	Pre-Sep 2013 Road Alignment
SS	Pre-Sep 2013 Sanitary Sewer Alignment
	Estimated Parcel Boundary (See Notes)
	Adjacent Map
	Post-Sep 2013 (ca. Nov. 2013) River Alignment
	Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

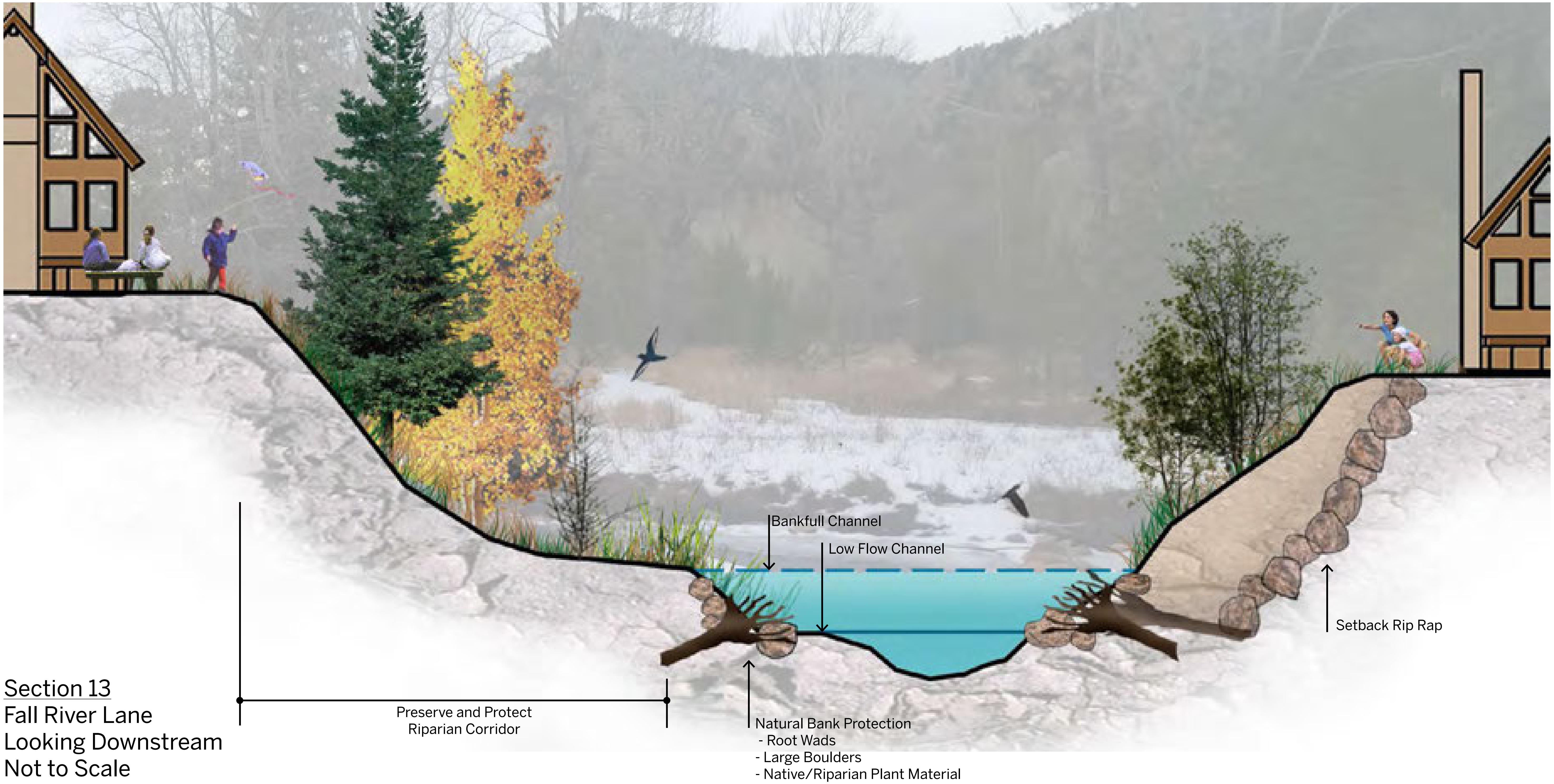
* Planning-Level Channel Migration Zone (pCMZ)

Highest Hazard Area

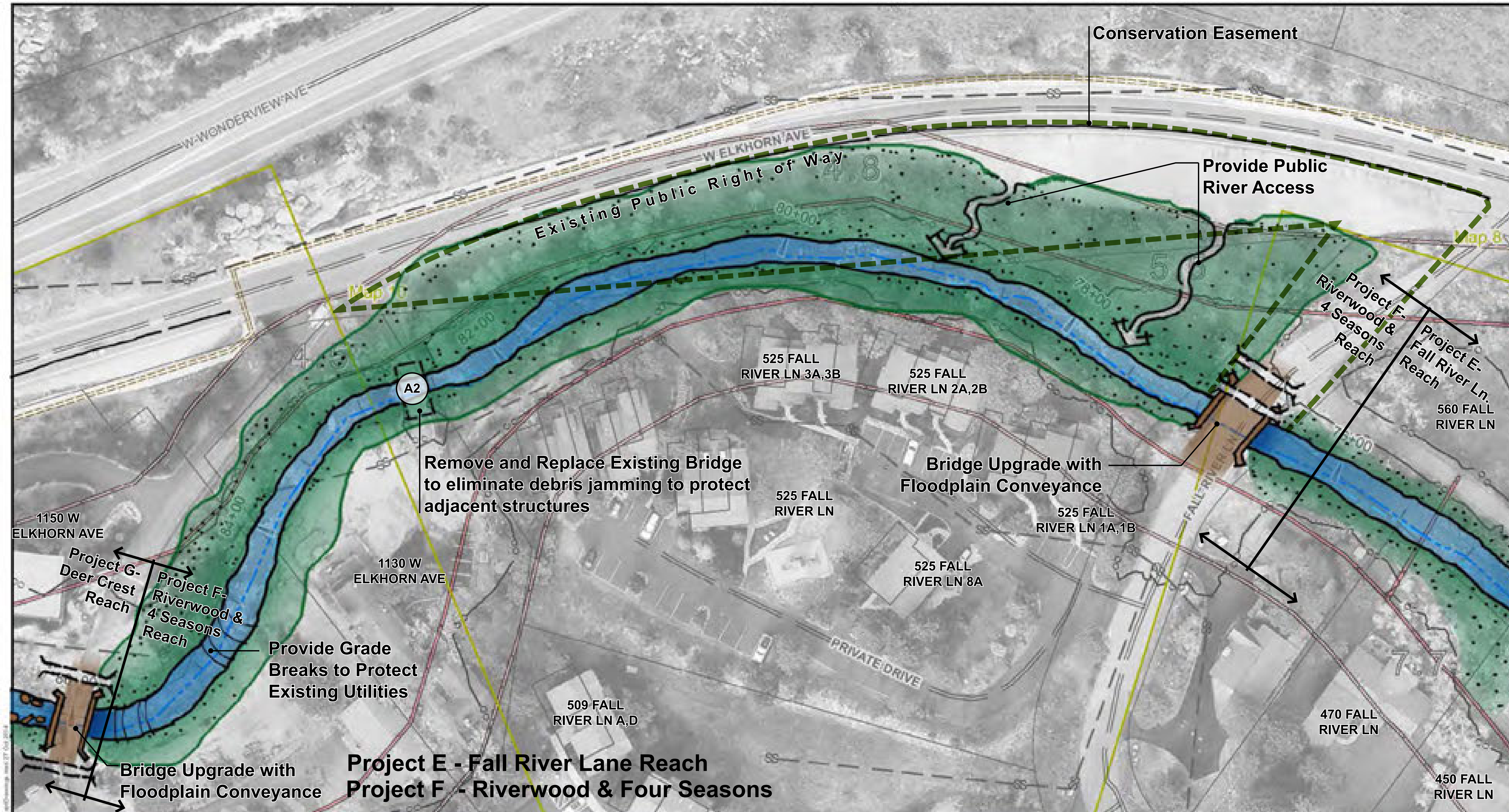
Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Corridor
"Plan for Resiliency"
Resiliency Ideas
Map 8 of 31



Section 13
Fall River Lane
Looking Downstream
Not to Scale



Project E - Fall River Lane Reach
Project F - Riverwood & Four Seasons

1:720
1 inch = 60 feet
0 60
Feet

=====	Pre-Sep 2013 Trail Alignment
	Pre-Sep 2013 Road Alignment
SS	Pre-Sep 2013 Sanitary Sewer Alignment
	Estimated Parcel Boundary (See Notes)
	Adjacent Map
	Post-Sep 2013 (ca. Nov. 2013) River Alignment
	Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)

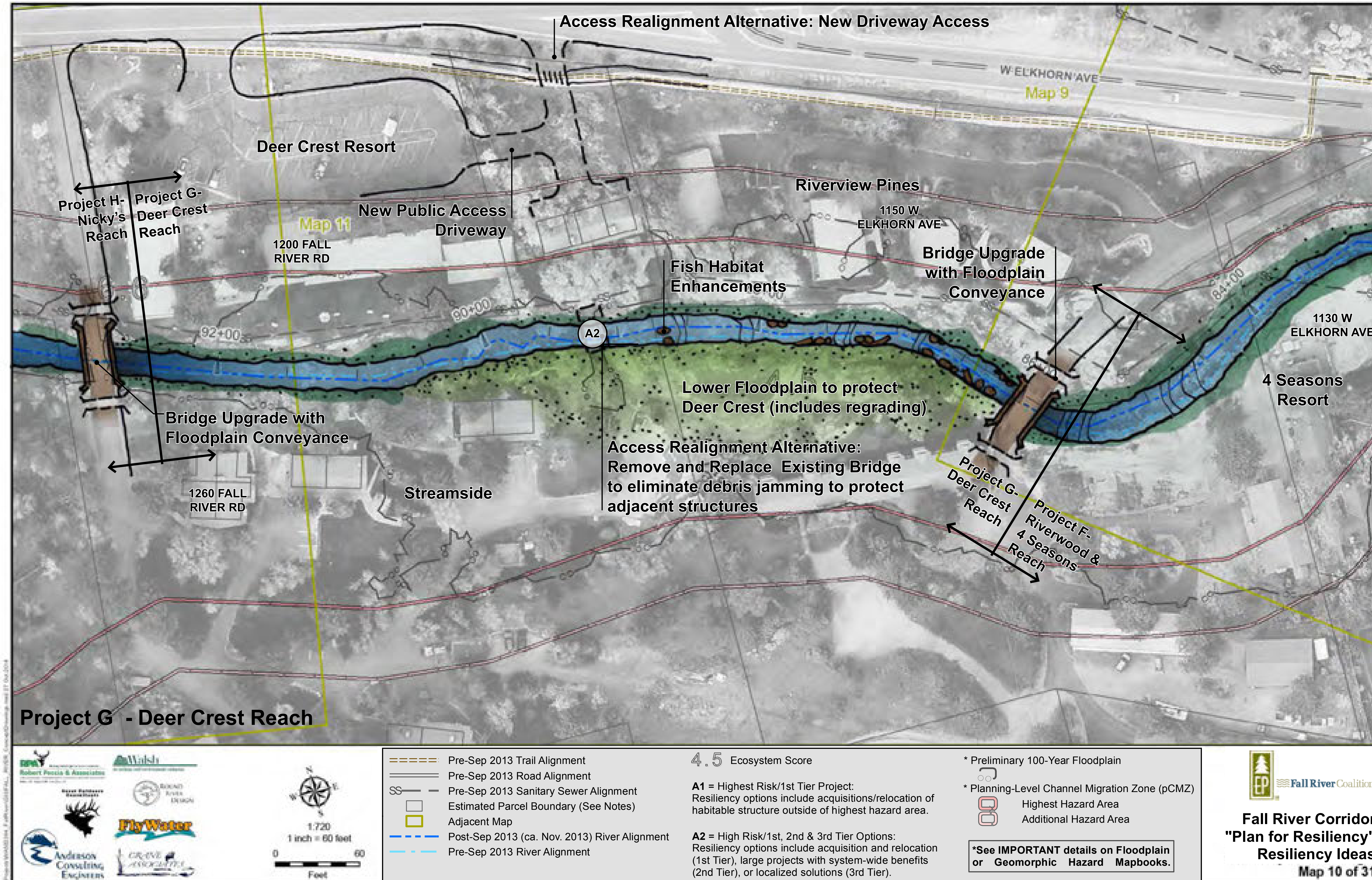
Highest Hazard Area

Additional Hazard Area

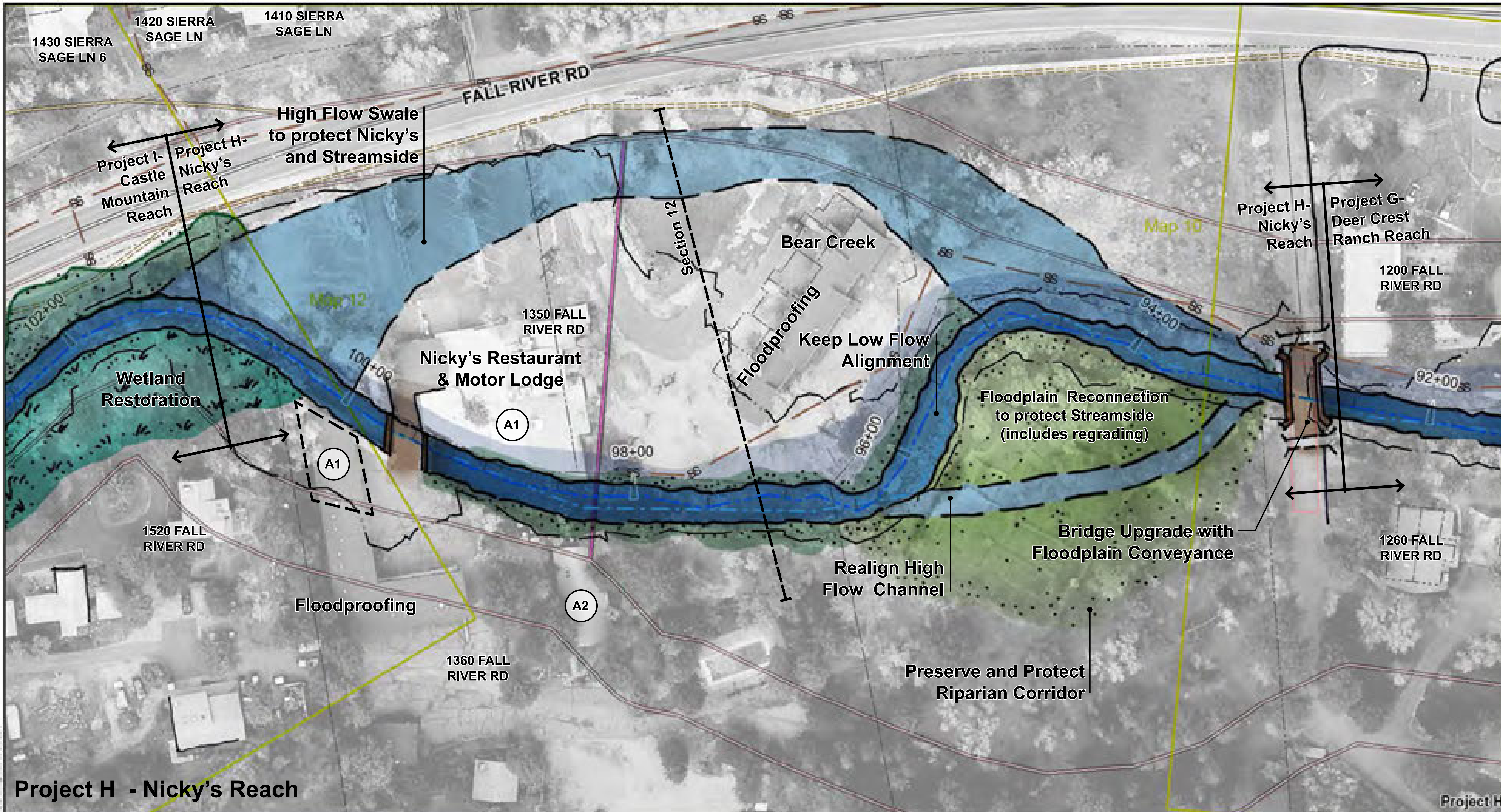
***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



Access Realignment Alternative: New Driveway Access
W ELKHORN AVE
Map 9
Deer Crest Resort
Riverview Pines
1150 W ELKHORN AVE
Project H- Nicky's Reach
Project G- Deer Crest Reach
New Public Access Driveway
Map 11
1200 FALL RIVER RD
Fish Habitat Enhancements
Bridge Upgrade with Floodplain Conveyance
92+00
90+00
84+00
A2
1130 W ELKHORN AVE
4 Seasons Resort
Lower Floodplain to protect Deer Crest (includes regrading)
Bridge Upgrade with Floodplain Conveyance
Access Realignment Alternative: Remove and Replace Existing Bridge to eliminate debris jamming to protect adjacent structures
1260 FALL RIVER RD
Streamside
Project G- Deer Crest Reach
Project F- Riverwood & 4 Seasons Reach
Project G - Deer Crest Reach
1:720
1 inch = 60 feet
0
60
Feet
Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment
4.5 Ecosystem Score
A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.
A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).
* Preliminary 100-Year Floodplain
* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area
*See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.
Fall River Coalition
Fall River Corridor
"Plan for Resiliency"
Resiliency Ideas
Map 10 of 31



N
1:720
1 inch = 60 feet
0 60
Feet

Legend	
	Pre-Sep 2013 Trail Alignment
	Pre-Sep 2013 Road Alignment
SS	Pre-Sep 2013 Sanitary Sewer Alignment
	Estimated Parcel Boundary (See Notes)
	Adjacent Map
	Post-Sep 2013 (ca. Nov. 2013) River Alignment
	Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)

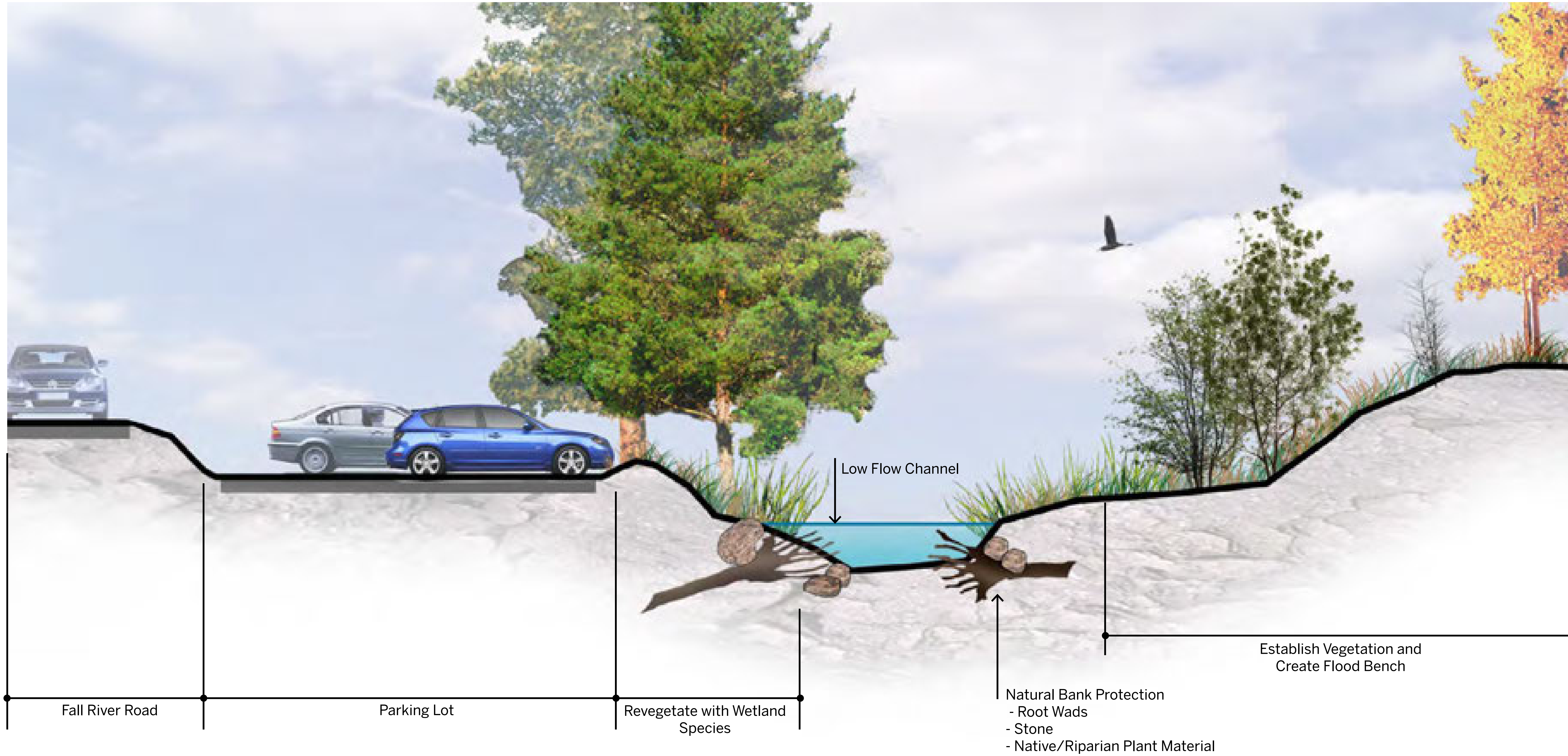
Highest Hazard Area

Additional Hazard Area

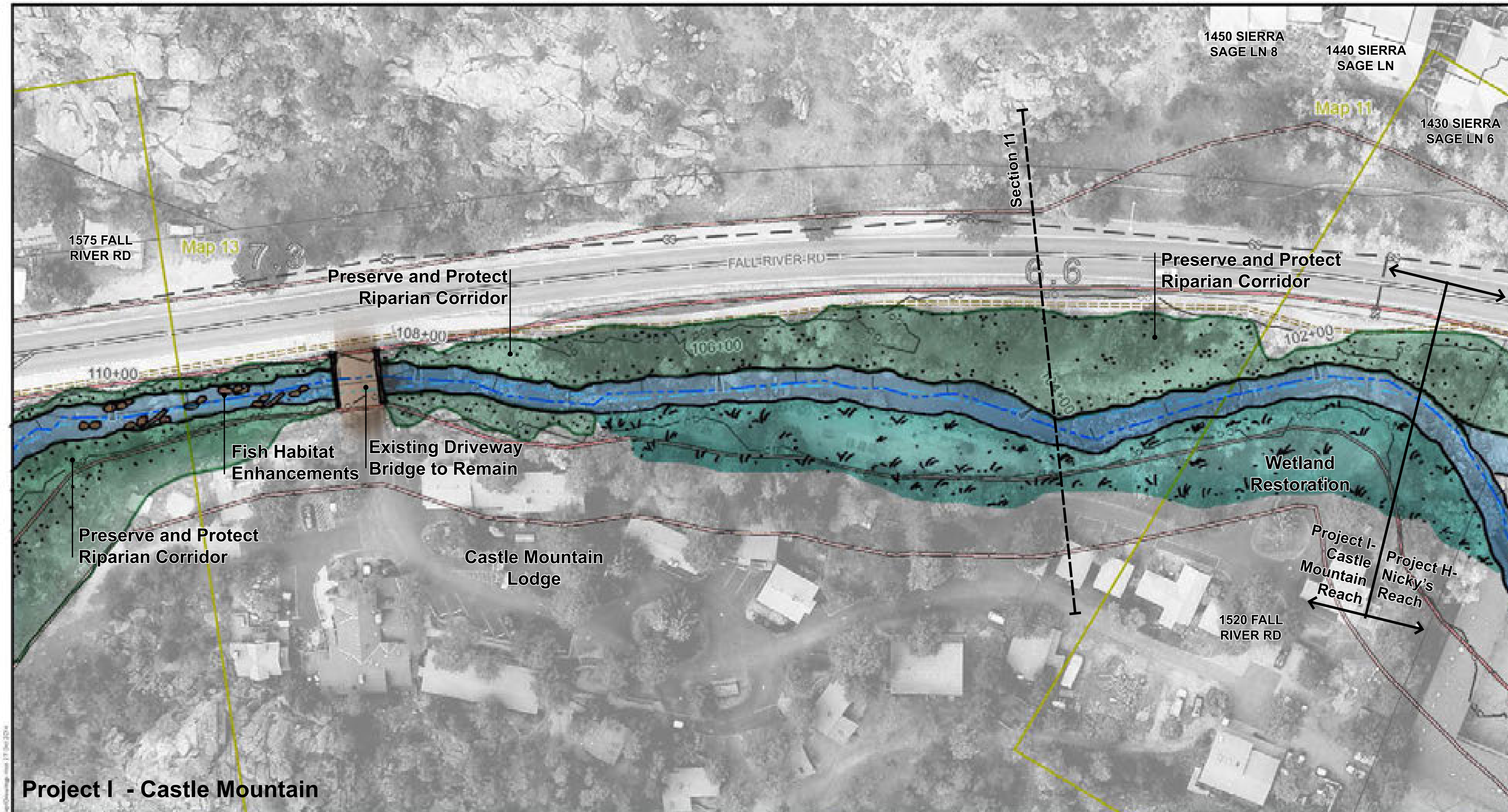
***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



Section 12
Fall River Nicky's Ranch
Looking Downstream
Not to Scale



1:720
1 inch = 60 feet
0 60
Feet

Legend	
=====	Pre-Sep 2013 Trail Alignment
═══	Pre-Sep 2013 Road Alignment
SS— —	Pre-Sep 2013 Sanitary Sewer Alignment
☐	Estimated Parcel Boundary (See Notes)
☐	Adjacent Map
— · —	Post-Sep 2013 (ca. Nov. 2013) River Alignment
— · —	Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)

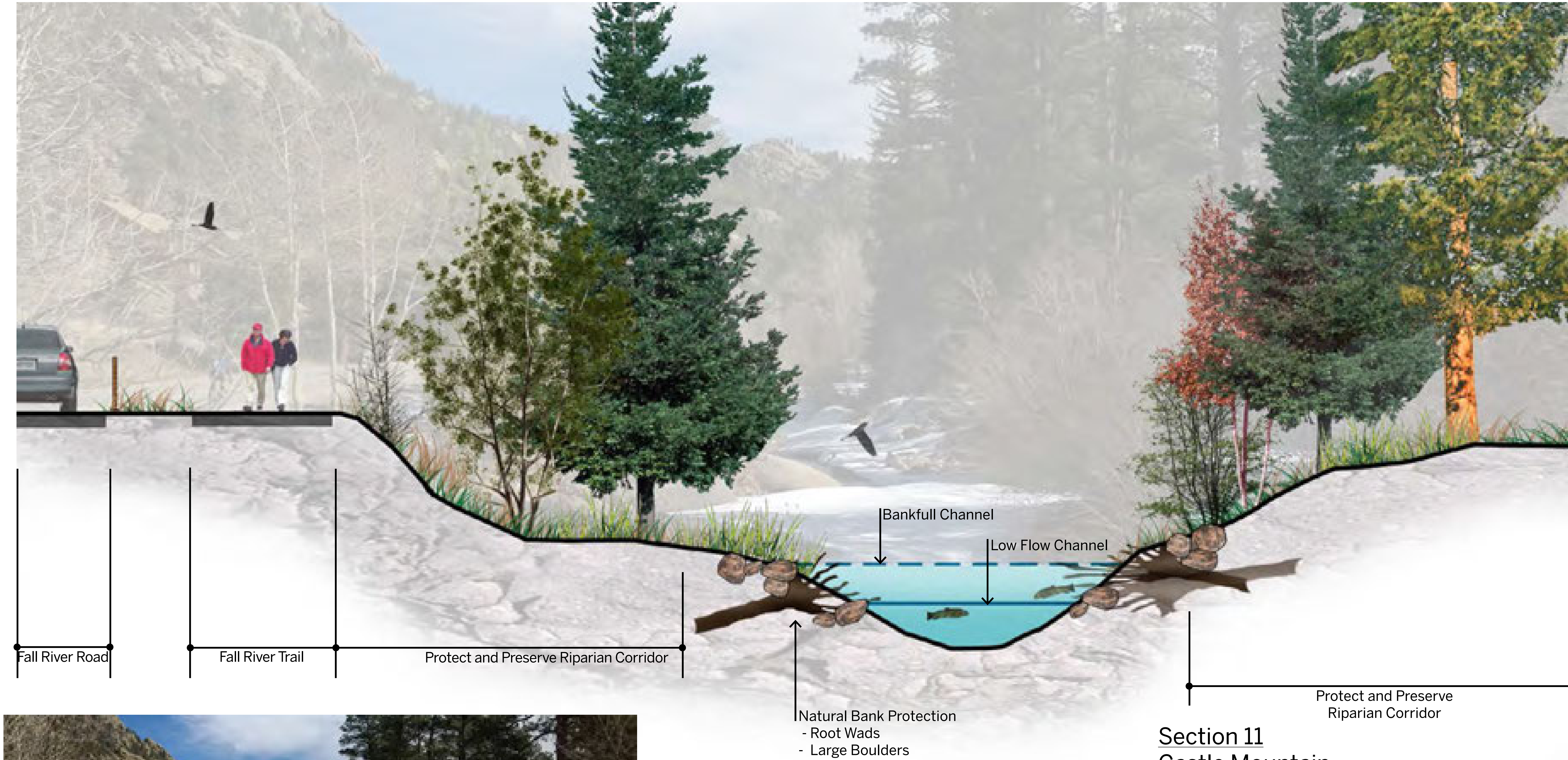
Highest Hazard Area

Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

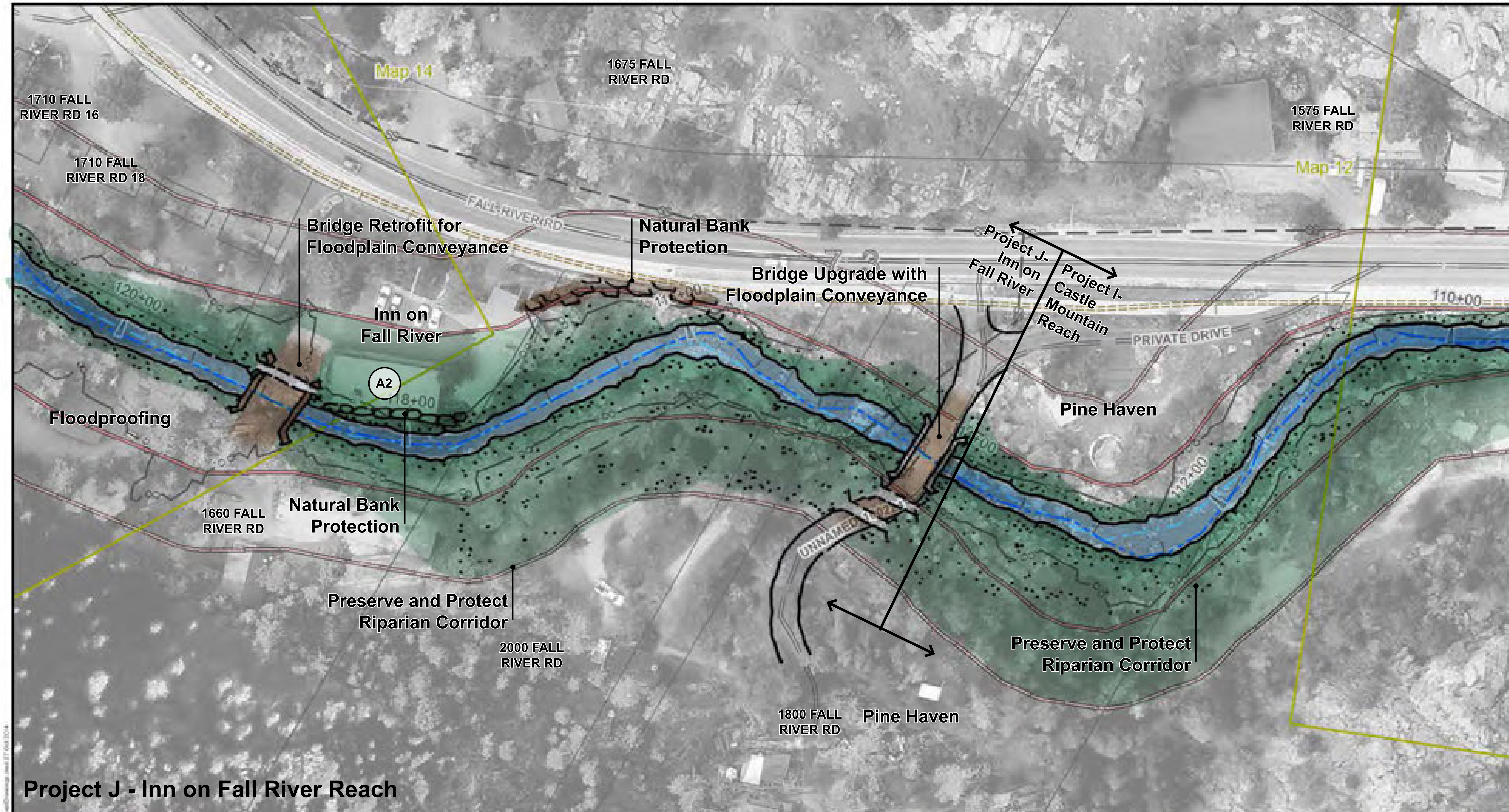
Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



Section 11
Castle Mountain
Looking Downstream
Not to Scale

Post Flood Image
Looking Downstream



1:720
1 inch = 60 feet
0 60
Feet

- Pre-Sep 2013 Trail Alignment
- Pre-Sep 2013 Road Alignment
- SS Pre-Sep 2013 Sanitary Sewer Alignment
- Estimated Parcel Boundary (See Notes)
- Adjacent Map
- Post-Sep 2013 (ca. Nov. 2013) River Alignment
- Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

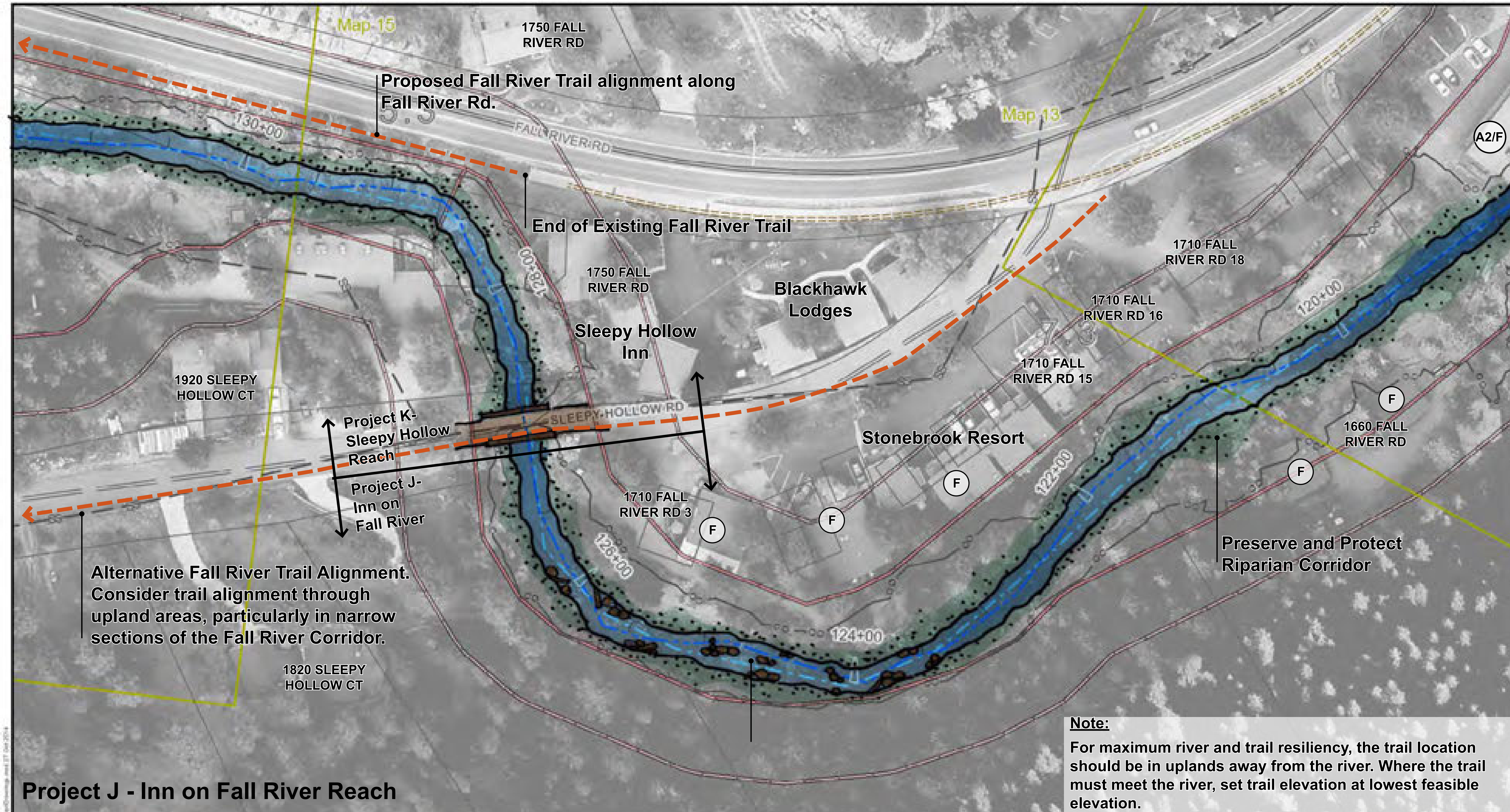
* Planning-Level Channel Migration Zone (pCMZ)

