Trinity River Restoration Program
Fiscal Year 2014 Preliminary Science Workplan Summary

Program Overview

The Trinity River Restoration Program (TRRP or Program) is seeking to restore and sustain natural production of anadromous fish populations downstream of Lewiston Dam to pre-dam levels. The Secretary of the Interior signed a Record of Decision (ROD) for the Trinity River Fishery Restoration Final Environmental Impact Statement/Report on December 19, 2000. This decision adopted a strategy for restoration and maintenance of the Trinity River's fishery resources that requires rehabilitating the river channel and restoring dynamic alluvial processes that maintain aquatic habitats as well as managing flows to meet biological needs of anadromous salmonids. The primary components of the restoration strategy are: mechanical channel rehabilitation, gravel augmentation, a variable flow regime to meet fluvial geomorphic and biological objectives, and watershed restoration. These management actions, in combination, are expected to increase habitat availability for juvenile anadromous salmonids, resulting in increased natural anadromous salmonid production, increased adult recruitment, and increased harvest opportunity in dependent fisheries. The ROD also established an adaptive management program to guide implementation of the restoration strategy. To allow for adaptive management, the Program's Integrated Assessment Plan (IAP) (TRRP and ESSA Technologies Ltd. 2009) identifies key assessments to assess the river's response to management actions and ultimately the response of fish and wildlife populations that depend on the river. The IAP served as the foundation for the identification of Fiscal Year (FY) 2014 information needs. Findings from these FY 2014 activities will be used to refine future study designs and restoration actions.

Document Overview

The intent of this document is to provide a concise description of what is being proposed for the FY 2014 science workplan to allow the Scientific Advisory Board (SAB) and Trinity Management Council (TMC) to evaluate the entire body of work. For each discipline, the proposed activities, as well as modifications based on the review of the FY 2013 science workplan (Atkins 2012), are briefly described. Additionally, we express how each proposed activity informs Decision Support System (DSS) development, channel rehabilitation design, flow management, and sediment management (see Tables 1-3). We also identify dependencies between proposed activities (see Tables 1-3). Finally, abstracts for proposed activities are included in Appendix A. Full investigation plans are also available for SAB and TMC review.

Fiscal Year 2014 Priorities

Two broad priorities were developed for FY 2014.

Monitoring data collection and analysis

The IAP includes assessments to (A) evaluate long-term progress toward achieving Program

goals and objectives, and (B) provide short-term feedback to improve restoration actions. As in past years, fishery, geomorphological, riparian, and wildlife monitoring projects will be pursued; emphasis in FY 2014 will be placed on evaluation of channel rehabilitation sites and design features within a broader programmatic and geomorphic context.

Decision Support System implementation

One key outcome of the continuing Phase I Channel Rehabilitation Review is the SAB recommendation to develop a DSS, a series of linked physical and biological models (SAB 2013). According to the SAB, the DSS will allow the Program to predict site and system response to alternative management actions in relation to objectives and focus monitoring efforts, thus providing an evaluation tool for adaptive management.

Workplan Development Process

A prioritized list of FY 2014 TRRP projects was developed based on input from individual technical workgroups. Each workgroup developed a list of priorities based on assessments included in the IAP and recent learning. The Science Coordinator and Executive Director integrated activities across groups and compiled the results in a single prioritized list (see Appendix A of the TRRP FY 2014 investigation plan solicitation) (*Note: all proposed activities were not included in the solicitation; Appendix B of this document included activities left out of the solicitation*). Following distribution of the FY 2014 solicitation authors submitted their respective invesigation plans. All invesigation plans are undergoing administrative review. Selected invesigation plans will also undergo external scientific review as deemed necessary. The SAB is now asked to evaluate the entire proposed body of work and to provide input to the TMC.

Fish Related Monitoring Activities

Intent of the Proposed Body of Work

The Fish Workgroup developed a consensus recommendation of prioritized fish and fish habitat monitoring activities to be considered for inclusion in the FY 2014 TRRP science workplan. The FY 2014 prioritized suite of fish related monitoring activities are intended to achieve several purposes that the Fish Workgroup believes are critical for advancement of the TRRP adaptive management program (see Table 1).

While the Fish Workgroup recognized that all of the FY 2013 fish related monitoring activities served to either 1) assess long term TRRP goals and objectives or 2) provide adaptive management feedback to annual management actions, we understood that the TRRP science program needed to consider additional projects while at the same time receiving less funding. The Fish Workgroup prioritized FY 2014 recommendation with the consideration of the development and support of a functional DSS, systemic and sites-specific channel rehabilitation assessments, juvenile salmonid assessments, and an integrated comprehensive adult fall Chinook

salmon assessment. The Fish Workgroup also recommended comprehensive adult assessments for other priority fish species, including spring Chinook salmon, coho salmon, and steelhead (as prioritized in the IAP), but these assessments were given a lower priority than the above mentioned assessments and projects. In addition, lower priorities such as assessments of impacts to Pacific lamprey habitat and juvenile and adult fish disease assessments were also recommended.

As part of the Phase I Review, the SAB has recommended the TRRP develop and implement a DSS. The Fish Workgroup recognizes the potential applications of a DSS, especially the fish production model component, and encourages development of critical sub-models and supporting data collection and monitoring activities for model/sub-model calibration and validation purposes. The fully developed fish production component of the TRRP DSS is envisioned to include systemic 2-dimensional fish habitat modeling to provide flow-habitat relationships, adult upstream migration submodel, ocean life history/harvest submodel, multi-species models incorporating variable life history strategies (i.e. ocean vs. stream type Chinook salmon, coho salmon and steelhead for extended freshwater rearing), and models addressing predation and competition. However, for FY 2014, we recommend that an initial functioning fish production model be developed for juvenile Trinity River Chinook salmon production. Several on-going long-term fish monitoring activities are expected to provide critical data inputs as well as model calibration and validation data sets in support of the initial and future juvenile fish production.

