Business Plan for the Russian River Coho
March 24, 2009
What Is a Business Plan?

A business plan serves two broad, primary functions. First, it provides specific information to those (e.g., prospective investors) not familiar with the proposed or existing business, including its goals and the management strategy and financial and other resources necessary to attain those goals. Second, a business plan provides internal guidance to those who are active in the operation of the business, allowing all individuals to understand where the business is headed and the means by which it will get there. The plan helps keep the business from drifting away from its goals and key actions through careful articulation of a strategy.

In the context of the National Fish and Wildlife Foundation’s conservation efforts, business plans represent the strategies necessary to meet the conservation goals of Keystone and other initiatives. Each business plan emphasizes the type(s) and magnitude of the benefits that will be realized through the initiative, the monetary costs involved, and the potential obstacles (risks) to achieving those gains. Each of the Foundation’s business plans has three core elements:

**Conservation Outcomes:** A concrete description of the outcomes to which the Foundation and grantees will hold ourselves accountable.

**Implementation Plan with Strategic Priorities and Performance Measures:** A description of the specific strategies that are needed to achieve our conservation outcome and the quantitative measures by which we will measure success and make it possible to adaptively revise strategies in the face of underperformance.

**Funding and Resource Needs:** An analysis of the financial, human and organizational resources needed to carry out these activities.

The strategies and activities discussed in this plan do not represent solely the Foundation’s view of the actions necessary to achieve the identified conservation goals. Rather, it reflects the consensus or majority view of the many federal, state, academic or organization experts that we consulted with during plan development.

In developing this business plan, the Foundation acknowledges that there are other ongoing and planned conservation activities that are aimed at, or indirectly benefit, keystone targets. This business plan is not meant to duplicate ongoing efforts but, rather, to strategically invest in areas where management, conservation, or funding gaps might exist in those broader conservation efforts. Hence, the aim of the business plan is to support the beneficial impacts brought about by the larger conservation community.
Summary

Central California Coast (CCC) coho salmon (*Oncorhynchus kisutch*, also known as silver salmon) are on the brink of extinction. Although their range once stretched inland along more than 250 miles of California’s coast, only a few watersheds now support anything more than remnant populations. The decline of CCC coho salmon has been especially rapid in recent decades, resulting in their listing as endangered under both the State of California and federal Endangered Species Acts.

Resource specialists estimate that fewer than 20 adults may return to the Russian River watershed to spawn, marking a substantial population decline from the historical presence of tens of thousands as recently as the early 20th century (Steiner, 1996). The near extirpation of coho in the Russian River watershed partly results from pressures associated with poor land and water use practices in the basin, including:

- Altered hydrologic regime / low flows
- Fish passage barriers
- Riparian disturbance
- Altered sediment transport
- Channel modification
- Low population abundance

Coho salmon spend one year in fresh water before migrating to the sea, typically in cool pools located on small tributaries. Therefore, these changes in land and water use affect several coho life cycle stages, including adults returning to freshwater streams to spawn, eggs maturing in riffles through winter and early spring, and juveniles rearing in freshwater streams through the summer dry season and winter rainy season.

As a result of these threats, the National Marine Fisheries Service (NMFS) ranks the Russian River as having the second-poorest habitat conditions for coho of all the watersheds within the CCC Evolutionarily Significant Unit (ESU) region (NMFS, 2008A). The severity of the population decline within the CCC ESU, generally, and the Russian River watershed, specifically, provides an imperative for coordinated, strategic recovery actions. As the largest watershed in the CCC ESU, the Russian River contains 17 percent of the historical habitat in the ESU (by stream length) and 33 percent of all habitat targeted for recovery. It is located in the heart of the ESU and, as a result, likely functioned as a source population to many other populations. In short, it is a keystone for coho recovery.

Despite the dire condition of the coho population in coastal California, there is consensus among resource experts that comprehensive and multi-faceted action can return a viable population of coho to the region. **The goal of this Keystone Initiative is to return a viable, self-sustaining population of coho salmon to the Russian River watershed.** This business plan describes a series of strategies for mitigating the direct threats to coho salmon populations. When implemented, the strategies should increase juvenile survivorship and contribute to a self-sustaining population of coho salmon in the Russian River watershed. Because the keystone region incorporates the freshwater (but not saltwater) portion of the coho life cycle, the Russian River Keystone Initiative will focus on increasing juvenile emergence and survivorship.

The primary actions necessary to achieve the Initiative’s goal are:

1. **Changing water management practices.** Currently, many farmers and homeowners divert water from streams or from wells next to streams throughout spring, summer, and fall, when streams naturally recede to low levels. To protect coho, people in the watershed must find and implement water management solutions that include storing water when it is plentiful, in the winter rainy season, for use when water is scarce, in the summer.

2. **Habitat restoration and conservation.** Physical activities must be undertaken to re-structure stream channels and riparian areas where alterations have had negative impacts on habitat value. Where intact instream and riparian habitat remains, it should be conserved.
3. **Population augmentation and monitoring.** Because of the low number of coho currently in the Russian River watershed, it is necessary to augment populations through a broodstock program while carefully monitoring both the population and genetic consequences and evaluating the success of stocking efforts to identify potential causes of mortality or survival.

Currently, there are some efforts underway to restore coho habitat and augment populations in the Russian River. Examples include reach-scale habitat restoration efforts in areas that once supported or currently support coho salmon and a captive broodstock hatchery and monitoring program to evaluate the success of broodstock releases. The work is important, but the needs far exceed available resources. Furthermore, little has been done to address water management conflicts between humans and aquatic/semi-aquatic organisms in the watershed (Christian-Smith and Merenlender, 2008). Therefore, the Initiative will prioritize actions that address water use and promote changes in water management while providing avenues to continue habitat restoration and coho population enhancement and monitoring efforts.

**An underlying hypothesis of this Keystone Initiative is that water for both human and coho salmon can be secured through careful planning and water supply management.**

The problem with water management in the Russian River watershed is that the abundant annual rainfall (between 1000 and 2000 mm in a typical year) occurs almost exclusively through winter. As a result, little water is naturally available to meet human needs through late spring and summer, when demand is greatest. At present, many residential and agricultural needs are met through diversions directly from the stream or from nearby wells throughout the dry season; these diversions cause water levels to fall below coho survival thresholds throughout the drainage network. If a viable coho population is to be returned to the Russian River watershed, both the physical mechanisms (e.g., off-stream ponds or small tanks and associated infrastructure for winter water storage) and social mechanisms (e.g., permitting and water management systems) must be implemented so that growers and residents have the incentives and means to shift their water diversions away from coho streams through the dry season.

Regarding social mechanisms, the Russian River Keystone Initiative area possesses the critical combination of receptive landowners and organizations with the skills and relationships to turn opportunity into action. To date, regulatory and institutional barriers, as much as funding shortfalls, have hindered their adoption. Together, the Partner organizations involved in the Initiative have decades of experience working with landowners in the region, are leaders within the field of water management and regulation, and have the relationships and expertise necessary to convert planning to implementation.