- Highest Hazard Area
- Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)

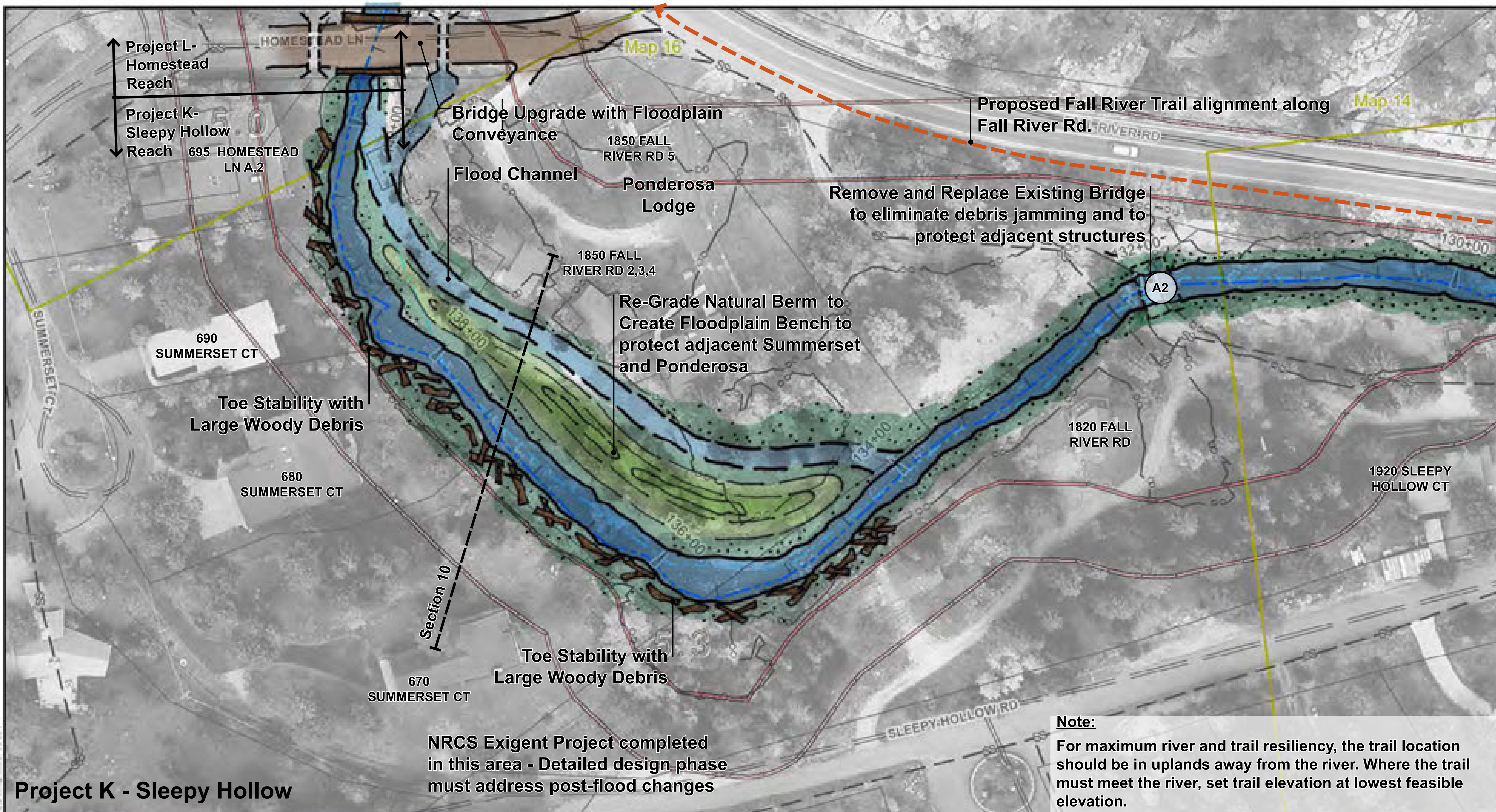
Highest Hazard Area

Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



1:720
1 inch = 60 feet
0 60
Feet

- Pre-Sep 2013 Trail Alignment
- Pre-Sep 2013 Road Alignment
- Pre-Sep 2013 Sanitary Sewer Alignment
- Estimated Parcel Boundary (See Notes)
- Adjacent Map
- Post-Sep 2013 (ca. Nov. 2013) River Alignment
- Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

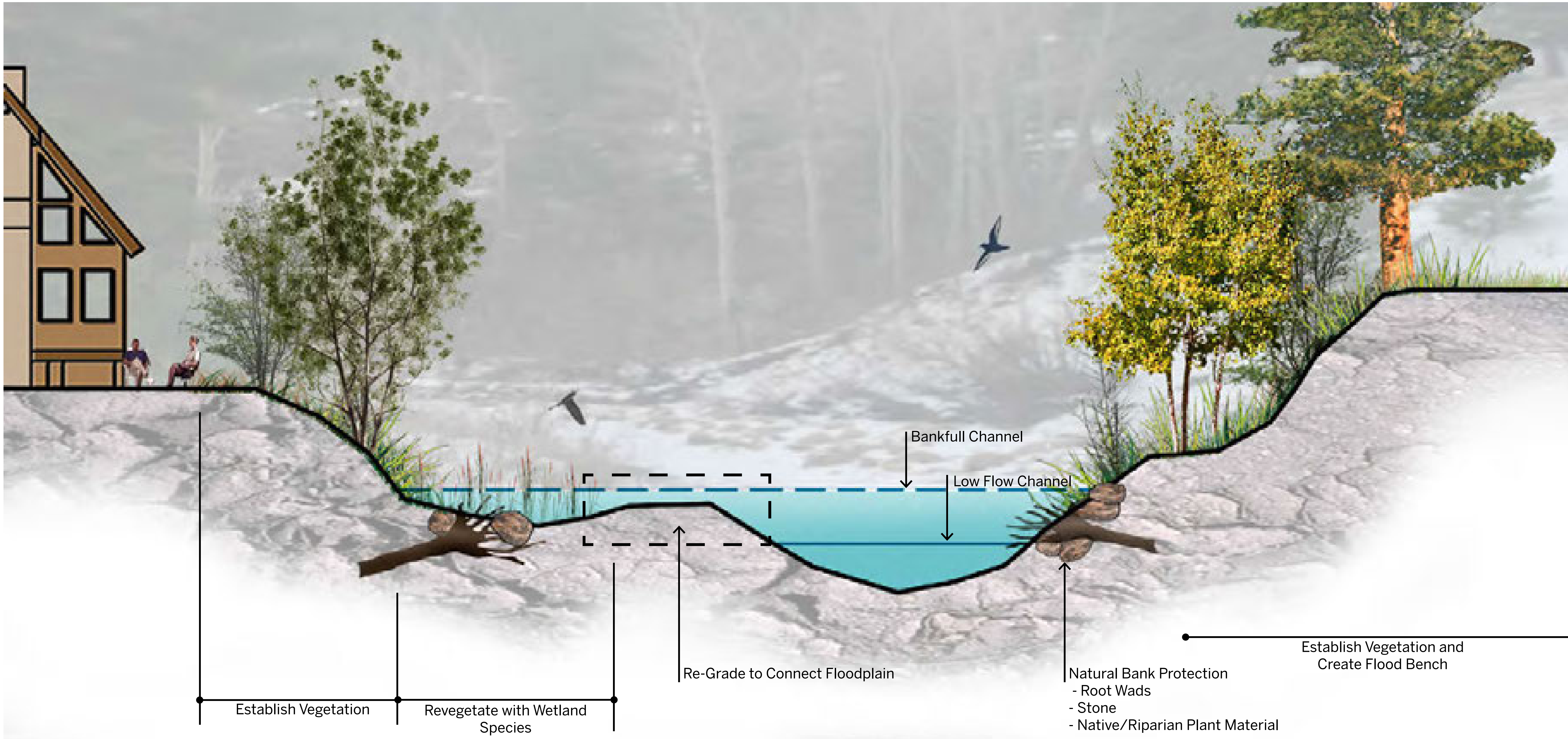
* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
- Highest Hazard Area
- Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

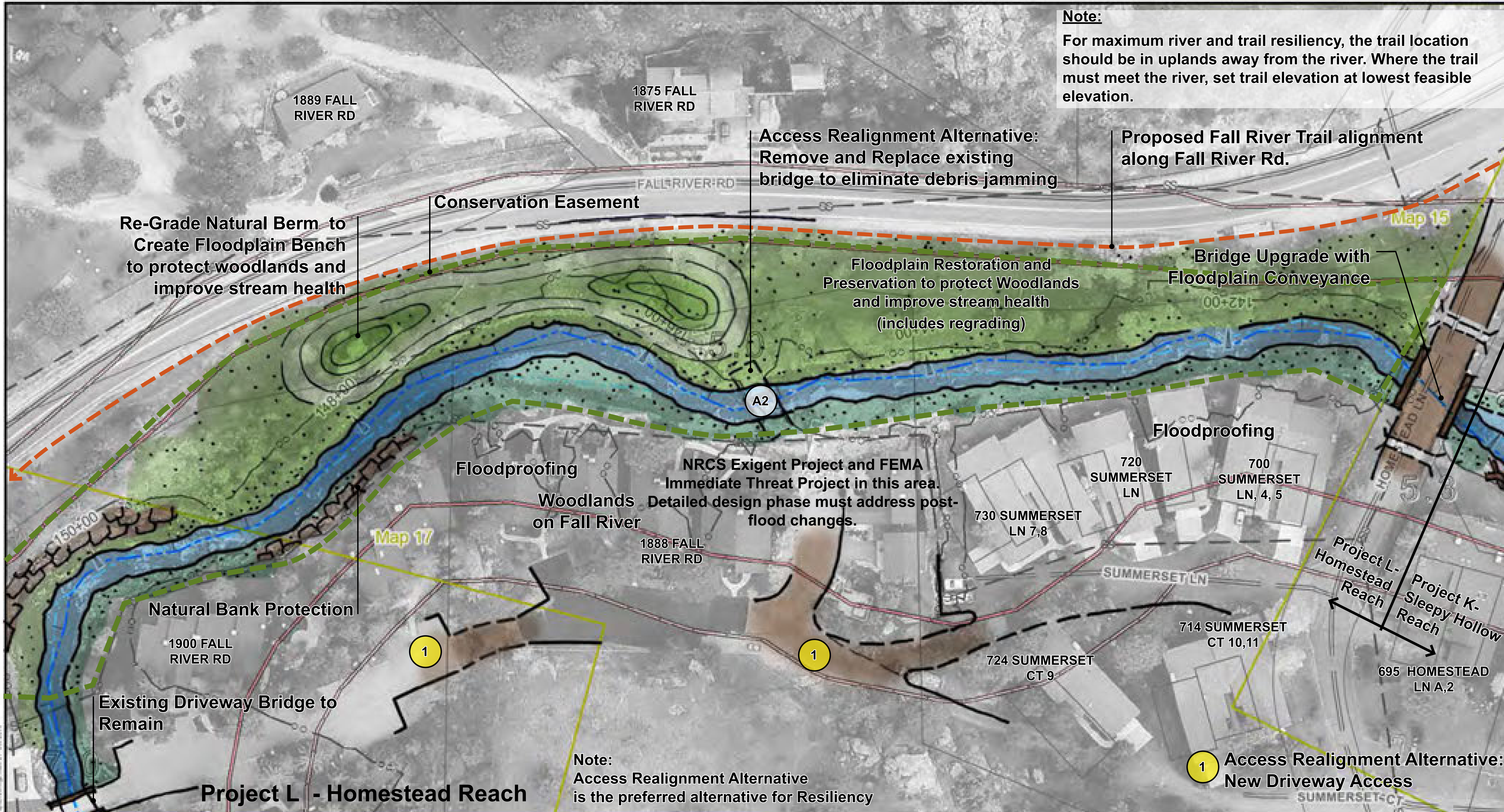
Fall River Coalition

Fall River Corridor
"Plan for Resiliency"
Resiliency Ideas



Section 10
Sleepy Hollow
Looking Downstream
Not to Scale

this page intentionally blank



Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

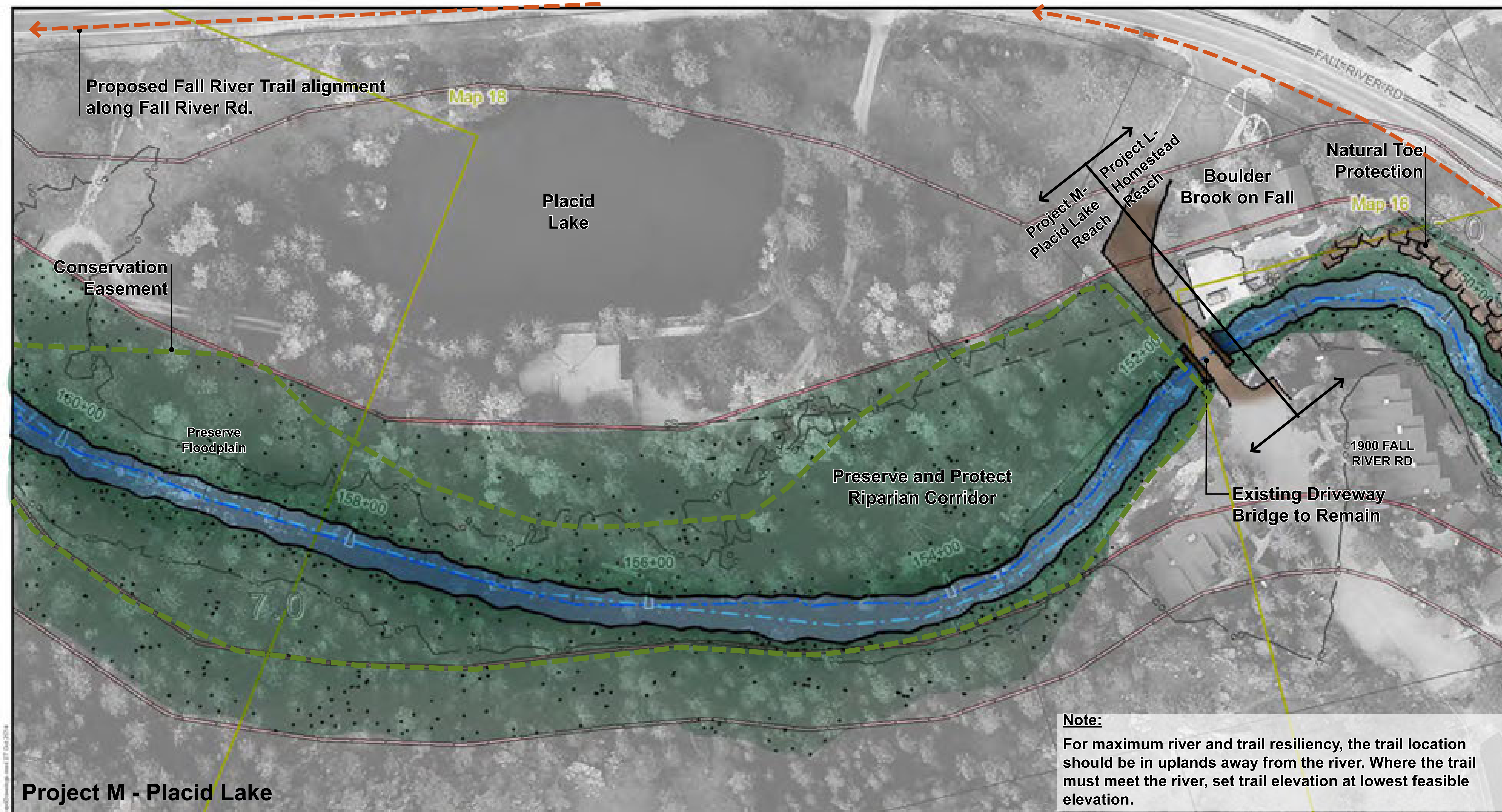
* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

1:720
1 inch = 60 feet
0 60
Feet

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas
Map 16 of 31



1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)

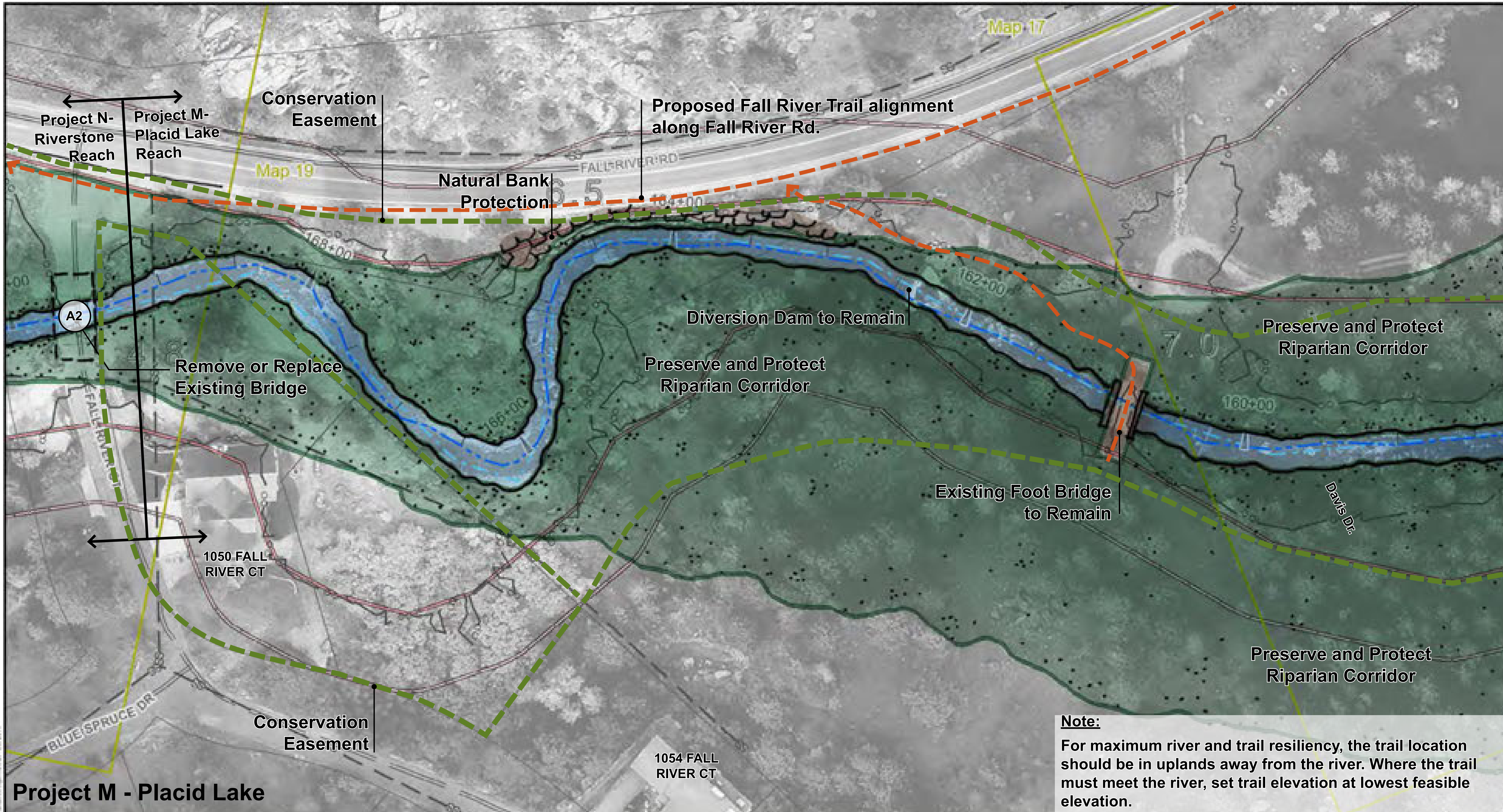
Highest Hazard Area

Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



1:720
1 inch = 60 feet
0 60
Feet

=====	Pre-Sep 2013 Trail Alignment
═══	Pre-Sep 2013 Road Alignment
SS— —	Pre-Sep 2013 Sanitary Sewer Alignment
☐	Estimated Parcel Boundary (See Notes)
☐	Adjacent Map
— · —	Post-Sep 2013 (ca. Nov. 2013) River Alignment
— · —	Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

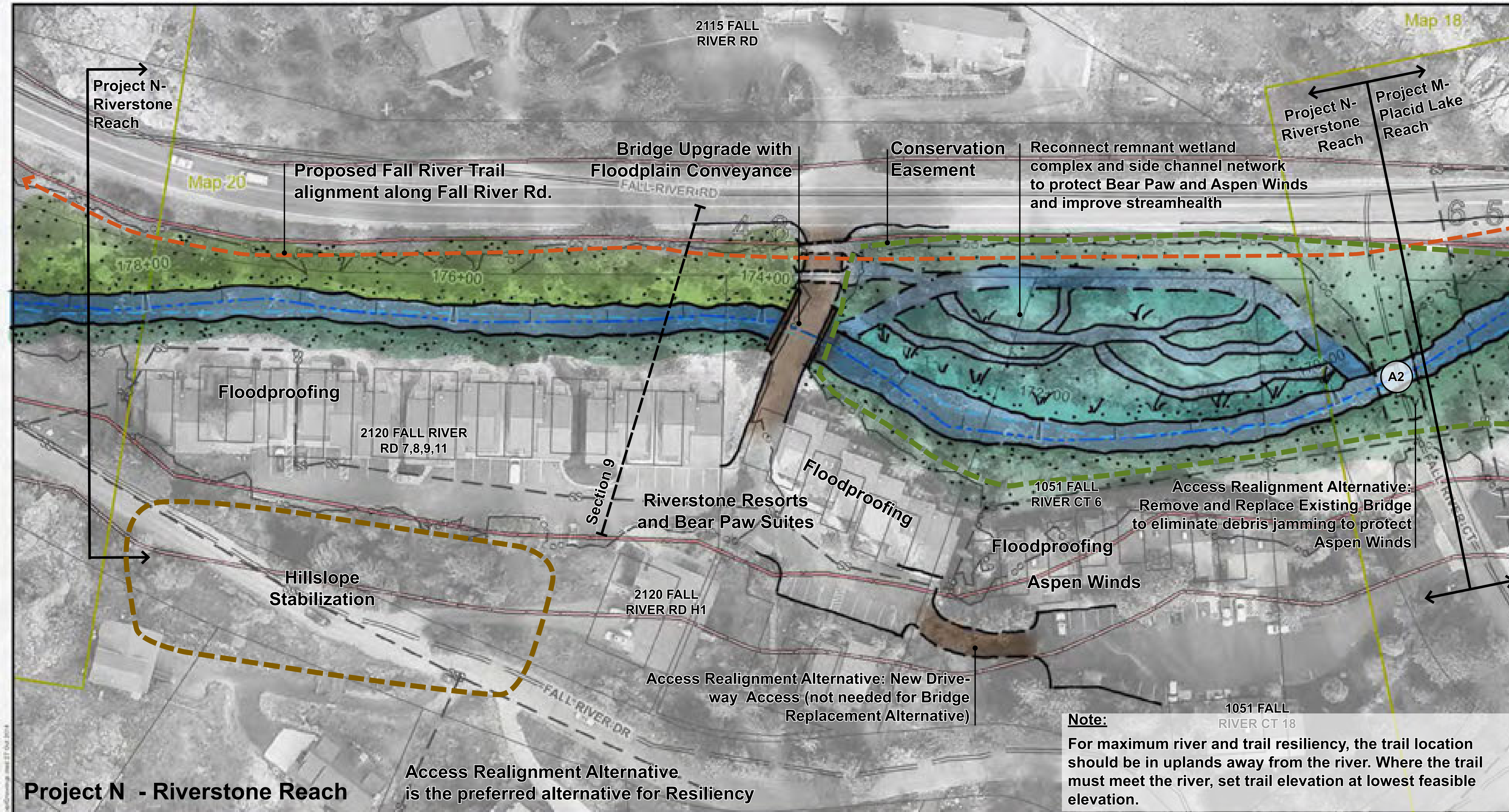
* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



Note:
For maximum river and trail resiliency, the trail location should be in uplands away from the river. Where the trail must meet the river, set trail elevation at lowest feasible elevation.

RPA Robert Peccia & Associates
Walsh
Round River Design
FlyWater
Anderson Consulting Engineers
Crane Associates

1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

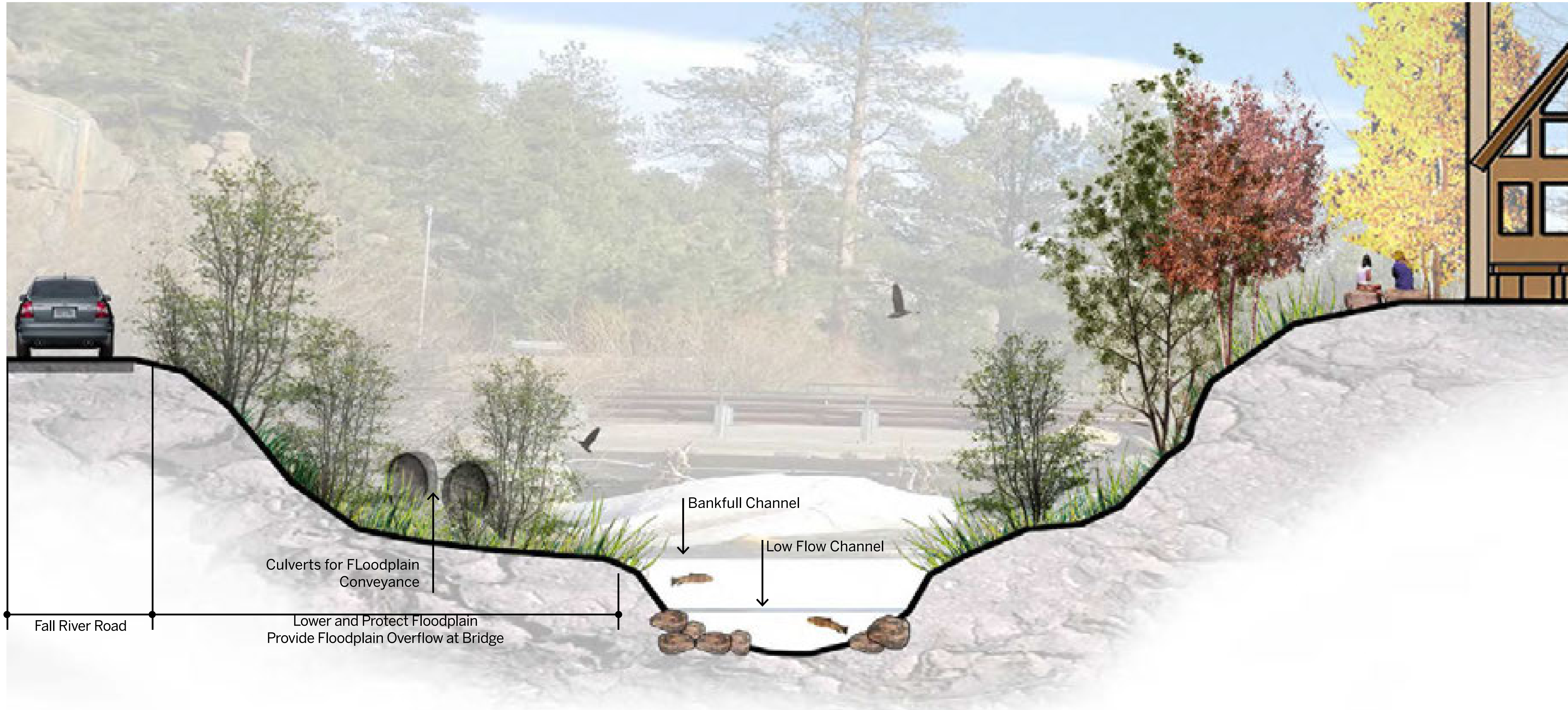
A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

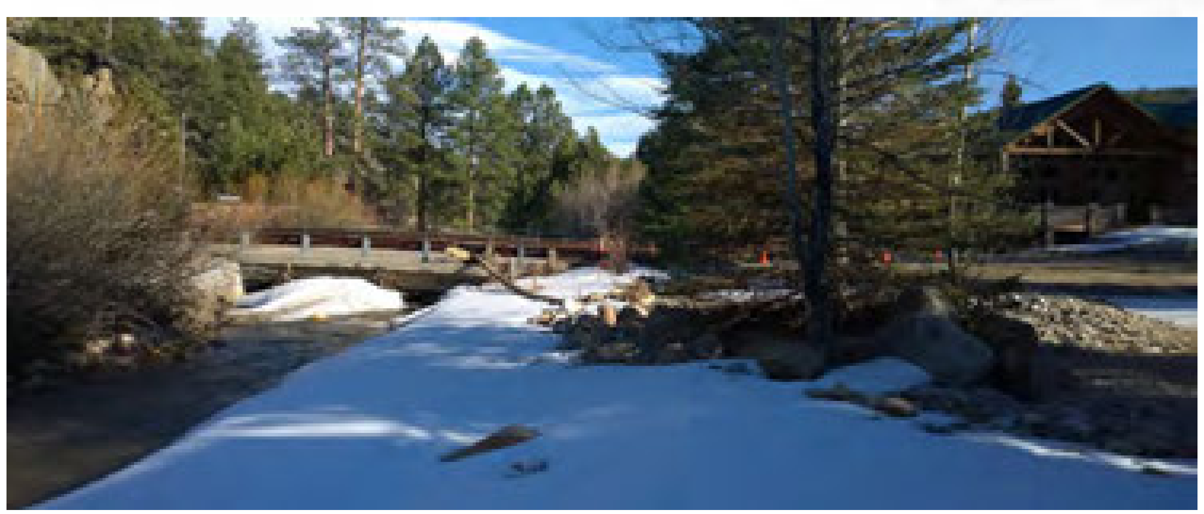
* Preliminary 100-Year Floodplain
* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

*See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.

Fall River Coalition

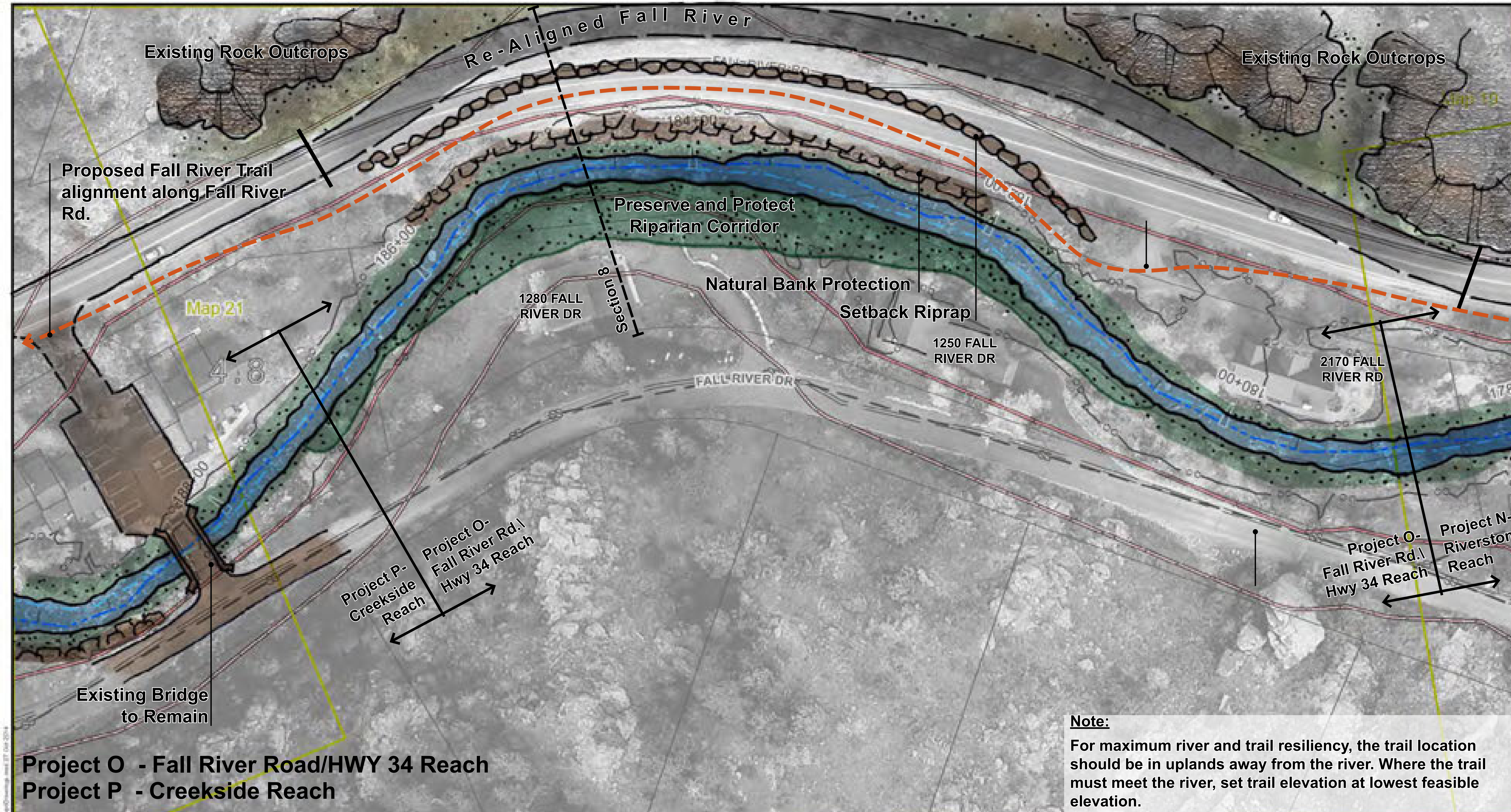
Fall River Corridor "Plan for Resiliency" Resiliency Ideas





Post Flood Image
Looking Downstream

<u>Section 9</u>
River Stone
Looking Downstream
Not to Scale



Project O - Fall River Road/HWY 34 Reach
Project P - Creekside Reach

Note:
For maximum river and trail resiliency, the trail location should be in uplands away from the river. Where the trail must meet the river, set trail elevation at lowest feasible elevation.