The TRRP Adult Salmonid Monitoring Evaluation (Bradford and Hankin 2012) also helped guide the Fish Workgroups recommendations. Branford and Hankin (2013) recommended that an analytical group be established to synthesize adult population information in order to evaluate TRRP hypotheses and IAP objectives and that emphasis should first be placed on synthesis and analyses of fall Chinook salmon populations, due to the robust long-term monitoring data sets that are available. The intent of the comprehensive suite of fall Chinook salmon monitoring activities included in the FY 2014 workplan is to maintain long-term data sets, improve integrative analyses, encourage evaluation of hypotheses and provide support for juvenile Chinook production model development.

Response to comments from FY 2013 workplan review
Recommendations were incorporated into the FY2014 workplan as follows:
1. The need for a fish production model was recommended as a critical part of the adaptive management process to evaluate different management outcomes and then measure the response of juvenile salmonid production. The development of a fish production model was the highest priority project recommended by the Fish Workgroup.
2. The review noted that the habitat assessment was a critical project needed to evaluate the physical response to the three primary management action; mechanical channel

rehabilitation, flow management, and coarse sediment augmentation. The habitat assessment, both site specific for channel rehabilitation sites and the systemic assessment, was given the second highest priority since this is a direct measure of the TRRP controlled management actions.

3. The review recommended that the juvenile salmonid density study be given a higher priority due to the importance of linking habitat availability to fish use. This project was given a higher priority to improve the relationships between habitat availability and fish use of those habitats as well as the need for these data to support the development of a fish production model.

4. The need for comprehensive adult assessments were recommended and the fish workgroup intentionally focused and prioritized fall Chinook salmon monitoring activities that contribute to a complete fall Chinook salmon assessment.

Wildlife and Riparian Activities

Intent of the proposed body of work

The wildlife and riparian portion of the science workplan has three components: 1) Map and Quantify Riparian Vegetation, 2) Avian Monitoring, and 3) Herpetological Monitoring. Riparian Vegetation Monitoring and Avian Monitoring are similar to the work conducted in previous years, while the Herpetological Monitoring component is fairly new (work is commencing in FY 2013).

The first component, Map and Quantify Riparian Vegetation, involves a riparian monitoring strategy employing multi-disciplinary monitoring efforts to address cause-and-effect relationships between management actions, physical processes, and riparian vegetation response. Riparian vegetation response to 2014 spring managed streamflows will be predicted using a model that is compatible with the TRRP's DSS. Those predictions will be evaluated along the mainstem Trinity River at sites selected using a Generalized Random Tesselation Stratified (GRTS) survey design. A complete census of channel rehabilitation sites will be conducted as part of evaluating the riparian vegetation recruitment, recovery, and revegetation response. Results will be used to revise conceptual models, link results to management actions, and potentially make adjustments to future management actions. The Avian Monitoring component includes monitoring temporal changes in riparian bird species performance metrics at the rehabilitation site, local reach, and restoration reach scales and determining restoration-associated mechanisms that explain variation in riparian bird performance metrics at the rehabilitation site scale. The Herpetological Monitoring component aims to establish robust, long-term monitoring protocols for two special-status aquatic species: western pond turtle and foothill yellow-legged frog. The protocols will be developed to be consistent with the assumptions required for occupancy modeling, in order to provide the Program with straightforward metrics for monitoring the status and trends of these populations. Concurrently, population models will be developed based on historic data collection efforts complimented with

new data that can be used to inform management decisions regarding impacts on these populations. There are no invesigation plans for the Avian and Herpetological Monitoring projects this year because both projects are beyond the first year of multi-year contracts.

Response to comments from FY 2013 workplan review

The Atkins review of the FY 2013 workplan emphasized the importance of "Map and Quantify Riparian Vegetation" in understanding the linkages between fine sediment dynamics, vegetation encroachment, and riparian berm accretion, and regeneration of riparian hardwood species large enough to provide large woody debris to the aquatic system. The need for a synthesis of information to clarify dominant patterns was noted, as well as an assessment of the critical questions noted in Figure 1.1 of the 2009 Integrated Habitat Assessment Project. The FY 14 workplan reflects these comments through a greater emphasis on modeling to synthesize and address critical questions. The Atkins review noted that the purposes of the avian and herpetological monitoring activities were not well articulated in supporting documents. Although IAP objectives speak to the relevancy of these studies, they have generally been used for environmental compliance rather than adaptive management. Discussions are ongoing related to the fundamental objectives of the Program and linkages among fish production, wildlife populations, and overall ecosystem health. As individual components of a DSS, quantitative predictions of riparian vegetation and wildlife responses to changes in flow, sediment, and topography would provide means to evaluate trajectories of riverine and floodplain health under different management scenarios.

Physical Activities

Intent of the proposed body of work

The intent of the proposed body of work is to document and understand the channel response to management actions and inform future management actions. Specifically, 1) track progress towards primary program objectives (e.g increase coarse sediment storage, periodically scour the channel bed), 2) inform development of the peak magnitude and duration of the spring flow releases, and 3) inform decisions on how much gravel augmentation is needed.

The heart of the physical program of work is 3 recurring annual projects: gravel implementation monitoring, sediment monitoring, and assessment of bed scour and mobility. These projects operate independently from one another. The sediment monitoring project collects and report sediment transport data. The data is utilized by program staff to compute the sediment budget which is the mechanism to track progress towards program objectives and inform management actions. The scour and mobility monitoring project collects and reports cross-section, scour, and mobility data. The data is used to track progress towards program objectives and inform on-going riparian studies. Lastly, the gravel implementation monitoring project collects and reports bathymetric and substrate data. That data is utilized by program staff to address specific implementation related questions regarding the fate of augmented gravels and helps inform future gravel augmentation. The remainder of the projects under the physical program of work

Table 1. Proposed fish activities for the FY 2014 preliminary science workplan. Activities are listed in order from highest to lowest priority.