Regarding physical mechanisms, many of the tools necessary to prioritize, analyze and ultimately implement such changes are already in early stages of development: researchers studying the hydrology and spatial dynamics of water need in the Russian River watershed have developed a spatially explicit modeling tool to assess cumulative water needs and the impacts of various methods of water extraction in a watershed (Merenlender et al., 2008). This tool can be used to achieve a balance between human and ecological needs: it can add and subtract diversions and reservoirs and evaluate their impacts on streamflow using various hydrologic scenarios, and it can show how methods of storing water in winter can relieve pressures through the dry season. In addition to providing a framework for assessing the impacts of new water storage on streamflow, it can incorporate real-time information to serve as a governance tool for managing water in a watershed to ensure that projects operate to minimize the impacts of winter diversions on coho.

The preliminary roles of the Partner organizations have been defined based on previous coho recovery actions in the Russian River watershed. The Gold Ridge Resource Conservation District and Sotoyome Resource Conservation District will lead initial outreach and develop the primary outreach mechanisms for communicating objectives and benefits with landowners. They are uniquely suited and qualified for that role as they are already coordinating much of the physical habitat restoration underway in the watershed. The RCDs will be assisted in their outreach efforts by the Occidental Arts and Ecology Center, which will provide regional and institutional guidance. The Center for Ecosystem Management and Restoration, with assistance from the University of California Hopland
Research and Extension Center, will provide scientific and technical guidance for creating and validating water management models. Trout Unlimited will work with landowners and agencies to break through the legal and institutional barriers to progress on stream flow restoration, generally, and the establishment of streamflow and water management plans for groups of water users, specifically. The California Department of Fish and Game (CDFG), University of California Cooperative Extension, NMFS, and Sonoma County Water Agency (SCWA) will provide monitoring and technical expertise related to understanding coho population dynamics in the watershed. The Sonoma County Salmon Coalition and other agricultural associations will be integral participants in the Initiative’s efforts.

The California Department of Fish and Game estimates the cost of physical habitat restoration to restore coho to the Russian River could total over $200,000,000 through the first half of the 21st Century (CDFG 2004). Coho recovery will require changes in water resources management in addition to physical habitat restoration; the physical and informational infrastructure necessary for these fundamental shifts in water management will likely push the cost for coho recovery much higher.
Conservation Need

Coho salmon native to the Russian River in northern coastal California are on the brink of extinction. Historically, the Russian River contained the largest coho population in the Central Coastal California ESU (NMFS, 2008A). Russian River coho were once sufficiently abundant to sustain an estimated commercial harvest of over 13,000 annually (Steiner, 1996). Good et al., (2005) report a 95 percent decline from approximately 5,000 coho in 1965 to fewer than 300 by the early 1990s. Despite its importance and its status as the largest watershed in the ESU, today the Russian River supports few adult coho salmon. Freshwater habitat degradation resulting from land and water uses is a primary driver of this dramatic decline (NMFS, 2008A). The Initiative’s Logic Framework (Figure 1) identifies six priority threats, detailed below (in bold):

Changes in land use associated with human development in the Russian River watershed have placed many pressures on stream and riparian ecosystems throughout the basin. Common land use practices have altered the hydrologic regime, from headwater tributaries to the major waterways that drain the basin. Coho salmon spend one year in fresh water before migrating to the sea, generally in small tributaries. In Russian River tributaries, small instream diversions and riparian groundwater pumping for agriculture, rural residential, and municipal use can cause instream conditions to change suddenly, potentially halting streamflow and in some cases drying streams completely (Deitch et al., 2009A). These changes in streamflow tend to be most pronounced in summer, when streamflow recedes naturally and water need for agriculture is highest (but may also occur in spring and fall, depending on local climate conditions and water use) (Deitch et al., 2009B).

Amplified runoff (another form of altered hydrologic regime) from adjacent land use also impacts tributary habitat. Vineyards and urbanized areas alter the pathways of rainfall once it reaches land, concentrating it in surface or subsurface drains, rather than allowing it to infiltrate to groundwater. As a result, winter runoff tends to be amplified during rainfall events, and less water percolates to replenish the groundwater that supplies base flow between rainfall events and through the dry season. Besides altering the hydrologic regime, amplified runoff increases channel erosion (through channel widening and incision) and landslide frequency, and reduces the filtration capacity of riparian areas. Together, these effects have negative consequences on water and channel substrate quality (by increasing the supply of fine sediment to the stream).

Other factors critical to coho survival have been altered as well. Riparian disturbance (e.g., the encroachment of human activities into the riparian zone) has altered channel morphology and increased the possibility of bank failure. Removal of riparian vegetation associated with these activities reduces shade, causing stream temperature to increase while also eliminating important sources of material for instream cover, nutrients, and pool-forming processes (especially important for coho because of their reliance on cool water temperatures and pools to complete their life cycle). Similar to amplified runoff, bank failures caused by channel destabilization can alter sediment transport through the addition of fine sediment to the stream. Fine sediment can cover and clog substrate in riffles, reducing the stream’s suitability for spawning and degrading water quality for incubating embryos and emerging fry.

Human-caused alterations to channel morphology can have other negative effects. Road crossings, diversion dams, and rapid bed erosion have created fish passage barriers throughout the watershed by limiting the extent of habitat that coho can access for spawning. Channel modification is common; streams are often armored and straightened to accommodate roads, driveways, or crops, increasing water velocity and eliminating the complexity of habitat types that would develop under natural processes. Land use practices such as forest harvesting and mining have also left legacy impacts on streams, most notably in the form of road crossings and fine sediment loading caused by landslides and poorly designed road networks.
In addition to the alterations to streamflow, instream habitat, and riparian habitat in tributaries, two major facilities are operated for flood control and water transmission to provide municipal and agricultural water supply within and outside the watershed. The altered flow regime caused by Coyote Valley Dam and Warm Springs Dam change the natural hydrology and geomorphology of the mainstem Russian River, its largest tributary Dry Creek, and the Russian River estuary. In Dry Creek, Warm Springs Dam releases artificially high flow through summer and reduces peak discharge through winter. In addition to altering flow regime, these flow releases have altered sediment transport and instream habitat, and has adverse impacts on estuary formation and function as well. Water transmission practices also entail channel modification to maintain municipal water delivery and reduce the impacts of flooding in the major urban and agricultural regions. NMFS determined that the alterations to the Russian River and Dry Creek caused by these projects jeopardized the continued existence of coho salmon, as well as Chinook salmon and steelhead trout (NMFS, 2008B). As a result of the NMFS Biological Opinion, a suite of flow modifications, habitat enhancements, population augmentation, and physical and biological monitoring strategies will be conducted by the Sonoma County Water Agency and the United States Army Corps of Engineers beginning in 2009 with restoration and monitoring continuing through 2023.

Finally, the markedly low abundance of coho salmon in the watershed creates its own set of challenges to restoring a viable population. At such low population levels, catastrophic events such as stream dewatering at a critical life stage could extirpate the population. Low numbers of returning adult coho also increases likelihood of depensation (specifically, the inability of returning coho to find spawning partners). Additionally, the coho captive broodstock program has found preliminary evidence of inbreeding depression within the remnant Russian River population. Without broodstock program supplementation, it would be nearly impossible for coho populations to increase to the levels targeted in this initiative. Other natural factors that can exacerbate stressor impacts on coho salmon, such as climate change and poor ocean conditions, are beyond the scope of this discussion but must be included as points for consideration and monitoring as implementation plans are developed.