1:720
1 inch = 60 feet
0 60
Feet

- Pre-Sep 2013 Trail Alignment
- Pre-Sep 2013 Road Alignment
- Pre-Sep 2013 Sanitary Sewer Alignment
- Estimated Parcel Boundary (See Notes)
- Adjacent Map
- Post-Sep 2013 (ca. Nov. 2013) River Alignment
- Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

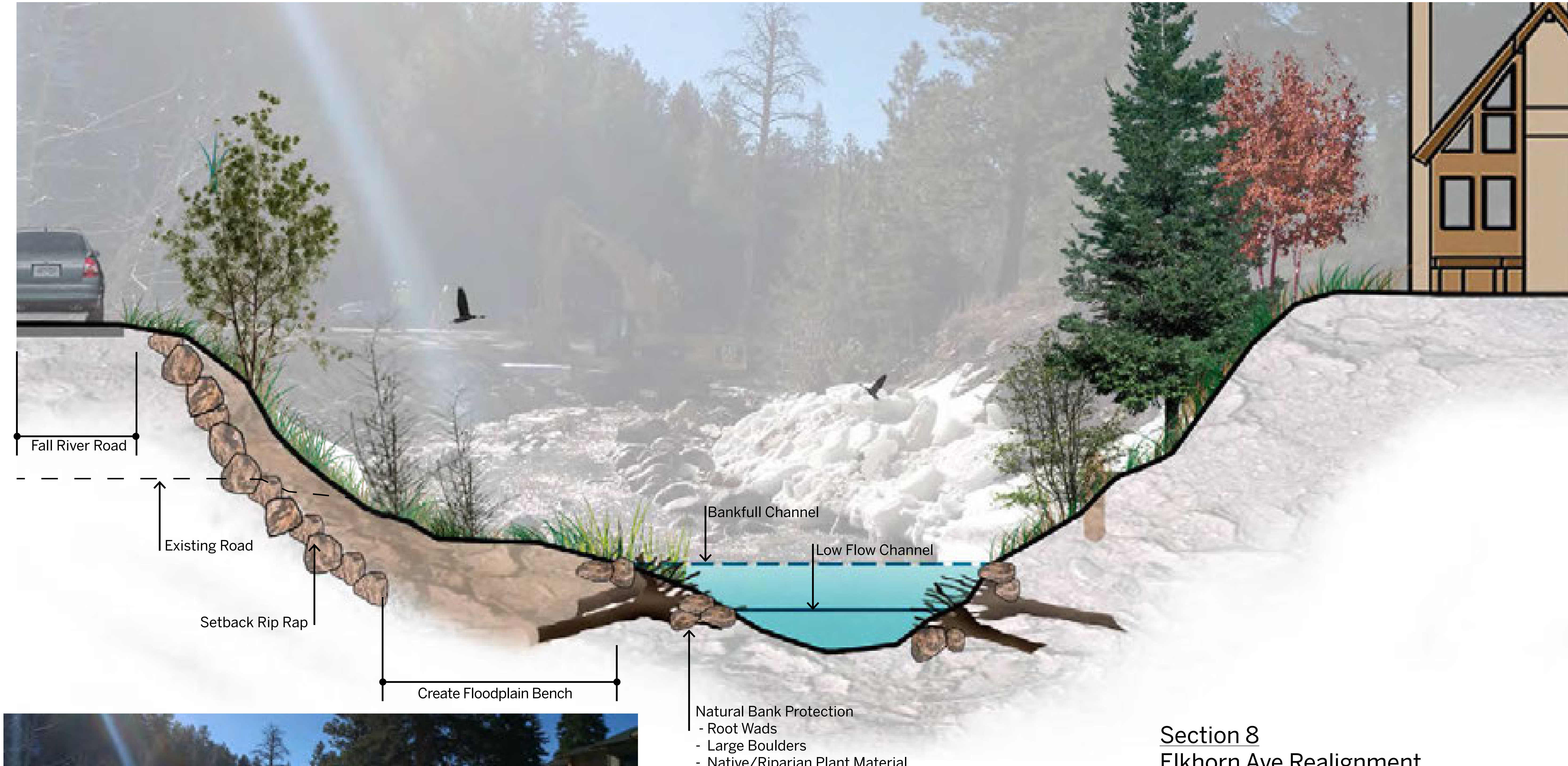
A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain
* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

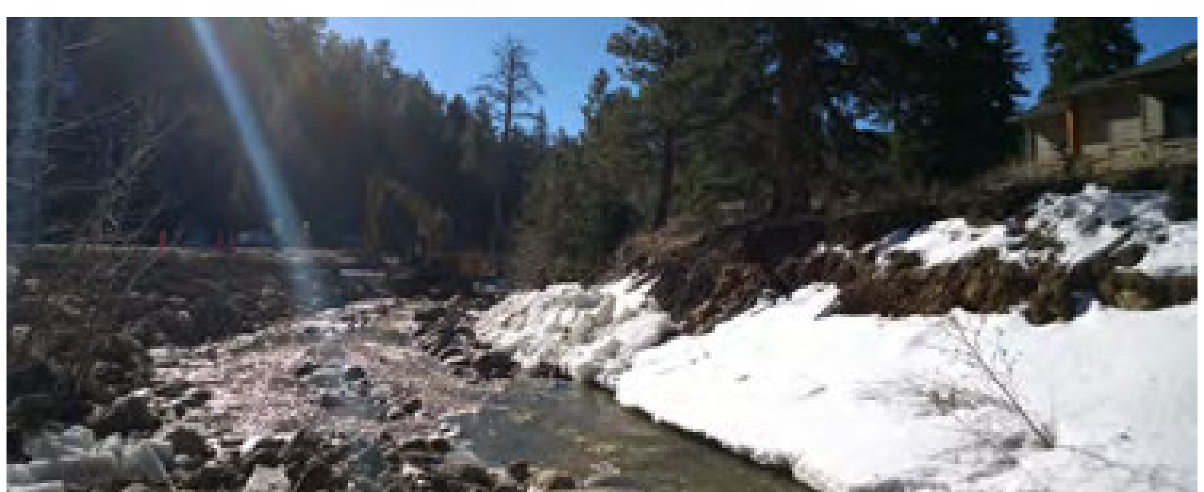
***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

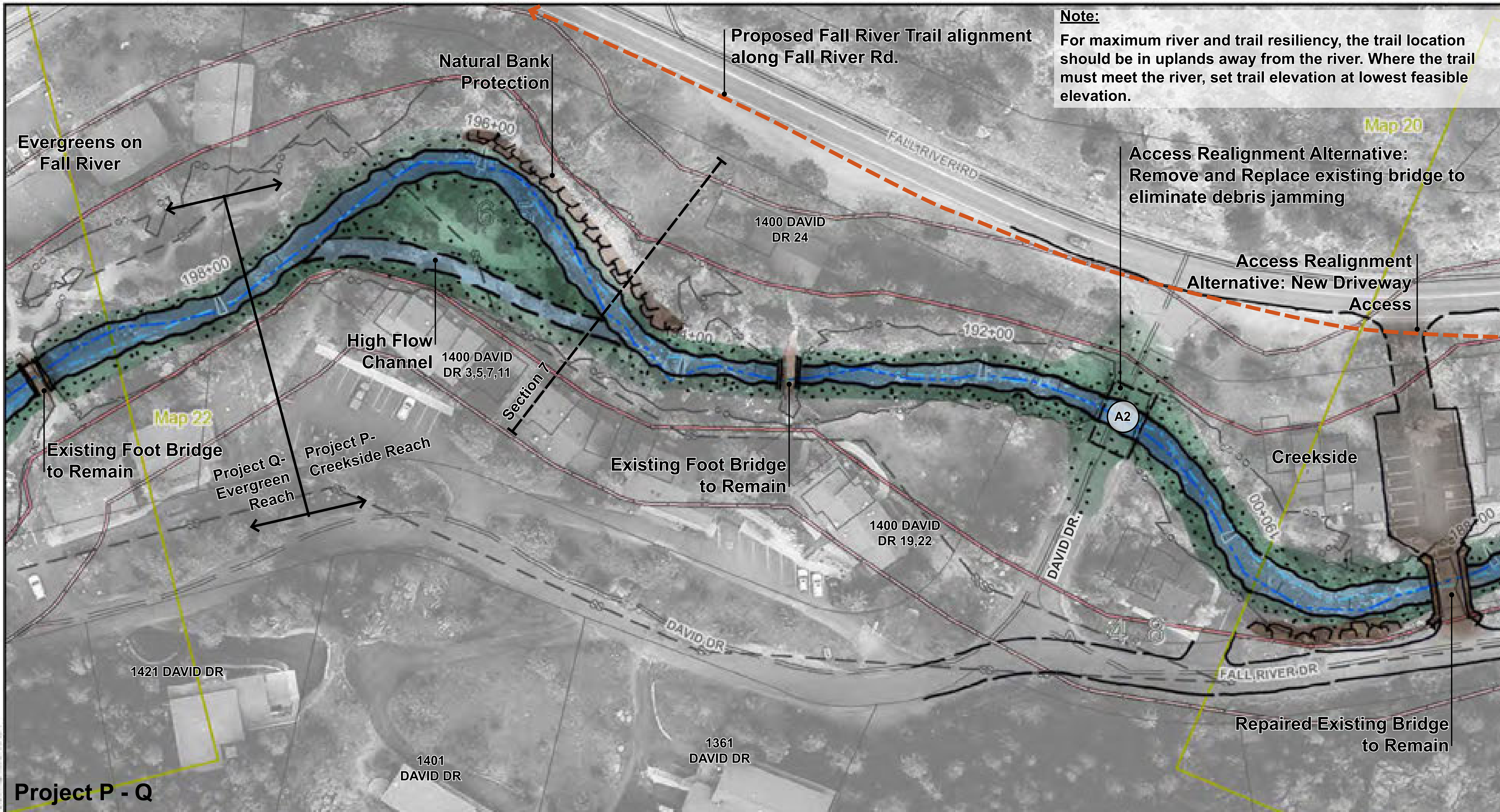
Fall River Corridor "Plan for Resiliency" Resiliency Ideas



Section 8
Elkhorn Ave Realignment
Looking Downstream
Not to Scale



Post Flood Image
Looking Downstream



1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
SS Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

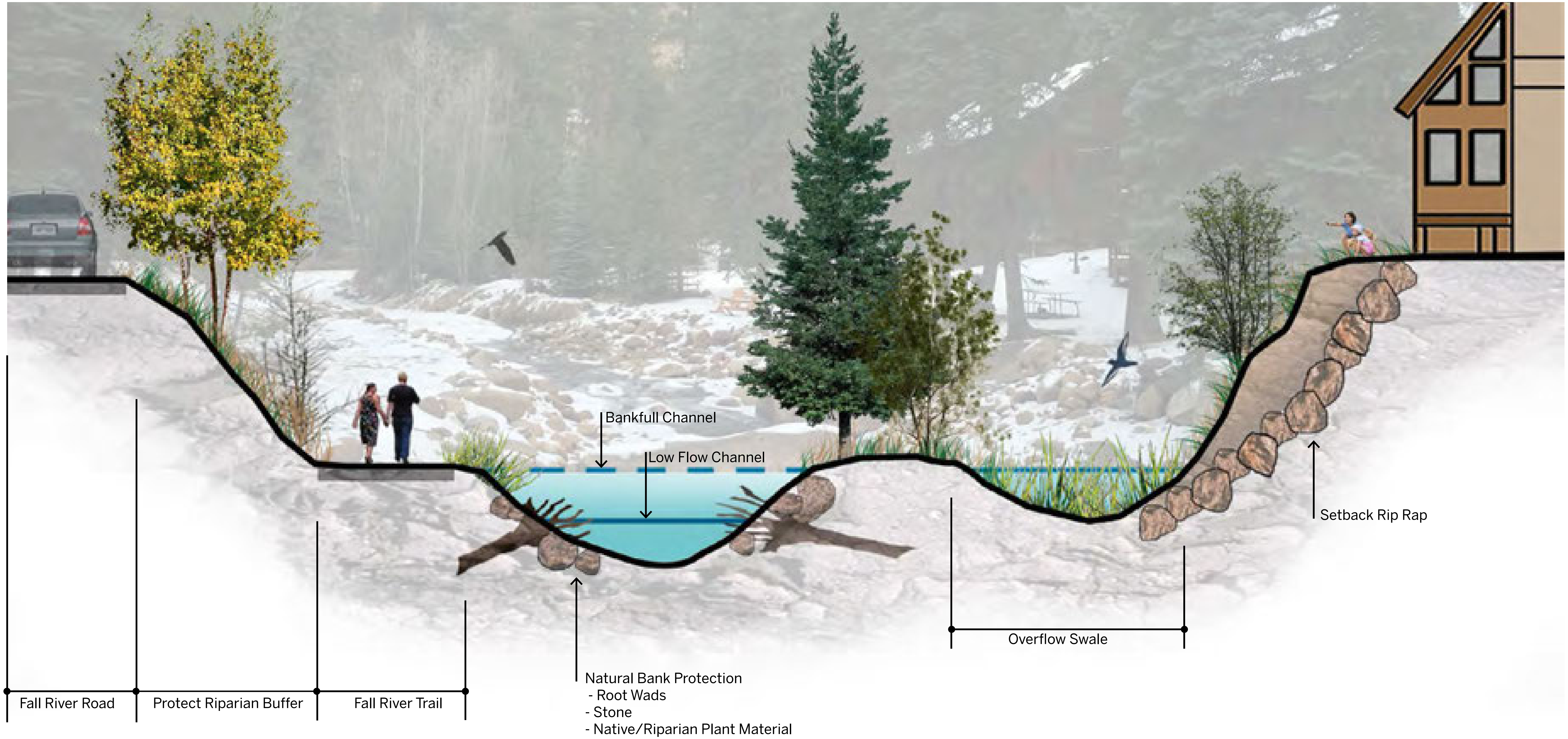
A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain
* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

*See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.

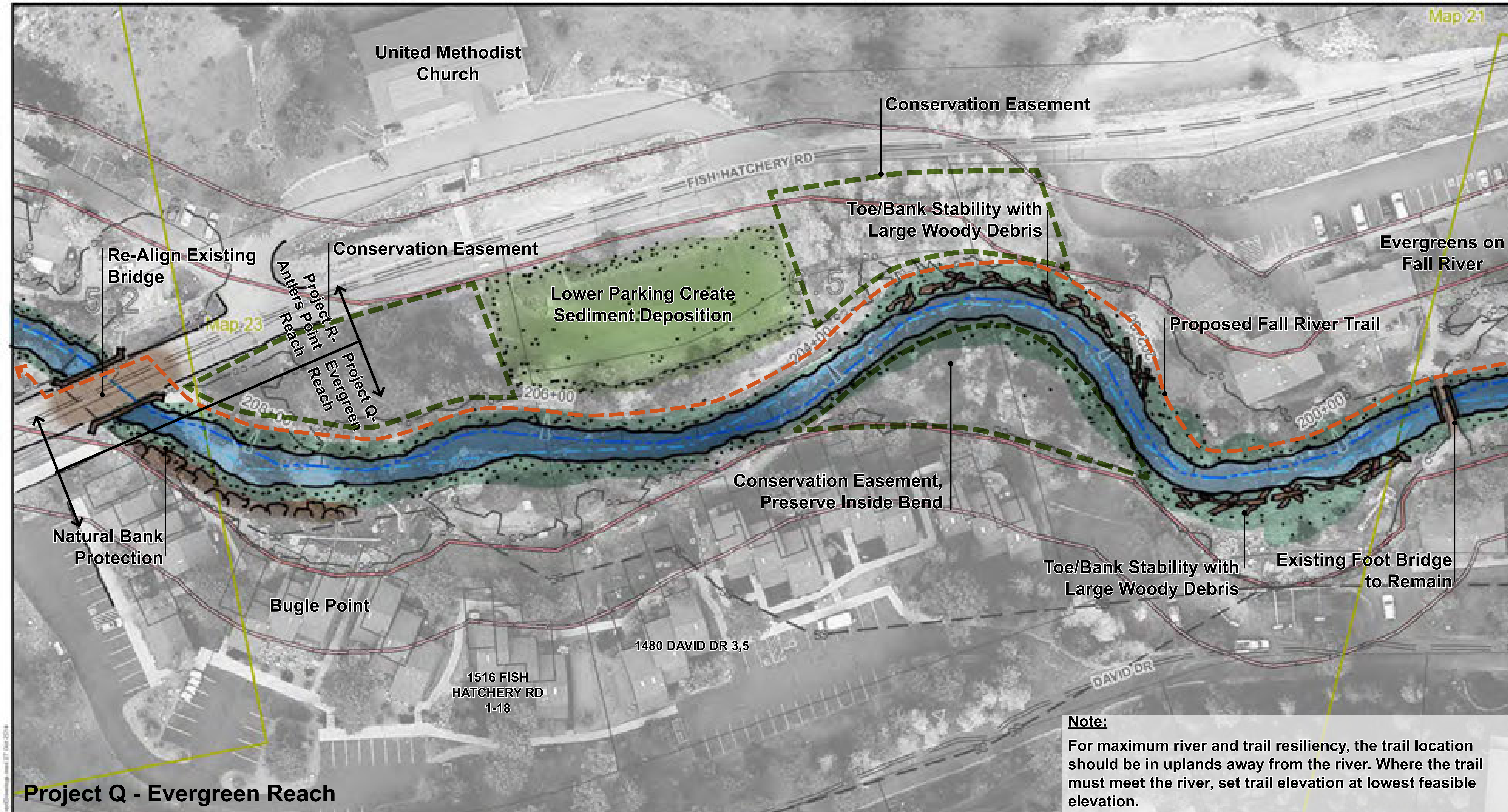
Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



Section 7
Fall River Creekside
Looking Upstream
Not to Scale

this page intentionally blank



Project Q - Evergreen Reach

Note:

For maximum river and trail resiliency, the trail location should be in uplands away from the river. Where the trail must meet the river, set trail elevation at lowest feasible elevation.

1:720
1 inch = 60 feet
0 60
Feet

- Pre-Sep 2013 Trail Alignment
- Pre-Sep 2013 Road Alignment
- Pre-Sep 2013 Sanitary Sewer Alignment
- Estimated Parcel Boundary (See Notes)
- Adjacent Map
- Post-Sep 2013 (ca. Nov. 2013) River Alignment
- Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

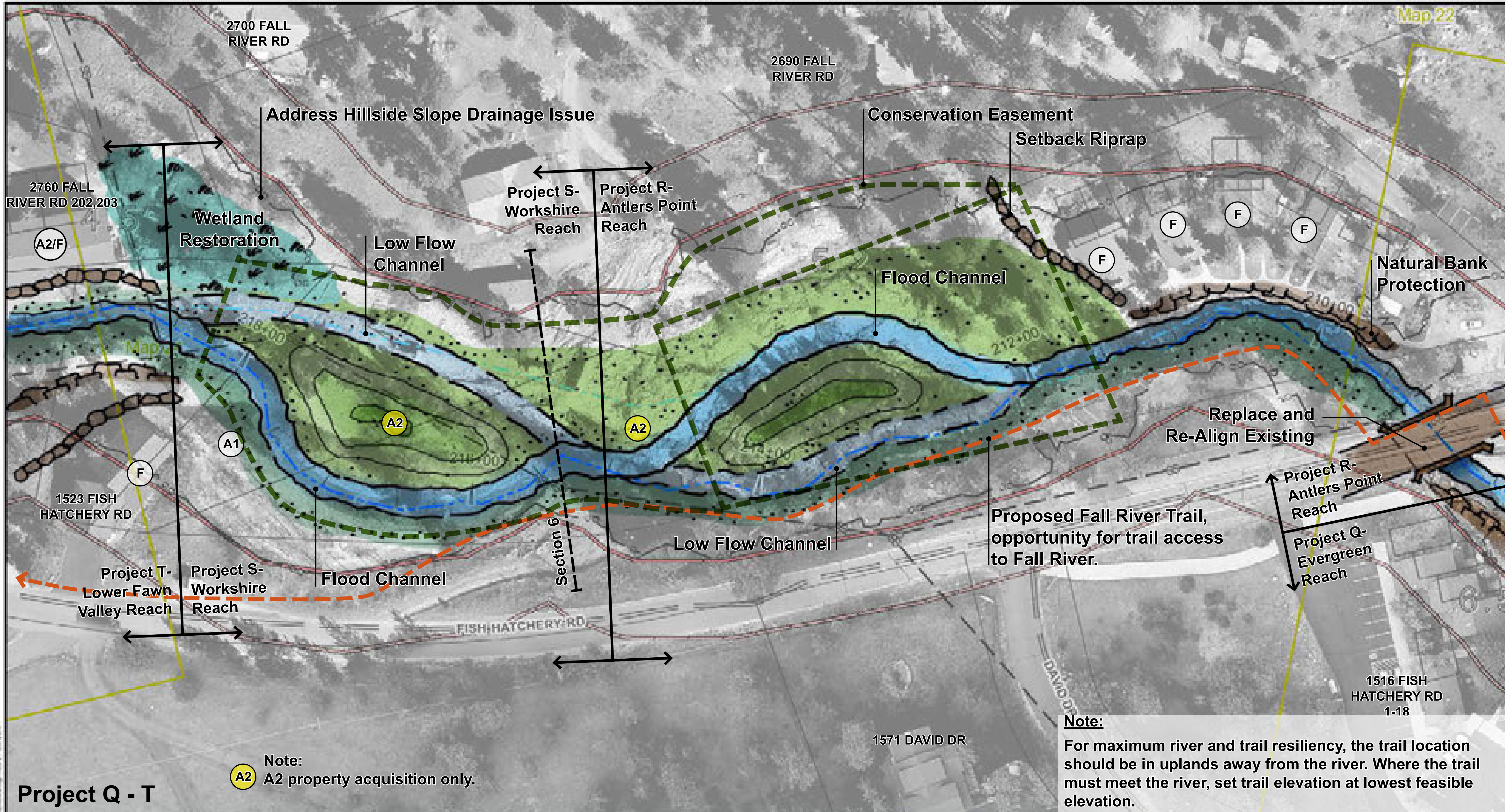
* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
- Highest Hazard Area
- Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



Project Q - T

1:720
1 inch = 60 feet
0 60
Feet

- Pre-Sep 2013 Trail Alignment
- Pre-Sep 2013 Road Alignment
- SS Pre-Sep 2013 Sanitary Sewer Alignment
- Estimated Parcel Boundary (See Notes)
- Adjacent Map
- Post-Sep 2013 (ca. Nov. 2013) River Alignment
- Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

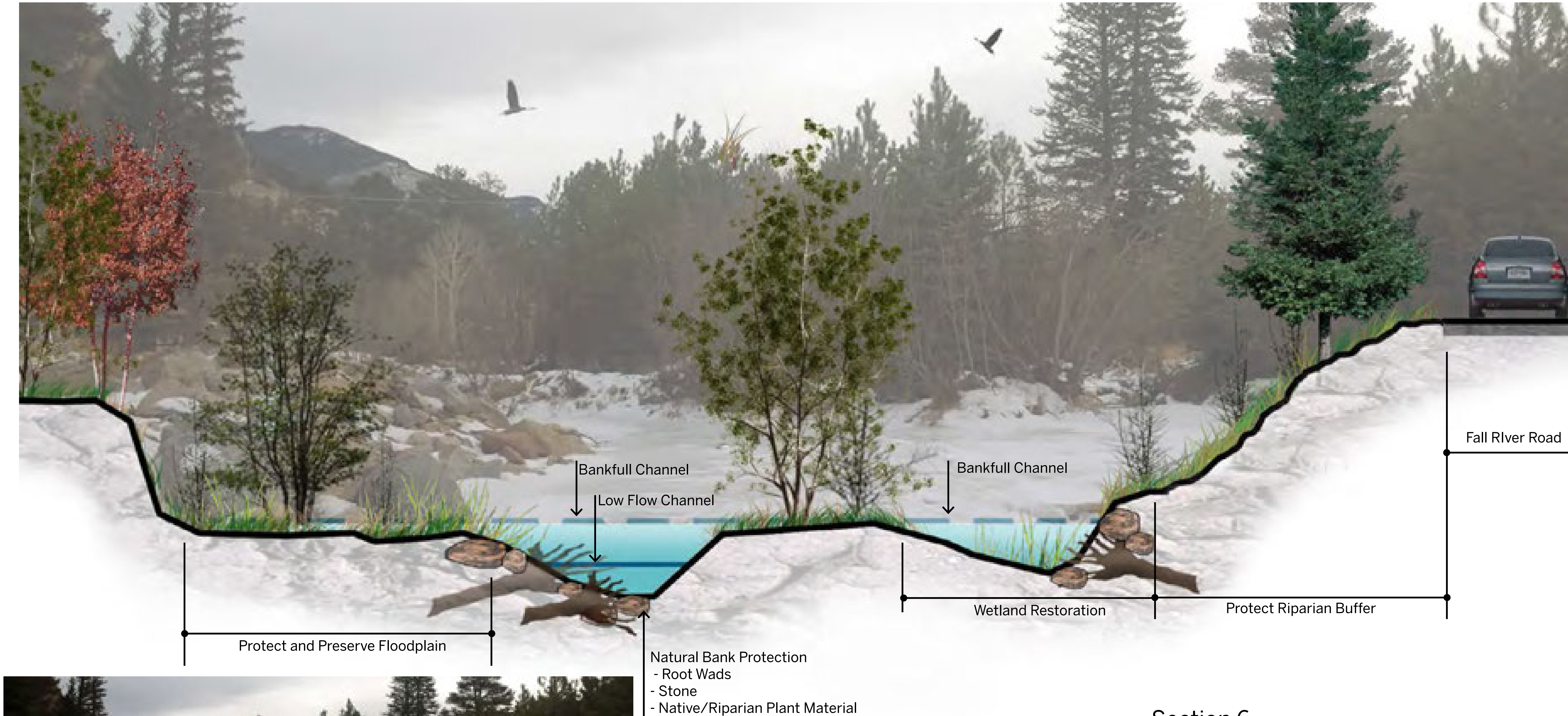
* Planning-Level Channel Migration Zone (pCMZ)

- Highest Hazard Area
- Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

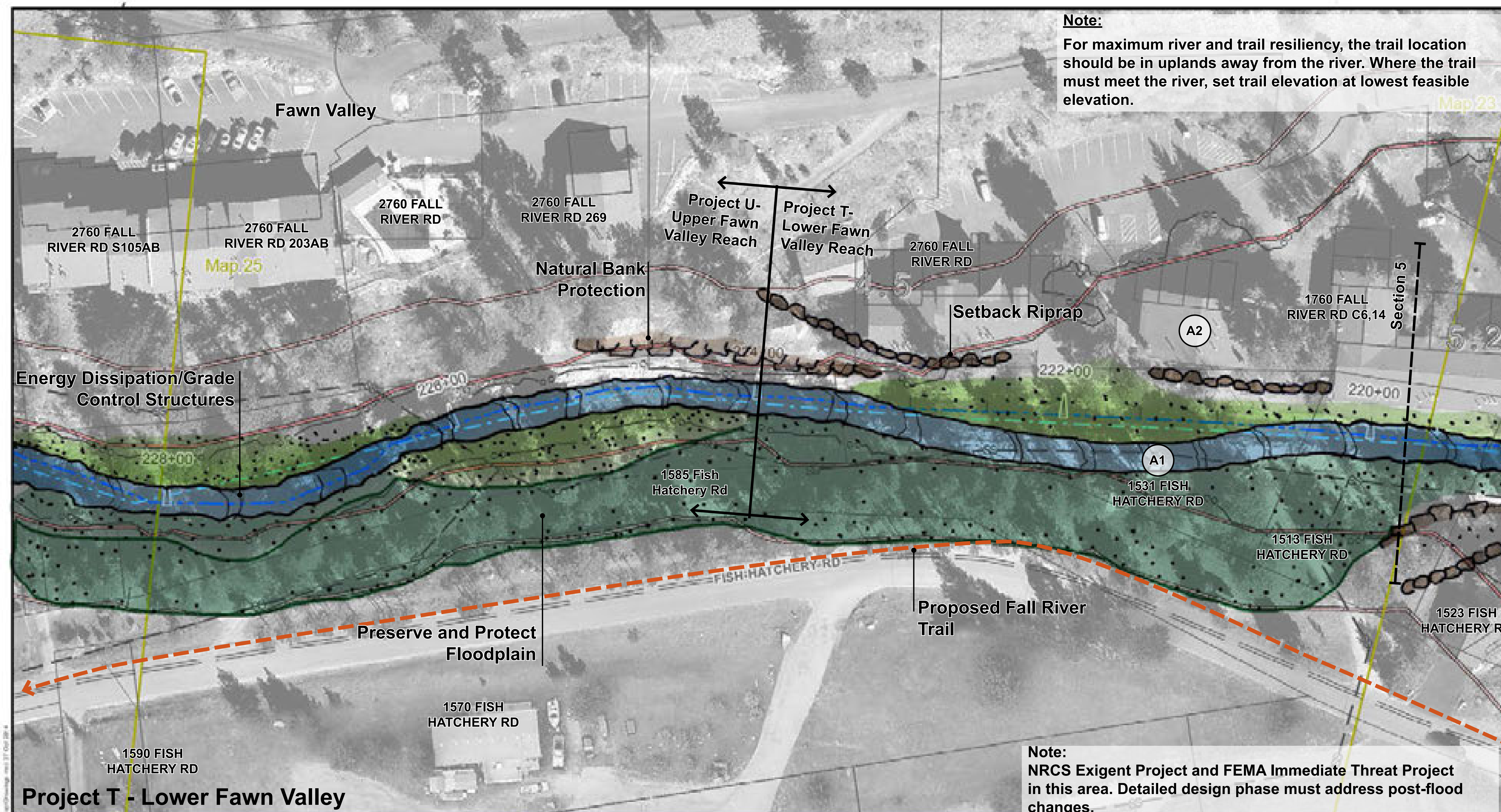
Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



Section 6
Fall River Workshire Oliver
Looking Upstream
Not to Scale

Post Flood Image
Looking Upstream



Project T - Lower Fawn Valley

1:720
1 inch = 60 feet
0 60
Feet

- Pre-Sep 2013 Trail Alignment
- Pre-Sep 2013 Road Alignment
- Pre-Sep 2013 Sanitary Sewer Alignment
- Estimated Parcel Boundary (See Notes)
- Adjacent Map
- Post-Sep 2013 (ca. Nov. 2013) River Alignment
- Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

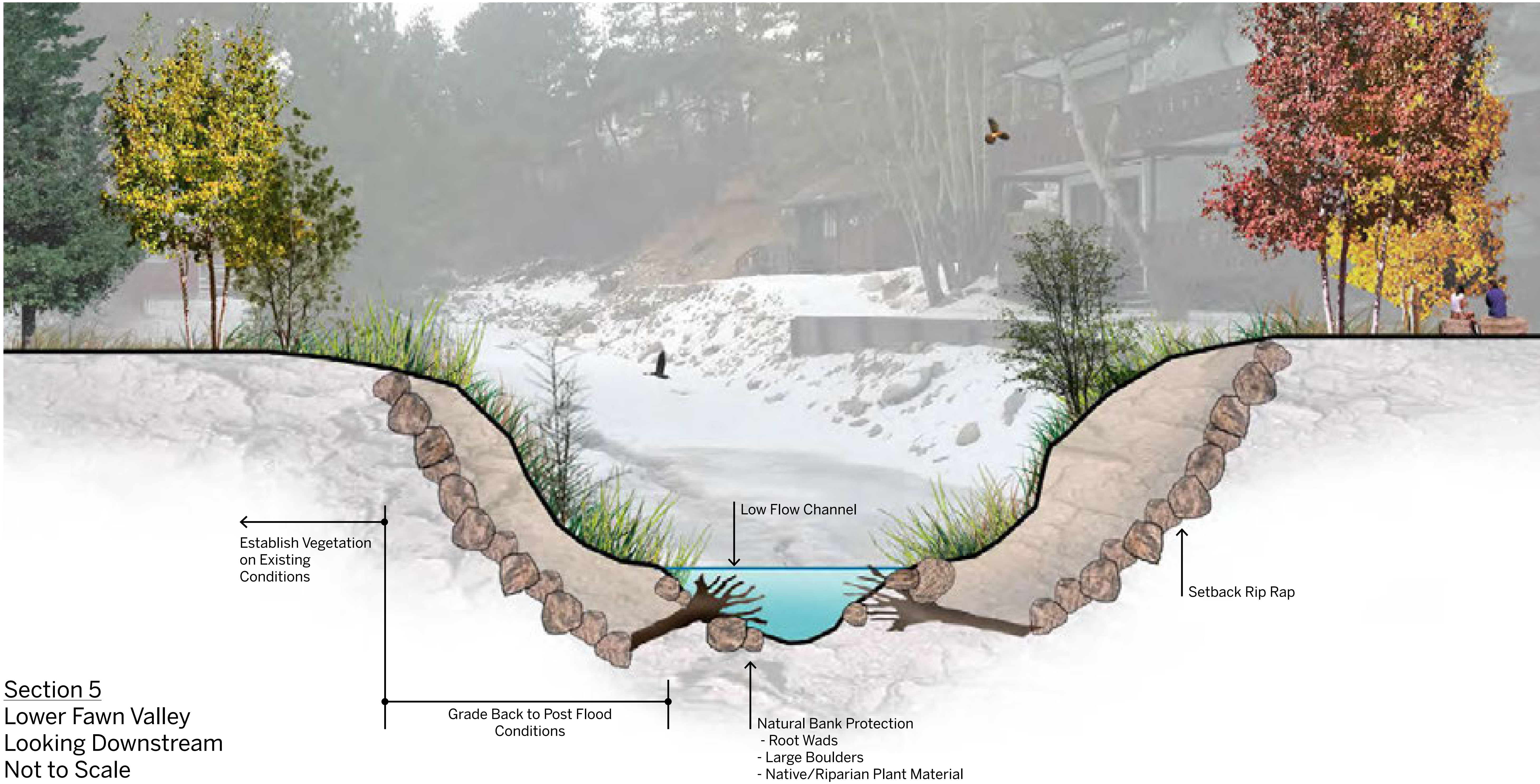
* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
- Highest Hazard Area
- Additional Hazard Area

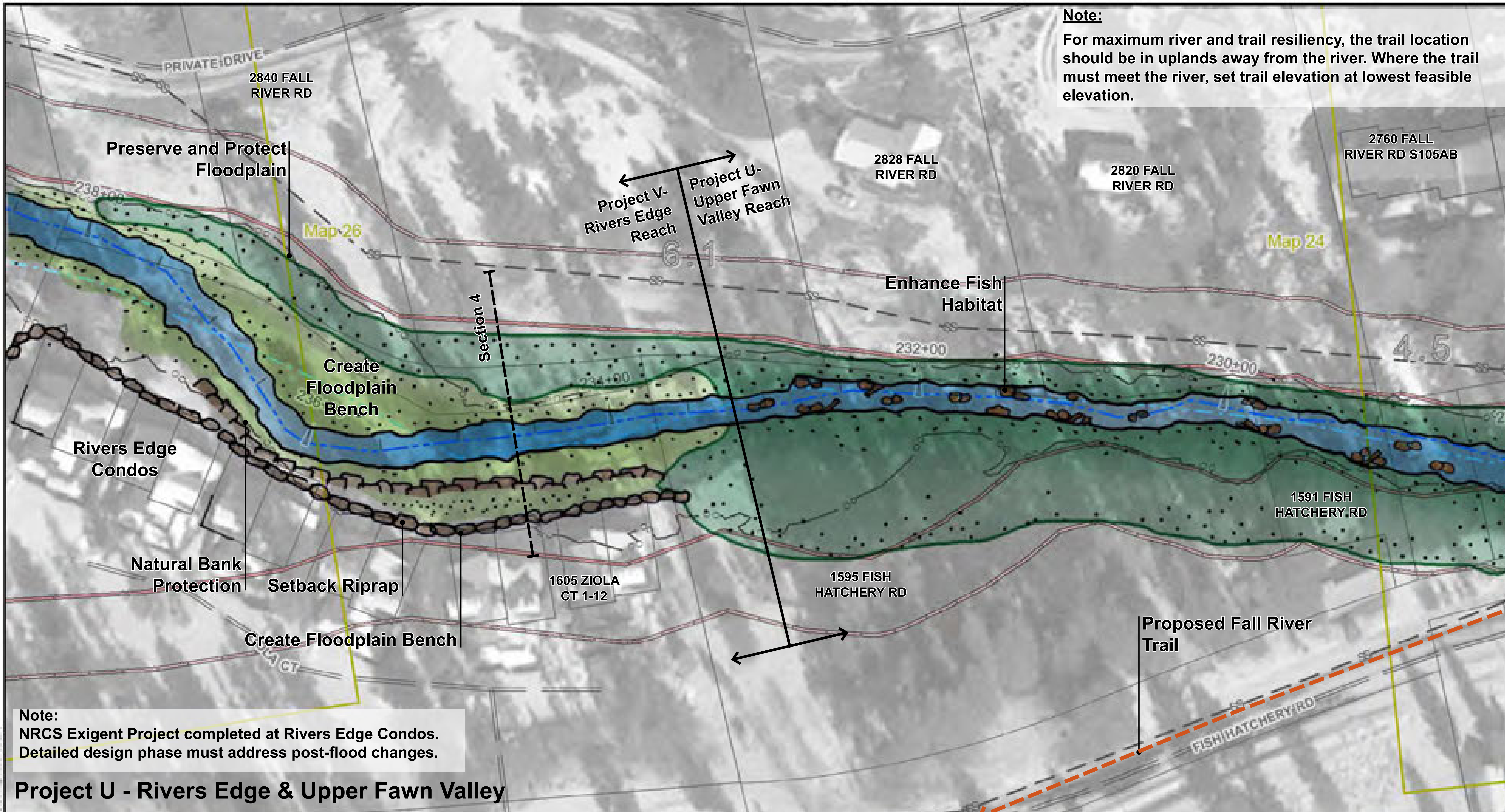
***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas



Section 5
Lower Fawn Valley
Looking Downstream
Not to Scale



Project U - Rivers Edge & Upper Fawn Valley

1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

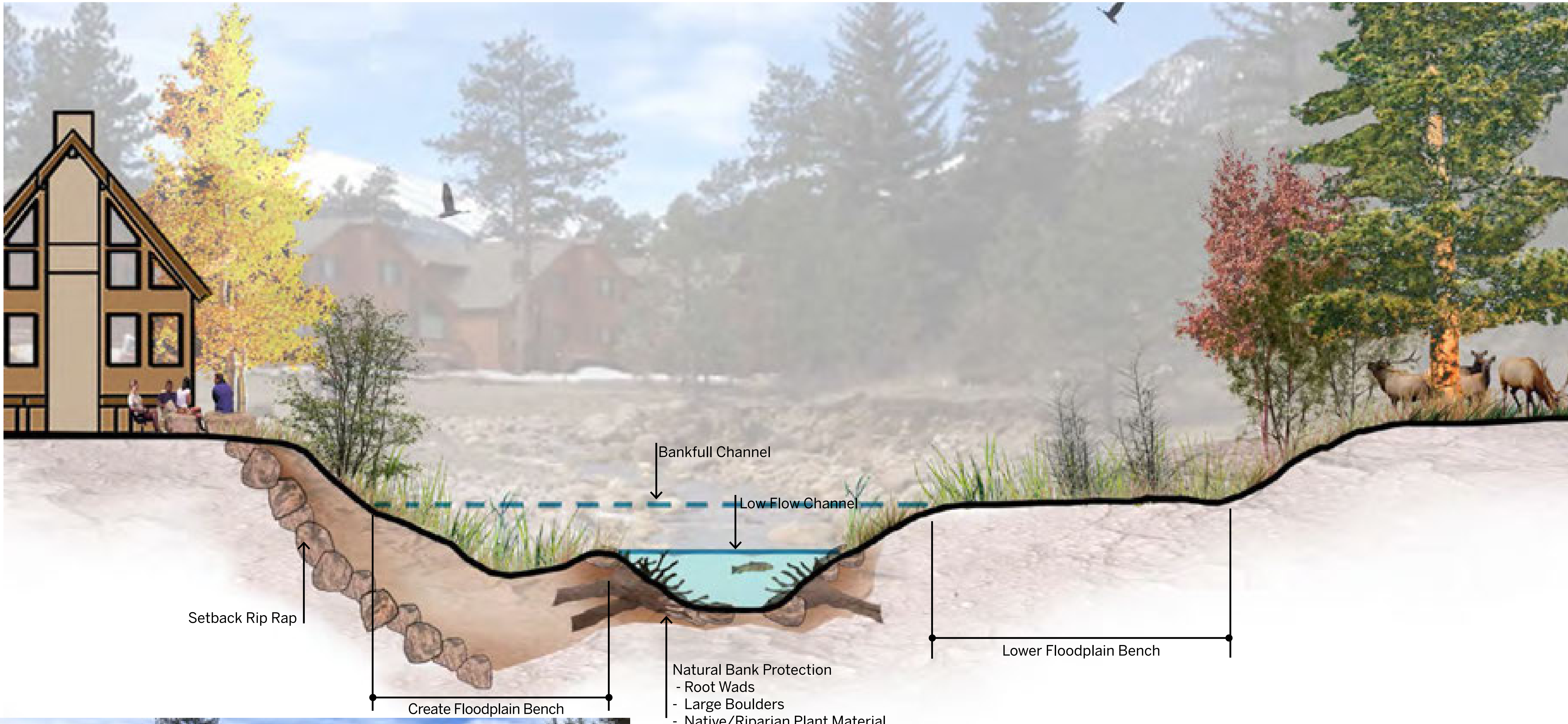
* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