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependences between projects within this discipline or with other disciplines
Fish Population Dynamics Model	Primary sub-model in proposed TRRP DSS structure.	If evaluating design alternatives.	Can be used to evaluate different flow releases.	Not as currently proposed. Another DSS component sediment model may feed into future fish prod model.	Yes - will be capable of modeling salmonid production with under varying restoration actions and relate these data to restoration goals.	Fish Habitat modeling, fry density monitoring, Chinook salmon outmigrant monitoring, Chinook salmon run-size estimation, redd and carcass surveys.
Rearing Habitat Assessment	(see tasks below)					
Channel Rehabilitation Site Rearing Habitat Assessment	Possibly - could be used in conjunction with 2D habitat modeling to improve the habitat submodels of the fish production model of DSS.	Assesses pre and post construction function and quantity of habitat change resulting from construction.	Documents physical change from flow releases.		Assesses changes in available fry/juvenile rearing habitat.	
Systemic Habitat Estimate	Possibly - could be used in conjunction with 2D habitat modeling to improve the habitat submodels of the fish production model of DSS.	Assesses systemic changes in quantity of habitat resulting from construction and flow management.	Documents physical change from flow releases.	Documents physical change from sediment management.	Assess changes in available fry/juvenile rearing habitat.	
Systemic Streamflow Relationships (Browns Creek site)	Increased 2D habitat dataset with covering an unrepresented channel type.		Evaluates changes of available rearing habitat at various managed flows.			fish production modeling, fry density monitoring are dependent.

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependences between projects within this discipline or with other disciplines
Support for Salmon Production model (Q to habitat)	Needed as the habitat basis for the fish production model.		Model changes in available rearing habitat at various managed flows.			fish production modeling is dependent on the habitat framework.
Large Wood Monitoring at new Rehab sites		Yes.				
Resource Selection Development (Pacific Lamprey spawning habitat investigation)						
Juvenile Salmonid Density Monitoring to Support Salmon Production Model (SSS) Development	(see tasks below)					
Early Spring Snorkel surveys of natural reared juvenile Chinook	Provide spatial and temporal fish density/habitat data for fish production model.	Documents fish density at 2D model sites (which overlap with rehab sites).			Yes.	Fish Habitat modeling, juvenile Chinook salmon production model, DSS.
Late Spring/summer snorkel surveys of natural and hatchery Chinook	Assess potential habitat capacity when hatchery fish saturate the system and will provide spatial and temporal fish density/habitat data for fish production model.	Documents fish density at 2D model sites (which overlap with rehab sites).			Yes.	Fish Habitat modeling, juvenile Chinook salmon production model, DSS.
Trinity River Juvenile Salmonid Outmigration Monitoring Program	Provides validation data sets for fish production model.		Relates outmigrant timing to flow management.		Assesses changes in juvenile Chinook salmon in relation to channel rehabilitation and flow management.	

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependences between projects within this discipline or with other disciplines
Estimate weekly trapping efficiencies and abundance of juvenile Chinook salmon	See above.		See above.		See above.	Dependent on Chinook CWT at TRH.
Conduct trapping operations at the Willow Creek site (Lower Trinity)	See above.		See above.		See above.	Dependent on Chinook CWT at TRH.
Conduct trapping operations at the Pear Tree Gulch trap site (Upper Trinity site)	See above		See above		See above	Dependent on Chinook CWT at TRH.
Conduct emigration timing analysis to inform Flow Workgroup	See above.		See above.		Relate outmigrant timing to flow management.	
Mainstem Chinook Spawning Survey	Provides model inputs: spawner abundance, distribution, timing, and pre-spawn mortality, sex ratios.	Provides data that can be overlaid with restoration site habitat data to evaluate changes in spawning areas and used to evaluate specific areas where spawning habitat is prioritized (i.e. hatchery reach).	Documents redd desiccation issues.	Can be used to evaluate coarse and fine sediment management effects on spawner distribution.	Redd data used to estimate total inriver spawning escapement in conjunction with weir generated data.	CWT recovery/tag recovery for separating hatchery/natural and spring and fall Chinook salmon spawning in the river, and spawning habitat assessment.
Chinook Run-size Estimation Using Mark-recapture Methods in the Trinity River basin	Provides estimates of natural returns for fish production model input.				Provides estimates adult Chinook salmon escapement to be evaluated against programmatic goals.	TRH Chinook CWT tagging, Klam-Trin fall-run scale age analysis, sport and tribal harvest monitoring.
Run-size, harvest, and spawner escapement estimates: Trinity Basin salmonids	Provides estimates of natural returns for fish production model input.				Provides estimates adult Chinook salmon escapement to be evaluated against programmatic goals.	TRH Chinook CWT tagging, Klam-Trin fall-run scale age analysis, cohort analysis, sport and tribal harvest monitoring.

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependences between projects within this discipline or with other disciplines
Evaluation of hatchery and naturally produced Chinook salmon using coded-wire tag recovery	Yes—allows differentiation of hatchery from natural returns for fish production model input.				Estimates contribution to hatchery and natural adult Chinook salmon escapement goals.	TRH Chinook CWT tagging.
Evaluations of hatchery and naturally produced coho salmon (marking of TRH coho)					Estimates contribution to hatchery and natural adult Chinook salmon escapement goals.	outmigration monitoring, sport and tribal harvest monitoring.
Trinity River Hatchery Chinook Coded Wire Tagging					Tagging data necessary to separate hatchery and naturally produced fish.	Chinook run-size estimates, outmigration monitoring, Klam-Trin fall-run scale age analysis, cohort analysis, sport and tribal harvest monitoring.
Klamath-Trinity River Fall Run Scale Age Analysis					Age composition data allows for separation of run into age classes to allow evaluation of adult spawning escapement goals.	contributes to sport and tribal harvest management, cohort reconstruction analyses, dependent on scale collections at TRH, wiers and carcass surveys.
Yurok Tribal Fisheries Monitoring					Assesses Program goal to "to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities".	contributes to CWT recovery, fall Chinook salmon age composition analysis, and cohort reconstruction analyses.
Hoopa Tribal Harvest Survey of Trinity River Fall Chinook					Assesses Program goal to "to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities."	contributes to CWT recovery, fall Chinook salmon age composition analysis, and cohort reconstruction analyses.