In addition to the obvious benefits of enhancing freshwater survival, providing opportunities for enhanced marine survival is also important. Studies have found a positive relationship between coho smolt body size and marine survival, particularly over years of poor ocean survival (Holtby et al., 1990) and when migrations occur early in the spring (Labelle et al., 1996). Although substantial growth occurs in tributary habitats, there is evidence that the mainstem of the Russian River and its estuary may provide opportunities for accelerated growth. For example, based on limited data, individual growth rates of coho smolts between their natal stream and the estuary averaged 1.0 grams/day (with one individual experiencing a 40 percent increase in body length during 47 days of travel time through the mainstem and estuary). This represents a 30 percent higher growth rate as compared to the previous year in the individual’s natal stream (UCCE, personal communication). Recent literature has also proposed that coho “nomads” (0+ coho that rear in the estuary and return to freshwater to overwinter) represent an alternative life history strategy that may contribute to the resilience of a population (Koski, 2009). These estuaries can be key locations for growth of anadromous salmonids in coastal California (Hayes et al., 2008). By better understanding the links between the various environments encountered by pre-smolt, smolt, and post-smolt life stages of coho, we can better ascribe and prioritize the relative importance of management and restoration options.

The Logic Framework on the following page describes how altered land use and water management can cause direct threats to coho salmon, adversely affecting habitat in ways that reduce coho survival.
Figure 1. Logic Framework illustrating the causes of the direct threats to coho salmon in the Russian River watershed. Logic frameworks are typically composed of several chains of logic whose arrows are read as “if-then” statements to help better understand how threats contribute to conservation target declines. Logic frameworks are used to define the conservation problem, assess limiting factors, and prioritize key strategies.
Conservation Outcomes

The overall goal of this Initiative is to recover a viable self-sustaining population of coho salmon to the Russian River watershed through actions that increase the likelihood of survival for coho salmon during freshwater and estuarine life stages. This includes:

- Adults access to appropriate spawning grounds, egg incubation in redds, and alevin emergence through winter and early spring;
- Juvenile survival through the spring, summer, and fall dry season;
- Juvenile survival through the rainy season;
- Smolt migration to the ocean.

The CCC Coho Salmon Recovery Plan produced by NMFS sets a goal of 6,240 returning adult coho to the watershed as a biological criterion to signify “population viability and final recovery.” NMFS (2008A) estimates that it could take 50-100 years to reach that goal. In addition to meeting this long-term adult recovery target, a goal of this Initiative is to provide habitat for a consistent, naturally spawning population of adult coho in five subwatersheds that serve as the near-term focus of this initiative, described below.

The Initiative underscores the importance of aquatic ecosystem conservation within the Russian River watershed; however, as described above, this represents only the freshwater and estuarine portion of the coho salmon life cycle. Because the Initiative focuses on the freshwater ecosystem and does not consider ocean factors beyond the Initiative’s control, it is useful to set intermediary, and freshwater-focused, life cycle targets linked to instream processes that more accurately evaluate progress under the Initiative. Since 2005, the University of California Cooperative Extension has been tracking seasonal survival of juvenile coho from a captive coho broodstock program (reports available online: http://groups.ucanr.org/RRCSCBP/). Based on these estimates, the Initiative identifies two conservation outcomes (in addition to an increase in adult coho abundance) that can indicate success:

- Increase average estimated juvenile oversummer survival from the present average rate of 35 percent to 50 percent.
- Increase average estimated juvenile overwinter survival from the present average rate of 18 percent to 40 percent.

If these targets are reached, the Russian River may have two to three times the number of returning adults as would be projected without the program (Figure 2). These estimates will vary with ocean conditions (which influence marine survival), but the increases in returning coho described here as “targets” for returning adults are estimated as a direct result of the Initiative.

To achieve these outcomes, the Initiative must include projects to restore and conserve instream and riparian habitat; and develop and implement plans for water management in tributaries expected to support coho salmon over the next 12 years. The CCC Coho ESU Draft Recovery Plan (NMFS, 2008A) identifies “Core” areas where existing populations must be stabilized as a first step to recovery, as well as “Phase I” areas with recently documented populations and habitat conditions potentially suitable for coho (Figure 3). All of these Core and Phase I watersheds are important for restoring and maintaining coho salmon in the Russian River watershed, and should be considered vital for this Keystone Initiative. Of these, five tributaries are identified in this Initiative as critical for near-term restoration activities that focus on restoring an adequate hydrologic regime. Three of these — Dutch Bill, Green Valley, and Mill Creeks — are Core areas; the other two — Mark West and Grape Creeks — are recognized as Phase I areas with potential for near-term repopulation recovery (NMFS, 2008A). In later years, the Initiative calls for hydrologic restoration activities for other core and Phase I tributaries. In addition, other (non-water) habitat restoration activities and monitoring will be essential in both the core and reintroduction areas, although the specific threats and opportunities vary by tributary.
Figure 2. Theoretical projection of returning adult coho salmon to the Russian River, with Russian River Keystone Initiative (Target instream survival rate) and without (Current instream survival rate). The projections vary with the ability for coho to survive through the marine portion of their life cycle. Theoretical projections are based on juvenile and smolt survival estimates (freshwater) with and without Keystone Initiative efforts, broodstock program juvenile releases, and estimates of marine survival.
Initial focus on water restoration activities

4. Grape; 5. Mark West

Figure 3. Core and Phase I watersheds (as identified by the National Marine Fisheries Service Coho Recovery Plan) that are essential for coho recovery in the Russian River watershed; and specific watersheds (numbered 1-5) for which restoration activities must focus on restoring an adequate hydrologic regime. (See Appendix for more details about existing and proposed habitat restoration in coho watersheds.)
Implementation Plan

The contributing factors and threats limiting persistence of a viable population of coho salmon in the Russian River watershed (as depicted in Figure 1) can be grouped into three categories:

1. Altered flow regime dynamics, resulting in less water available during the dry season, and greater streamflow fluctuations the wet season, and altered sediment dynamics in winter.

2. Degraded and reduced instream and riparian habitat resulting in less habitat, reduced channel complexity, and altered biochemical processes and natural sediment dynamics.

3. Population threats that include low abundance of coho in the watershed, resulting in reduced reproductive success (depensatory effects), and a generally poor understanding of linkages among freshwater, estuarine, and marine habitats.

The Russian River Coho Salmon Keystone Initiative Business Plan identifies three Key Strategies, described below, to address these threats. Implementation strategies for restoring coho salmon in this Keystone Initiative will:

1. Alter water management practices in ways that will improve water security for residential and agricultural needs and improve streamflow for coho.

2. Increasing the amount and quality of riparian and instream habitat.

3. Augment the populations and genetic diversity of coho in streams, to monitor coho populations in the Russian River basin, and expand our understanding of factors limiting coho survival in its estuary and the ocean.

Of these Strategies, watershed-scale efforts to develop and implement ecologically sustainable water management practices are currently the least developed within the basin; but are crucial for recovery.

Key Strategy 1 — Water management plan development and implementation.

As described above, human development and land use practices have altered the dynamics of streamflow in the Russian River watershed. The California Department of Fish and Game Coho Recovery Strategy (2004) and the NMFS Draft Recovery Plan (2008A) identify water diversions as a significant threat to coho salmon populations. According to the Draft Recovery plan, water diversion is one of the most difficult threats to abate, yet threat abatement is “paramount” to coho recovery (NMFS, 2008A).