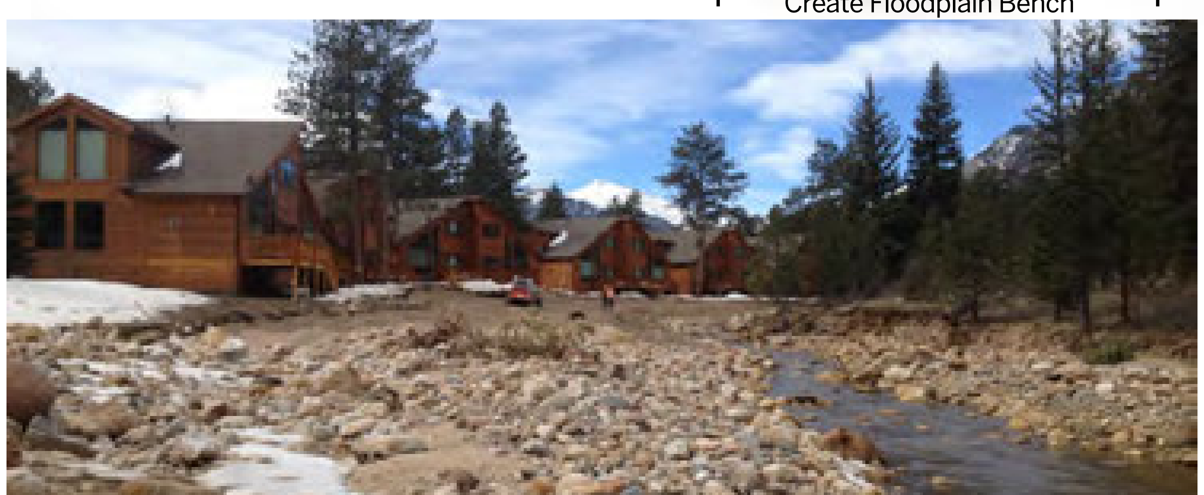
***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

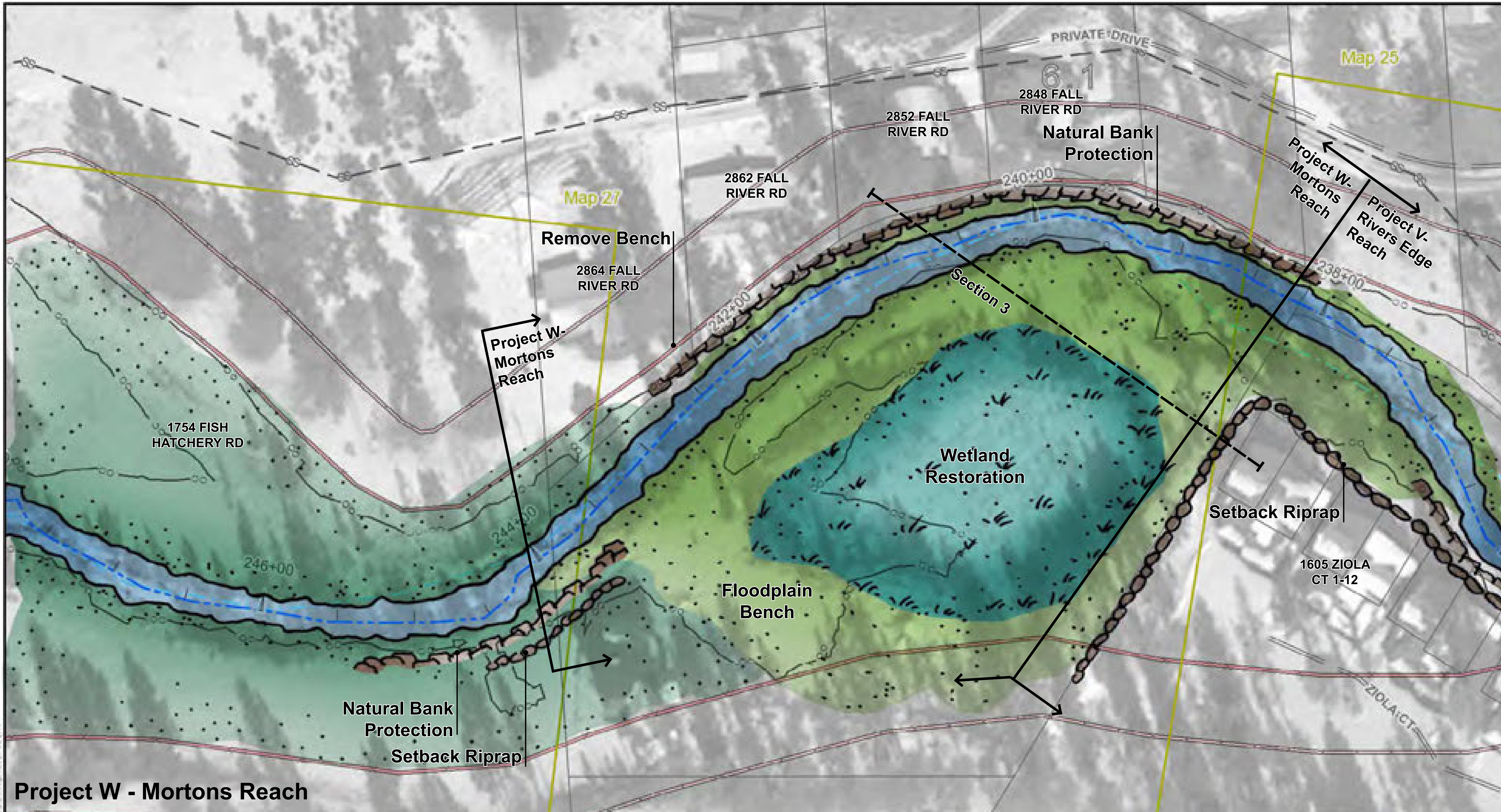
Fall River Corridor "Plan for Resiliency" Resiliency Ideas



Section 4
River's Edge
Looking Upstream
Not to Scale



Post Flood Image
Looking Downstream



Project W - Mortons Reach

N
W E
S
1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
SS Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

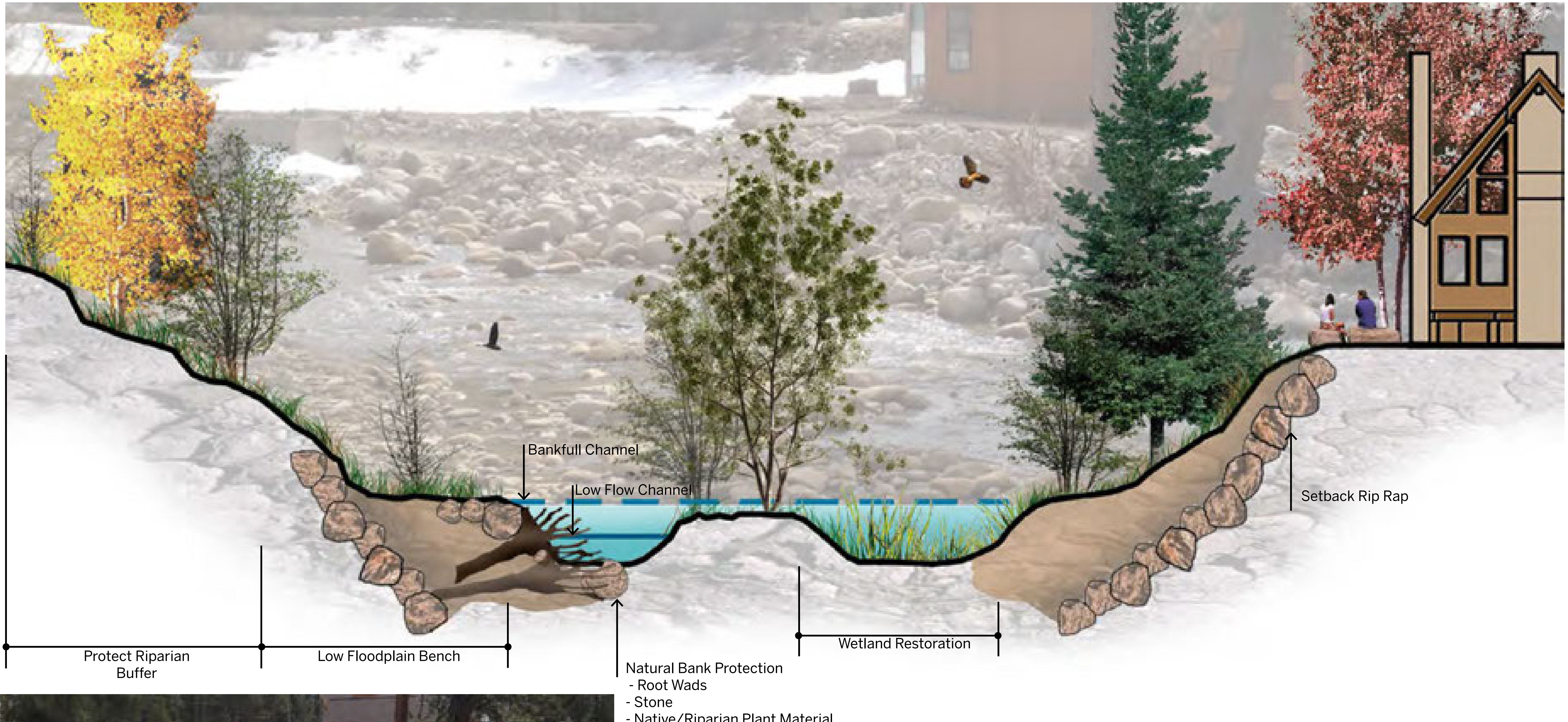
A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain
* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

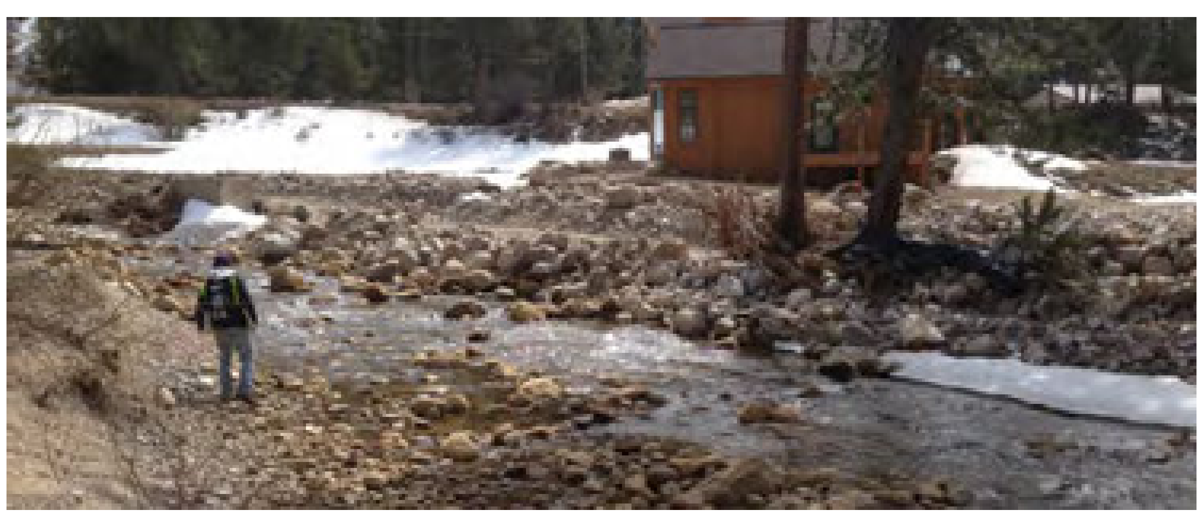
***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

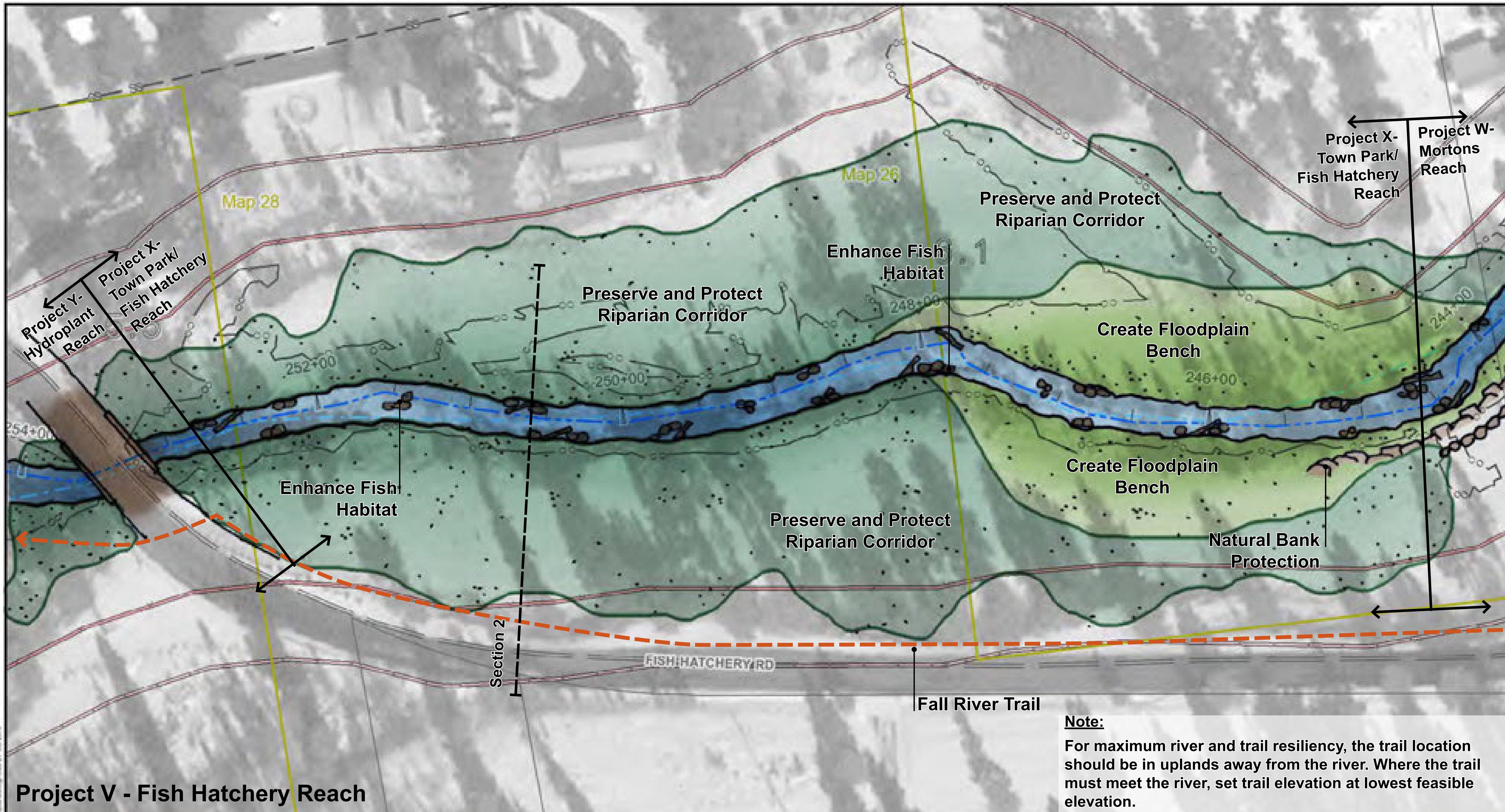
Fall River Corridor
"Plan for Resiliency"
Resiliency Ideas



Section 3
Fall River Morton's
Looking Downstream
Not to Scale



Post Flood Image
Looking Downstream



Note:

For maximum river and trail resiliency, the trail location should be in uplands away from the river. Where the trail must meet the river, set trail elevation at lowest feasible elevation.

Project V - Fish Hatchery Reach

1:720
1 inch = 60 feet
0 60
Feet

- Pre-Sep 2013 Trail Alignment
- Pre-Sep 2013 Road Alignment
- Pre-Sep 2013 Sanitary Sewer Alignment
- Estimated Parcel Boundary (See Notes)
- Adjacent Map
- Post-Sep 2013 (ca. Nov. 2013) River Alignment
- Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

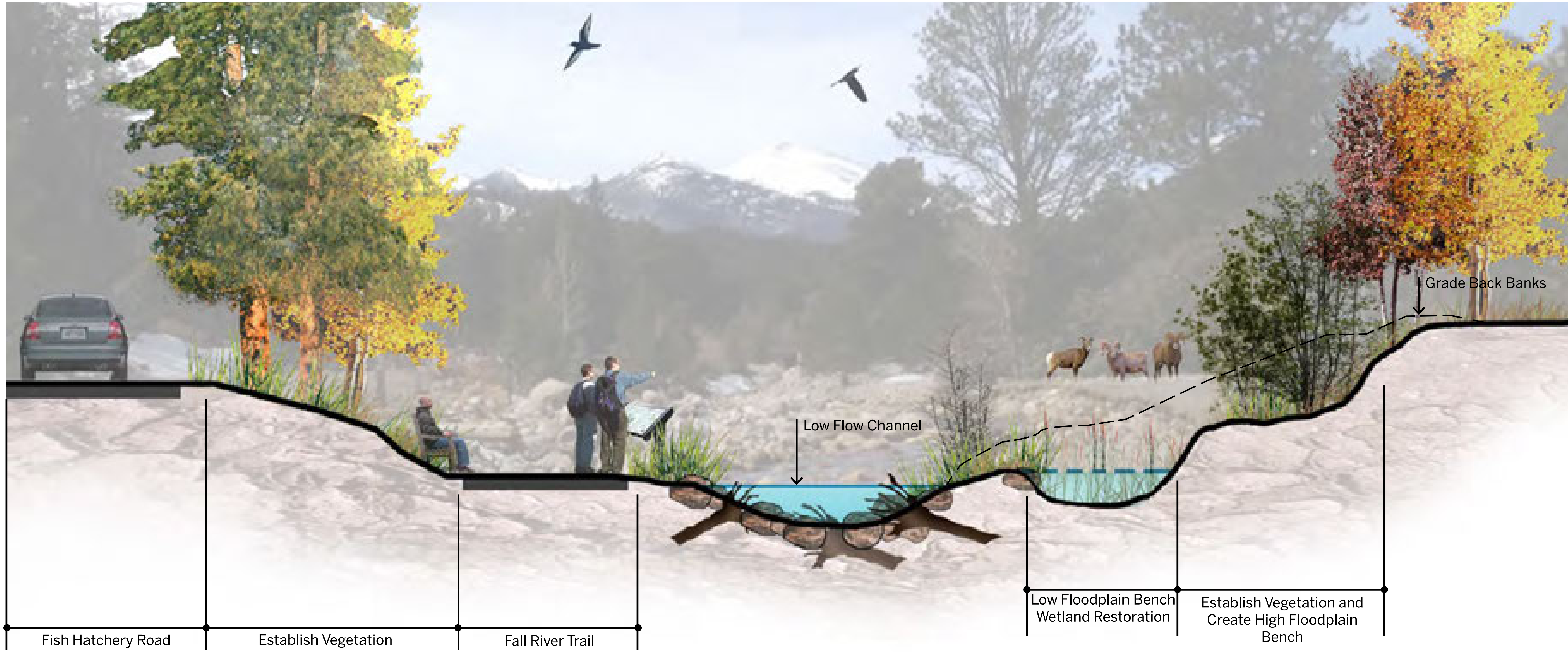
* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
- Highest Hazard Area
- Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

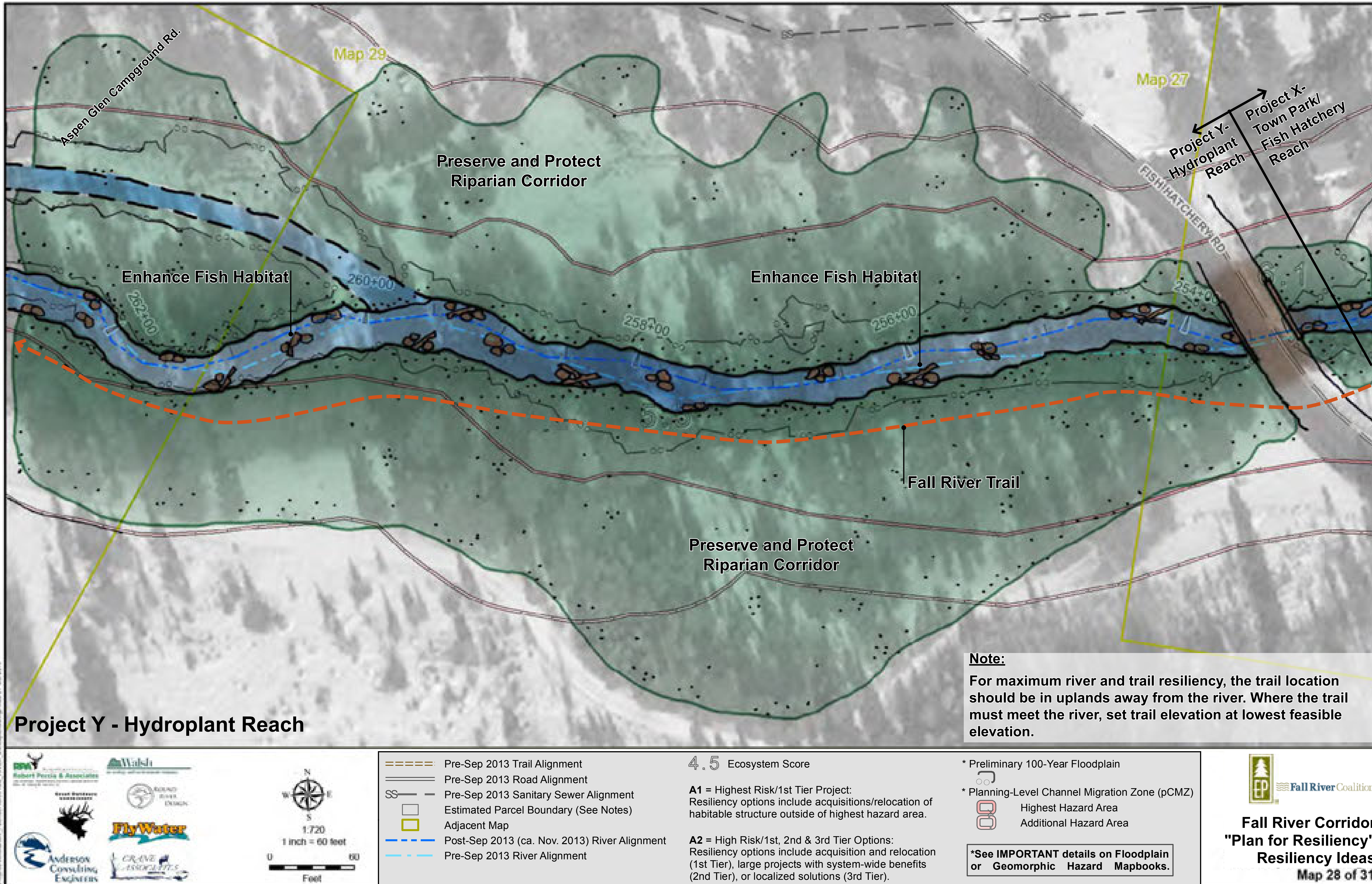
Fall River Corridor "Plan for Resiliency" Resiliency Ideas



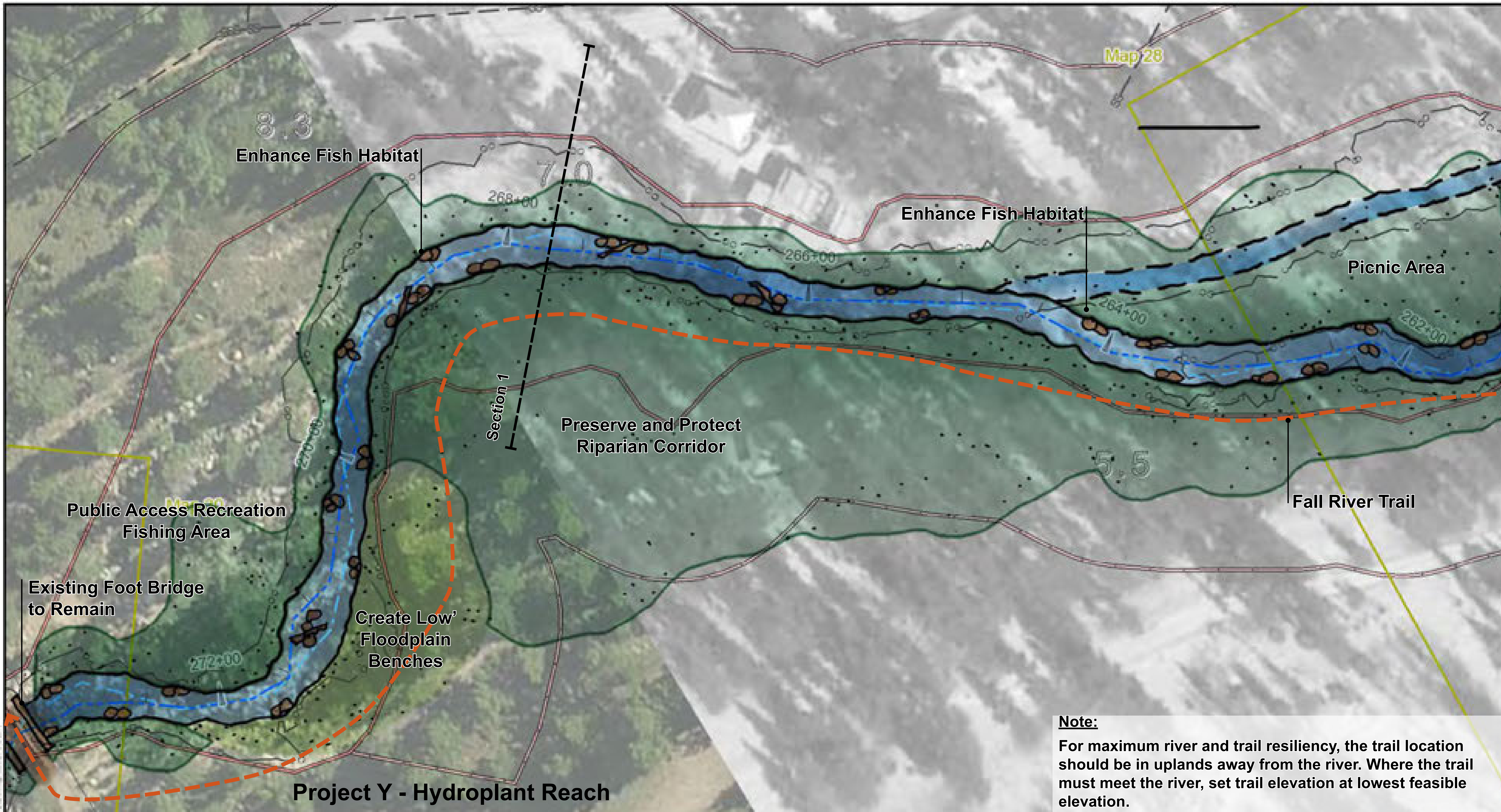
Post Flood Image
Looking Upstream

Section 2
Town Park at Fish Hatchery
Looking Upstream
Not to Scale

this page intentionally blank



Aspen Glen Campground Rd.
Map 29
Map 27
Project Y- Hydroplant Reach
Project X- Town Park/ Fish Hatchery Reach
FISH HATCHERY RD
Preserve and Protect Riparian Corridor
Enhance Fish Habitat
Enhance Fish Habitat
262+00
260+00
258+00
256+00
254+00
Fall River Trail
Preserve and Protect Riparian Corridor
Note:
For maximum river and trail resiliency, the trail location should be in uplands away from the river. Where the trail must meet the river, set trail elevation at lowest feasible elevation.
Project Y - Hydroplant Reach
Robert Peccia & Associates
Walsh
FlyWater
Anderson Consulting Engineers
N
W
E
S
1:720
1 inch = 60 feet
0
60
Feet
Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment
4.5 Ecosystem Score
A1 = Highest Risk/1st Tier Project: Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.
A2 = High Risk/1st, 2nd & 3rd Tier Options: Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).
* Preliminary 100-Year Floodplain
* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area
*See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.
Fall River Coalition
Fall River Corridor
"Plan for Resiliency"
Resiliency Ideas
Map 28 of 31



Note:
For maximum river and trail resiliency, the trail location should be in uplands away from the river. Where the trail must meet the river, set trail elevation at lowest feasible elevation.

1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
SS Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

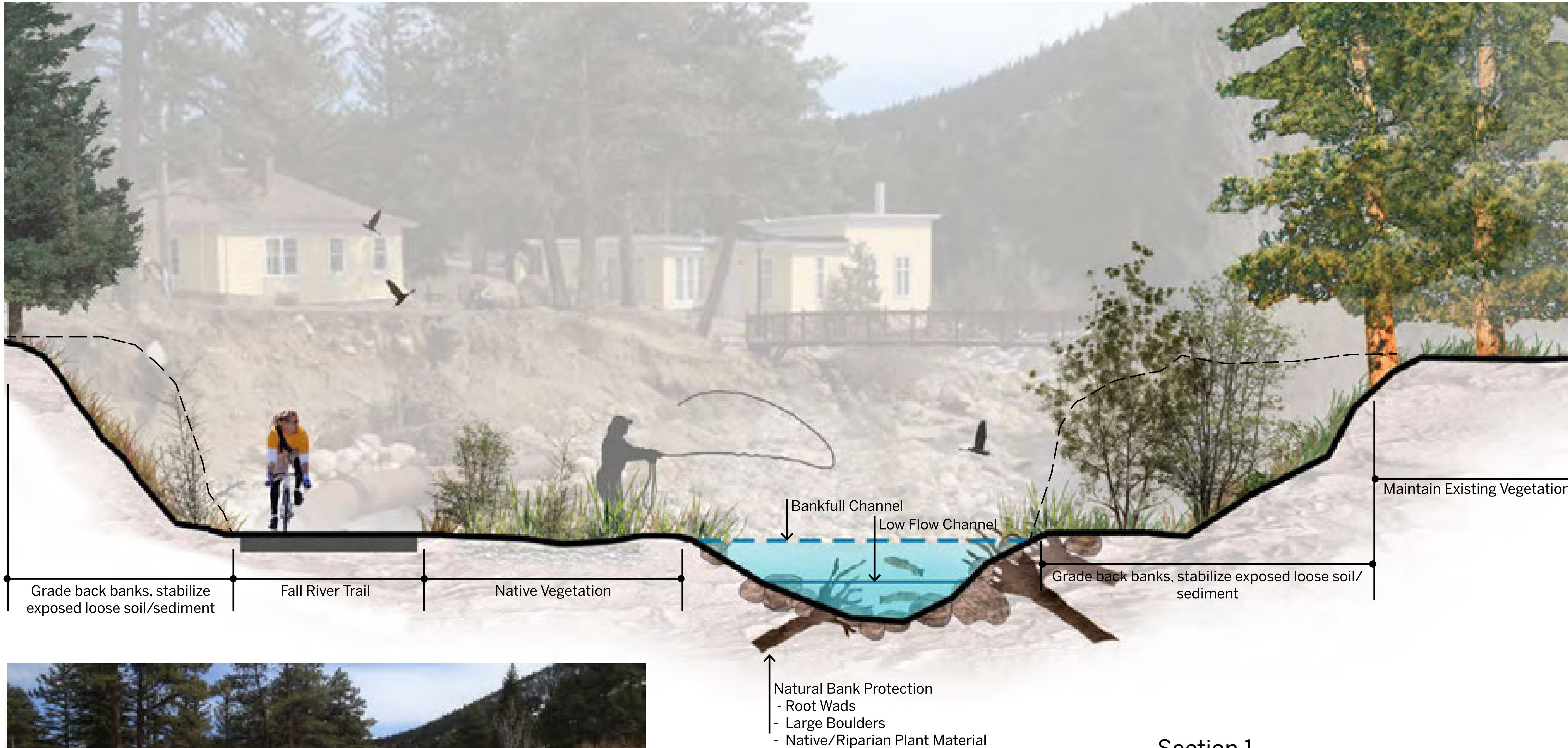
A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain
* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

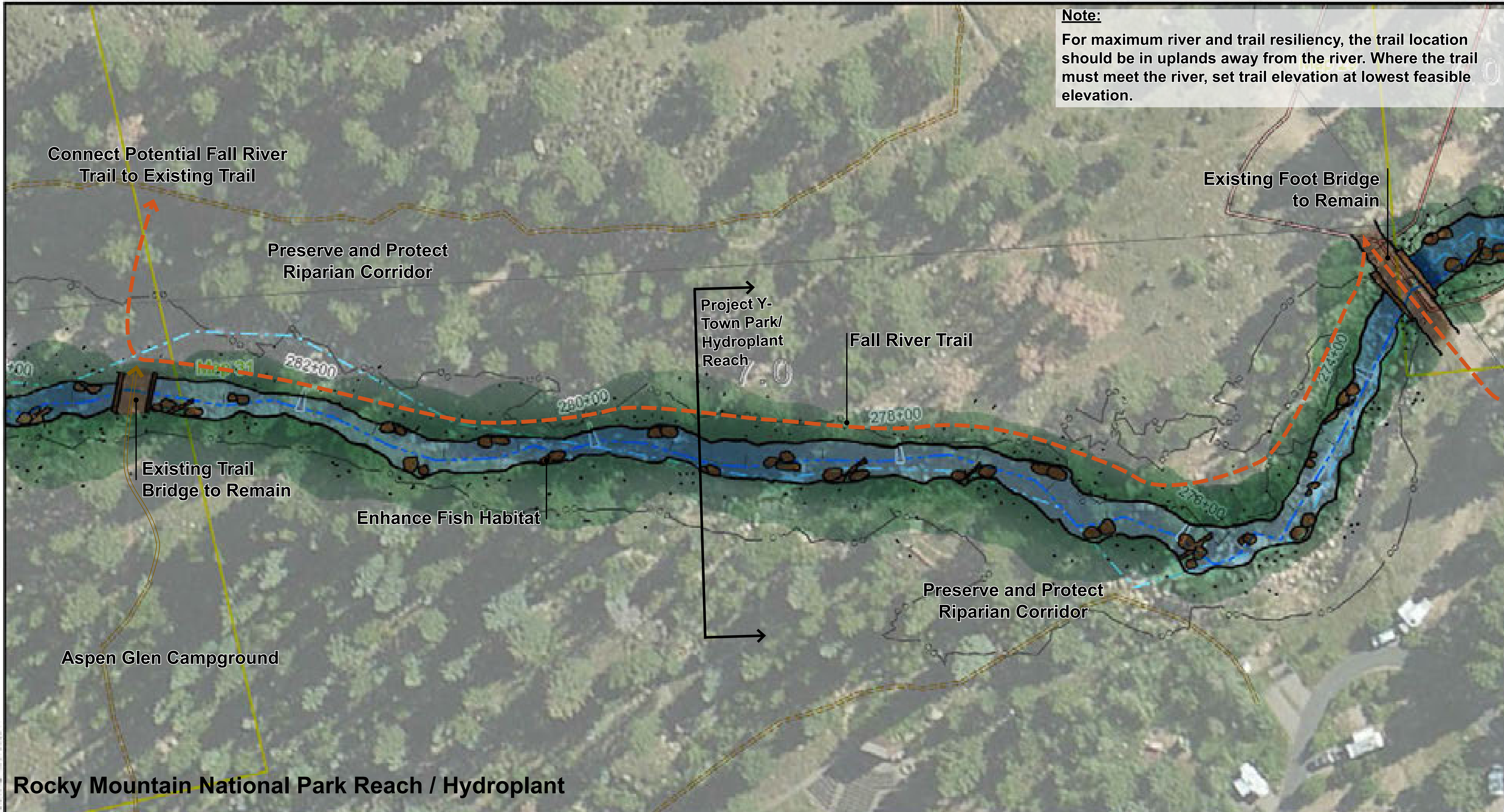
Fall River Coalition

Fall River Corridor
"Plan for Resiliency"
Resiliency Ideas



Section 1
Town Park at Hydro Museum
Looking Downstream
Not to Scale

Post Flood Image
Looking Downstream



1:720
1 inch = 60 feet
0 60
Feet

Pre-Sep 2013 Trail Alignment
Pre-Sep 2013 Road Alignment
Pre-Sep 2013 Sanitary Sewer Alignment
Estimated Parcel Boundary (See Notes)
Adjacent Map
Post-Sep 2013 (ca. Nov. 2013) River Alignment
Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

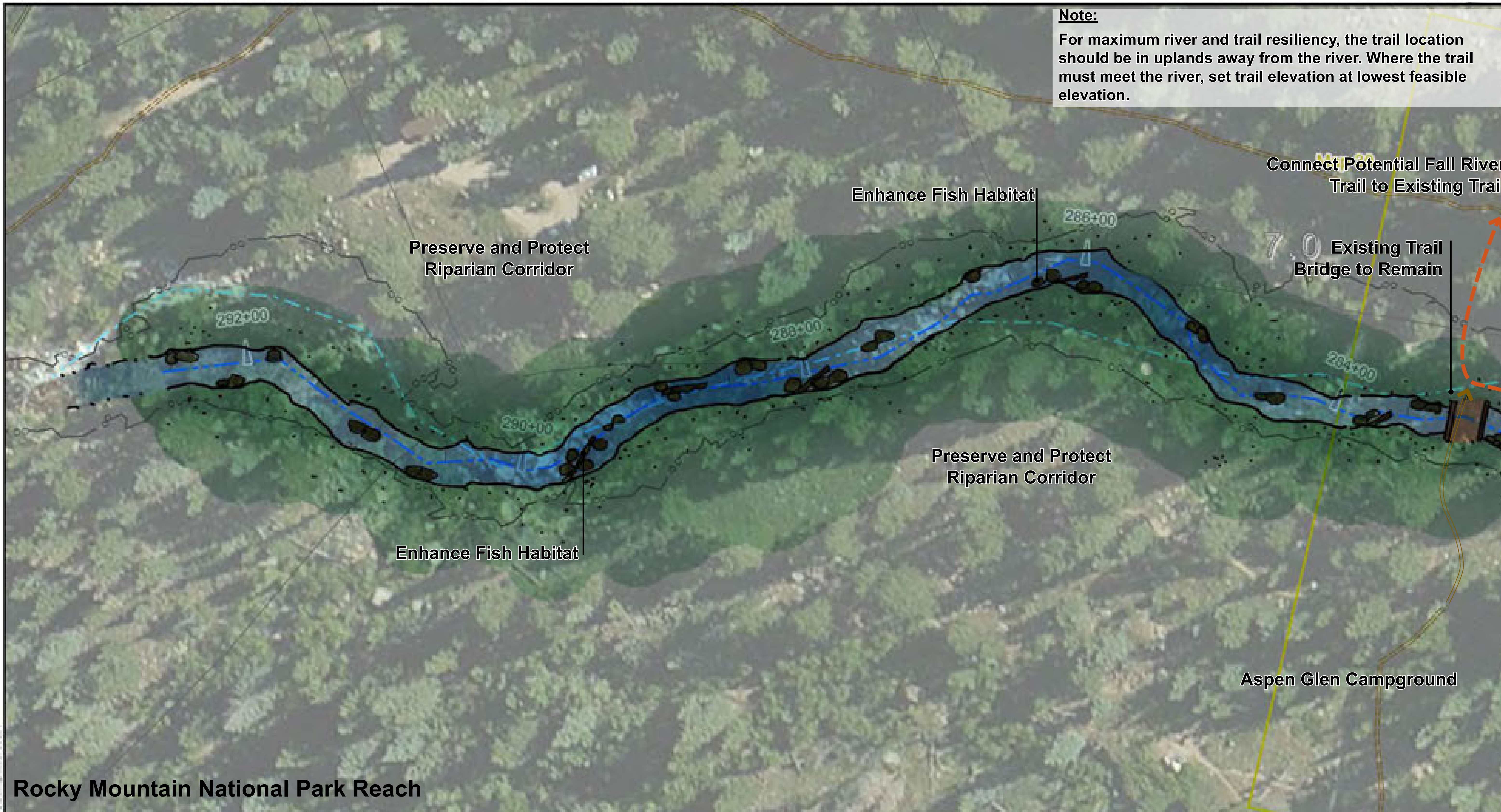
* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor "Plan for Resiliency" Resiliency Ideas
Map 30 of 31



1:720
1 inch = 60 feet
0 60
Feet

	Pre-Sep 2013 Trail Alignment
	Pre-Sep 2013 Road Alignment
SS	Pre-Sep 2013 Sanitary Sewer Alignment
	Estimated Parcel Boundary (See Notes)
	Adjacent Map
	Post-Sep 2013 (ca. Nov. 2013) River Alignment
	Pre-Sep 2013 River Alignment

4.5 Ecosystem Score

A1 = Highest Risk/1st Tier Project:
Resiliency options include acquisitions/relocation of habitable structure outside of highest hazard area.