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependencies between projects within this discipline or with other disciplines
Lower Trinity River Sport Harvest Survey					Assesses Program goal to "to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities".	contributes to CWT recovery, fall Chinook salmon age composition analysis, and cohort reconstruction analyses.
Lower Klamath Creel Census					Assesses Program goal to "to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities".	contributes to CWT recovery, fall Chinook salmon age composition analysis, and cohort reconstruction analyses.

Table 2. Proposed wildlife and riparian activities for the FY 2014 preliminary science workplan. Activities are listed in order from highest to lowest priority.

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependences between projects within this discipline or with other disciplines
Map and Quantify Riparian Vegetation	(see tasks below)					
Exposed Bar Census						Systemic Riparian Vegetation Response to Managed Streamflows, Quantify Changes in Large Wood Storage and Structural Characteristics of Abundant Riparian Vegetation Patches.
Systemic Riparian Vegetation Response to Managed Streamflows	Informs models (TARGETS) and flow scheduling.		Scour and establishment inform flow releases.	Rates of berm formation checks sediment augmentation and fine sediment reduction.	Measures progress towards bed mobilization and vegetation establishment objectives.	Geomorphic monitoring and assessment of bed scour and mobility; Potential to further integrate flow and sediment modeling to predict planform dynamics.
Quantify Changes in Large Wood Storage and Structural Characteristics of Abundant Riparian Vegetation Patches	Informs models (e.g., CASIMIR).	Informs progress towards LWD targets; floodplain lowering and disturbance design elements.			Measures progress towards LWD objectives and wildlife habitat objectives.	
Evaluate Riparian Vegetation Response to Channel Rehabilitation Site Construction	Informs models (e.g., CASIMIR).	Informs constructed floodplain and disturbance feature designs.	Scour and establishment inform flow releases.		Measures progress towards environmental compliance objectives (1:1 replacement of impacted riparian vegetation).	
Avian Monitoring	High-level indicators of ecosystem health.	Avian habitat use influences revegetation designs.			Measures progress towards wildlife objectives.	Evaluates use of vegetation placed or impacted during channel rehabilitation.
Herpetological Monitoring	Long-term indicators of ecosystem health; used in flow scheduling.	FYLF and WPT occupancy influences design feature placement.	FYLF breeding chronology indicates degree synchronicity between tributaries and mainstem.	FYLF require bars for breeding; informs sediment augmentation.	Measures progress towards wildlife objectives.	

Table 3. Proposed physical activities for the FY 2014 preliminary science workplan. Activities are listed in order from highest to lowest priority.

Activity	Informs DSS development	Informs rehab design	Informs flow release	Informs sediment management	Tracks accomplishments of program goals	Dependences between projects within this discipline or with other disciplines (list item #)
Gravel Implementation Monitoring		Evaluates past augmentation and Informs future augmentation.		Evaluates past augmentation and Informs future augmentation.		
Geomorphic response to high flow duration			Informs development of flow duration using geomorphic response.			
Sediment Monitoring	Informs models (transport / morph dynamics) and sediment budge.t		transports rates and dynamics inform high flow releases.	Transport rates inform sediment budget and gravel augmentation requirements.	Transport rates inform sediment budget i.e. quantifies sediment storage goals.	
Geomorphic monitoring and assessment of bed scour and mobility	Informs riparian model.		Via riparian response.		Measures scour/mobility goals for riparian managemen.t	Systemic Riparian Vegetation Response to Managed Stream Flows.
Gravel implementation tracer experiment			Gravel transport dynamics inform peak flow release development.	Gravel transport dynamics inform quantity, location, and frequency of gravel augmentation.		

APPENDIX A

TRINITY RIVER RESTORATION PROGRAM
FY 14 INVESTIGATION PLAN ABSTRACTS

TRINITY RIVER RESTORATION PROGRAM
FY 14 INVESTIGATION PLAN ABSTRACTS

Development of a Salmonid Production Model for the Trinity River

PI: Perry,Russell

Abstract: Salmonid production models are employed for a variety of reasons in the management of Pacific salmon populations. The most common uses have been for harvest management (KRTT 1986, Prager and Mohr 2001, PFMC 2008) and imperiled species conservation (NMFS 1997, Winship et al. 2012, Zeng et al. 2012). However, increasing focus on restoring freshwater habitats of anadromous salmonids has led to the development of freshwater production models that can be used to identify limiting factors and evaluate alternative restoration strategies (McHugh et al. 2003, Hendrix et al. 2011, Hardy et al. 2012, Null and Lund 2012).
Restoration actions implemented by the Trinity River Restoration Program (TRRP) are expected to increase natural anadromous salmonid production in the Trinity River. The effectiveness of the restoration actions were to be assessed under an adaptive management structure to evaluate if management goals and objectives were being achieved and guide potential modifications of future actions. A core component of this structure is modeling potential outcomes of management actions, evaluating the outcome(s) and modifying management actions as necessary to meet programmatic goals (USFWS et al. 2000).

A fish production model could support the TRRP's adaptive management efforts as a component of the Decision Support System (DSS) by:

- Evaluating the response of fish production to different flow management alternatives, including variable flow levels during specific life history stages
- Evaluating the response of fish production to different channel rehabilitation actions (these would be large scale changes, not at the channel rehabilitation feature scale)
- Evaluating the overall restoration strategy of the TRRP utilizing potential habitat estimates to attain fish population goals
- Evaluating the temperature response of fish growth and resulting production
- Evaluating the growth/size of fish in response to different flow/temperature alternatives and relate this to potential survival

The overall goal of our investigation plan is to construct, calibrate, and validate a fish production model for the Trinity River. This fish production model will be formulated using the framework of the Stream Salmonid Simulator (SSS) currently under development for the Klamath River (See Attachment 3 and 4 in Polos 2013). The SSS is a deterministic population model that simulates habitat availability and use, growth, mortality, and movement of all juvenile life stages of Chinook salmon (eggs, fry, and parr). A key feature of SSS is its representation of the river's habitat structure. The river's spatial structure is comprised of a linked series of habitat units of given length and mesohabitat type (e.g., pool, riffle, run). This spatial and temporal structure makes SSS uniquely suited to address critical questions and uncertainties as a cornerstone of the Trinity River DSS.