By diverting water from streams or nearby groundwater during the dry season when water need is greatest, people may be drawing the last surface flow from streams that support over-summering coho until rains begin again the following winter. Restoration of coho to the Russian River will require changes in traditional water management practices on a watershed scale, including modifications in how and when water is acquired and dispersed for human use. It will also require a level of planning, coordination, and management unprecedented in California. As such, the Keystone Initiative will serve as a model and proving ground for successful flow restoration throughout the CCC ESU.

The complex nature of water law and water right governance has caused prior efforts to address stream flow and water quantity to gain less traction than more traditional restoration arenas (e.g., sediment reduction, riparian vegetation enhancement). For a farmer or homeowner, water is the essential predicate for stable living. In California, as throughout the West, questions of water supply and allocation are notoriously thorny, and trigger emotional reactions. It does not help matters that state water right governance is ineffective at best, and at worst antithetical to aquatic ecosystem conservation (Deitch, 2006).

Physical solutions—namely, changes in the timing and manner of diversion — may allow people to meet their water needs in a way that dramatically improves stream conditions. Storage of winter streamflow in small ponds and water tanks can ameliorate many of the hydrologic impacts of altered
land use and associated diversion practices. Small water tanks can provide domestic water supply through the dry season, and ponds may be designed to meet vineyard water needs for frost protection in spring and irrigation in summer and fall. Small reservoirs and settling ponds can also be constructed to increase groundwater infiltration and increase streamflow through summer. However, many challenges must be anticipated in the process of changing water management, underscoring the importance of a carefully designed and executed plan. Such a plan should include:

A. Initial water management planning for focal watersheds

Recognized as supporting or recently having supported coho salmon where low summer streamflow is a primary limiting factor for coho survival (numbered 1-5 in Figure 3). Preliminary planning sessions will provide the opportunity for cursory watershed-scale water analysis, and allow team members to effectively communicate our message and objectives to landowners who might be interested in the project.

Risks and challenges: (i) failing to find and create appropriate incentives for landowner participation; (ii) failing to respond adequately to the concerns of water users.

Solution: The project implementation team should represent diverse perspectives and bring with it a diverse suite of expertise and experience. The team should also familiarize itself with the handful of successful (and unsuccessful) streamflow restoration projects in California and other western states.

B. Landowner outreach/recruitment

Because the project ultimately rests on the participation of water users in the watershed, outreach is an important component of developing a comprehensive water management plan. Outreach and recruitment may include identifying the appropriate audience, developing relationships with landowners, performing educational workshops on how changes in management actions can increase water security and help restore coho populations, and a great deal of one-on-one trust building.

Risks and challenges: (i) presenting an unclear message; (ii) failure to describe benefits specific to landowners; (iii) failing to reach important water users and political players in each watershed.

Solutions: These risks can be minimized through preliminary planning, internal meeting evaluation, inclusion of local stakeholder groups, formulation of a watershed Technical Advisory Committee, and follow-up meetings and workshops.

C. Watershed-scale water need and availability analyses

Understanding the amount of water needed in a watershed for humans and for fish, as well as the temporal and spatial dynamics of its availability, will be critical to determine methods for meeting human water needs while protecting and enhancing streamflow for coho salmon. GIS models can calculate human water need cumulatively through a drainage network and depict the cumulative impacts of hypothetical water storage and diversions to meet those needs. Assessments of water available for diversion will require streamflow monitoring across a drainage network to describe how streamflow varies from headwaters to lower reaches through the year. It also will require thorough biological studies of the relationship between streamflow and ecosystem function for coho salmon (e.g., migration, spawning needs) so that prescribed management objectives minimize the impacts to instream flow needs and maximize water returned to the stream.

Risks and challenges: (i) gathering insufficient/incomplete information; (ii) collecting information at the wrong locations; (iii) using inappropriate information for making assessments of coho water needs.

Solutions: Mitigating these risks will require successful outreach to refine and confirm model inputs, strategic placement of gauges to inform hydrologic models, and thorough studies of instream water needs to protect coho flow needs (with input from resource agencies and other experts in the field). These risks also underscore the importance of continual monitoring and adaptive feedback loops to ensure that prescribed diversion practices protect coho.
D. **Identify management objectives and develop water management plans.** After water demand and supply have been characterized, we will identify opportunities for improvement (water storage, efficiency, coordination of diversions, etc.). Management objectives combine the management of the physical projects to be completed (ponds, tanks) with the maintenance of instream processes important for sustaining coho in the watershed (flow, temperature). For example, if a potential management action includes shifting an agricultural diversion from summer to winter with the use of a pond, we will need to identify terms and conditions for the permits that enable the new diversion. These may include instream flow analyses to establish thresholds for flow associated with successful upstream migration, egg incubation, and juvenile outmigration, as well as peak flows needed to form and maintain habitat structure. Management plans are watershed-scale frameworks that define the methods and locations for diversion and storage to meet human water needs, in the context of defined management objectives. Beyond balancing human and ecosystem water needs, management plans also require several actions. These include the legal and regulatory support for water storage and distribution through a watershed, assessments of physical and geological limitations to storing water where needed, and finding ways to fund the water storage construction.

**Risks and challenges:** (i) historical inability of agencies to process water right applications and changes in a timely matter; (ii) making inaccurate linkages between streamflow and coho water needs; (iii) other legal hurdles in water storage (e.g., creating or destroying habitat for other endangered species or non-native species); (iv) inter-landowner disagreements preclude cooperation; (v) landowner fear of regulatory agencies and regulatory uncertainty; (vi) financial and physical constraints of reservoir construction; (vii) management plans not achieving streamflow objectives.

**Solutions:** Risks associated with identifying management objectives and creating water management plans can also be addressed through support from previous activities and careful planning. Management objectives will be informed through assessments of water availability; like those assessments, management objectives must also contain feedback loops to ensure that objectives provide their intended benefit. Legal issues regarding storing water will require team members to work with several state and federal regulatory agencies and use the water availability assessments to show how removing water fits within regulatory guidelines. One of the project partners sponsored an important piece of legislation to establish the region’s instream flow policy (State Assembly Bill 2121), and the emerging policy is expected to support water user efforts to change the timing of diversion and complete stream flow restoration projects. Outreach with landowners in each watershed will be a continuous component of the Initiative, and will be necessary as project leaders propose methods for acquiring water, share them with various stakeholders, and demonstrate the benefits of water storage as defined by the management plans. Team members will also have to reach to additional funding sources, as needed, to fund reservoir and storage tank construction.

E. **Develop governance mechanisms to implement water management plans.** Governance mechanisms are the methods through which the water management plans are implemented. They describe the rules and protocols for people in each watershed to obtain water, and must consider priorities and rights to using water, given the amounts available for diversion. Similar to creating management plans, creating governance mechanisms will also require communication among water users and other stakeholders, and regulatory agencies that approve water management strategies from a legal perspective.

**Risks and challenges:** (i) participation among landowners; (ii) regulatory fears and concerns; (iii) compliance with governance mechanisms; (iv) communication in operation of diversions; (v) inaccurate linkages to management objectives.