A2 = High Risk/1st, 2nd & 3rd Tier Options:
Resiliency options include acquisition and relocation (1st Tier), large projects with system-wide benefits (2nd Tier), or localized solutions (3rd Tier).

* Preliminary 100-Year Floodplain

* Planning-Level Channel Migration Zone (pCMZ)
Highest Hazard Area
Additional Hazard Area

***See IMPORTANT details on Floodplain or Geomorphic Hazard Mapbooks.**

Fall River Coalition

Fall River Corridor
"Plan for Resiliency"
Resiliency Ideas
Map 31 of 31

7.3.2 Recommended Project Matrix

Each recommended project is evaluated in the recommended project matrix which allows for comparison of the projects against each other. The matrix evaluates the existing ecological condition, flood risk, and geomorphic risk. It states if the recommended project will effect change locally in that reach or on a larger scale in the river. To compare the feasibility of the recommended projects, they are evaluated for the relative cost, funding partner potential, and number of owners in that reach. A project with funding partner potential and fewer owners is expected to be easier to implement. Finally, the projects are evaluated for their potential to meet the community values, and evaluation criterial which were ranked through the community survey.

ID	Criteria	Ranking	Options Ranking Potential Project A Downtown Reach, Confluence to Spruce Drive (HMGP Priority #2) (Maps 1 - 3)	Potential Project B Spruce Reach (HMGP Priority #6) (Map 3)	Potential Project C Islander Reach (Map 4)	Potential Project D Elkhorn Lodge Reach (Maps 4 - 6)	Potential Project E Fall River Lane Reach (Map 6 - 8)	Potential Project F Riverwood & Four Seasons Reach (Map 9)	Potential Project G Deer Crest Reach (Map 10)	Potential Project H Nicky's Reach (Map 11)	Potential Project I Castle Mountain Reach (Maps 11 - 13)	Potential Project J Inn on Fall River Reach (Map 13 - 14)	Potential Project K Sleepy Hollow/ Summerset Reach (Maps 14 - 15)	Potential Project L Homestead Reach (Maps 16 - 17)	Potential Project M Placid Lake Reach (Maps 17 - 18)
	OPPORTUNITIES														
	Existing Conditions:														
	Ecologic score		2.7 to 4.0 *severely degraded to poor*	4.0 *poor*	4.0 *poor*	4.8 *poor*	7.7 *good*	4.8 to 5.5 *poor to fair*	4.5 *poor*	6.6 *fair*	6.6 *fair*	7.3 *good*	5.3 *fair*	5.0 to 7.0 *fair to good*	6.5 to 7.0 *fair to good*
	Flood hazard *(based on preliminary 100-yr mapping)*		*Remapped 100-yr boundaries likely to map in additional structures* *LIST DOLLAR VALUES* *(ASSESSORS VALUES)*	*New structures potentially in 100-yr*	*New structures potentially in 100-yr*	*New structures potentially in 100-yr*	*New structures potentially in 100-yr (fewer than reaches below)*	*New structures potentially in 100-yr (1 new structure)*	*New structures potentially in 100-yr (5 new structures*	*New structures potentially in 100-yr (1 new structure)*	*No new structures potentially in 100-yr*	*New structures potentially in 100-yr (fewer than reaches below)*		*New structures potentially in 100-yr (3 new structures)*	*New structures potentially in 100-yr (fewer than reaches below)*
	Geomorphic hazard		*VERY HIGH extensive inundation, structures in MVB LIST DOLLAR VALUES*	*VERY HIGH extensive inundation, structures in MVB*	*VERY HIGH extensive inundation, structures in MVB*	*VERY HIGH: structures, driveway in Avulsion Hazard; road in EHA*	*VERY HIGH: structures, driveways in MVB; more structures and roads in EHA*	*VERY HIGH: one structure in MVB; structures and roads in EHA*	*VERY HIGH: structures, driveways in MVB; more structures and roads in EHA*	*VERY HIGH: structures, driveways in MVB; more structures trail and roads in EHA*	*MEDIUM: trail in MVB; structures and roads in EHA*	*VERY HIGH: structures, driveways in MVB; more structures trail and road in EHA*	*VERY HIGH: structures, driveways in MVB; more structures trail and road in EHA*	*VERY HIGH: lots of structures, driveways in MVB; more structures and road in EHA*	*MEDIUM structure and road in EHA*
	Problems & Constraints:		*downtown development right up to river channel, undersized crossings* *Increase flow capacity through DT business district via culvert improvements and managed high flow channel system*	*Lower elevations at parking lots to increase capacity, improve floodplain connectivity, relocate public restroom facility out of floodplain*	*High hazard properties identified for acquisition and lower elevations at inside bend*	*high hazard properties identified for acquisition, maintain as natural deposition area, remove road from 100-year floodplain, managed high flow channel system with new culvert*	*preservation strategy, floodproofing, natural bank protection, including at highway 34*	*continued conservation strategy, bridge removal and upgrades*	*Lower floodplain elevations bank right, bridge removal and upgrades*	*high hazard acquisition (Nicky's), lower floodplain elevations bank right, managed high flow network, bridge upgrade*	*conservation strategy, canyon reach starts here for a stretch u/s*	*acquistion Inn on Fall River only vehicle bridge lost in Sep 2013, bridge retrofits for overflow conveyance, natural bank protection at road, conservation strategy*			
	System-wide vs Localized Solutions		**System-wide** *sediment deposition area to protect Lake Estes, power plant operations*	**Localized**	**System-wide** *significant effect on immediate upstream and downstream reaches*	**System-wide** *sediment deposition area to protect downstream reaches*	**Localized**	**Localized**	**Localized**	**System-wide** *significant effect on immediate upstream and downstream reaches*	**Localized**	**Localized**	**Localized**	**Localized**	**Localized**
	COST CATEGORY														
	Design/ Permitting/ Implementation ($) low end cost range (under $100K) ($$) medium cost range ($100K to $500K) ($$$) high end cost range (over $500K) ($$$$ OVER $1M)		$$$ acquisitions, bridges	$$$ acquisitions, bridge	$$$ acquisitions	$$$ acquisition, bridges	$$	$$	$$	$$$ acquisitions	$	$$	$$$ major stabilization	$$	$$
	PROJECT PARTNERS														
	Funding Partner Potential (improved via conservation esmt.)		Best (Downtown partnering)	Best (Downtown partnering)	Best (conservation easement potential/ recreation potential)	Best (conservation easement: potential @Elkhorn Lodge existing @downstream end)/ recreation potential	Better (conservation easement potential)	Best (conservation easement potential/ recreation potential)	Better (Utilities partnering flood damage here, temporary fix)	Fair CORRECT STREAMSIDE TO BEAR CREEK	Better (conservation easement)	Fair	Better (conservation easement)	Better (conservation easement)	Better (conservation easement)
	Number of Owners		High	Medium	Medium	Low (existing CE is additional stakeholder)	Medium (low density, longer reach)	Low	Medium	Low	Low	Medium	Medium	Medium	Low (existing CE is additional stakeholder)

Criteria	Options Ranking Potential Project N Riverstone Reach (Maps 19)	Potential Project O Fall River Road/ Hwy 34 Reach (Map 20)	Potential Project P Creekside Reach (Maps 20 - 21)	Potential Project Q Evergreen Reach (Maps 21 - 22)	Potential Project R Antlers Point (Map 23)	Potential Project S Workshire Reach (Map 23)	Potential Project T Lower Fawn Valley Reach (Maps 24)	Potential Project U Upper Fawn Valley Reach (Maps 24 - 25)	Potential Project V River's Edge Reach (Maps 25 - 26)	Potential Project W Mortons Reach (Map 26)	Potential Project X Town Park/ Fish Hatchery Reach (Maps 26 - 27)	Potential Project Y Town Park/ Hydroplant Reach (Maps 28 - 30)
OPPORTUNITIES												
Existing Conditions:												
Ecologic score	4.8 *poor*	4.8 *poor*	4.8 *poor*	6.5 *fair*	5.2 *fair*	5.2 *fair*	4.5 *poor*	4.5 to 6.1 *poor to fair*	6.1 *fair*	6.1 *fair*	6.1 *fair*	5.5 *fair*
Flood hazard *(based on preliminary 100-yr mapping)*	*New structures potentially in 100-yr (10+ new strectures)*	*New structures potentially in 100-yr (1 new structure)*	*No new structures potentially in 100-yr*	*No new structures potentially in 100-yr*	*New structures potentially in 100-yr (4 new structures)*	*New structures potentially in 100-yr (2 new structures)*	*New structures potentially in 100-yr (2 new structures)*	*No new structures potentially in 100-yr*	*New structures potentially in 100-yr (1 new structure)*	*No new structures potentially in 100-yr*	*No new structures potentially in 100-yr*	*No new structures potentially in 100-yr*
Geomorphic hazard	*VERY HIGH: structures, driveways in MVB; road in EHA*	*VERY HIGH: structures, road in MVB and EHA on outside bend*	*VERY HIGH: structures, driveways in MVB; more structures and road in EHA*	*VERY HIGH: structures, driveways in MVB; more structures and road in EHA*	*VERY HIGH: structures in MVB and Avulsion Hazard, road in EHA*	*VERY HIGH: structures in MVB and Avulsion Hazard, road in EHA*	*VERY HIGH: structures, driveways in MVB; more structures in EHA*	*VERY HIGH: structures, driveways in MVB; more structures in EHA*	*VERY HIGH: structures, driveways in MVB; more structures in EHA*	*VERY HIGH: structures, driveways in MVB; more structures in EHA*	*MEDIUM: strutures in EHA*	*LOW*
Problems & Constraints:	*riverstone:*						*acquisitions, regain some sinuousity, lessen the shotgun, 2-tiered stabilization, very high energy reach*		*open up XS, compound channel, 2-tiered stabilization, wetland restoration at Morton's pond*		*Town owned reach, Town considering selling, candidate to leave undeveloped, need to coordinate with proposed Fall River Trail, steeper gradient precludes extensive meandering*	*stabilize onsite sediments to protect downstream reaches, need to coordinate with proposed Fall River Trail*
System-wide vs Localized Solutions	**Localized**	**Localized**	**Localized**	**System-wide** *sediment deposition area to protect downstream reaches*	**System-wide** *sediment deposition area to protect downstream reaches*	**System-wide** *sediment deposition area to protect downstream reaches*	**System-wide** *channelized reach notably affects downstream reach*	**Localized**	**Localized**	**Localized**	**Localized**	**System-wide** *stabilize onsite sediments*
COST CATEGORY												
Design/ Permitting/ Implementation	$$	$$$ road, major stabilization	$$	$$	$$	$$$ acquisitions	$$$ acquisition	$	$$	$$	$	$$$ major earthwork
PROJECT PARTNERS												
Funding Partner Potential (improved via conservation esmt.)	Better (conservation easement)	Best (CDOT project)	Fair	Better (conservation easement)	Best (conservation easement potential/ recreation potential)	Best (conservation easement potential/ recreation potential)	Best (conservation easement potential/ recreation potential)	Better (conservation easement)	Fair	Better (conservation easement)	Best (conservation easement potential/ recreation potential)	Best (conservation easement potential/ recreation potential)
Number of Owners	Low (existing CE is additional stakeholder)	Low	Medium	Low	Low	Low	Low (existing CE is additional stakeholder)	Low	Low	Medium	Low	Low

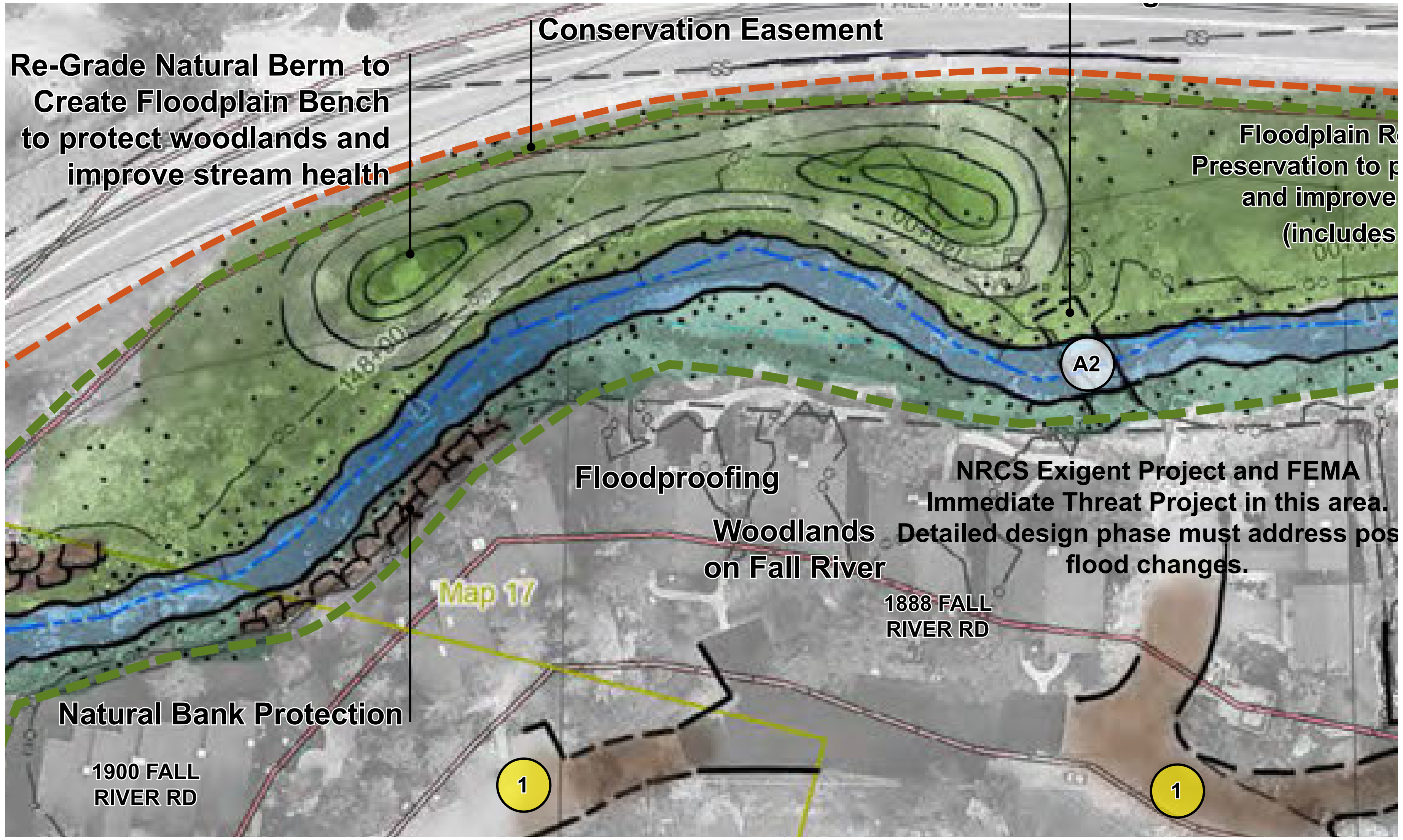
ID	Criteria	Ranking	Options Ranking Potential Project A Downtown Reach, Confluence to Spruce Drive (HMGP Priority #2) (Maps 1 - 3)	Potential Project B Spruce Reach (HMGP Priority #6) (Map 3)	Potential Project C Islander Reach (Map 4)	Potential Project D Elkhorn Lodge Reach (Maps 4 - 6)	Potential Project E Fall River Lane Reach (Map 6 - 8)	Potential Project F Riverwood & Four Seasons Reach (Map 9)	Potential Project G Deer Crest Reach (Map 10)	Potential Project H Nicky's Reach (Map 11)	Potential Project I Castle Mountain Reach (Maps 11 - 13)	Potential Project J Inn on Fall River Reach (Map 13 - 14)	Potential Project K Sleepy Hollow/ Summerset Reach (Maps 14 - 15)	Potential Project L Homestead Reach (Maps 16 - 17)	Potential Project M Placid Lake Reach (Maps 17 - 18)
	OPPORTUNITIES														
	Existing Conditions:														
ID	**PERSONAL VALUES** *Ranked from survey response*	Ranking													
2	Important for wildlife habitat	7		Fair	Fair	Best	Best	Better	Fair	Fair	Better	Best		Better	Best
1	Soothing natural aesthetic	6	Fair	Fair	Better	Best	Best	Better	Fair	Better	Better	Best		Better	Best
4	Supports healthy, native plant communities	5	Fair	Fair	Better	Best	Best	Better	Fair	Fair	Better	Best		Better	Best
8	Important for water quality, air quality, groundwater replenishment, soil stabilization	5	Fair	Fair	Better	Best	Best	Better	Fair	Better	Better	Best		Better	Best
3	Bird watching, wildlife viewing	4	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair		Fair	Fair
7	Hike along it, fish it, wade in it, skip rocks, build sandcastles, and more	4	Best	Best	Best	Best	Best	Fair	Fair	Better	Best	Best		Better	Best
5	Socializing, source of community pride (e.g., the annual duck race	3	Best	Best	Best	Better	Fair	Better	Fair	Fair	Fair	Fair		Fair	Best
9	Protection/ expect it to not threaten my property	3	Best	Best	Best	Best	Better	Best	Best	Better	Fair	Better		Best	Fair
6	Important draw for business	1	Best	Best	Best	Better	Fair	Better	Fair	Fair	Better	Fair		Fair	Fair

Criteria	Options Ranking Potential Project N Riverstone Reach (Maps 19)	Potential Project O Fall River Road/ Hwy 34 Reach (Map 20)	Potential Project P Creekside Reach (Maps 20 - 21)	Potential Project Q Evergreen Reach (Maps 21 - 22)	Potential Project R Antlers Point (Map 23)	Potential Project S Workshire Reach (Map 23)	Potential Project T Lower Fawn Valley Reach (Maps 24)	Potential Project U Upper Fawn Valley Reach (Maps 24 - 25)	Potential Project V River's Edge Reach (Maps 25 - 26)	Potential Project W Mortons Reach (Map 26)	Potential Project X Town Park/ Fish Hatchery Reach (Maps 26 - 27)	Potential Project Y Town Park/ Hydroplant Reach (Maps 28 - 30)
OPPORTUNITIES												
Existing Conditions:												
PERSONAL VALUES *Ranked from survey response*												
Important for wildlife habitat	Fair	Fair	Better	Fair	Best	Best	Better	Fair	Fair	Better	Best	Best
Soothing natural aesthetic	Fair	Fair	Fair	Fair	Best	Best	Better	Fair	Fair	Better	Best	Best
Supports healthy, native plant communities	Fair	Fair	Fair	Fair	Best	Best	Better	Fair	Fair	Better	Best	Best
Important for water quality, air quality, groundwater replenishment, soil stabilization	Fair	Fair	Fair	Fair	Best	Best	Better	Fair	Fair	Better	Best	Best
Bird watching, wildlife viewing	Fair	Fair	Fair	Fair	Best	Best	Fair	Fair	Fair	Fair	Better	Best
Hike along it, fish it, wade in it, skip rocks, build sandcastles, and more	Fair	Fair	Better	Better	Best	Best	Better	Fair	Fair	Best	Best	Best
Socializing, source of community pride (e.g., the annual duck race	Fair	Fair	Fair	Best	Best	Best	Better	Fair	Fair	Fair	Best	Best
Protection/ expect it to not threaten my property	Better	Best	Best	Better	Better	Better	Better	Fair	Better	Better	Fair	Fair
Important draw for business	Better	Fair	Fair	Fair	Better	Better	Fair	Fair	Fair	Fair	Fair	Fair

ID	Criteria	Ranking	Options Ranking																								
			Potential Project A Downtown Reach, Confluence to Spruce Drive (HMGP Priority #2) (Maps 1 - 3)	Potential Project B Spruce Reach (HMGP Priority #6) (Map 3)	Potential Project C Islander Reach (Map 4)	Potential Project D Elkhorn Lodge Reach (Maps 4 - 6)	Potential Project E Fall River Lane Reach (Map 6 - 8)	Potential Project F Riverwood & Four Seasons Reach (Map 9)	Potential Project G Deer Crest Reach (Map 10)	Potential Project H Nicky's Reach (Map 11)	Potential Project I Castle Mountain Reach (Maps 11 - 13)	Potential Project J Inn on Fall River Reach (Map 13 - 14)	Potential Project K Sleepy Hollow/ Summerset Reach (Maps 14 - 15)	Potential Project L Homestead Reach (Maps 16 - 17)	Potential Project M Placid Lake Reach (Maps 17 - 18)	Potential Project N Riverstone Reach (Maps 19)	Potential Project O Fall River Road/ Hwy 34 Reach (Map 20)	Potential Project P Creekside Reach (Maps 20 - 21)	Potential Project Q Evergreen Reach (Maps 21 - 22)	Potential Project R Antlers Point (Map 23)	Potential Project S Workshire Reach (Map 23)	Potential Project T Lower Fawn Valley Reach (Maps 24)	Potential Project U Upper Fawn Valley Reach (Maps 24 - 25)	Potential Project V River's Edge Reach (Maps 25 - 26)	Potential Project W Mortons Reach (Map 26)	Potential Project X Town Park/ Fish Hatchery Reach (Maps 26 - 27)	Potential Project Y Town Park/ Hydroplant Reach (Maps 28 - 30)
OPPORTUNITIES																											
Existing Conditions:																											
ID	**EVALUATION CRITERIA** *Ranked from survey response*	**Ranking**																									
1	Address safety of the public and residents	96	Best	Best	Best	Best	Better	Better (bridge update/removal)	Better (bridge update/removal)	Best	Fair	Better		Better (bridge update/removal)	Fair	Better (bridge update/removal)	Best	Better (bridge update/removal)	Fair	Better	Better	Better	Fair	Better	Better	Better	Better
6	Increases river stability, reduces future erosion	94	Fair	Fair	Fair	Best	Best	Better	Better	Better	Better	Better		Better	Better	Better	Better	Better	Better (sediment containment)	Better	Better	Better	Fair	Better	Better	Better	Better
5	Reduces flood and geomorphic hazards to reduce future damage	89	Best	Best	Best	Best	Best	Fair	Better (bridge update/removal)	Better	Fair	Better		Better	Better	Fair	Better	Better	Better	Better	Better	Fair	Fair	Better	Better	Better	Best
27	Incorporate input from property owners	89	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
36	Provides the corridor with multiple benefits (e.g. flood mitigation, habitat enhancements, recreation and public access)	88	Better	Better	Best	Best	Best	Fair	Fair	Better	Better	Best		Better	Better	Fair	Fair	Better	Fair	Fair	Fair	Fair	Fair	Fair	Better	Best	Best
7	Improve stream health	85	Fair	Fair	Fair	Best	Best	Better	Fair	Better	Better	Best		Better	Best	Fair	Fair	Better	Fair	Fair	Fair	Fair	Better	Fair	Better	Best	Best
4	Allow continued utility service during construction	79	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
34	Protect and enhance stream corridor vegetation	79	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
38	Uses locally available materials	79	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
31	Protect and enhance fish habitat	77	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
10	Create infrastructure investments that are reasonable to construct	76	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
21	Enhances *local* natural outdoor recreational opportunities such as trails (hiking ,biking, and equestrian) and fishing	76	Better	Better	Better	Better	Better	Best (river access)	Fair	Fair	Fair	Better		Fair	Best	Fair	Fair	Fair	Best	Better	Better	Fair	Fair	Fair	Fair	Fair	Best
11	Projects with the best value for their life cycle	75	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
35	Enhances water quality	75	Fair	Fair	Better	Best	Best	Fair	Fair	Fair	Best	Best		Fair	Best	Fair	Fair	Fair	Better (sediment containment)	Better (sediment containment)	Better (sediment containment)	Fair	Fair	Fair	Best	Best	Best
2	Restore public access and utility service without restricting access to private properties	73	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
3	Provide access to recreational amenities, schools, and businesses	73	Fair	Fair	Fair	Fair	Fair	Best (river access)	Fair	Fair	Fair	Fair		Fair	Fair	Better	Fair	Fair	Best	Better	Better	Fair	Fair	Fair	Fair	Fair	Better
14	Incorporates new flood flow/ rainfall information	72	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
28	Incorporate input from the community	72	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
22	Enhances *regional* natural outdoor recreational opportunities	71	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
32	Protect and enhance avian habitat	70	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
30	Incorporate input from businesses and business leaders	69	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
16	Provides neighborhood and reach scale solutions requiring multiple land owners to come to consensus	66	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
39	Uses environmentally friendly processes	66	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
13	Effectively uses undamaged infrastructure	65	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
37	Limits maintenance costs	65	Better (bridge update/removal)	Fair	Better (bridge update/removal)	Best	Best	Better (bridge update/removal)	Better (bridge update/removal)	Better (bridge update/removal)	Fair	Better		Fair	Fair	Fair	Fair	Better	Fair	Better	Better	Fair	Fair	Fair	Fair	Fair	Fair
9	Complete the reconstruction while lowering risk to permanent infrastructure and the public	64	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
29	Incorporate input from conservation and environmental organizations	63	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
20	Enhances access to neighborhoods	62	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair		Fair	Fair	Better	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
24	Enhance neighborhood & community livability	62	Better	Better	Best	Better	Better	Fair	Fair	Fair	Fair	Fair		Fair	Fair	Fair	Fair	Fair	Better	Fair	Fair	Fair	Fair	Fair	Fair	Better	Better
17	Enhance tourist destinations	61	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail

ID	Criteria	Ranking	Potential Project A Downtown Reach, Confluence to Spruce Drive (HMGP Priority #2) (Maps 1 - 3)	Potential Project B Spruce Reach (HMGP Priority #6) (Map 3)	Potential Project C Islander Reach (Map 4)	Potential Project D Elkhorn Lodge Reach (Maps 4 - 6)	Potential Project E Fall River Lane Reach (Map 6 - 8)	Potential Project F Riverwood & Four Seasons Reach (Map 9)	Potential Project G Deer Crest Reach (Map 10)	Potential Project H Nicky's Reach (Map 11)	Potential Project I Castle Mountain Reach (Maps 11 - 13)	Potential Project J Inn on Fall River Reach (Map 13 - 14)	Potential Project K Sleepy Hollow/ Summerset Reach (Maps 14 - 15)	Potential Project L Homestead Reach (Maps 16 - 17)	Potential Project M Placid Lake Reach (Maps 17 - 18)
			Options Ranking												
	OPPORTUNITIES														
	Existing Conditions:														
17	Enhance tourist destinations	61	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail
19	Enhances access to community facilities, and neighborhoods	61	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair		Fair	Fair
12	Meet Federal and Local standards for design	60	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail
8	Complete the projects in the shortest time possible	57	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail
25	Enhance neighborhood & community aesthetics	57	Fair	Fair	Best	Better	Fair	Fair	Fair	Fair	Better	Better		Fair	Better
23	Enhances community supported recreation opportunities such as golf, camping and water based activities (canoeing, kayaking, stand up paddleboarding, motorboats, waterskiing etc.)	55	Fair	Fair	Fair	Fair	Fair	Best (river access)	Fair	Fair	Fair	Fair		Fair	Fair
26	Preserve neighborhood & community culture & history	52	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail
18	Enhances access to tourist destinations	51	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail
15	Is innovative	50				Best	Fair	Fair	Fair	Fair	Fair	Fair		Better	Better
33	Protect and enhance beaver habitat	48	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail		design/ construction detail	design/ construction detail

ID	Criteria	Ranking	Potential Project N Riverstone Reach (Maps 19)	Potential Project O Fall River Road/ Hwy 34 Reach (Map 20)	Potential Project P Creekside Reach (Maps 20 - 21)	Potential Project Q Evergreen Reach (Maps 21 - 22)	Potential Project R Antlers Point (Map 23)	Potential Project S Workshire Reach (Map 23)	Potential Project T Lower Fawn Valley Reach (Maps 24)	Potential Project U Upper Fawn Valley Reach (Maps 24 - 25)	Potential Project V River's Edge Reach (Maps 25 - 26)	Potential Project W Mortons Reach (Map 26)	Potential Project X Town Park/ Fish Hatchery Reach (Maps 26 - 27)	Potential Project Y Town Park/ Hydroplant Reach (Maps 28 - 30)
			Options Ranking											
	OPPORTUNITIES													
	Existing Conditions:													
17	Enhance tourist destinations	61	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
19	Enhances access to community facilities, and neighborhoods	61	Better	Fair	Fair	Better	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
12	Meet Federal and Local standards for design	60	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
8	Complete the projects in the shortest time possible	57	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
25	Enhance neighborhood & community aesthetics	57	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Better	Fair	Better
23	Enhances community supported recreation opportunities such as golf, camping and water based activities (canoeing, kayaking, stand up paddleboarding, motorboats, waterskiing etc.)	55	Fair	Fair	Fair	Better	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Better
26	Preserve neighborhood & community culture & history	52	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
18	Enhances access to tourist destinations	51	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail
15	Is innovative	50	Fair	Fair	Better	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Better
33	Protect and enhance beaver habitat	48	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail	design/ construction detail



Resiliency Ideas

7.4 Prioritized Projects

7.4.1 Overview

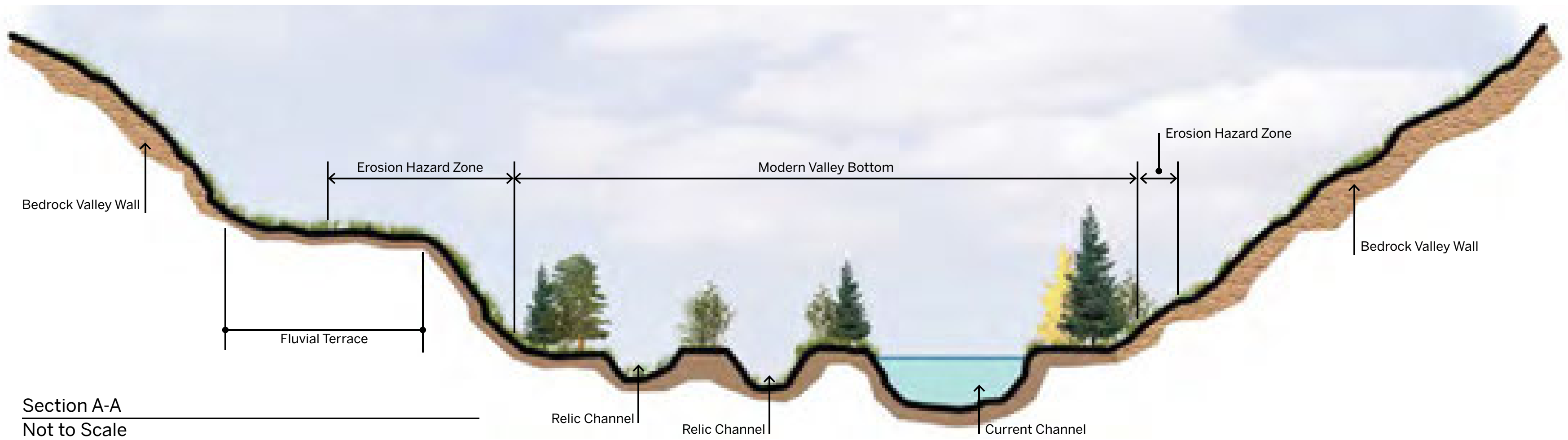
The technical team prioritized the top five projects because they have multiple and large benefits, possibly for the whole river rather than just the specific reach, and also compare favorably in terms of competitiveness for funding and implementation. It should be understood that the technical team recommends implementing all of the projects in order to reduce risk, and increase public and local resident safety. However, as funding is limited the prioritized projects represent the best opportunity to meet the long-term goals for the whole river.