This project will initiate the development of a fish population dynamics model that will be an integral component of the DSS that has been initiated by the TRRP. It is anticipated that it will take approximately two years to develop the model and populate it with data pertinent to the Trinity River. Future efforts may include refinement of model subcomponents as needed (ie: habitat availability below the North Fork Trinity River), development of

an adult upstream migration component and an ocean population dynamics component. It is anticipated that this model will be integrated into the Stream Salmonid Simulator (SSS) that has been developed for the Klamath River.

Habitat assessment
PI: Goodman, Damon

Abstract: The Trinity River is the focus of a restoration effort designed to improve riverine function as a means for increasing anadromous fish populations. Anadromous fish populations are limited by habitat area which is the primary focus of the restoration effort. This project focuses on evaluating changes in habitat availability from restoration actions in the Trinity River. These observations are then leveraged to develop tools for decision makers to improve the impact restoration actions on increasing freshwater habitat quantity and quality. The primary components of this assessment include 1) an assessment of the effects of channel rehabilitation actions and 2) an evaluation of system level response to restoration actions. The primary components of this proposal include before and after comparisons of channel rehabilitation actions, an assessment of trends in habitat quantity and quality throughout the restoration reach, improvement in our ability to predict the effects of streamflow management on habitat availability and support for the development of salmon production modeling. General awesomeness and lots of applause will ensue shortly thereafter.

Juvenile Salmonid Density Monitoring to support Salmon Production Model (SSS) Development
PI: Pinnix, Bill

Abstract: The partners propose to continue monitoring juvenile salmonid density in relation to physical habitat characteristics in the upper 40 miles of the Trinity River to support development of the salmon production model (SSS) to be utilized by Trinity River Restoration Program (TRRP). Efforts in FY2014 will utilize methods used in 2013 to document juvenile salmonid density at 2-D model sites in a variety of depth/velocity/cover classifications both during natural emergence and the juvenile Chinook salmon hatchery release; this will estimate maximum densities at peak abundance of both natural and hatchery juvenile Chinook salmon and potentially provide information on differences in habitat utilization between natural and hatchery Chinook salmon. In addition, the partners propose to collect data on the range of juvenile salmonid density and habitat parameters associated with the 'meso-habitat' categories to be used to populate the spatial cells of the salmon production model.

Trinity River Juvenile Salmonid Outmigrant Monitoring Program
PI: Pinnix, Bill

Abstract: The partners propose to continue juvenile salmonid emigration monitoring data on the mainstem Trinity River, California in 2014 at Pear Tree Bar (PTRST; rkm 118) and Willow Creek (WCRST; rkm 34). Monitoring at PTRST is conducted to estimate juvenile salmonid population size passing PTRST during the sampling season. Monitoring at WCRST is conducted to estimate juvenile salmonid population size and emigration timing during the monitoring period. The goal of this project is to assess juvenile salmonid abundance, run timing, condition and health; the primary population of interest is juvenile Chinook salmon (Oncorhynchus tshawytscha) in the mainstem Trinity River. Age of salmonid outmigrants, length frequency distributions, migration rates, and hatchery contributions will be estimated. Catch data will be used to calculate flow based abundance indices for juvenile Chinook salmon, coho salmon (O. kisutch), and steelhead (O. mykiss). Catch data of other fishes will also be presented. Weekly stratified mark-recapture population estimates of emigrating age-0 Chinook salmon will be calculated for both naturally and hatchery-produced sub-populations. Juvenile salmonid emigration target dates were developed as part of the flow recommendations contained in the Trinity River Flow

Evaluation (USFWS and Hoopa Valley Tribe 1999, Figure 5.46) to assess at what date 80% of the juvenile salmonid population had left the Trinity River, and provides information for managing water temperatures in the mainstem Trinity River. The date at which 80% of the population passed the WCRST site will be calculated for age-0 Chinook salmon, age-1 steelhead, and sge-1 coho salmon.

In addition to quantifying salmonid outmigrant production and timing, fish condition and hatchery/natural composition of outmigrants will be presented in a data series report to provide timely dissemination of data to local managers and for inclusion in agency databases. A technical report synthesizing multi-year datasets developed by this project will be periodically published to evaluate trends in outmigrant salmonid production, outmigrant timing, hatchery/natural contribution and condition/health. Monitoring emigrating juvenile salmonid populations in conjunction with habitat availability and suitability studies is expected to provide a direct evaluation of restoration efforts because these studies focus on the early freshwater life-history phase which is directly affected by instream conditions and management actions. In Summer of 2013, the partnership that implements the TRRP outmigrant monitoring will conduct an analysis of sampling effort and related precision of outmigrant estimates generated by this project that are used to address IAP objective:3.3.2 'Increase freshwater production of anadromous fish' (TRRP and ESSA 2009). This effort will evaluate systematically and advantageously reducing sampling effort and evaluate the relative reduction in the precision of outmigrant estimates using the methods developed by Schwarz et al. (2009) and the extensive mark-recapture database that has been generated over the past five years. Depending on the results of this analysis, the effort and related funding needed to implement this project may be reduced for FY2014. This analysis was recommended by the 1AP Steering Committee during the development of the FY2011 TRRP science work plan (June 15, 2010).A report summarizing the results of this analysis and the recommendation(s) of the project proponents will be forwarded to the TRRP science coordinator when it is completed.