**Solutions:** The risks and challenges associated with establishing and implementing governance mechanisms underscore the importance of establishing strong stakeholder relationships before the latter stages of the project and an active role for legal experts to interface with
regulatory agencies. If the previous activities are completed successfully, mitigating these risks will be much easier. Also, the technical infrastructure must be created to communicate water levels and diversion operation instantaneously to ensure that diversions operate in compliance with management plans. For example, if the management plan relies on a group of landowners to coordinate wintertime diversions to meet designated instream flow thresholds, governance tasks might include defining the organization that would manage the stream gauges, funding sources, permit reporting, and dispute resolution.

Key Strategy 2 — Riparian/instream habitat restoration, conservation, and augmentation (R/C/A).

Human development and land use practices in the Russian River watershed have also frequently resulted in altered stream channels, reduced riparian zones, and reduced access to suitable spawning habitat. Streambank alterations have resulted in a loss of natural habitat complexity (i.e., riffles, pools, and other refugia), effectively limiting the capacity for freshwater streams to serve as spawning, rearing, and migratory habitat for a viable coho salmon population. The removal of riparian vegetation has caused increases in temperature, fine sediment, and toxins that impair coho productivity and survival, as well as reduced instream complexity as a result of fewer sources of large woody debris. Effective restoration will address both impaired habitat functions and habitat forming processes, and it will protect those habitats that presently function well.

Activities designed to address this Key Strategy may include, but are not limited to:

A. Riparian enhancement projects, which include developing enhancement plans and executing revegetation activities. Riparian enhancement improves riparian zone function, which can improve water quality and increase instream habitat complexity.

B. Sediment reduction projects, which include source identification, reduction plans, and implementation activities. Fine sediment reduction improves water quality and habitat complexity, and can increase the likelihood of spawning success.

C. Instream habitat improvement projects. Repairing instream habitat may include actions to increase channel complexity (through boulder or large woody debris placement), modify local channel gradient, and reconnect floodplain.

D. Barrier removal projects, which include actions to quantify the extent and quality of coho habitat above barriers, draft alternative structure designs, and execute barrier removal. Depending on the location of these barriers, their removal could reconnect large reaches of coho habitat.

E. Habitat conservation, which may include actions to acquire easements or purchases of lands or corridors identified as having important value to coho salmon. Conservation efforts are intended to protect habitat from potential future degradation.

Landowner outreach and education are important components of all these activities. Partnerships among many groups, including the Sotoyome and Gold Ridge Resource Conservation districts, NMFS, CDFG, SCWA, and Trout Unlimited have begun R/C/A activities in the areas identified as primary coho watersheds (See Appendix A). However, given the extent of development in the watershed, it is likely that additional efforts will be necessary to restore watershed processes (through riparian and instream restoration) to benefit coho salmon in each stream system identified here. Partnerships with local conservation organizations such as the Sonoma County Agricultural Preservation and Open Space District and the Sonoma Land Trust, and many others, will be expanded.
Primary risks and challenges to conducting habitat restoration, conservation, and augmentation include the cost of such activities, opportunistic rather than strategic project implementation, obtaining permission from landowner and regulatory organizations, and evaluation mechanisms to assess the benefits of various actions on coho habitat. Initiative partners will work together on a strategy to fund, implement, and monitor projects and facilitate project implementation via landowner outreach and agency cooperation.

**Key Strategy 3 — Population augmentation, monitoring, and evaluation.**

In addition to habitat restoration efforts aimed at addressing the rapid decline of coho salmon in the Russian River, CDFG, NMFS, and the United States Army Corps of Engineers (USACE) began the Russian River Coho Salmon Captive Broodstock Program in 2001, with the long-term goal of restoring self-sustaining runs of coho to tributaries of the Russian River. Under this program, juvenile coho are collected from streams within the Russian River watershed, and, more recently, the Olema Creek watershed. These fish are raised to maturity and spawned at Don Clausen Warm Springs Hatchery at Lake Sonoma according to a genetic matrix provided by NMFS Southwest Science Center that is designed to maximize genetic diversity in the Russian River population. Beginning in 2004, CDFG began releasing the offspring of these captive-bred fish into Russian River tributaries that historically held runs of coho salmon. Today, juvenile coho are released annually into several streams including Mill, Green Valley, Dutch Bill, Sheephouse, Gray, and Gilliam Creeks. Integral to this program is a monitoring component that UC Cooperative Extension developed in coordination with CDFG, NMFS, USACE, and SCWA. The monitoring program was designed to assess growth and survival of coho released from the hatchery into the tributaries. Current monitoring includes annual operation of smolt traps and adult traps on Mill and Green Valley Creeks that provide data to estimate smolt abundance, juvenile overwinter survival, abundance of returning adults, and smolt to adult survival. Spawner surveys and juvenile presence/absence dive surveys are also conducted on these creeks as well as on Dutch Bill Creek. Four years of juvenile oversummer survival data was collected on selected coho program streams, but these efforts have been discontinued. Results from monitoring efforts are used to inform the future direction of the program.

Although a core coho broodstock and monitoring program is currently in place, augmentation of this program will be necessary to reach the goals targeted in this Initiative. Although it is too early in the broodstock program to determine whether it has been successful based on adult returns, monitoring efforts indicate that the program will need to expand its rearing capacity so that it can release more fish into additional tributaries each year and develop strategies to successfully release smolts.

Monitoring thus far has focused on the instream portion of the life cycle, and there is a lack of information related to how released fish perform once they emigrate from the tributaries into the larger riverine and estuarine environments. Evidence from other studies has shown that estuaries provide critical habitat for growth growth for steelhead (*Oncorhynchus mykiss*) (Bond *et al.* 2008; Hayes *et al.*, 2008) and Chinook salmon (*O. tshawytscha*) (Reimers, 1973; Simenstad *et al.*, 1982), and that estuarine rearing may be significant for coho salmon as well (Koski, 2009). Because the Russian River is relatively long, the riverine and estuarine environments may provide either huge benefits or detrimental impediments to survival and ocean preparedness. An improved understanding of linkages between survival in freshwater, estuarine, and marine environments would help explain trends in adult return data.

Additional monitoring will also be required to directly evaluate the effects of changes in flow management that result from this Initiative. Estimation of oversummer growth, movement, and survival of salmonids in priority streams (before and after changes in flow management in both treatment and reference reaches) will provide evidence for improvements in habitat. By comparing these population metrics with environmental data including seasonal patterns in flow, stream connectivity, wetted area and water temperature, we will be able to evaluate the outcomes of the proposed Initiative.
Strategies to increase the number of coho returning to the Russian River, and to more directly monitor the effects of actions taken in Keystone Strategies 1 and 2 include (but are not limited to):

A. Continue current coho releases and evaluation of release strategies.
B. Develop and evaluate new release strategies (e.g., smolt acclimation tanks on tributaries).
C. Increase coho rearing capacity at Warm Springs Hatchery (current capacity is 100,000 juveniles).
D. Outreach to sport anglers to prevent incidental take of program adult returns (adipose-clipped program coho can be confused with hatchery steelhead).
E. Expand monitoring efforts to include estimates of oversummer growth, movement and survival of salmonids in priority streams in relation to habitat conditions such as flow and temperature.
F. Expand monitoring to include assessment of estuarine and marine coho growth and survival. Although this Initiative is focused on the stream portion of the life cycle, it is important to identify critical bottlenecks to growth and survival in the estuarine and marine environments that may be preventing recovery.
G. Relate growth and survival of Russian River coho populations to neighboring CCC ESU populations and to trends in the marine environment (e.g., upwelling cycles, productivity) so that progress towards meeting recovery goals can be evaluated in the context of recovery of the entire ESU.