7.4.2 Prioritized Project Cut Sheets

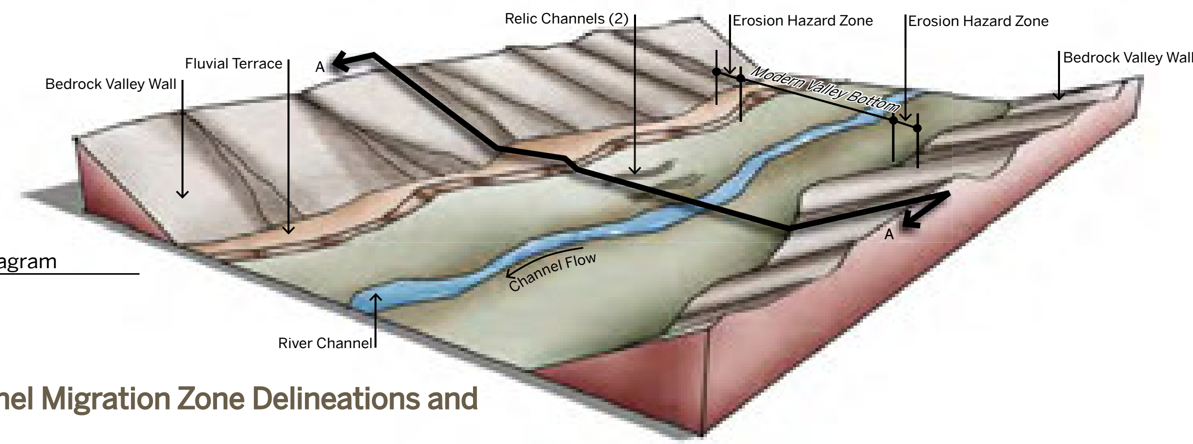
Each prioritized project includes a cut sheet that describes the project in more detail including:

- The objective of the project
- Project benefits for avoided or reduced risk, ecosystem health, and recreation and access
- Implementation and construction strategies
- Permitting requirements
- Construction cost estimate
- Project partners and sponsors (agency, non profit, land-owners, or other)
- Cost share and funding strategies
- Physical layout and/or management framework

Project Cut Sheet - CMZ Strategies



Section A-A
Not to Scale



Axonometric Diagram
Not to Scale

Finalize and Adopt Channel Migration Zone Delineations and Policy

Objective

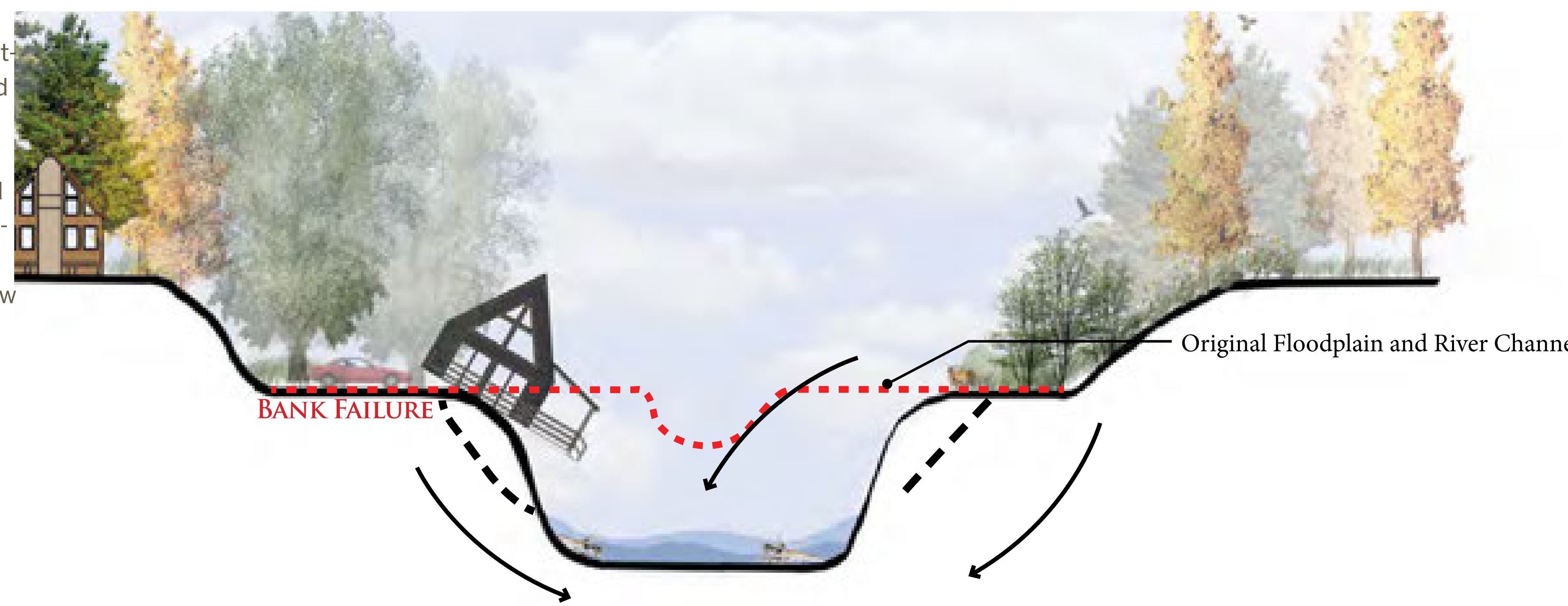
Estes Valley has preliminary Channel Migration Zones delineated for Fall River and Fish Creek. These areas were determined with guidance from the the Washington State Department of Ecology's Planning Level Channel Migration Zone Protocol. This project would finalize the delineations, provide a detailed peer-review of the hazard areas, and work with the town of Estes and the Colorado Water Conservation Board to draft and adopt language that influences future development toward low hazard areas.

Benefits for Avoided or Reduced Risk, Ecosystem Health, and Recreational Access

Limiting investment and asset development within a mapped CMZ hazard area is the most effective strategy to reduce risk and comes with multiple concurrent benefits. See section xx.xxx and section xx.xxxx for details. Identification and management of channel migration zones is intended to reduce flood and erosion damage to public and private infrastructure and homes– all of which may be in jeopardy when and if the channel does meander or avulse. Immediate benefits to the community include providing undeveloped areas for riparian floodplain vegetation and forests to establish. These in turn provide habitat to large mammals such as elk and big horn sheep as well as aquatic species, amphibians, and fish species. They may also provide undeveloped areas for trails and stream access. These areas, under normal runoff conditions may also see overbank flooding which provides measurable benefits to the river system even during times when significant channel movement does not occur.

Management Framework

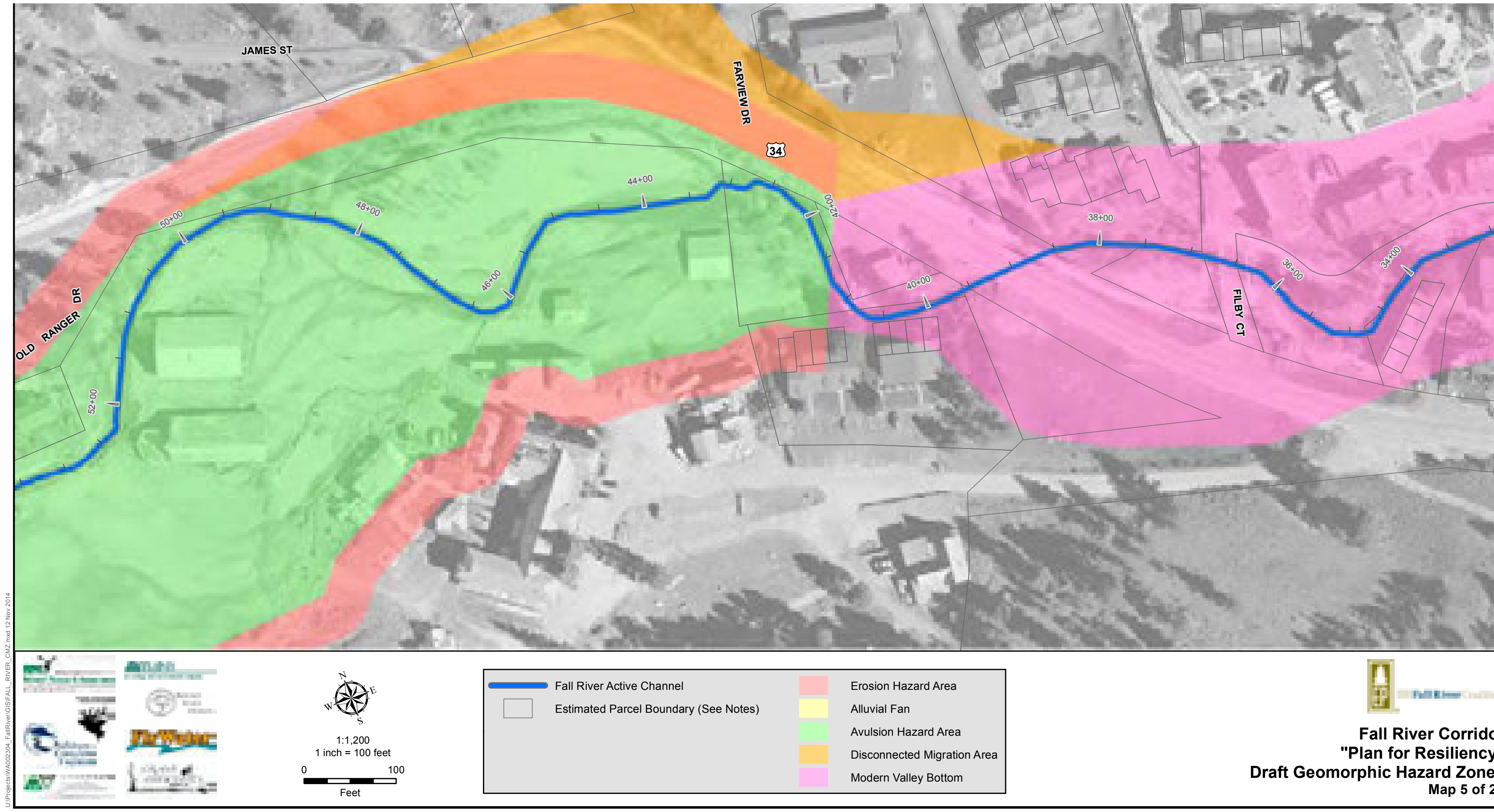
Limiting investment in high hazard zones should be a part of the Town of Estes Park's development code. There may be incentives for the Town of Estes within the National Flood Insurance Program's Community Rating System (see Project xxxx.xx) to adopt and regulate investment in these areas. As applicable, the language can identify characteristics of safe building placement and/or incentives for purchasing flood insurance in these areas.



Project Cut Sheet - CMZ Strategies

1117 Whispering Pines Drive Fish Creek

1117 Whispering Pines Drive Fish Creek



Maintenance, updates, and management of the CMZ maps will be the responsibility of the Town of Estes Park unless otherwise designated to a County or State agency. Public input on the location of the CMZ and its attributes should be solicited for a period of time before adoption but all proposed changes must be reviewed and approved by an experienced river engineer or geomorphologist and the peer review committee. After adoption, further requests to waive conditions set by such a map should be on a case by case basis and require technical review and certification by an experienced river engineer or geomorphologist, any interested state or federal agency, and by the Town itself.

Project Partners and Sponsors

The State of Colorado's Water Conservation Board will be a key partner in providing technical knowledge to aid in map maintenance and application. There is interest at FEMA and within the Colorado Department of Local Affairs (DOLA) as well as CWCB to use Estes Park as a pilot program for CMZ adoption and regulation which may include technical, policy, and financial support.

Cost Sharing and Funding Strategies

The State of Colorado's Water Conservation Board will be a key partner in providing technical knowledge to aid in map maintenance and application. There is interest at FEMA and within the Colorado Department of Local Affairs (DOLA) as well as CWCB to use Estes Park as a pilot program for CMZ adoption and regulation which may include technical, policy, and financial support.

Estimated Cost

The cost to finalize and adopt the channel migration zone mapping is estimated to be approximately 40k-60k.

Project Cut Sheet - River Corridor Strategies

Create a River Corridor Protection Program

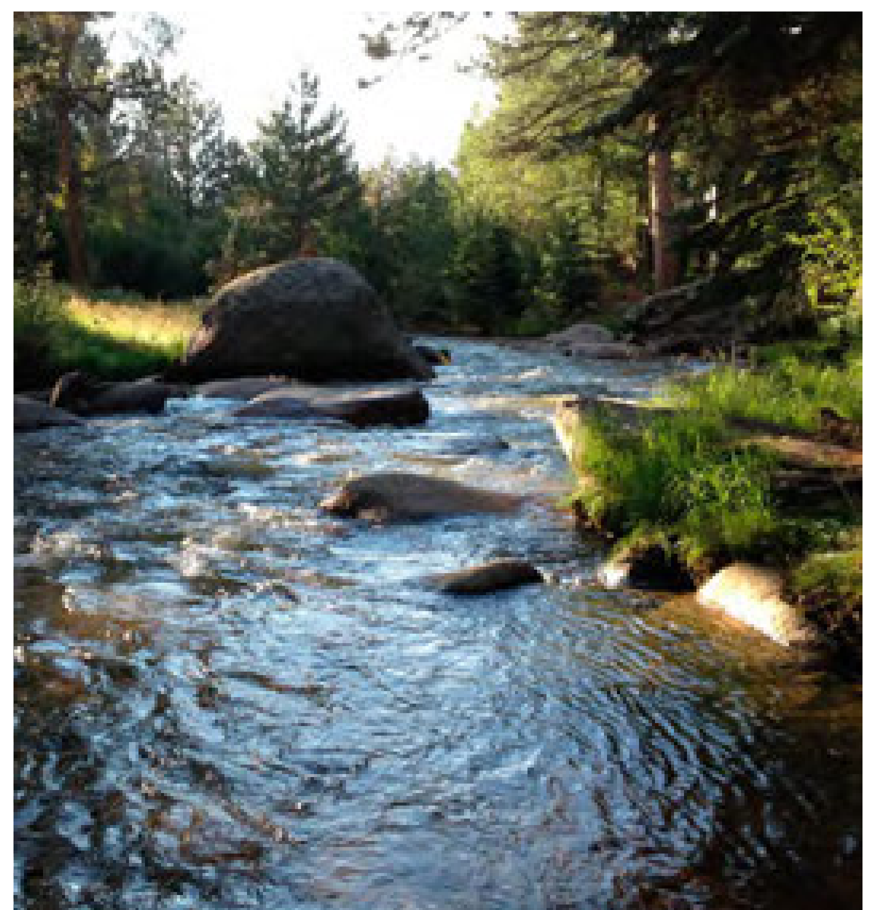
Objective
The best means to protect life and property as well as promote healthy riparian ecosystems is to protect and preserve the land that has yet to be developed. A "river corridor" is the swath of land surrounding a river where dynamic system processes, under a broad range of flow conditions, can occur providing for long-term geophysical stability and biological health. The ultimate objective would be to create a continuous, connected river corridor throughout the whole system, including tributaries.

Benefits for Avoided or Reduced Risk, Ecosystem Health, and Recreational Access
Limiting investment and asset development, as well as reclaiming assets at the end of their lifespan that currently exist within the river corridor is the most effective means to reduce risk within the river systems. Although primarily intended to avoid future flood damage, the river corridor, will benefit the community immediately by providing undeveloped areas for riparian floodplain forests and habitat. They may also provide undeveloped areas for trails and stream access. These areas, under normal runoff conditions may also see overbank flooding (providing benefits to the river system) during times when significant channel movement does not occur but floodplain/river interactions are none the less important.

Management Framework
The river corridor can be approximated by the CMZ delineations; however, it should not be limited to only those high and moderate risk areas. Any property that is adjacent to or within the vicinity of the CMZ delineation should be considered for inclusion under this program.
There are several ways to limit investment in and remove assets from the river corridors within the Estes Valley:
Conservation Easements
A "conservation easement" is a legal agreement between a landowner and a land trust or government agency that permanently limits uses of the land in order to protect its conservation values. It allows landowners to continue to own and use their land, and they can also sell it or pass it on to heirs. Conservation easements offer great flexibility. An easement may apply to all or a portion of the property, and need not require public access.

When a conservation easement is donated to a land trust, some of the rights associated are surrendered with the land. For example, you might give up the right to build additional structures, while retaining the right to recreate on the land. The easement is in perpetuity-- future owners also will be bound by the easement's terms. The land trust is responsible for making sure the easement's terms are followed. This is managed through "stewardship" by the land trust which includes annual (or more frequent) site visits to assure that easement terms are being upheld, and corrective actions which can include litigation if violations are detected.

Estes Valley Land Trust has volunteered to host any river corridor conservation easements. The EVLT is a nationally accredited land trust with over 27 years of experience "preserving and protecting open space, valleys, wetlands, streams, ranch lands, and wildlife habitat in the Estes Valley." The proposed conservation easement lands that are included in these Master Plans are well within the mission of the Land Trust. As detail plans and implementation projects are developed, EVLT welcomes the opportunity to work with the implementation teams to protect the critical conservation values of the Estes Valley watersheds.


A Healthy Fall River Corridor

Transfer of Development Rights
Section forthcoming.

Voluntary Fee and Title Acquisitions
Section forthcoming.

Project Partners and Sponsors
The River Corridor Program is most likely to succeed if spearheaded by the Estes Valley Watershed Coalition with the Estes Valley Land Trust, the Town of Estes Park and Larimer County as strong partners. Each property that participates in this program will require unique conditions and terms that fit the goals and objectives of the sponsoring entities and the property owners.

Cost Sharing and Funding Strategies
It is recommended that the program's administration work be included as a task within the Watershed Coordinator or Watershed Coordinator Assistant job descriptions. Costs to cover properties for inclusion will need to be covered by programmatic grant funding such as DOLA's DR planning grants, HMGP grants, and/or a combination of other grant or general budget funding sources.
Estimated Cost

The cost to administer the program is estimated to be approximately \$10,000-\$20,000 a year. The cost of property inclusion will vary widely depending on the individual property and the legal means that are used to ensure protection. Reclamation, demolition, and/or restoration costs are also expected to vary widely depending upon the individual property's characteristics.

Project Cut Sheet - New Flood Insurance Study (FIS)

Objective and Background

Floodplain mapping represents an important aspect of the stream restoration master plan, both in terms of informing and regulating development along the river corridor but also in terms of managing risk associated with extreme flood events. The development and utilization of the floodplain mapping products also provide useful information related to the planning and resiliency of the river corridor. The floodplain mapping recommendations associated with this planning project are integrated with channel and overbank improvements to promote the sustainability of the ecological function of the river while minimizing the risk to public infrastructure, adjacent landowners and the public during flooding events.

The effective Larimer County Flood Insurance Study was originally published in 1979 by FEMA and republished on February 6, 2013. Detailed floodplain and floodway mapping along the Fall River within the Town of Estes Park and Larimer County was republished by FEMA with an effective date of December 19, 2013. The effective hydrology data associated with the Flood Insurance Study identified the peak discharge associated with the 100-flood event (1% chance of occurrence) as 680 cfs throughout the length of the study reach.

Following the September 2013 flood event, estimates of the peak discharge in the Fall River were developed in a report for CDOT (Jacobs, August 2014). This information identified a

Fall River Post Flood Damage

Fall River Post Flood Damage

peak discharge of 1,669 cfs for the 100-year flood event. The floodplain mapping associated with this master planning effort reflects the limits of the 100-year floodplain associated with a peak discharge of 1,669 cfs through the study reach and should be considered approximate given the methods and level of detail associated with the work.

Project Benefits for Avoided Risk, Ecosystem Health, and Recreation and Access

It is important to identify the risks associated with flooding within the study reach. Utilizing data from the September 2013 flood event along with subsequent reports prepared within the Big Thompson watershed, revised hydrology data and floodplain mapping should be prepared to reflect the limits of the 100-year floodplain associated with: (a) the condition of the channel that presently exists, (b) improvements to the channel subsequent to the flooding event; and (c) improvements proposed by this planning effort, as necessary.

In general, the revised floodplain information combined with the improvements identified in this planning effort will provide benefits to the adjacent landowners and the community as indicated below:

- Awareness of the risk associated with flooding and through knowledge of these risk, benefits accrued to the health, safety and welfare of the landowners, residents in the community as well as visitors will be generated.
- Benefits related to federal flood insurance for those structures located within the 100-year floodplain.
- Location of public infrastructure to promote flood resiliency and avoidance of risk.
- Identification of improvements to connect the channel to the floodplain that also integrate opportunities to increase the ecological function and potential recreation opportunities (trails, fisheries, etc.) along the river corridor.
- Reduction in flood risk associated with improvements in the conveyance capacity of river crossings thereby increasing the safety associated with private or public access.
- Planning and administration of proposed improvements along the floodplain will be facilitated to reduce the flood risk.

Project Plan (finalize hydrology, HEC-modeling, adoption, etc.)

As stated previously, revisions to the hydrology data and floodplain mapping will be required to accomplish the objectives associated with the planning document and provide a more flood resilient river corridor within the community. This will include, but not be limited to:

a. Completion of a hydrology study to develop revised data that can be utilized to map the 100-year floodplain along

Project Cut Sheet - New Flood Insurance Study (FIS)

the river corridor.

b. Completion of a floodplain mapping study to illustrate the limits of the revised 100-year floodplain and regulatory floodway along the river corridor. It is assumed that processing of the existing LIDAR mapping will be necessary to meet FEMA criteria along with collection of additional surveying data for channel cross sections and structures.

c. Revisions to information contained in the effective Flood Insurance Study as it pertains to the Fall River.

d. Development of revisions to the digital flood insurance rate maps (DFIRMs).

It is anticipated that a Physical Map Revision will be submitted to support the revisions to the floodplain and floodway. This submittal will include the information described above and will be reviewed and approved by CWCB, and FEMA in accordance with the procedures and regulations established by the State of Colorado and FEMA. Following the approval of the information by the agencies, an opportunity for the community to review and appeal the results of the revised floodplain information will be provided.

Project Partners and Sponsors

The study limits associated with the revised floodplain mapping encompass the jurisdictions within the Town of Estes Park and Larimer County. It is anticipated that both jurisdictions will be involved in the review of the revised floodplain mapping information as well as the implementation of projects along the river corridor.

Estimated Cost

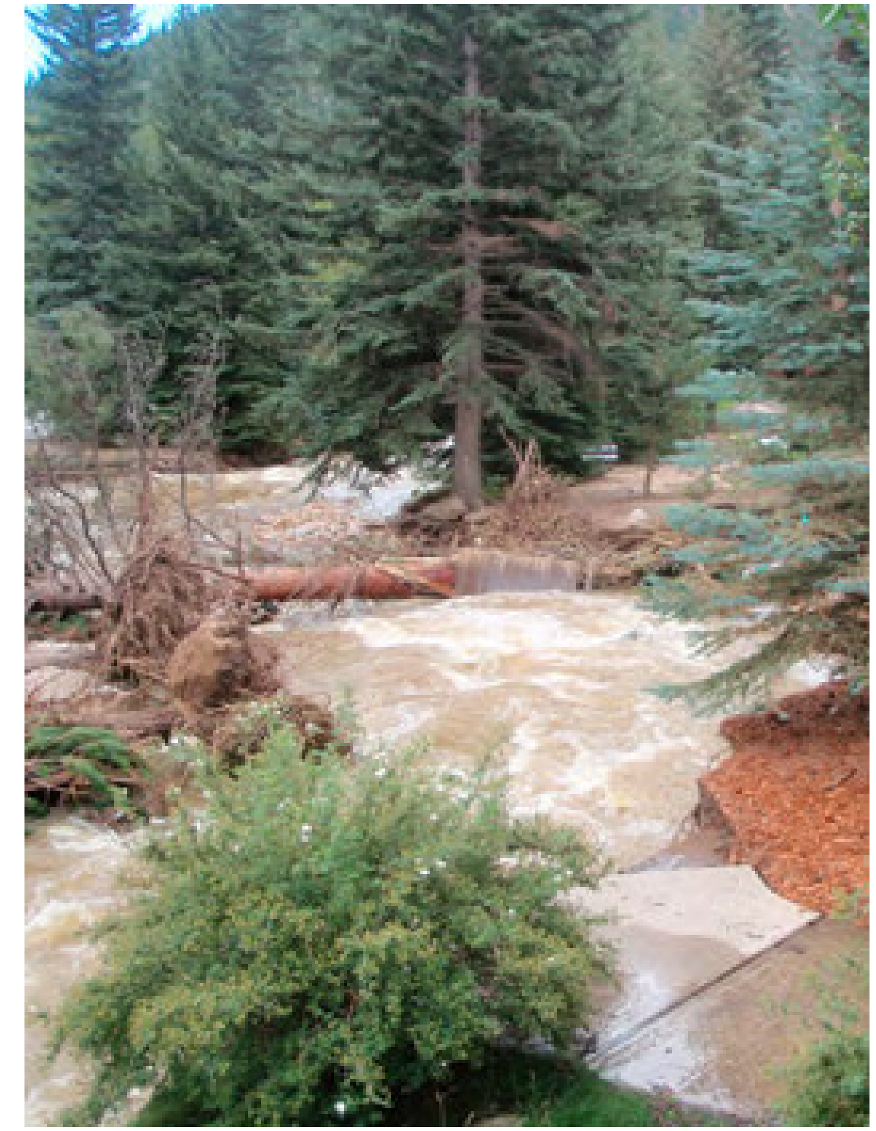
A preliminary cost estimate was prepared to complete the revisions to the floodplain mapping along the Fall River Corridor. It is assumed that the study reach defined by the limits of the effective floodplain mapping (encompassing 5.03 miles) will be revised. The reach can be generally described as the confluence with the Big Thompson River upstream to the Rocky Mountain National Park boundary near Fish Hatchery Road. In this reach, the effective floodplain modeling/mapping includes 35 structures and one overflow path. Based on an initial review of the existing information, additional structures will likely be incorporated into the revised mapping as well as an additional overflow path.

Give the information discussed above, the cost estimate is itemized below:

- Revised hydrology study
  $30,000
- LIDAR processing and mapping/surveying
  $22,000
- Revised floodplain and floodway modeling/mapping
  $50,000
- Revised FIS report/DFIRMs/documentation
  $12,000

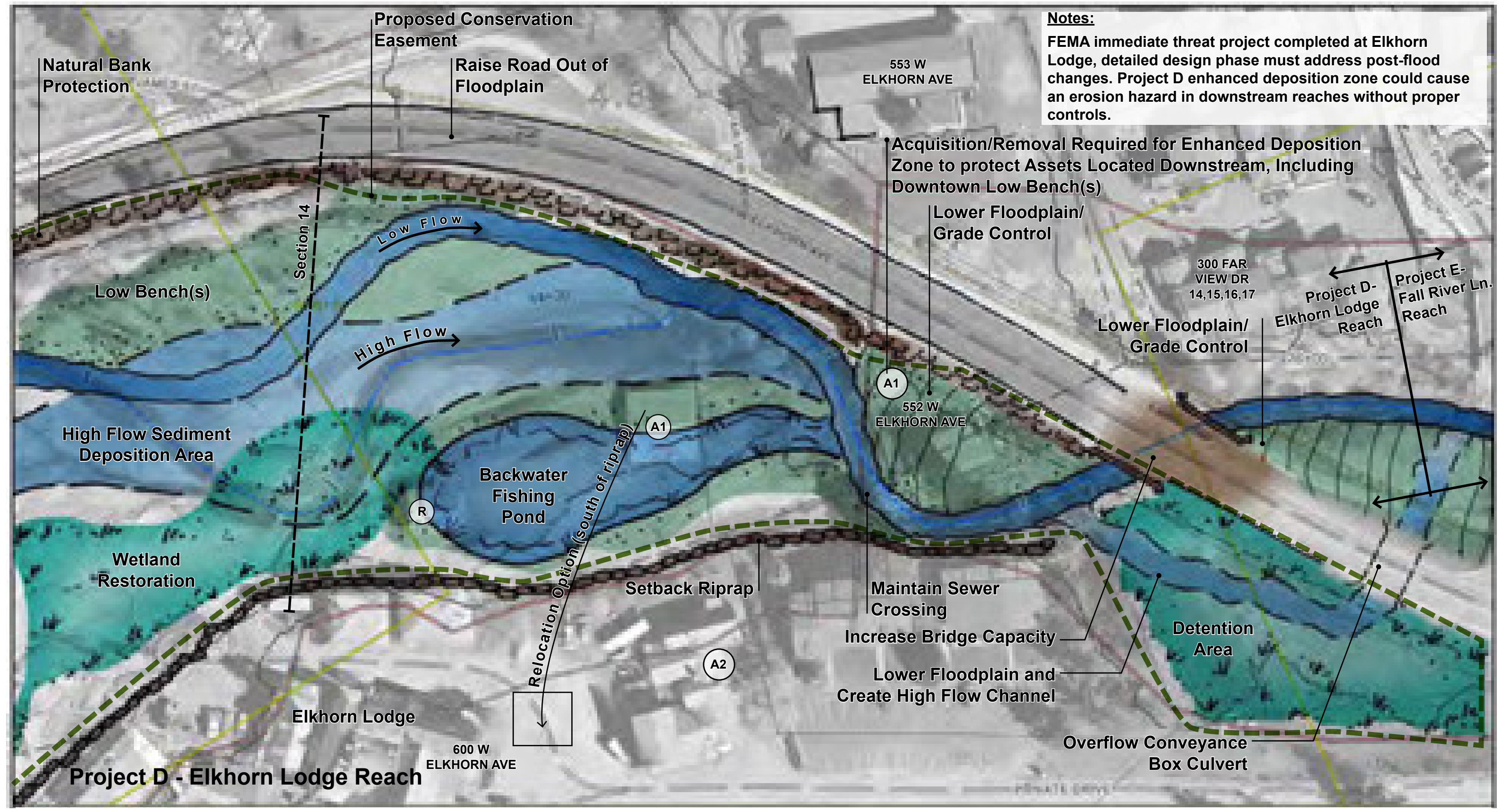
Cost Sharing and Funding Strategies

Funding for the revisions may include contributions from the Town of Estes Park, Larimer County, and the CWCB. CWCB offers several programs for potential funding which may include: (a) Flood Recovery Grant Program, (b) Flood and Drought Response Fund, and (c) grants related to flood assessment, feasibility, design and planning. FEMA may also be a funding source depending on the availability of funds for new floodplain mapping studies. Other funding sources administered though the Colorado Department of Local Affairs in conjunction with the U.S. Department of Housing and Urban Development may be available (CDBG-DR funds).

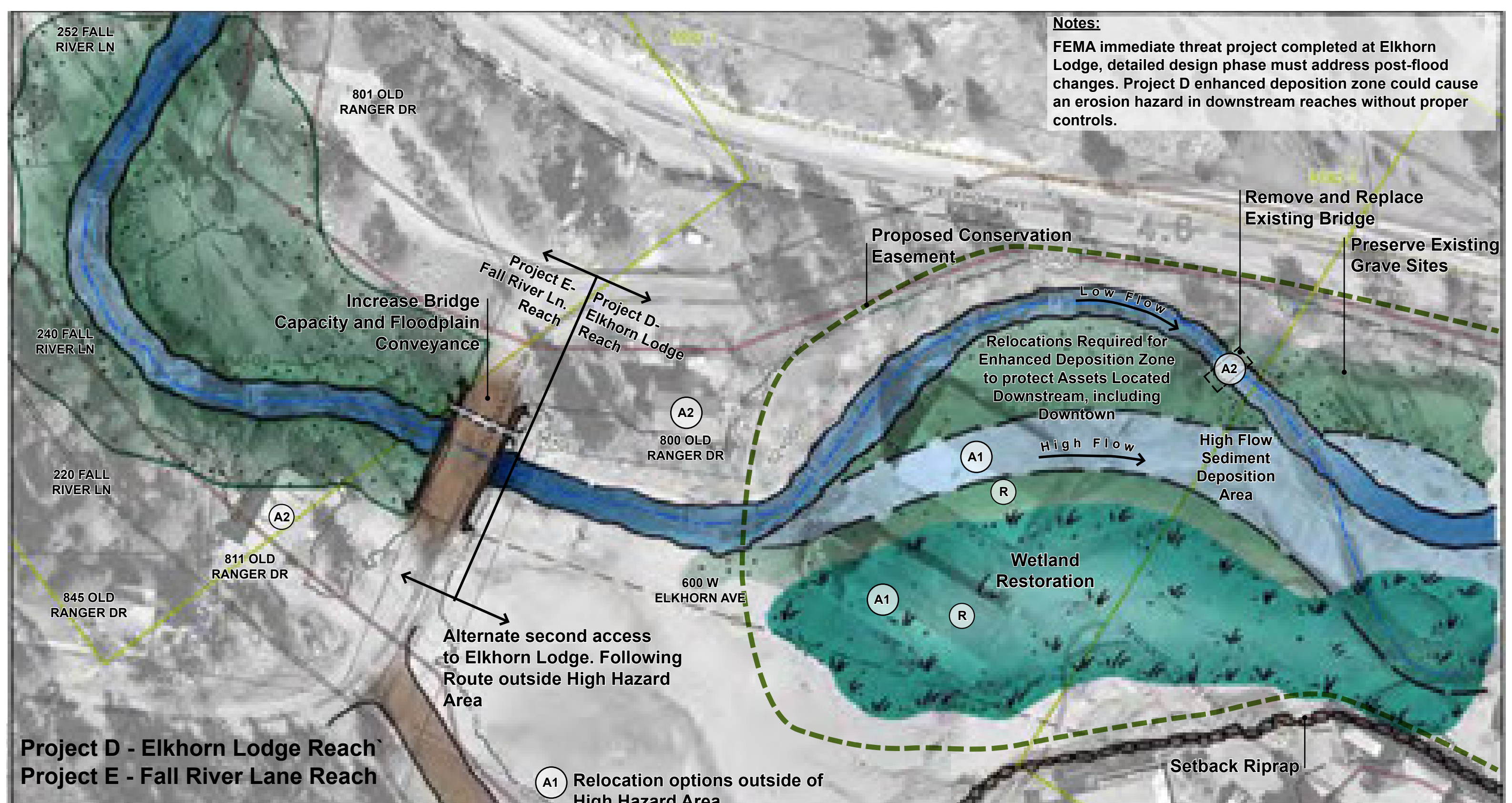


Fall River Post Flood Damage

Project Cut Sheet - Elkhorn Lodge



Elkhorn Lodge Resiliency Ideas



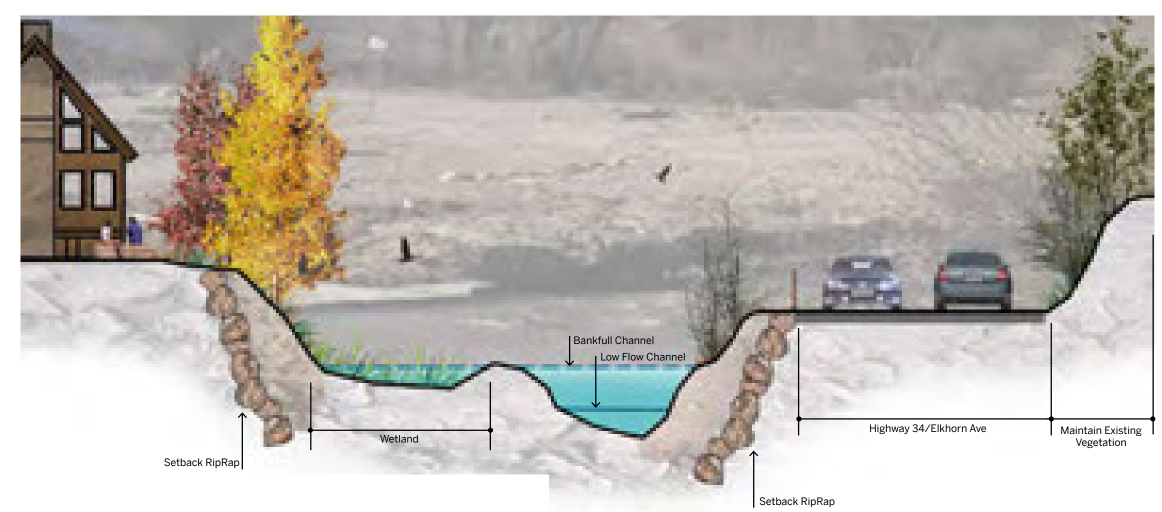
Project Objective

The objective of the Elkhorn Lodge project is to create a permanent sediment deposition zone upstream of downtown Estes Park, to shift the Fall River high flows away from the Highway 34 road embankment and to increase conveyance and reduce flood surface elevations at the Highway 34 Bridge, at Elkhorn Lodge, and at the Elkhorn Plaza Lodge condominium complex at 550 W Elkhorn Avenue.

Physical Layout

The project will lower and re-grade the approximately 5 acre site to establish planned overflow channels and sediment deposition areas. This project will also widen and lower the river corridor at the downstream end of the project site through acquisition and removal of the building at 552 Elkhorn Avenue reducing flood surface elevations at Elkhorn Lodge and Elkhorn Plaza Lodge Condominiums.

Elkhorn Lodge Reach



Project Cut Sheet - Elkhorn Lodge

The barns and other structures will be relocated to outside the 100-year floodplain and behind the setback rip rap. Secondary access to the lodge and barns will change from the undersized private bridge downstream of Ranger Ave to a driveway from Ranger Ave west of the Ranger Ave Bridge over Fall River.

Project Benefits

The project has system wide sediment transport benefits in that likely will deposit fine sediments in planned areas upstream of the downtown business district and will lower the 100-year flood surface elevation between Ranger Ave and the Highway 34 Bridge potentially removing Elkhorn Lodge and the Elkhorn Plaza Lodge Condominiums from the regulatory 100-year floodplain. The preservation of the open space will ensure that future risks will not increase through development or investment in the very high-hazard channel avulsion zone.

Elkhorn Lodge Reach

Implementation and Construction Strategies

This project can be done either with or without fee and title transfer for the five acres adjacent to the river. It is possible that the five impacted acres could go into a conservation easement with the Estes Valley Land Trust in conjunction with the physical implementation of the project. There is also an option of transferring the land to the Town of Estes for long term maintenance and preservation.

Elkhorn Lodge Reach

Elkhorn Lodge Reach

Project Partners

Potential project partners include the local property and business owners, the Town of Estes Park, Estes Valley Land Trust. To approve a tax credit for a conservation easement, the project partners must also work with the Colorado Department of Regulatory Agencies, Division of Real Estate.