Mainstem Chinook salmon spawning survey
PI: Chamberlain, Charles
Abstract: This study targets spring and fall Chinook salmon spawning in the mainstem Trinity River. Trinity River Chinook salmon spawning begins in early September and continues through mid-December. Monitoring salmon redd and carcass abundance and distribution will inform estimates of total natural mainstem spawning escapement, and reveal temporal and spatial response of mainstem spawning to restoration through time. We postulate that the spatial distribution of returning spawners (hatchery fish excluded) is influenced not only by the spatial distribution of spawning habitat, but by the distribution of habitats that specific to other life history stages that facilitate successful emergence, rearing, and recruitment to adulthood. The mainstem spawning distribution of natural origin Trinity River Chinook salmon upstream of the Burnt Ranch Gorge is currently skewed toward Lewiston Dam; the distribution of hatchery origin fish much more so (Sinnen 2004, Knechtle and Sinnen 2006, Hill 2009, Chamberlain et al 2012). As the success of fish born from gravels in the mainstem increases in response to improved rearing habitat conditions, we expect spawning distribution to be driven increasingly by distribution of habitat, rather than proximity to the hatchery.

Trinity River Hatchery Chinook Coded Wire Tagging
PI: Kautsky, George
Abstract: The project objective is to apply a 25% constant fractional mark (CFM) of all Chinook production at Trinity River Hatchery (TRH) using Coded Wire Tags (CWT). This project applies CWTs and Ad fin clips to spring- and fall-run Chinook salmon reared at TRH. Twenty-five percent of each race (spring/fall) and each

release strategy within race (smolt or yearling) are to be marked. An automated tagging trailer constructed by Northwest Marine Technology will be used in 2014. Representative marking will be ensured by the automated tagging trailer as well ensuring that 25 percent Ad CWT is assigned to each rearing pond sub-population. The marks subsequently recovered in juvenile and adult monitoring projects in river are used to estimate contributions of hatchery and natural populations in mixed stock marine and river fisheries and adult spawning escapements. Population estimates are used to assess juvenile and adult production by brood year, run, and rearing type. Brood tables constructed for hatchery and wild fish, based on Ad CWT results, may be used to model performance of hatchery and naturally spawned fish.

Yurok Tribal Fisheries Monitoring
PI: Williams, Desma
Abstract: The goal of this project is to gather information from the Yurok Tribal fall fishery to assess the harvest of Klamath/Trinity fish stocks by the Yurok Tribe. This information is critical to determine the abundance of particular broods of fall-run Chinook from the Klamath and Trinity Basins, as well as their hatchery or natural origin. The companion age composition project then allows this information to be apportioned to each brood. The Tribal harvest numbers, and in river run data from other areas/fisheries combined with the age composition, and coded wire tag recoveries, can be used to develop a cohort reconstruction for ocean escapement of Trinity River fall Chinook; both hatchery and natural origin fish. This project will not conduct this cohort reconstruction analysis, but will provide information from the Yurok harvest that is necessary to conduct this analysis. The cohort reconstruction modeling will provide the number of ocean recruits (pre-harvest adult fish) per brood, which can then allow for an evaluation of brood year success relative to environmental factors (such as flow regimes), as well as an evaluation of the success of the Trinity River Restoration Program (TRRP). The Tribe's harvest information is also used for the management of Klamath/Trinity fall Chinook fisheries. This project also allows the tracking of progress toward meeting long-term TRRP goals as identified in the IAP, such as restoring and sustaining natural production of anadromous fish populations downstream of Lewiston Dam to pre-dam levels, to facilitate dependent tribal, commercial, and sport fisheries' full participation in the benefits of restoration via enhanced harvest opportunities.

Hoopa Tribal harvest survey of Trinity River fall Chinook
PI: Kautsky, George
Abstract: The primary goal of this study is to provide a total estimate of Hoopa Tribal harvest of fall Chinook. CWT recovery and analysis is necessary to determine the contribution of Trinity Hatchery fish to the over-all harvest. CWT data are also useful for correcting bias in the estimates of scale-based age structures for fall Chinook. Further, hatchery/natural composition for fall Chinook is estimated through expansion of CWTs recovered in this fishery. This provides the Program with a tool to assess the potential confounding influence of hatchery stock on the naturally produced fall Chinook target. Net harvest sampling methods include field acquisition of catch and biological data and samples in a two-stage sampling schedule. Net harvest analyses include two-stage calculations of harvest estimates for sampling stata and season totals, calculations of statistical confidence intervals, proportions of hatchery and natural -origin fish of each species. Reporting metrics include timely generation of catch estimates, and magnitudes of statistical uncertainty. For tribal hook and line fishing, sampling is carried out in week-day and week-end strata. Types of biological data acquired are similar to those from net harvest sampling. Estimation of total harvest involves sample data for total anglers, angler fishing hours, and catch per hour fished on sampled days within strata. Stratum estimates are summed to week estimates. Development of methods to calculate measures of uncertainty of estimates are in progress.

Lower Trinity River Sport Harvest Survey

PI: Kautsky, George

Abstract: The overall project goal is to estimate total angler harvest of Chinook and steelhead from Willow Creek Weir (WCW) downstream to the confluence of Trinity River with Klamath River. This project evaluates the hypothesis that by restoring natural production of the Trinity River, dependent fisheries will be restored. The project monitors harvest by non-tribal fishers participating in annual recreational harvest of fish produced in the Trinity River. Complementary investigations assessing contribution of naturally produced Trinity River origin fish are also conducted within the Tribal harvest sector. Analysis comprises mathematical expansion of sample data values to generate estimates of total harvest within sample strata, and summing to season totals. A useful metric will be calculated estimates of uncertainty, or confidence intervals, for stratum and season total estimates. Developing methods for estimating uncertainty in results of the Lower Trinity River Sport Harvest Survey is a work-in-progress.

Lower Klamath Creel Census

PI: Borok, Sara

Abstract: The California Department of Fish and Wildlife proposes to continue creel census data collections to monitor the number of Chinook salmon harvested by sport anglers in the lower Klamath River. The main objectives of the creel census are to estimate the sport harvest and sport angling effort for Chinook salmon, estimate the harvest of naturally produced Chinook and estimate the contribution from TRH and Iron Gate hatchery stocks to the Chinook harvests. Access point creel census design and analysis are used to develop quantitative data describing the sport fishery. The sport harvest statistics are used to evaluate a fundamental objective of the Trinity River Restoration Program (TRRP); to facilitate and expand salmonid harvest opportunities. We will use trend analysis techniques to determine if harvest opportunities are changing over time. In addition, scales collected from all fish and coded-wire-tag data collected from hatchery fish during creel census are integrated into cohort reconstruction efforts needed to estimate the harvest of naturally produced Trinity River Chinook salmon from the lower Klamath River. The budget for this Investigation Plan is for support of field crew activities. A California Department of Fish and Wildlife funded Biologist is the project manager.