The primary risks and challenges to successfully augmenting and monitoring populations include inadequate or inconsistent funding, and a multitude of factors and interannual variability influencing salmonid growth, residency, and survival. A critical overarching risk to this project is that the population will continue to be supported primarily through hatchery fish, rather than wild ones; hatchery fish may innately not survive as well as wild fish, requiring a higher number of smolts to sustain the population than would be necessary for sustaining a run of wild coho. The overall goal of this Initiative is to overcome this risk, and the strategies described above of developing/implementing water management plans and conducting habitat restoration/conservation/augmentation are intended to develop a wild coho population to the Russian River watershed.

Organizing Strategy

Partners participating in the initiative will coordinate their efforts and their relations with NFWF and other stakeholders as described below. The structure follows models used successfully by Trout Unlimited and OAEC Water Institute on other initiatives.

First, there will be a Technical Advisory Committee. The purpose of the TAC is to both ensure involvement of all partners throughout the process and to develop a common understanding between the Partners, local water users, and regulatory agencies as to the study designs and approach that will be used to develop the social, scientific, and regulatory foundation for stream management plans described above.

Second, the grantees will hire and support a person to coordinate the Initiative. This coordinator will report to a Steering Committee of NFWF grantees (over time, the groups on the steering committee may change as proposals are funded under the umbrella of the Business Plan). Her job duties will include coordinating partner efforts to fulfill the Business Plan, convening the TAC, and coordinating partner communication (e.g., grant reports) with NFWF, and other duties defined by the steering committee. She will have an email address and letterhead that identify her as working on behalf of the full Initiative, rather than any of the member groups. However, for administrative convenience, the partners expect that one of the member groups will serve as the fiscal sponsor for her office and for payroll and benefits, and other administrative matters.
Funding Needs

The following tables describe the funding that has either (a) been committed for recovery of coho over the following two decades; or (b) is still needed for near-term projects to recover coho populations. Table 2 describes the total amount for projects that are priorities in the near future, and for which plans have already been developed, rather than the total amount that resource agencies have recognized as needed for coho recovery. In total, the California Department of Fish and Game estimated that habitat restoration for coho population recovery in the Russian River watershed would cost over $220,000,000 (CDFG, 2004). The budgets laid out in these tables represent significant steps toward reaching the long-term funding need.

Table 1. Committed funding for coho restoration

*Key Strategy 1: Water management*

<table>
<thead>
<tr>
<th>Lead Group</th>
<th>Action</th>
<th>Cost</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trout Unlimited</td>
<td>Water management improvements, Grape Creek watershed</td>
<td>$200,000</td>
<td>2010-2013</td>
</tr>
</tbody>
</table>

*Key Strategy 2: Habitat restoration, conservation, and augmentation*

<table>
<thead>
<tr>
<th>Lead Group</th>
<th>Action</th>
<th>Cost</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sonoma County Water Agency</td>
<td>Habitat Enhancement of Dry Creek channel (In-stream improvements for 6 miles of mainstem)</td>
<td>$18,000,000</td>
<td>2013-2020</td>
</tr>
<tr>
<td>Sonoma County Water Agency</td>
<td>Dry Tributary Fish Passage and Restoration Projects</td>
<td>$1,000,000</td>
<td>2009-2011</td>
</tr>
<tr>
<td>USACE</td>
<td>Dry Creek Winter Flow Stream Enhancements (14 mile segment)</td>
<td>$12,900,000</td>
<td>2013-2020</td>
</tr>
<tr>
<td>NMFS Restoration Center</td>
<td>Habitat restoration in Russian River — competitive grant process</td>
<td>$1-2,000,000 annually</td>
<td>2009-</td>
</tr>
</tbody>
</table>

*Key Strategy 3: Broodstock Program support / coho population evaluation*

<table>
<thead>
<tr>
<th>Lead Group</th>
<th>Action</th>
<th>Cost</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFG/UCCE/USACE</td>
<td>Broodstock hatchery operation/improvement/monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sonoma County Water Agency</td>
<td>Dry Creek Fisheries Monitoring</td>
<td>$3,000,000</td>
<td>2009-2023</td>
</tr>
<tr>
<td>SCWA</td>
<td>RRCSCBP (coho broodstock program) annual production of additional 10,000 smolts for Dry Creek</td>
<td>$1,200,000</td>
<td>3/1/09 to 2/28/21</td>
</tr>
<tr>
<td>SCWA</td>
<td>Russian River Estuary Fisheries, Invertebrate, and Water Quality Sampling</td>
<td>$2,500,000</td>
<td>5/1/09 to 10/31/18</td>
</tr>
<tr>
<td>USACE</td>
<td>RRCSCBP (coho broodstock program) $300K/yr program with escalation for 15 year duration</td>
<td>$6,000,000</td>
<td>3/1/09 to 2/28/21</td>
</tr>
<tr>
<td>USACE</td>
<td>WSD Emergency Water Supply for Hatchery Estimated cost from Corp Feasibility Study — one time cost</td>
<td>$9,400,000</td>
<td></td>
</tr>
</tbody>
</table>

Total: $54,200,000
Table 2. Funding needs (funds still needed for previously identified projects)

Key Strategy 1: Water management

<table>
<thead>
<tr>
<th>Lead Group</th>
<th>Action</th>
<th>Cost</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russian River coho partnership</td>
<td>Water management improvements, initially in 5 key watersheds</td>
<td>$6,000,000</td>
<td>2010-2022</td>
</tr>
</tbody>
</table>

Key Strategy 2: Habitat restoration, conservation, and augmentation

<table>
<thead>
<tr>
<th>Lead Group</th>
<th>Action</th>
<th>Cost</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sotoyome RCD</td>
<td>Habitat and water quality improvement, Russian River coho tributaries</td>
<td>2,166,800</td>
<td>2009-2012</td>
</tr>
<tr>
<td>Gold Ridge RCD</td>
<td>Habitat and water quality improvement, Russian River coho tributaries</td>
<td>$1,855,000</td>
<td>2009-2012</td>
</tr>
<tr>
<td>California State Parks</td>
<td>Habitat and water quality improvement, Russian River coho tributaries</td>
<td>$800,000</td>
<td>2009-2011</td>
</tr>
</tbody>
</table>