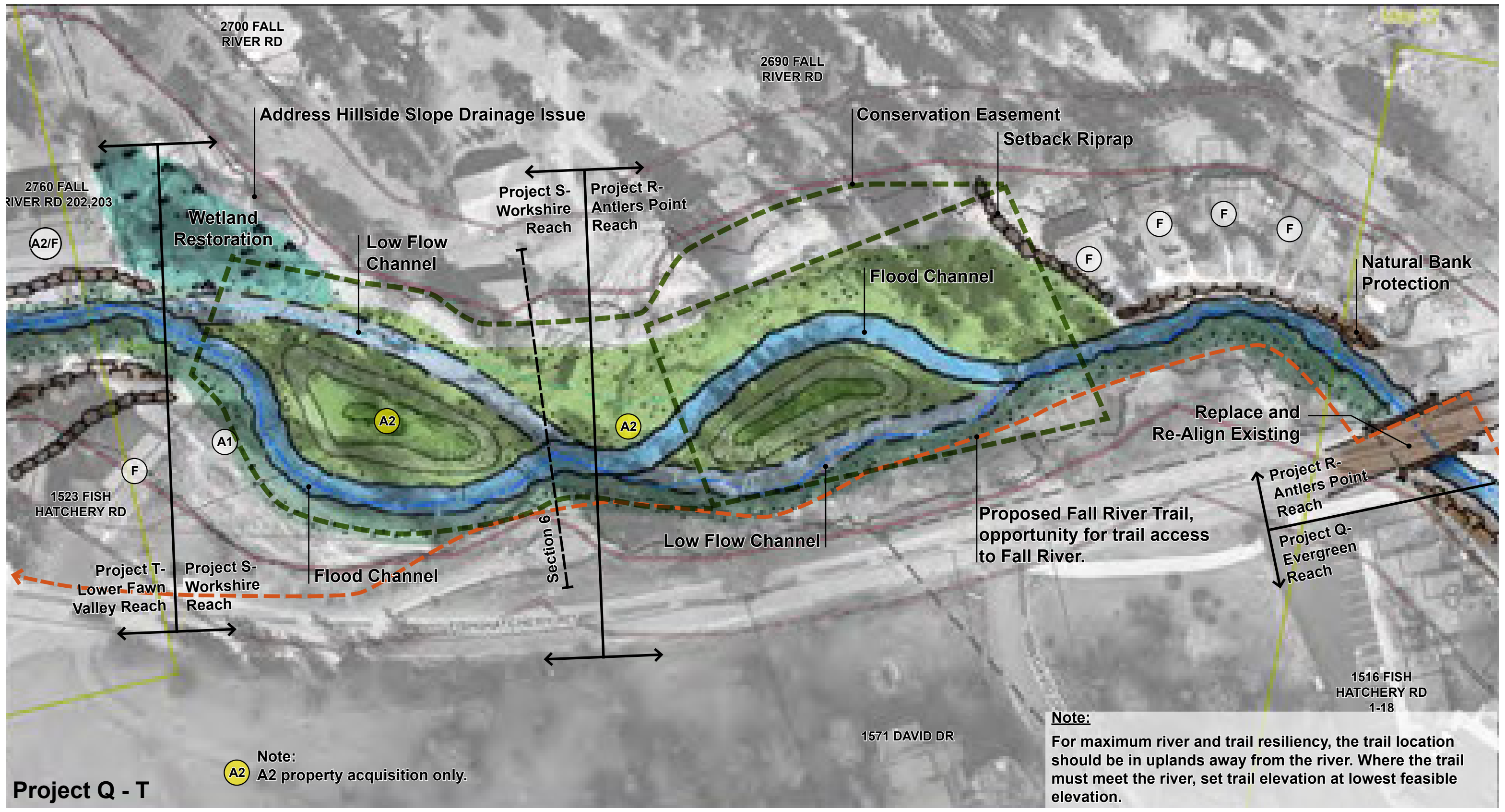
Cost Share and Funding Strategies

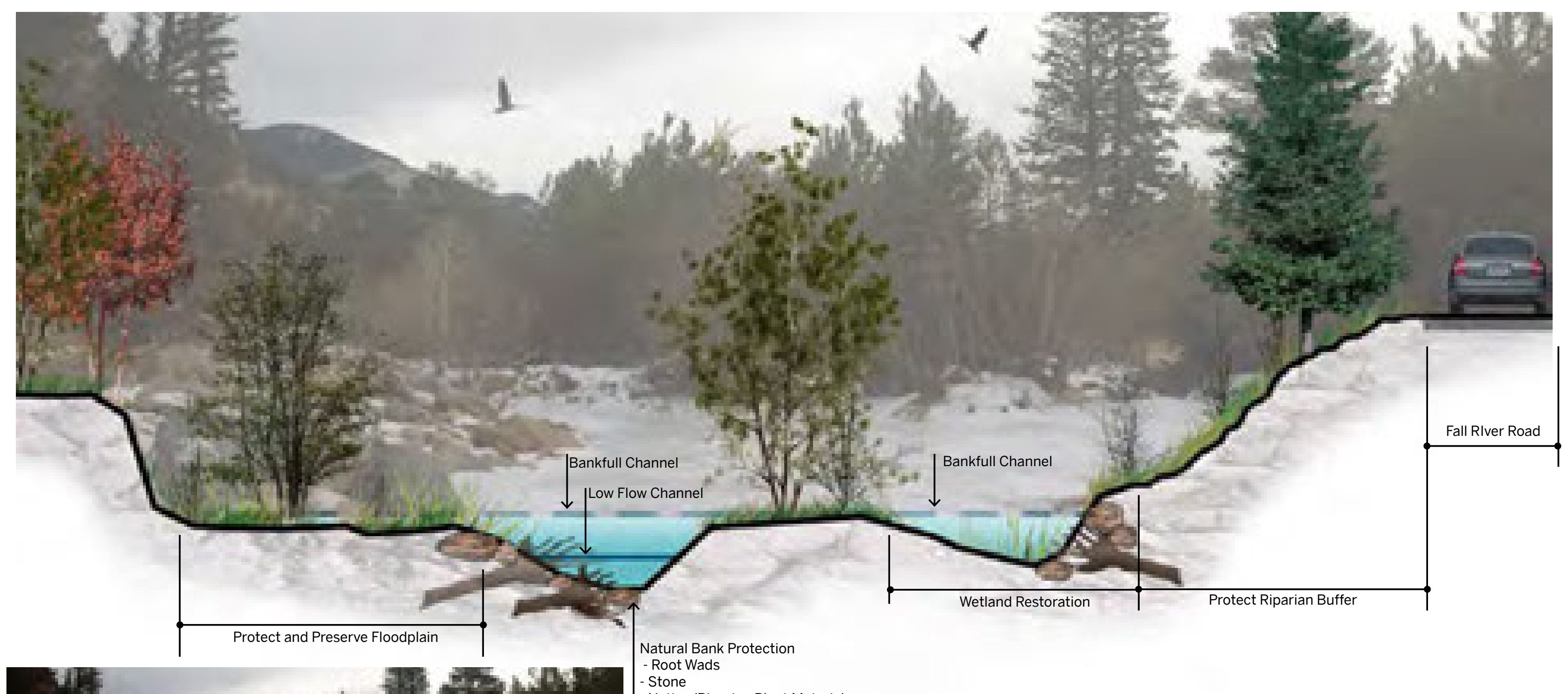
A conservation easement is one way to help generate funding for the project costs.

Construction Cost Estimate

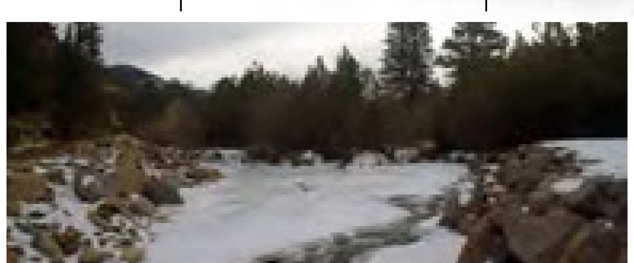
Relocations required for enhanced deposition zone	$750,000.00
Wetland Restoration	$55,000.00
Remove Existing Bridge	$80,000.00
High flow Sediment Deposition Area	$35,000.00
Low Flow Channel	$50,000.00
Backwater Fishing Pond	$60,000.00
Setback Rip Rap	$225,000.00
Increase Bridge Capacity	$2,000,000.00
Lower Floodplain and Create High Flow Channel	$15,000.00
Lower Floodplain/ Grade Control	$45,000.00
Natural Bank Protection	$185,000.00
Raise Road out of Floodplain	$1,500,000.00
Overflow Conveyance Box Culvert	$135,000.00
Proposed Conservation Easement	
Preserve Existing Grave Sites	$10,000.00
Maintain Sewer Crossing	
Detention Area	$20,000.00
Acquisition/ Removal Required for Enhanced Deposition Area	
Grand Total	**$5,165,000.00**

Project Cut Sheet - Antlers Point, Workshire Lodge, and Lower Fawn Valley





Section 6
Fall River Workshire Oliver
Looking Upstream
Not to Scale



Post Flood Image
Looking Upstream

Project Objective

Project objectives include: 1) improve natural channel form and function and fishery health by restoring appropriate sinuosity and alignment for the mainstem channel, and create a side channel network, 2) create complex channel cross section, including low bench areas, 3) re-establish a diversity of native riparian vegetation, 4) reduce flood and geomorphic hazards to protect adjacent infrastructure, and 5) enhance the recreational experience via new pocket park. Accomplishing these objectives will lead to improved stream health, greater resiliency, and good recreational opportunities for the citizens of and visitors to the Estes Valley.

Physical Layout

This project will focus on the recovery and restoration for the Fall River corridor at the Oliver and Workshire properties.

Project Benefits

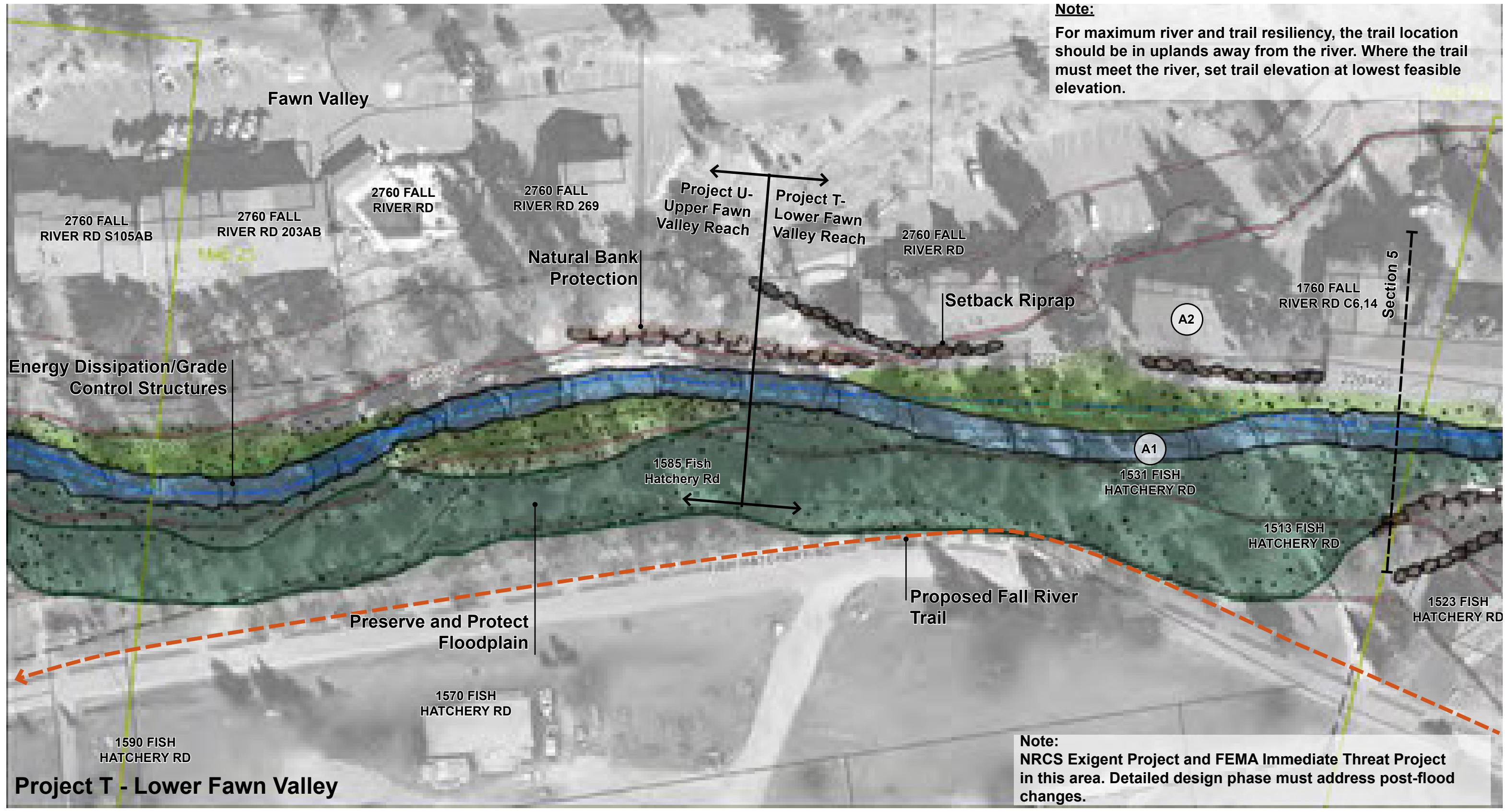
This project will increase resiliency for the natural stream system, as well as the homes and utilities located along it, and it will provide enhanced recreational opportunities to benefit its residents and the community, as well as the local economy.

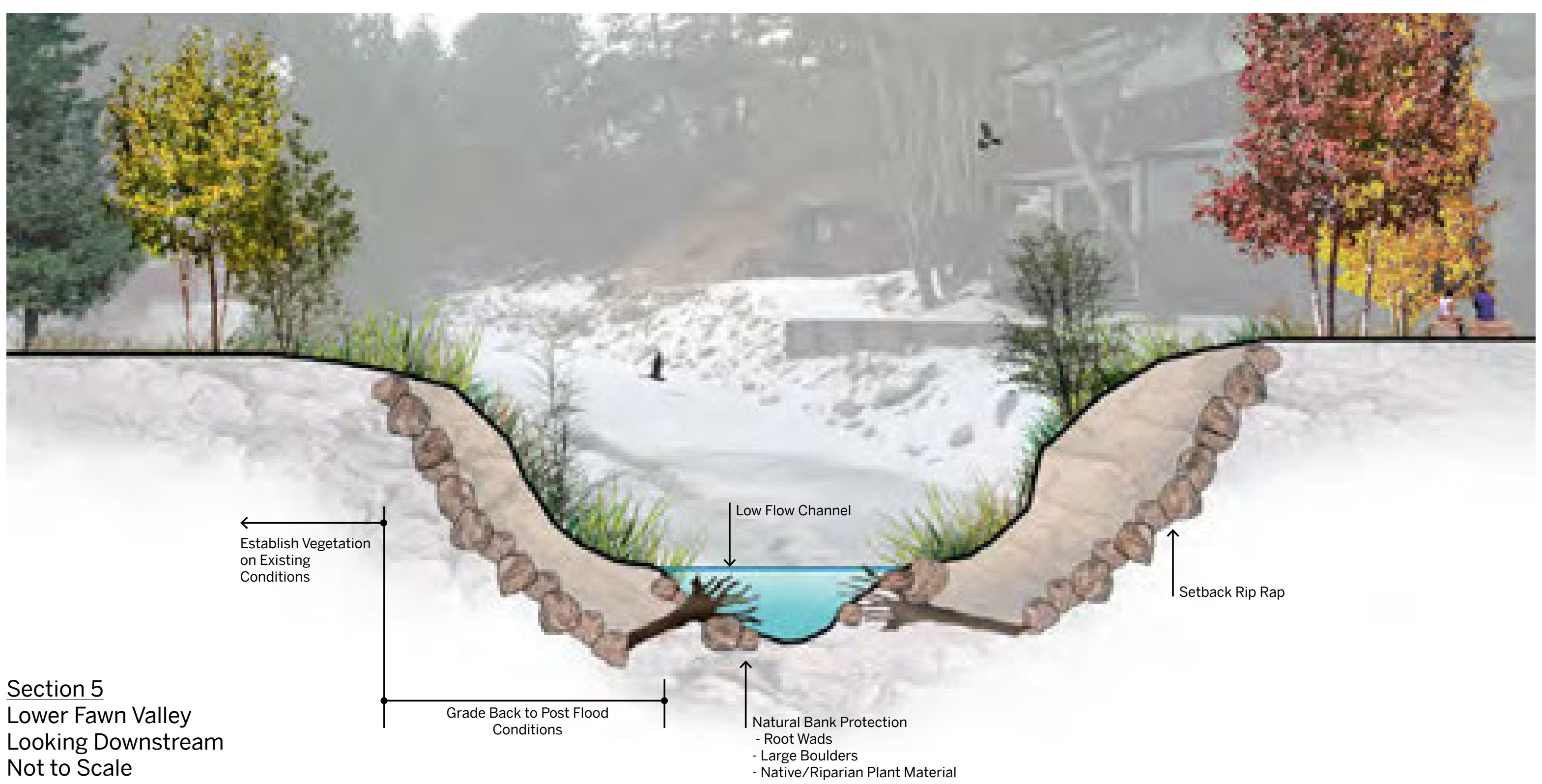
Project Partners

Potential project partners for Brook to County Club are the Town of Estes Park Community Development Department, Estes Valley Land Trust, Estes Valley Recreation and Park District, and the property owners within the reach.
Cost Share and Funding Strategies
This funding for this project can be supported through a variety of local, state, and federal grants, along with financial and in-kind support from the local project partners. Potential funding sources include:

- GOCO Grant- Estes Valley Riparian Restoration Project,
- Community Foundation of Northern Colorado- Flood Recovery Funds
- Funds from Estes Valley Recreation and Park District for Trail Rebuild-ing

Project Cut Sheet - Antlers Point, Workshire Lodge, and Lower Fawn Valley





Section 5
Lower Fawn Valley
Looking Downstream
Not to Scale

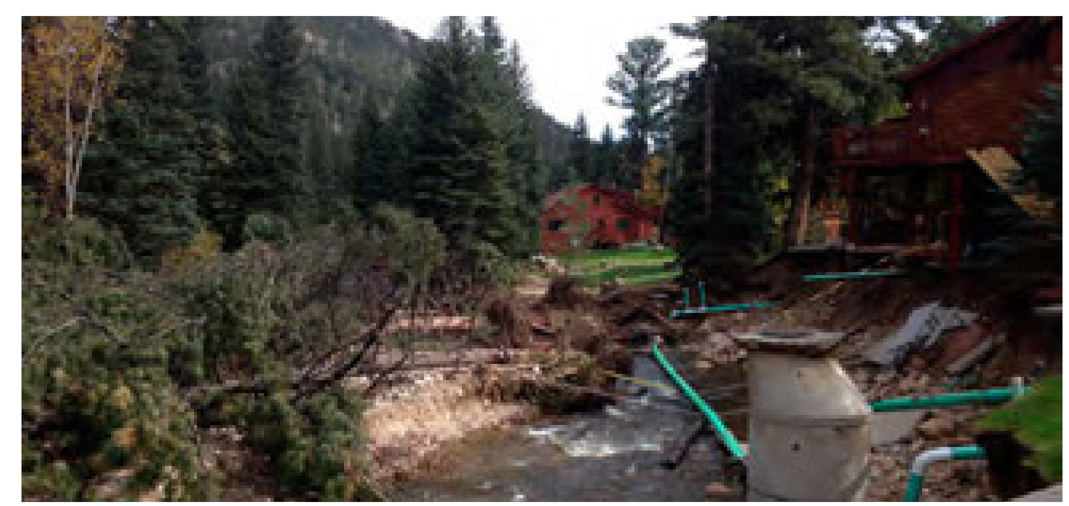
- FEMA Public Assistance to the Town of Estes Park Public Works for Trail Re-building Larimer County Open Lands
- GOCO Fall Grant Cycle for Land Conservation and Trails Restoration along Fish Creek
- SB 14- 179 Funding

Construction Cost Estimate

ANTLERS POINT REACH	
Re-Align Existing Bridge	$2,000,000.00
Natural Bank Protection	$125,000.00
Setback Rip Rap	$65,000.00
Flood Channel	$10,000.00
Low Flow Channel	$10,000.00
Conservation Easement	
Fall River Trail	$10,000.00
GRAND TOTAL Antlers Point	**$2,220,000.00**

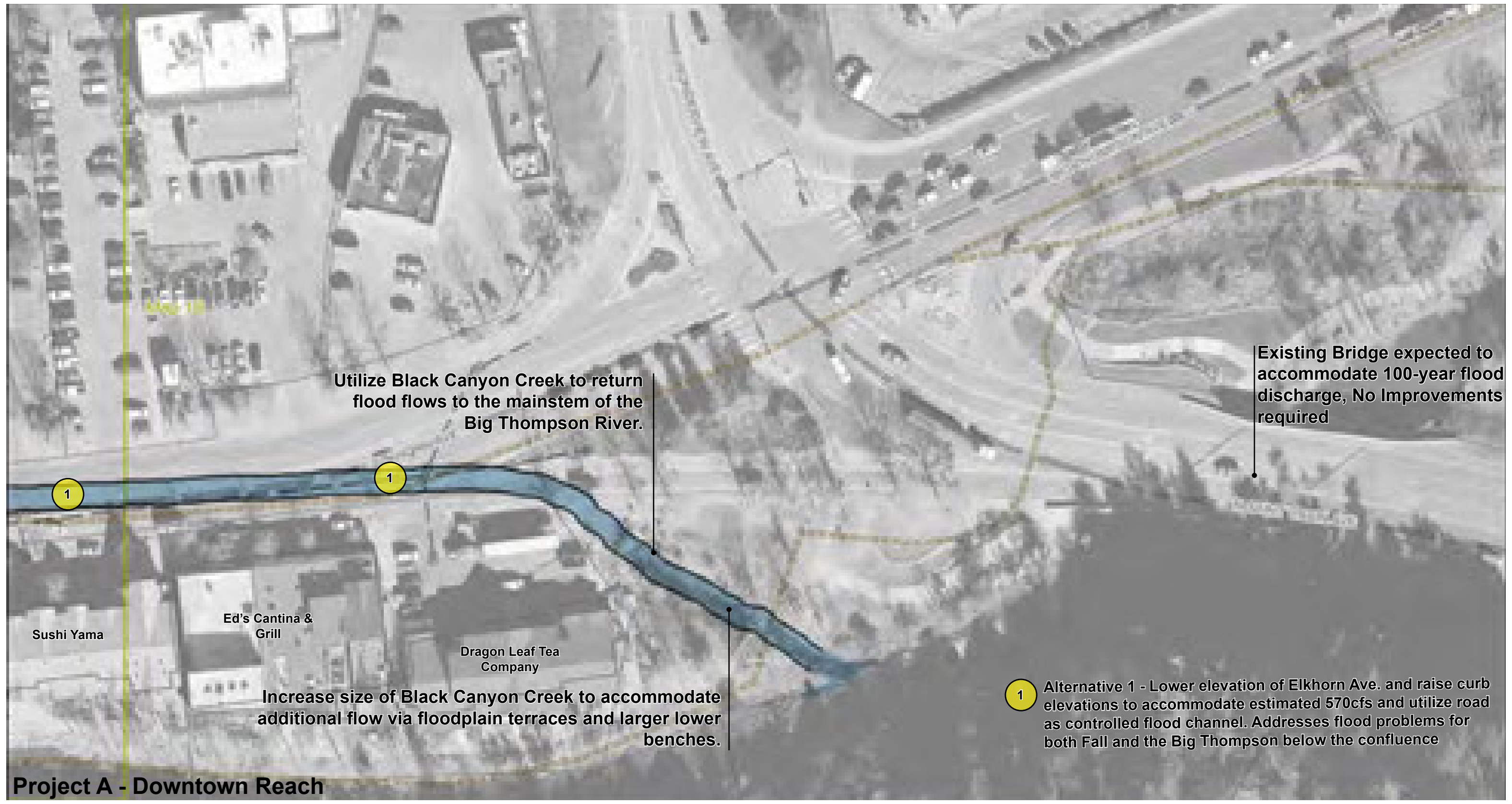
WORKSHIRE REACH	
Wetland Restoration	$10,000.00
Flood Channel	$10,000.00
Low Flow Channel	$10,000.00
Address Hillside Slope Drainage Issue	$20,000.00
Conservation Easement	
Fall River Trail	$5,000.00
Grand Total Workshire	**$55,000.00**

LOWER FAWN VALLEY	
Setback Rip Rap	$15,000.00
Natural Bank Protection	$15,000.00
Grade Control Structures	$10,000.00
Fall River Trail	$9,000.00
Grand Total Lower Fawn Valley	**$49,000.00**



Antlers Point Utility Damage

Project Cut Sheet - Downtown



Elkhorn Lodge Resiliency Ideas

Project Objective

Fall River Downtown Project will make critical flood hazard reductions for the downtown area by increasing flood conveyance along the river to remove assets (structures, bridges) from flood or geomorphic hazard areas and to reduce inundation depths during both large, infrequent flood events (100-, 500-year) and smaller, more frequent events (10-, 50-year). The goal of the project is to contain the maximum percent of flood flows possible within channel and bridge cross sections, then to provide managed routing and safe return to the river for unavoidable overflow volumes, and finally to provide flood proofing to commercial structures still at risk of inundation. Flood conveyance improvements include bridge retrofits, channel improvements, managed high flow channels, retaining walls, road and curb improvements, and floodplain reconnection using existing parking lots as overflow areas.

Physical Layout

The Fall River Downtown Project area extends along Fall River from its confluence with the Big Thompson River, upstream to Performance Park. The lateral extents include one two blocks of the surrounding downtown area.

Project Benefits

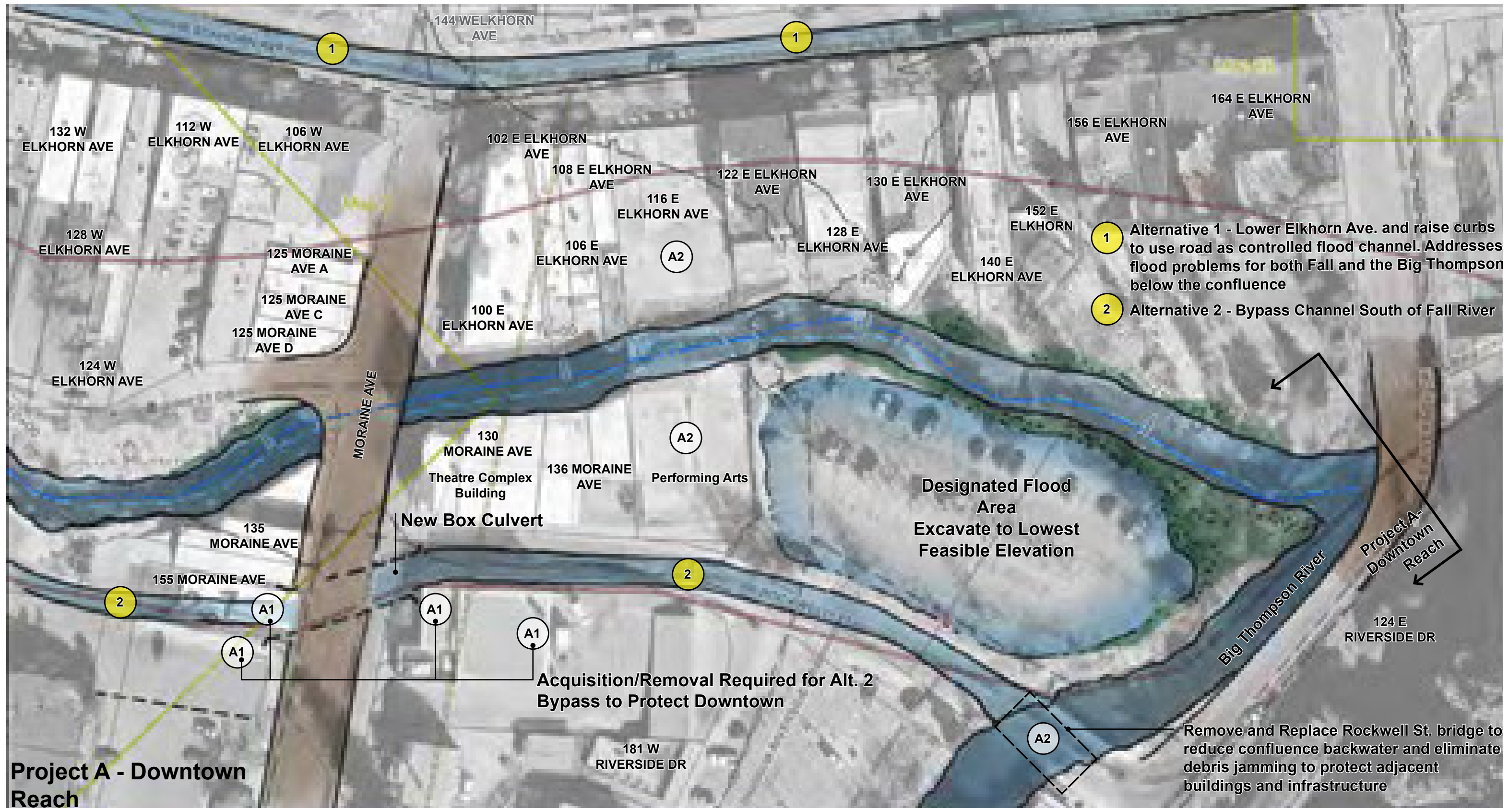
Project Benefits include flood hazard reduction for the downtown area was well as minor ecological and water quality improvements for the reach.

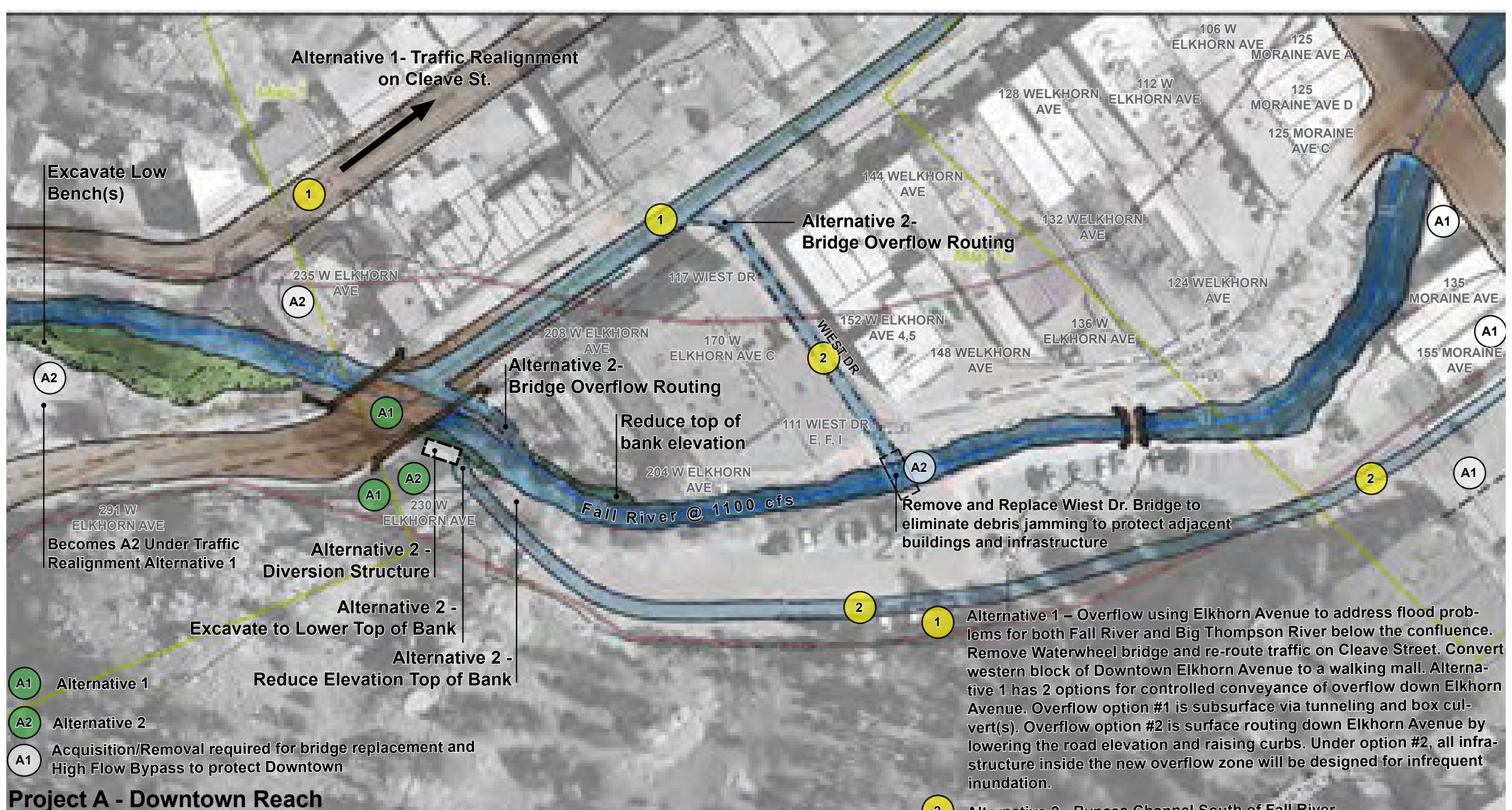
Implementation and Construction Strategies

Construction access and staging will be a particular challenge in the densely developed downtown area. Construction in the downtown area will need to address the short term impacts to traffic flow and vehicular delay. Potential staging areas for the downtown project include:

- The town owned public parking area west of Spruce Drive Bridge.
- Town owned parking area south of Wiest St.
- Parking area at the confluence of Fall River with Big Thompson River.

Project Cut Sheet - Downtown





Permitting Reqs

The downtown may have additional permitting requirements including

- Town Right-of-Way Permit
- CDOT Utility/ Special Use Permit Application
- CDOT Right-of-Way/ Access Permit
- Air Quality Conformity Permit

Project Partners

Potential project partners include the Town of Estes Park.

Cost Share and Funding Strategies

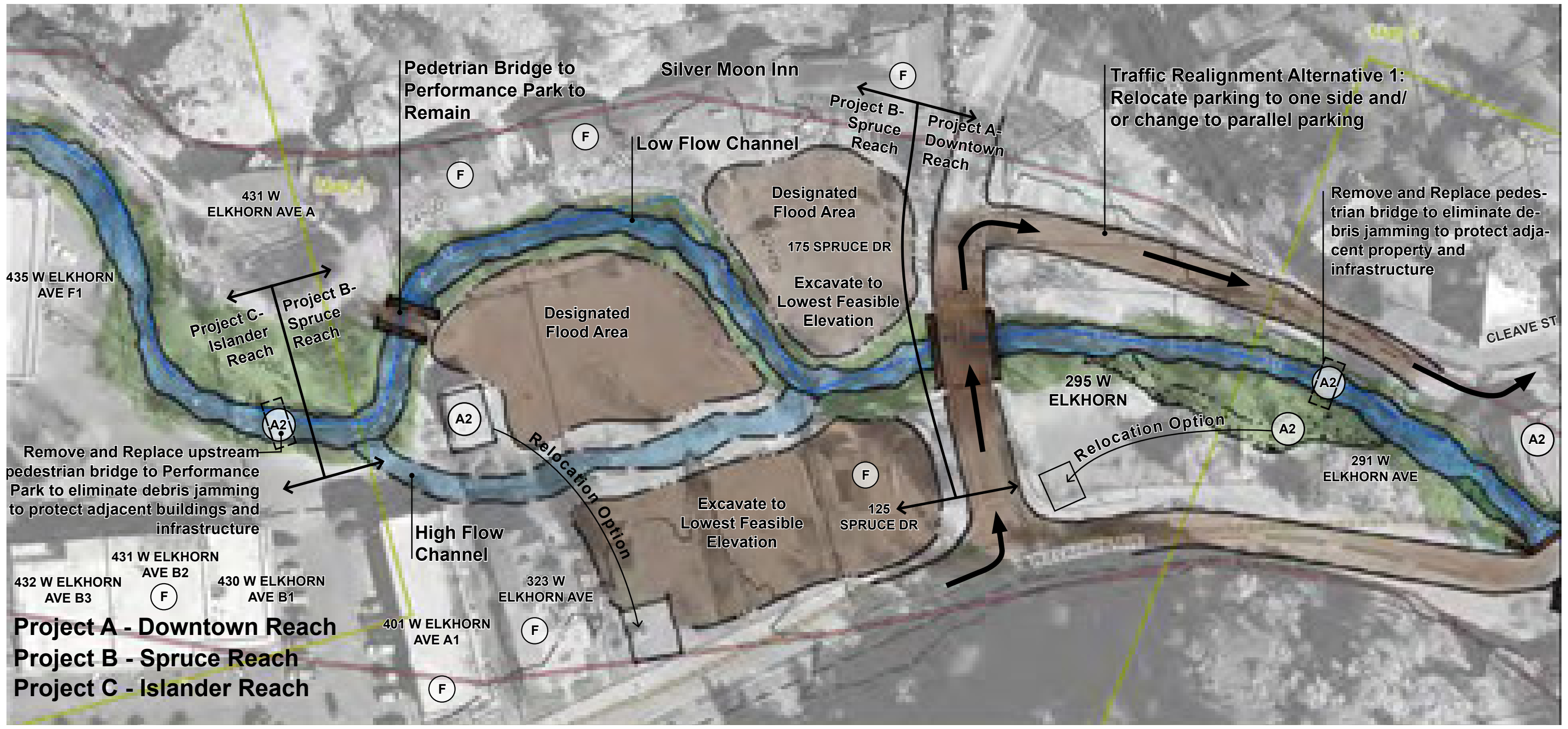
The Town of Estes Park and Federal Highways Administration via their work on the FLAP grant are potential cost share partners. Due to the large costs associated with the project.