Klamath-Trinity River fall run Chinook scale age analysis

PI: Kautsky, George

Abstract: This project is dependent upon partnering with fishery managers responsible for monitoring the harvest and escapement of fall Chinook within the Klamath-Trinity Basin. Scales collected from these field efforts are catalogued, cleaned, impressed on acetate slides, and aged by the proposers. Age structure data complements general totals estimated for the Klamath Basin fall run Chinook stratified by recovery sector (e.g. fishery, hatchery, or natural spawning areas). This project contributes invaluable information to related efforts such as the annual Chinook harvest management process of the PFMC and the development of cohort reconstructions to assess performance of subsequent broods of Klamath-Trinity Chinook. This project evaluates long-term progress toward achieving TRRP goals and objectives. An Adult Fish PITA in the IAP summarizes: "What is the effect of TRRP habitat improvements on recruits per spawner and harvest, after removing effects of ocean conditions, temperatures, in-river flows, etc.?" One method for probing this question is the completion of cohort analyses based upon age-structured assessments of river returns by run and their specific contributions to fisheries. Cohort reconstructions are dependent upon age-structured run and fishery recovery data that are developed by the activity proposed herein.

Develop cohort reconstructions for fall Chinook to evaluate cohort performance or year class strength, and population growth rate.

PI: Kautsky, George

Abstract: The objective of developing and maintaining a cohort model is to provide insight on the performance of successive cohorts of naturally produced fish as a step toward analyzing the variability in adult recruitment and parental stock size. This effort assembles and analyzes existing data for coded-wire-tag recoveries of Trinity River Hatchery fall Chinook in marine and freshwater recovery areas. Trinity River Hatchery-origin cohort numbers are reconstructed. Using hatchery-origin cohort numbers-at-age and annual age-specific river run estimates, this effort attempts to reconstruct numbers-at-age for cohorts of naturally produced Trinity River fall Chinook. Integration of each year's new data, with subsequent cohort reconstruction of additional brood years and ages of fish, produces useful stock-attribute information for project managers. This investigation will also focus on more detailed documentation of the cohort model for fall Chinook. Making such information available to partners fulfills a primary reporting metric.

Gravel Implementation Monitoring

PI: Gaeuman, David

Abstract: This proposal integrates monitoring activities needed to evaluate the transport and deposition of gravel introduced into the channel via high-flow injection or low-flow placement, and to support the planning and design of future gravel augmentation activities. These monitoring activities will also help to evaluate the performance of individual rehabilitation design elements and rehabilitation strategies. The proposed monitoring builds upon similar activities initiated in FY2011 and continued in FT2013. In FY2013, the work focused on assessing how gravel additions and channel rehabilitation actions have affected pool depths at both the local and system-wide scales in response to questions regarding the potential filling of adult holding habitat raised by certain stakeholder groups. Although the tracking of pool depth changes remains an important component of this monitoring effort, it is proposed that the scope of the FY2014 work will be expanded to address a wider range of questions regarding the fate of augmented gravel and how it interacts with other management actions to alter geomorphic complexity at the reach scale.

Map and Quantify Riparian Vegetation

PI: Lee, James

Abstract: This riparian investigation plan (IP) proposes assessments to evaluate riparian related program hypotheses and objectives (TRRP 2005, TRRP and ESSA 2009). The riparian monitoring strategy employs multi-disciplinary monitoring efforts, where appropriate and possible, to address cause-and-effect relationships between management actions, physical processes, and riparian vegetation response. Riparian vegetation response to 2014 spring managed streamflows will be predicted using a model that is compatible with the Trinity River Restoration Program's Decision Support System. Riparian vegetation response prediction will be evaluated along the mainstem Trinity River at sites selected using a Generalized Random Tesselation Stratified (GRTS) survey design. Additional sites will be selected for evaluating large wood storage and characterizing vegetation structure utilizing the systemic GRTS 400 m segment based sub-sampling strategy that was developed and used in WY 2010-2013 (Goodman et al 2012). The evaluation of large wood and the characterization of riparian vegetation structure will be co-located with the fish habitat assessment sample sites. A second sampling design was developed in 2013 to include a census of exposed bars between Lewiston Dam and the North Fork Trinity River. A sub-sample of exposed bars will be selected using the GRTS method to evaluate certain geomorphic and riparian related objectives (Pickard 2012) and to evaluate systemic predictions of riparian vegetation response.

Many of the methods, analyses, and metrics proposed in this IP have been previously used in Trinity River geomorphic and riparian monitoring (McBain and Trush 2004, McBain and Trush 2006, McBain and Trush 2007). Based on the Science Advisory Board review of 2013 science work plans, a new less intensive sampling method will be explored to reduce the effort of evaluating seedling establishment along the summer baseflow water edge (Atkins 2012). Band transects will be used to document changes in woody plant demographics resulting from managed spring streamflows and results from the GRTS sample sites will be expanded to describe systemic response to water year (WY) 2014 high flow event(s). A complete census of channel rehabilitation sites will be conducted as part of evaluating the riparian vegetation recruitment, recovery, and revegetation response. Riparian vegetation recruitment and revegetation response will be related to topographic variability of specific elements (alcoves, side channels, constructed benches, constructed gravel bars, etc.), inundation frequency and duration, groundwater proximity where feasible, and substrate texture. Results will be used to revise conceptual models, link results to management actions, and potentially adjustments to future management actions.