Key Strategy 3: Broodstock Program support / coho population evaluation

<table>
<thead>
<tr>
<th>Lead Group</th>
<th>Action</th>
<th>Cost</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russian River coho partnership/UCCE</td>
<td>Expansion of coho monitoring to specifically evaluate over-summer survival, growth, and migration as it relates to flow on the five priority streams</td>
<td>$1,200,000</td>
<td>2010-2022</td>
</tr>
<tr>
<td>Sonoma County Water Agency</td>
<td>Russian River Estuary salmon diet, otolith microstructure/microchemistry, and bioenergetics modeling</td>
<td>$250,000</td>
<td>7/1/09 to 3/31/11</td>
</tr>
<tr>
<td>Sonoma County Water Agency</td>
<td>North Coast Studies Program Bodega Line zooplankton and hydrographic sampling</td>
<td>$350,000</td>
<td>3/31/09 to 2/28/10</td>
</tr>
<tr>
<td>Sonoma County Water Agency</td>
<td>North Coast Studies Program Bodega, Line sampling coordinated monthly with Fort Bragg, Humboldt, Newport line sampling</td>
<td>$3,150,000</td>
<td>3/1/10 to 2/28/19</td>
</tr>
<tr>
<td>UCCE/SCWA</td>
<td>Acoustic tracking of coho smolts to estimate growth, survival and migration timing through the riverine and estuarine environments</td>
<td>$150,000</td>
<td>2010-2013</td>
</tr>
</tbody>
</table>

Total: $15,921,800

The funding needs outlined in “Group 2” tables include only those projects that have already been identified, and do not represent funding needs for returning a viable population of coho salmon to the Russian River watershed. CDFG (2004) estimates that over $220,000,000 will be needed for habitat restoration to recover the population of coho in the Russian River watershed. Because this does not include the likely additional costs associated with water management and infrastructure necessary to achieve streamflow objectives or monitoring of coho salmon populations to evaluate success of restoration efforts, it can be expected that the total cost of restoring coho to the Russian River watershed will be much higher.
Evaluating Success

All conservation investments are made with a desire to have something change. Monitoring tells us whether that change is occurring. Evaluation tells us whether the combined set of investments being made are being designed and implemented to maximize that change.

The Foundation will work with outside experts to prioritize proposals based on how well they fit in with the results chains and priorities identified in this plan. Success of funded projects will be evaluated based upon success in implementing proposed activities and achieving anticipated outcomes. As part of each project’s annual (for multi-year awards) and final reports, individual grantees will provide a summary of completed activities and key outcomes directly to NFWF. These would likely include outcome metrics identified at the initiative scale.

Periodic expert evaluation of all investments funded under this initiative will occur and will help grantees to monitor key indicators to ensure that data across individual projects can be scaled up to programmatic and initiative levels. Findings from monitoring and evaluation activities will be used to continuously learn from our grantmaking and inform future decision-making to ensure initiative success.

Success of the Russian River Coho Salmon Keystone Initiative can be evaluated in terms of progress through the steps to achieve the ultimate goal (the development of a self-sustaining population of coho salmon). Success can be defined in terms of whether particular indicators are achieved, relative to previously defined outcomes.

Key Strategy 1 — Water management plan development and implementation.

Each of the sub-strategies for the Initiative’s Water Management component is important for its overall success. The interactions among each of these sub-strategies are outlined in the Water Management Planning/Implementation Results Chain (Figure 4). A results chain is a chain of logic that illustrates how a specific strategy is presumed to reach a particular conservation outcome. Results chains are used to develop a suite of indicators to show progress at different stages in the initiative. All parts of the results chain below lead to improving habitat for coho salmon.

- **Sub-strategy: Initial planning for particular watersheds.**
  
  Outcomes for initial planning may include developing outreach goals and an outreach plan; and creating materials to communicate project benefits to landowners. Indicators may include lists of landowners, maps showing the distribution of water users in the watershed, and a predefined quantity of materials to share with landowners. It will be necessary to achieve these outcomes early in the project, such as by the conclusion of 2009.

- **Sub-strategy: Landowner outreach/recruitment.**
  
  A necessary outcome for landowner outreach is landowner buy-in, which may be defined early in the project as having landowners attend workshops, and in middle stages, having landowners participating in water need analyses. Indicators for these outcomes may include contacting all landowners in a watershed, engaging a percentage of landowners in each selected watershed through workshops and subsequent analytical activities (e.g., 50 percent or 75 percent). Other important outcomes will include regulatory literacy, improving landowners’ awareness of regulations and options for water management. Early stages of outreach must also be started and concurrent through early stages of the project (2010-2013).
Sub-strategy: Watershed-scale water need and availability analyses

Outcomes of water need and availability analyses should include innovative models to illustrate local and cumulative water needs for human water use through each drainage network (which can be refined by outreach efforts), as well as installing stream gauges and developing expressions of the streamflow regime at each selected gauge location. Because these data are essential for identifying management objectives and developing water management plans, they should be gathered in the first two to three years of the project.

Sub-strategy: Identify management objectives and develop water management plans

The two major outcomes of this sub-strategy are described clearly in its title: it requires identifying the management objectives in terms of flow needs for each life coho freshwater cycle stage (e.g., magnitude of flow required for coho to migrate upstream; duration of flow necessary for sustaining juvenile coho through the summer), and developing management plans for water in each selected watershed. Indicators of this sub-strategy may include a resource agency-approved list of management objectives for each stream, and a water management plan that includes 50 or 75 percent of water users to change their timing of diversion from spring and summer to winter. Considering the time it might be expected to implement the plan overall, it may be necessary for this sub-strategy to be completed one-third of the way through the project.

Sub-strategy: Develop governance mechanisms and implement water management plans

The governance mechanism development and plan implementation sub-strategy may include additional outcomes, such as developing both the institutional capacity to implement plans and a mechanism to share streamflow information to participants in the plan, and securing funding for construction of tanks and reservoirs. Possible indicators of success include changes to water rights that stipulate winter storage rather than summer diversion or implemented other water management changes, 80 percent of participants in the program having successfully obtained storage structures, and an operating interactive governance tool to assess impacts of diversion in real-time. Governance plan implementation should begin no later than one-half of the way through the duration of the project.

In addition to creating a self-sustaining population of coho salmon in the watershed, other outcomes to the water management component of the project may be defined in terms of streamflow benefits. One outcome may include fewer sudden reductions in streamflow that occur as a result of diversion for frost protection (Deitch et al., 2009B), greater persistence of streamflows and pools into through the dry season, and increased connectivity between pools, than occurred prior to water management plan implementation.

Adaptive management must be an underlying element of the entire Initiative, especially for the Water Management Key Strategy. Each sub-strategy should be reviewed to ensure that outcomes are reached because subsequent sub-strategies are dependent on earlier ones. For example, in order to achieve the benefit of restoring summer streamflow, water management plans must incorporate a sufficient number of water users to achieve the defined streamflow target. The success of these outcomes (or others defined later) must be reviewed to ensure that participation is sufficient to move to the next step. Similarly, streamflow objectives should also be incorporated into an adaptive management plan. Water management plans will hinge on particular diversion strategies operating to maintain flow magnitudes required for instream processes; an adaptive management framework can be designed to evaluate these diversion strategies as hypotheses, and then follow a plan to test whether they maintain their intended benefits (and propose alternative strategies if necessary).
Figure 4. Results chain for altering water management practices through planning, outreach, watershed-scale water need analysis, developing water management plans, developing governance mechanisms, and implementation. A results chain is a chain of logic that illustrates how a specific strategy is presumed to reach a particular conservation outcome. Results chains are used to develop a suite of indicators to show progress at different stages in the initiative.
Key Strategy 2 — Riparian/instream habitat restoration, conservation, and augmentation (R/C/A).