Construction Costs

Construction costs for Alternative 2 for the Fall River Downton Project are estimated at 5.4 million dollars. This includes the following components:

- Waterwheel Bridge Retro-fit and Emergency Barricade System to increase bridge capacity from current approximate capacity of 800 cfs to 1,600 cfs via bridge deck raise of approximately one foot and width increase from 20 ft to approximately 36 ft
- Managed overflow routing along the left overbank, including: a) along Elkhorn Avenue, with controlled return to the Big Thompson River through Black Canyon Creek and b) the undeveloped area between the river and the existing buildings
- Retaining walls on river right and river left below the bridge, with the wall on

Project Cut Sheet - Downtown



the left built higher than the parking lot on river right to direct water into the parking lots, and the wall on the right tapering into the existing parking lot (150 LF total both banks)

- Widen the existing channel below Waterwheel bridge to the extent possible within existing constraints and without negative effects to structural integrity at bridges and to stream health (400 LF)
- Removal and demolition of Wiest Bridge
- Diversion and managed high flow channel off of Waterwheel Bridge, routing overflow along existing parking lot with created floodplain bench and overflow return via pipe to the Big Thompson River, sized to convey 570 cfs (open channel: 500 LF, piped: 850 LF)
- Conversion of existing parking lots upstream of Spruce Drive to overflow area by lowering the elevation of the most waterward portion of the parking lot (0.65 AC)
- Removal and demolition of the upper pedestrian bridge to Performance Park

Alternative 1 addresses flood risk downtown at Fall River as well as flood risks on Big Thompson River downstream of Riverside Drive Bridge. As a result, the overall costs are expected to be lower when the additional costs of addressing Big Thompson River flood risk are also included. Alternative 1 includes the following components:

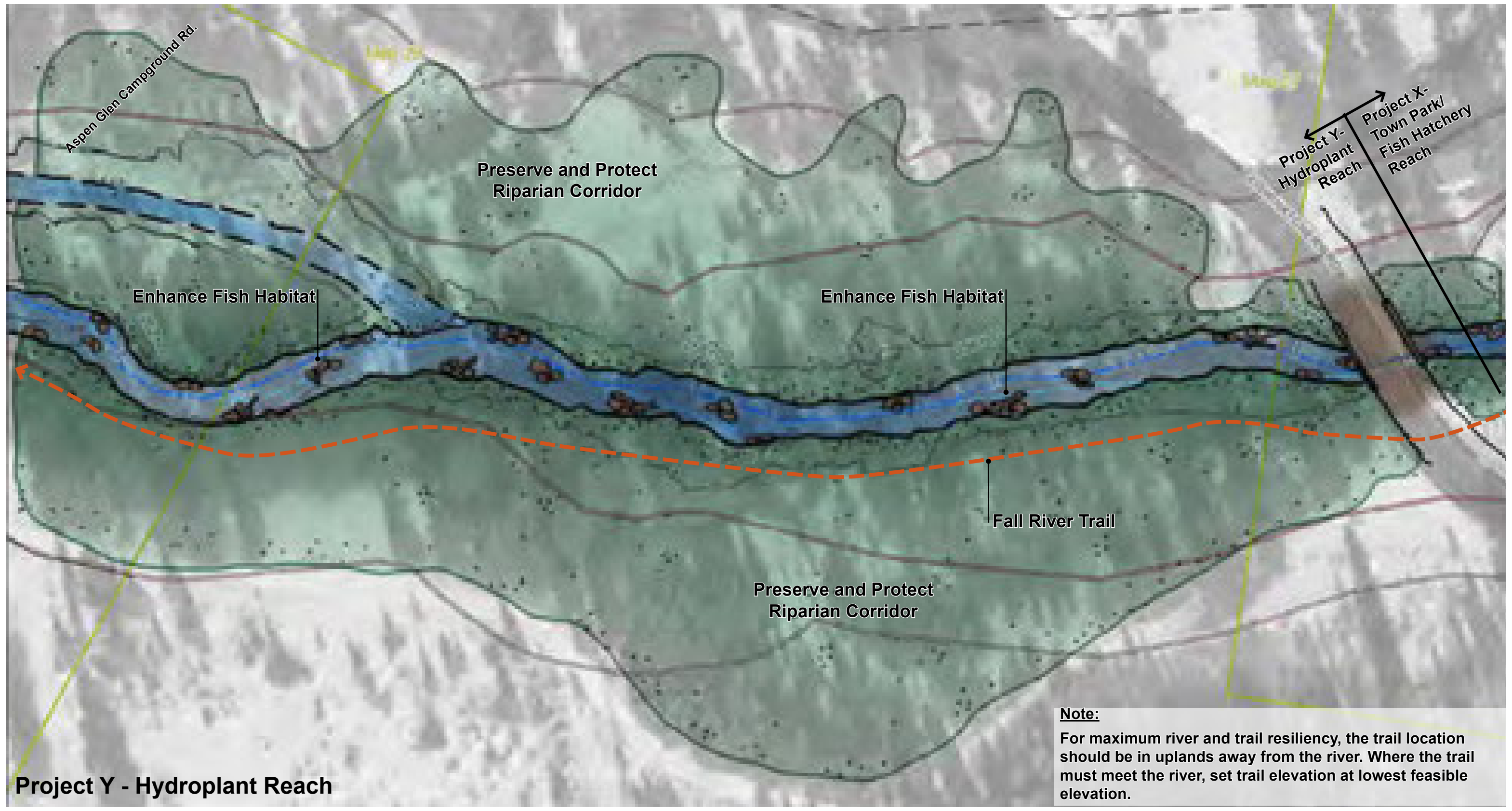
- Managed overflow routing along Elkhorn Avenue, with controlled return to the Big Thompson River through Black Canyon Creek just upstream of the Hwy-34/36 Bridge through lowering and other modifications of Elkhorn Avenue. The Hwy-34/36 Bridge is expected to have adequate conveyance.
- Potentially widen the existing channel below Waterwheel bridge to the extent possible within existing constraints and without negative effects to structural integrity at bridges and to stream health (400 LF)
- Potential removal and demolition of Wiest Bridge
- Conversion of existing parking lots upstream of Spruce Drive to overflow area by lowering the elevation of the most waterward portion of the parking lot (0.65 AC)
- Removal and demolition of the upper pedestrian bridge to Performance Park

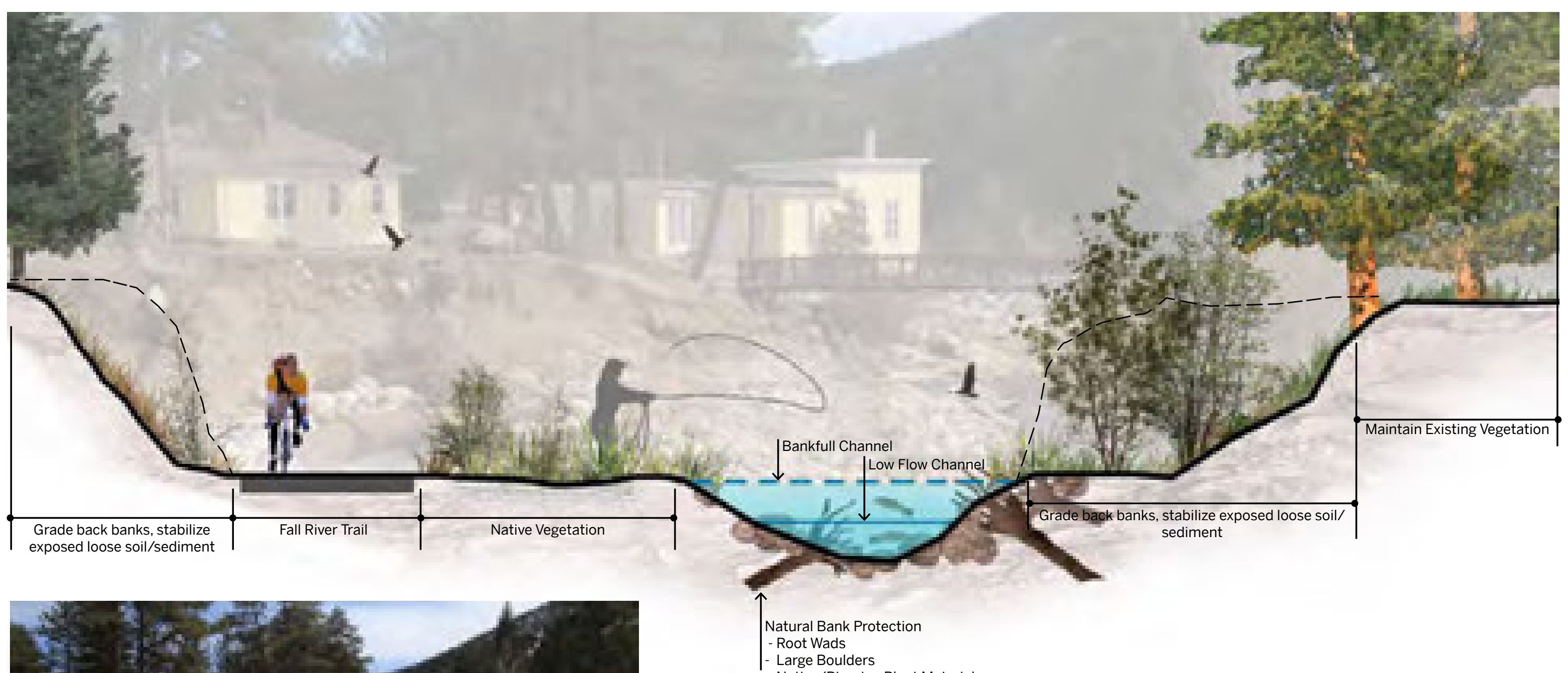
Construction Cost Estimate

Increase Capacity of Black Canyon Creek	$100,000.00
Lower Elevation of Elkhorn Ave. and Raise Curb Height	$5,000,000.00
Waterwheel Bridge Realignment	$2,000,000.00
Remove Weist Dr. Bridge	$80,000.00
Remove Pedestrian Bridge	$800,000.00
Grand Total	**$7,980,000.00**

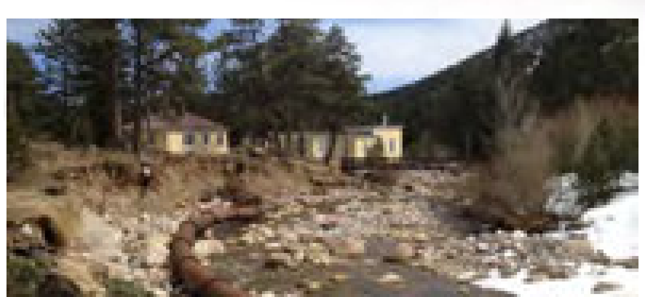
Downtown Reach

Project Cut Sheet - Hydroplant





Section 1
Town Park at Hydro Museum
Looking Downstream
Not to Scale



Post Flood Image
Looking Downstream

Project Objective

The project objectives for the Town Park project at the Hydro Plant are to stabilize the existing sediment and banks in the project reach, preserve and protect the riparian corridor potentially through a conservation easement, enhance fish habitat, enhance flood conveyance with low benches, provide public access for fishing and picnics, and to construct a trail through the corridor.

Physical Layout

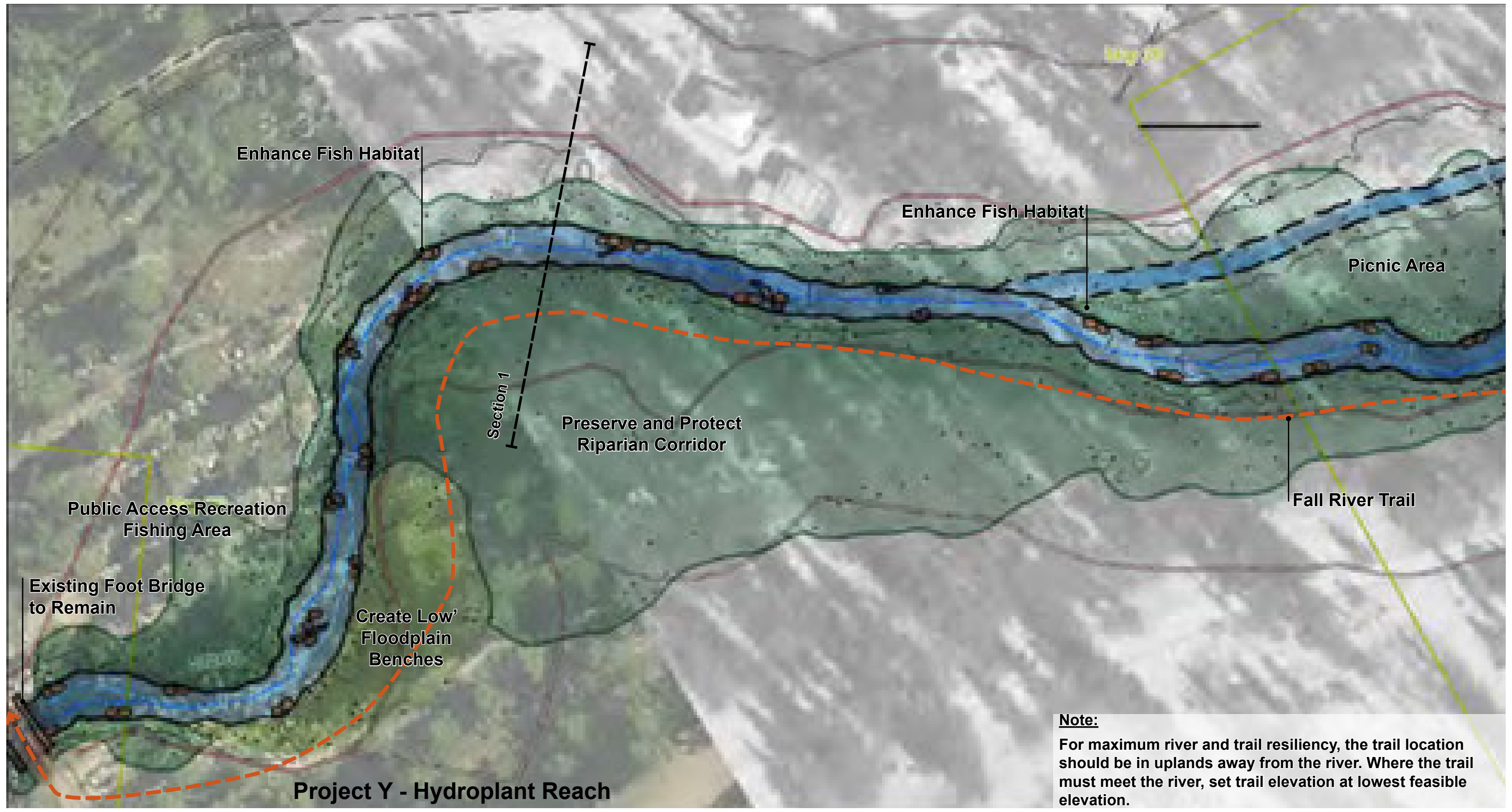
The projects extents are from the Fish Hatchery Rd. Bridge downstream of the old Hydro Plant to just upstream of the Aspen Glen Campground. The total project length is approximately 2,600 feet of stream length. The project width extends across the riparian corridor.

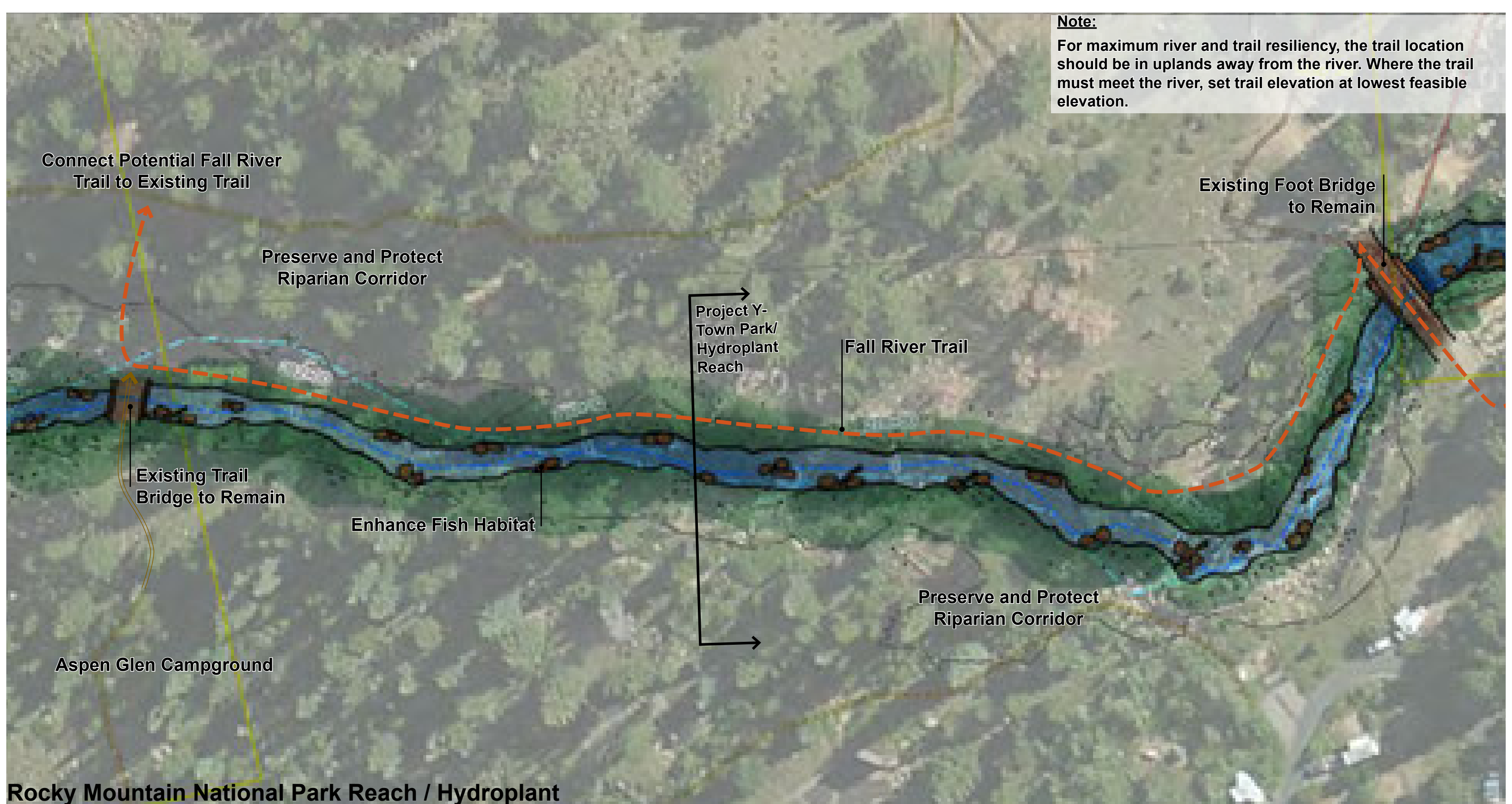
Project Benefits

The Town Park at Hydro Plant project has the potential to provide system-wide benefits to Fall River and the community. Benefits include reduced sediment load downstream, increased flood conveyance, enhanced fish habitat and ecosystem benefits, and increased recreational opportunities.

Hydroplant Reach

Project Cut Sheet - Hydroplant





Implementation and Construction Strategies

No specific strategies are available.

Project Partners

Potential project partners include the local property and business owners, the Town of Estes Park, Estes Valley Land Trust. To approve a tax credit for a conservation easement, the project partners must also work with the Colorado Department of Regulatory Agencies, Division of Real Estate.

Cost Share and Funding Strategies

A conservation easement is one way to help generate funding for the project costs.

Construction Cost Estimate

Enhance Fish Habitat	$100,000.00
Preserve and Protect Riparian Corridor	$15,000.00
Create Low Floodplain Benches	$65,000.00
Create High Flow Channel	$50,000.00
Public Access Recreation Fishing Area	$50,000.00
Picnic Area	$40,000.00
Fall River Trail	$45,000.00
Grand Total	**$365,000.00**

this page intentionally blank

8 Next Steps

8.1 Long-term coalition building and engagement

The September 2013 floods caused significant damage to several watersheds on the Northern Front Range of Colorado. Dozens of state and federal agencies along with volunteer organizations galvanized an array of resources to recover from this event. Many of these groups initially responded by undertaking short-term and temporary actions in order to address the damage caused by the flood. While local short-term solutions were being implemented, there was a recognized need for long-term planning on a watershed level.

Colorado's flood-affected communities have been encouraged to come together to create a coordinated, future-oriented framework to restore and create resilience in their watershed communities and ecosystems. In order to begin long-term river and watershed restoration in a thoughtful and coordinated way, the Colorado Water Conservation Board granted funds to flood-affected watersheds to create stakeholder-driven Watershed Master Plans to assess damage and develop a list of prioritized restoration projects. This process has catalyzed communities around their rivers, challenged stakeholders to work hand in hand with their neighbors and set the stage for a long-term recovery process that highlights multiple objectives and promotes resiliency.
Resilience means different things to different communities. According to the National Disaster Recovery Framework, "Resilience incorporates hazard mitigation and land use planning strategies; critical infrastructure, environmental and cultural resource protection; and sustainability practices to reconstruct the built environment, and revitalize the economic, social and natural environments."

The master plans being developed in each flood affected drainage basin are working within a watershed approach framework. A watershed approach is a flexible framework for managing natural resources within specified drainage areas, or watersheds. It is a strategy that provides assessment and management information for a geographically defined watershed, including the analyses, actions, participants, and resources related to developing and implementing the plan. This approach includes stakeholder involvement and management actions supported by sound science and appropriate technology using a series of cooperative, iterative steps to characterize existing conditions, identify and prioritize projects, define management objectives within the prior appropriation system, and implement and adapt selected actions as necessary. The outcomes of this process are documented or referenced in the plan.
One of the key characteristics of the master planning process is the implementation of a plan that is developed by a coalition of stakeholders in the basin. In prior watershed planning processes throughout Colorado, diverse stakeholder input at the beginning stages of planning has generally improved the likelihood of successful implementation. Using a stakeholder involved collaborative approach to selecting management strategies oftentimes will reduce conflicts associated with watershed management and address projects in a holistic manner. This approach will help to expedite cooperative, integrated restoration planning and implementation. It is this reason that funding agencies and organizations will look favorably on applications submitted by collaborative community coalitions.

Fall River Coalition

Fish Creek Coalition

8.2 Master Plan Implementation

As the master plan process concludes, site specific planning and project implementation will be commencing. The State is encouraging each flood-affected watershed to organize a stakeholder coalition and adopt a governance structure that can represent the interests of all stakeholders in the watershed. That includes local governments, special districts (water, sewer, fire, soil conservation, irrigation etc.) business interests, the residential community, state and federal agencies, environmental and recreational concerns and any others that have a stake in developing a resilient economy and environment.

The Colorado Water Conservation Board (CWCB) and the Department of Local Affairs (DOLA) are providing resources to communities to help establish collaborative organizations that can understand and coordinate the specific interests of each stakeholder. Assistance can be provided to navigate the often complicated process of establishing mission/vision statements, fiscal administration procedures and governance structures so government and private funding can legally flow through these organizations to fund local projects. Funding organizations tend to look favorably on organizations that can negotiate and coordinate projects at the local level to develop consensus and leverage local resources that generates cost-effectiveness.

Furthermore, the State recognizes that there is a substantial amount of work required to run these proposed organizations. Oftentimes volunteer community members interested in pursuing the establishment of these groups are quickly overwhelmed with all the fundraising, coordinating, project development and fiscal oversight necessary to maintain a successful organization. With that in mind, the State has developed the Watershed Resilience Pilot Program as a holistic program designed to align watershed restoration and risk mitigation with community and economic development using a collaborative, multi-jurisdictional, coalition-of-partners approach. These watershed program funds will support capacity building through watershed coalition staffing, site specific planning, conceptual design activities, planning for multi-objective uses and project implementation to address long term catalytic watershed system improvements that build resilience. This program will be made available to areas that sustained damage from recent federally-declared flood and fire disasters.

Limited funding will be made available to new coalitions to hire a watershed coordinator and an assistant for 3 years, possibly longer, to successfully carry out projects listed in the Watershed Master Plan. To be competitive for this funding, the position must address disaster impacts and the watershed coalition must consider how this position will help the coalition implement prioritized recovery projects and strengthen the coalition's long-term capacity. Watershed Coordinators and Program Assistants may be coordinated by, and receive assistance and training, from a state program devoted to increase capacity among flood and fire-affected watersheds. Coalitions and/or their stakeholders will be expected to provide matching funds for a this capacity building grant, which can be in the form of indirect and operating costs for items such as office space, computers, telephones, furniture, printers, etc. Indirect, operating and equipment costs are not eligible under this grant.

8.2.1 Coalition leadership

These coalitions will only be successful with strong local leadership. Although coordinators will be hired to do the bulk of the project development work, decision-making and fiscal oversight responsibilities will fall to the leadership of the coalition. Governance structures for these types of organizations are as diverse as the organizations themselves and there are many models available depending on the specific needs of the community. Assistance will be offered to help identify the appropriate type of governance structure that will provide the best representation of the different stakeholder groups within a specific watershed.

Once a structure is established the community will need to recruit leaders to sit on a Board or a Steering Committee that will oversee the operation of the organization and the implementation of the master plan. Ultimately, this Board or Committee will represent the interests of the varying

Elk Along Fall River

Bighorn Sheep Along Fall River

stakeholders in the watershed.

8.2.2 Potential funding sources

Colorado Water Conservation Board
CWCB has several loan and grant programs related to watershed restoration. Some of these programs are explained in further detail here. Please go to http://cwcb.state.co.us/LoansGrants/Pages/LoansGrantsHome.aspx for the complete list of CWCBs loan and grant programs.

Colorado Healthy Rivers Fund
The Colorado Healthy Rivers Fund was established by CWCB, the Water Quality Control Commission, and the Colorado Watershed Assembly. This grant can be used for projects such as erosion control, watershed restoration, water quality monitoring, flood protection, etc. Locally-based watershed protection groups are eligible to apply for a grant from this program. Grant applications are due April 30th of each year. Further details are available at http://cwcb.state.co.us/LoansGrants/colorado-healthy-rivers-fund-grants/Pages/main.aspx#ExampleProjects.

Colorado Watershed Restoration Grant
Money from the Colorado Watershed Restoration Grant program can be used to projects that involve, stream restoration, erosion control, restoration of riparian areas, flood hazard reduction, etc. CWCB will provide the application upon request. See http://cwcb.state.co.us/LoansGrants/colorado-watershed-restoration-grants/Pages/main.aspx for additional information.

Community Development Block Grant – Disaster Recovery
The Colorado Department of Local Affairs (DOLA) received grant dollars to fund flood recovery programs through the Community Development Block Grant – Disaster Recovery (CDBG-DR) program, administered by the U.S. Department of Housing and Urban Development (HUD). The first phase of CDBG-DR funding has already been allocated as of the writing of this document, but the Coalition can still pursue CDBG-DR funding in the second and third phases. The State of Colorado was awarded $199,300,000 in the second phase. CDBG-DR funds can be used to help fund the long-term Coalition building effort. Some activities, such as grant writing, cannot be funded with CDBG-DR money. Further information on CDBG-DR can be found at http://dola.colorado.gov/cdbg-dr/.

Colorado Flood and Drought Response Fund
Colorado's Flood and Drought Response Fund was created in 2012 and is managed by the CWCB. The Fund can be used for flood and drought preparedness and for response and recovery activities following flood or drought events and disasters. Up to $300,000 is available through this fund on an annual basis.

Colorado Department of Public Health and Environment
The Colorado Department of Public Health and Environment (CDPHE) has a few grant programs that may be applicable to future LHCC projects, including the Water Pollution Control Revolving Fund and the Water Quality Improvement Fund. Additional details on these grant programs are available at https://www.colorado.gov/pacific/cdphe/wq-grants.

Colorado Watershed Assembly
The Colorado Watershed Assembly (CWA) is a support resource for watershed groups in Colorado. CWA also acts as an advocate for these groups to work with other stakeholders and raise public awareness of watershed issues. CWA lists several other private and government funding opportunities here: http://www.coloradowater.org/Funding%20Opportunities%20List.

Basin Roundtables
The Colorado Water for the 21st Century Act established nine basin roundtables that represent Colorado's watersheds. The South Platte Basin Roundtable planning area includes the Left Hand Creek Watershed.

Red Lodge Clearinghouse
The Red Lodge Clearinghouse was founded in 2001 as a collaborative natural resources management website. The site includes brief overviews of natural resources management loan and grant programs and a list of agencies that can provide assistance on collaboration and stakeholder engagement. It has a searchable funding database at http://rlch.org/funding.
El Pomar Foundation

The El Pomar Foundation in Colorado Springs is a general purpose foundation that approves grants for a variety of projects. The San Miguel Watershed Coalition was awarded $20,000 in 2011 to develop the Dolores River Riparian Action Plan. General information on El Pomar Foundation grants can be found at http://www.elpomar.org/what-we-do/grants. Other sources similar to the El Pomar Foundation may include the Bill and Melinda Gates Foundation (http://www.gatesfoundation.org/How-We-Work/General-Information/Grant-Opportunities) and the Adolph Coors Foundation (http://grants.coorsfoundation.org/login.html?return=%2F). These are also general purpose foundations that may approve grants for many different types of projects.

Additional State and Federal Sources

- Colorado Department of Agriculture
- Trout Unlimited
- EPA and CDPHE for Section 319
- Fishing is Fun through Colorado Parks and Wildlife
- National Fish and Wildlife Foundation
- USACE
- Colorado Parks and Wildlife Wetland program
- Colorado Department of Local Affairs

8.2.3 National Flood Insurance Program

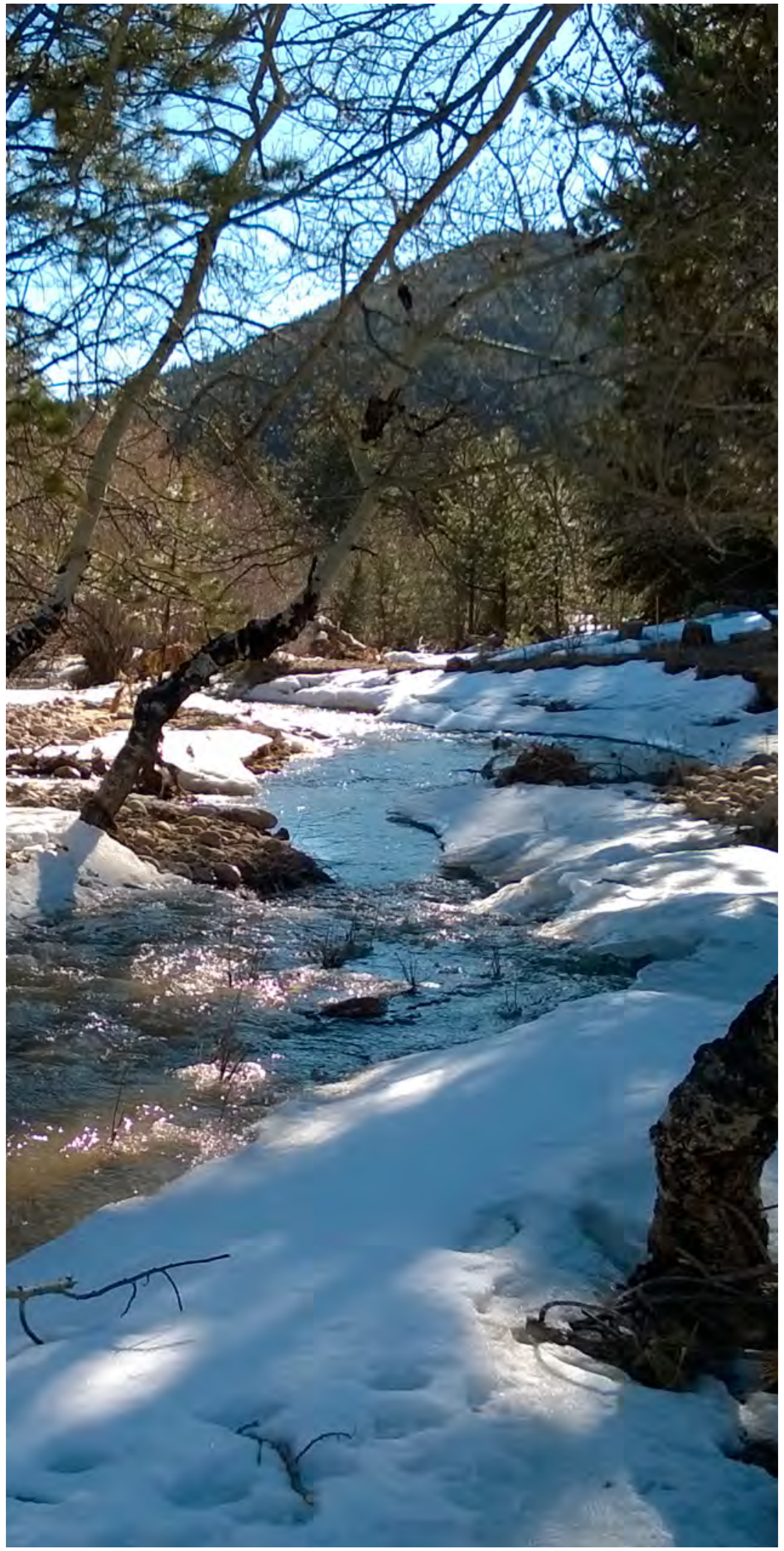
The National Flood Insurance Program (NFIP) is in the process of implementing Congressionally mandated reforms required by the Homeowner Flood Insurance Affordability Act of 2014 that repeal and modify the Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12).

As risks change, insurance premiums also change to reflect those risks. Flood insurance premiums may be going up for some structures; however they may be reduced by building safer, higher, and stronger. The Biggert-Waters Flood Insurance Reform Act of 2012 provides long-term changes to the National Flood Insurance Program. Under the new law, rates are likely to increase overall to reflect the true flood risk of buildings and many insurance discounts will be eliminated. Policy rates for all properties could increase based on one or all of the following circumstances:

- Lapse in coverage
- Change in risk
- Substantial damage or improvement to a building

Some changes will depend on external factors such as when flood risk maps are revised, buildings are damaged or improved, or when flood claims are filed. Flood risk can, and does, change over time. Flood risks change for many reasons: new development, improvements in hazard information, and environmental changes, to name a few. As a result, flood hazard maps are periodically updated. These new flood maps, also, known as Digital Flood Insurance Rate Maps (DFIRMs), show flood risk at a property-by-property level.

When new maps are issued, a property's risk classification may have changed along with the flood insurance requirements. If a property is mapped out of a high-risk area, the flood insurance costs will likely decrease. If a property has been mapped into a high-risk area, it will be required to purchase flood insurance if the mortgage is through a federally regulated or insured lender. One can save money with the Preferred Risk Policy Eligibility Extension and through a process known as grandfathering provided by the National Flood Insurance Program. One can take advantage of grandfathering by buying a policy before the new maps take effect. For older structures built before the community's first flood map was issued (known as pre-FIRM buildings), this is the only grandfathering option when they are mapped into a high-risk area.


Fal River Corridor

9 References

ArcGIS Software

Army Corps of Engineers, HEC-RAS software
CDOT/CWCB (2014). CDOT/CWCB Hydrology Investigation Phase One – 2013 Flood Peak Flow Determinations.

Cluer, B., & Thorne, C. (2013). A Stream Evolution Model Integrating Habitat and Ecosystem Benefits. . Wiley Online Library. , DOI: 10.1002/rra.2631.

Junk, W. J., Baley, P. B. & Sparks, R. E. (1989). The Flood Pulse Concept in river-Floodplain Systems. S.I., Canadian Special Publication of Fisheries and Aquatic Sciences, pp. 110-127.

Kline, M. (2010). Vermont ANR River Corridor Planning Guide: to Identify and Develop River Corridor Protection and Restoration Projects, 2nd edition. Waterbury, Vermont: Vermont Agency of Natural Resources.

Montgomery, D., & Buffington, J. (1997). Channel-reach Morphology in Mountain Drainage Basins. GSA Bulletin, 109(5), 596-611.

NRCS (2009). National Biology Handbook, Subpart B-Conservation Planing, Part 614-Stream Visual Assessment Protocol Version 2, Washington D.C.: United States Department of Agriculture Natural Resources Conservation Service.

Olsen et al. (2014). A Methodology for Delineating Planning-level Channel Migration Zones. Department of Ecology State of Washington, Natural Systems Design, GeoEngineers. https://fortress.wa.gov/ecy/publications/publications/1406025.pdf

Rosgen, D. (1994). A Classification of Natural Rivers. Catena, 22, 169-199.

Schumm, S., Harvey, M., & Watson, C. (1984). Incised Channels: Morphology, Dynamics and Control. Littleton, Colorado: Water Resources Publications.

CDOT, Colorado United, CDOT Incident Command Center, DRAFT March 2014, Update July 2014, Draft Hydrologic Evaluation of the Big Thompson Watershed, Post September 2013 Flood Event, Jacobs, Muller Engineering Company, Inc., Parsons Brinckerhoff, Ayres Associates.

ICON Engineering, Inc., October 29, 2013, Town of Estes Park – High Water Documentation & Flow Estimates.

NRCS, December 2013, COLORADO FRONT RANGE FLOOD of 2013: Peak Flow Estimates at Selected Mountain Stream Locations, Steven E. Yochum, Daniel S. Moore, PE.

this page intentionally blank