Geomorphic Response to High Flow Duration
PI: Krause, Andreas
Abstract: Little guidance exists in the literature or in practice to develop the duration of high flow release schedules intended to accomplish geomorphic work. The Trinity River Flow Evaluation Study (USFWS et. al. 1999) and the Record of Decision recommended high flow release magnitudes and durations to convey sediment supplied by Rush Creek. It was envisioned that those releases would also to build and maintain a complex channel, with a specific focus on building bars, initiating channel migration, and other physical processes. Uncertainty surrounding the appropriate high flow duration target would be reduced by the including additional geomorphically based targets. One potential additional target identified by the Physical Workgroup and 2010 Sediment Symposium is the duration of flow where the rate of bar building decreases, which has been considered on the Glen Canyon Project. This proposed study aims to develop geomorphic response curves for bar height, bar volume, pool depth, and residual pool volume that could also be used to help develop annual high flow release duration recommendations. Topographic monitoring will be conducted at selected bar and pool locations during a high flow release hydrograph exceeding 8,500 cfs to develop these geomorphic response curves. Such flow releases only occur in wet and extremely wet water years that happen in about 4 out of 10 years. Deliverable dates shown in this proposal assume WY2014 will be a wet or extremely wet water year.

Sediment Monitoring Summary
PI: Krause, Andreas
Abstract: Investigation plans for on-going contracts (e.g. sediment transport monitoring) are not required in FY14. This abstract simply provides a high level overview of sediment transport monitoring to indicate it is part of the overall program of work. Sediment transport data provides the basis to quantify the track the sediment budget for the Trinity River. Sediment transport and sediment budget information is used to assess whether we are meeting stated sediment management objectives and to guide high flow releases and gravel augmentation management actions. Mainstem sediment transport monitoring has been conducted at 4 locations since 2004 in dry and wetter water years. The standard protocols for monitoring and analyses set forth by the US Geological Survey are used to determine suspended sediment and bedload transport rates, develop sediment transport curves, and determine total sediment loads by size fraction that represent the entire flood hydrograph. This information is provided to the Restoration Program in the form of a final report from the sediment monitoring contractor. Computation of the sediment budget is a separate task performed by program staff.

Geomorphic monitoring and assessment of bed scour and mobility

PI: Franklin, Robert

Abstract: The Trinity River Restoration Program developed an Integrated Assessment Plan ([IAP] Trinity River Restoration Program and ESSA Technologies Ltd. 2008) to identify assessments that: (1) evaluate long-term progress toward achieving Program goals and objectives, and (2) provide short-term feedback to improve Program management actions. The IAP identifies priority assessments necessary to evaluate the effectiveness of the restoration efforts (management actions) in meeting intended objectives, as well as evaluating the overall effectiveness of the restoration strategy in meeting Program goals. Tasks implemented under this investigation plan (IP) address a subset of the IAP assessments, and employ multi-disciplinary monitoring efforts where appropriate and possible, to address cause-and-effect relationships between physical processes and riparian vegetation response. Geomorphic monitoring will be conducted at 24 selected sites along the mainstem Trinity River. Site selection will follow both systemic sampling and site-specific sampling strategies developed for the water year (WY) 2013 study design (revised from the WY 2009-2012 approach based on coordination with the Conceptual Monitoring Plan for Rehabilitation Sites on the Trinity River [Pickard 2012]). Proposed methods, analyses, and metrics are consistent with those used over the past 20 years. For bed mobility and scour assessments, tracer rocks and scour chains will be used to document actual field conditions, and results from the GRTS sample sites will be expanded to describe systemic response to WY 2014 high flow event(s). Metrics will be percentage of bed mobilized and relative scour depth, which can be compared to management objectives in the TRFEFR. Results from the bed mobility and scour analysis will be compared with the riparian band transect results (see WY 2014 Riparian Monitoring Proposal) to establish cause and effect relationships at the GRTS sample sites. Additional synthesis of results from previous years of bed mobility and scour monitoring (through WY 2013) will be used to aid in developing a statistical model intended for providing systemic bed mobility and bed scour predictions that will assist in developing water year 2014 streamflow release recommendations.

Gravel Implementation Tracer Experiment

PI: Gaeuman, David

Abstract: This proposal is intended to demonstrate the extent to which gravel injected into the channel during high flow events is transported downstream. This investigation will provide an independent line of evidence regarding the fate of augmented gravel to improve confidence in inferences drawn in a related investigation (Gravel Implementation Monitoring).

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APPENDIX B

TRINITY RIVER RESTORATION PROGRAM
FISH WORKGROUP ACTIVITIES NOT INCLUDED IN
FY 14 INVESTIGATION PLAN SOLICITATION

Trinity River Restoration Program Fish workgroup activities that were not included in the FY 14 solicitation:

1. Monitor adult escapement of hatchery and naturally produced spring Chinook Monitor harvest (tribal, sport and commercial) of naturally produced spring Chinook
2. Conduct age -composition analysis for spring chinook
3. Develop cohort reconstructions for spring Chinook and evaluate cohort performance or year class strength, and population growth rate
4. Monitor adult escapement of hatchery and naturally produced coho
5. Monitor harvest (tribal, sport and commercial) of naturally produced coho
6. Develop cohort reconstructions for naturally produced coho and evaluate cohort performance or year class strength, and population growth rate
7. Monitor smolt outmigrant numbers - coho and steelhead
8. Monitor size (length/wt and condition of fry/smolts)-coho and steelhead
9. Monitor adult escapement of hatchery and naturally produced steelhead
10. Monitor harvest (tribal, sport and commercial) of naturally produced steelhead
11. IAP. 2.1.5 Minimize physical impacts to lamprey habitat
12. Trinity River Juvenile Chinook Salmon Disease Assessment
13. Adult Fall-Run Chinook Salmon Disease Assessment
14. Monitor pre-smolt size, condition and disease incidence at outmigration (fish in hand)
15. Monitor fry density and abundance at GRTS sites across upper 40 miles (standing stock assessment)
16. Monitor fry density and abundance at rehab sites
17. Map and quantify the extent (area) of available adult spawning habitat at rehab sites and throughout the mainstem