The success of habitat restoration, conservation, and augmentation may also be defined in terms of outcomes and indicators toward achieving those outcomes; relationships of various strategies to the overall conservation goal of restoring a coho salmon population to the Russian River are illustrated in Figure 5. Many organizations working in the Russian River watershed are currently managing projects that could be categorized within this Key Strategy. It will be necessary to continue to fund R/C/A projects listed under Funding Needs and similar projects as they are proposed, throughout the duration of the Initiative.

☐ Outcomes of riparian enhancement may include increased canopy cover and reduced water temperature. Indicators can include the number of riparian enhancement projects implemented, an increase in riparian shading, and decrease in water temperature through summer.

☐ Outcomes of sediment source assessments and reductions may include the implementation of source identification and mitigation projects, a reduction in the amount of fine sediment in the stream, and a more favorable distribution of channel substrate material for spawning. Indicators may include addressing 50 percent of the acute fine sediment sources described in a forthcoming fine sediment TMDL.

☐ Outcomes of modifying and improving migration barriers may include removing barriers and increasing the total amount of high-quality spawning habitat accessible to coho. Indicators may include increasing the total amount of good coho habitat in each Core or Phase I watershed by 10 or 20 percent.

☐ Outcomes of improving instream habitat activities may include adding channel complexity, reducing channel gradient, and reconnecting floodplains. Indicators of these outcomes include addressing the top five critically degraded reaches as defined in coho recovery plans.

☐ Outcomes of conserving habitat may include acquiring land in fee, acquiring conservation easements, or acquiring water rights through joint water and land transactions in critical habitat through voluntary transactions. An indicator may be acquiring easements to a percentage of predefined key reaches.

☐ Outcomes of improving estuary habitat and understanding of its role in the watershed may be conducting studies of appropriate timing of breaching, and implementing the results; or physically adjusting the depth of the estuary at particular locations to benefit coho. Indicators may be an increase in the number of juvenile coho using the estuary, and an increase in their survival.

Key Strategy 3 — Population augmentation, monitoring, and evaluation.

As described under Conservation Outcomes above, the overall indicator of the success of this plan can be defined in terms of returning adult coho to the watershed, as well as increased juvenile coho survival through the period over which juveniles remain in freshwater streams. Indicators of success can include an increase in the rate of winter and summer survival of coho. Another indicator of success of the Initiative is to have naturally spawning coho salmon in each of the Core and Phase I streams by the end of the Initiative.

Monitoring coho populations will be a key component of determining the overall success of this project. In addition to maintaining the current level of monitoring as part of the broodstock plan, additional monitoring must be conducted at other times of the year, and in other watersheds (specifically, Phase I watersheds) to evaluate whether the Initiative is achieving its objectives.
Figure 5. Results chain for habitat restoration, conservation, and augmentation, and for monitoring/evaluating coho populations in the Russian River watershed.
Long-Term NFWF Support

This business plan lays out a strategy to achieve clear outcomes that benefit coho salmon over a 12-year period. At that time, it is expected that the conservation actions partners have taken will have brought about new institutional and societal standards and environmental changes that will have set the population in a positive direction such that maintaining those successes or continuing them will be possible without further (or greatly reduced) NFWF funding. To help ensure that the population and other gains made in 12 years will not be lost after the exit of NFWF funding, the partnership must seek the development of solutions that are long-lasting, cost-effective, and can be maintained at lower levels of funding in the future. Therefore, part of the evaluations of this initiative will address that staying power and the likelihood that successful strategies will remain successful at lower management intensity and financial investment.

The adaptive nature of this initiative will also allow NFWF and partners to regularly evaluate the strategies behind our objectives, make necessary course corrections or additions within the 12 year frame of this business plan. In some cases these corrections and additions may warrant increased investment by NFWF and other partners. However, it is also possible that NFWF would reduce or eliminate support for this initiative if periodic evaluation indicates that further investments are unlikely to be productive in the context of the intended outcomes.
Additional Benefits

Many additional benefits can be expected as a result of the Russian River Keystone Initiative for Coho Salmon. Increasing summer streamflow will likely have benefits for other native anadromous salmonids (namely, chinook salmon and federally threatened steelhead trout) that oversummer in Russian River tributaries. Other aquatic organisms that rely on table water levels through spring and summer should benefit as well, (e.g., other native fishes). Relieving the pressures on streamflow and adjacent groundwater during spring and summer may also encourage development of riparian vegetation and colonization of other beneficial species to the riparian zone.

In addition to ecosystem benefits, this Initiative will benefit water users in each project watershed. The storage of water for use in spring and will provide those water users who choose to participate in the project with a more stable water supply through the dry summer. Rural residents whose wells may go dry as early as July or August and who may rely on water shipped by truck could become self-sufficient with water stored in tanks.

GIS models can provide a framework to assess how diverting water at particular times during winter can affect streamflow, and to ensure that diversions operate to minimize those impacts and operate in compliance with regulations. GIS models can also provide a means for governance of water resources when combined with real-time streamflow data to ensure appropriate ecosystem protections.

The initiative will also provide a new legal and institutional foundation for governing water rights and coordinating diversions among multiple landowners. Water supply and stream flow matters represent the "hard case" in conservation, and successful models are in short supply.

Together, the legal and spatial-analytical frameworks that result from this project can be adapted to other areas in coastal California to provide a method for water-focused ecosystem protection that has long been missing from aquatic ecosystem conservation.
Literature Cited


Deitch, M.J., G.M. Kondolf, and A.M. Merenlender. 2009A. Surface water balance to evaluate the hydrological impacts of small instream diversions and application to the Russian River basin, California, USA. Aquatic Sciences:Marine and Freshwater Ecosystems DOI: 10.1002/aqc.1012.


Appendix A

Identified Habitat Restoration Projects in Russian River Tributaries Vital to Coho Salmon Recovery
Authors: Russian River Coho Salmon Partnership, including the Center for Ecosystem Management and Restoration, Trout Unlimited, Sotoyome Resource Conservation District, Gold Ridge Resource Conservation District, University of California Cooperative Extension, Sonoma County Water Agency, Occidental Arts and Ecology Center

With Contributions from the National Marine Fisheries Service and the California Department of Fish and Game

Photo credits (left to right): University of California Cooperative Extension and California Dept of Fish and Game
Acknowledgements

Authors: Russian River Coho Salmon Partnership, including the Center for Ecosystem Management and Restoration, Trout Unlimited, Sotoyome Resource Conservation District, Gold Ridge Resource Conservation District, University of California Cooperative Extension, Sonoma County Water Agency, Occidental Arts and Ecology Center

With Contributions from the National Marine Fisheries Service and the California Department of Fish and Game

Mark Hudy, Forest Service
Elizabeth Macklin, Trout Unlimited
Kathy Wolf, Trout Unlimited

About NFWF — The National Fish and Wildlife Foundation is a 501(c)(3) organization dedicated to funding sustainable conservation initiatives. Chartered by the United States Congress in 1984, NFWF leverages federal grants and private support to achieve maximum conservation impact. Recently, the Foundation — through its Keystone Initiatives — strategically repositioned itself to more effectively capture conservation gains by directing a substantial portion of its investments towards programs that had the greatest chance of successfully securing the long-term future of imperiled species. By leveraging innovative program design from scientific experts, the Foundation is able to structure conservation programs that consistently achieve measurable and meaningful outcomes. [www.nfwf.org]