Subject	Data Type	Sources	Comments	Data Gaps	Recommended Studies
Rainfall and temperature	Rainfall, temperature	Ca. Data Exchange Center (from Ca. Dept. of Water Resources (DWR) & National Weather Service (NWS)): 13 real-time rainfall gages. Ca. Irrigation Management Information System (CIMIS): five weather stations. Community Collaborative Rain, Hail & Snow Network: 31 citizen-owned weather stations. Additional stations run by CalFire, USACE, Bureau of Land Management.	There are numerous private agricultural weather stations in the watershed.	For flow analysis, a rainfall gage and air temperature station will be needed in each tributary.	Not a priority study
Geology	Surficial geology-maps.	Entire watershed: 1:250,000 geologic mapping Upper Russian River: 1:62,500 geologic mapping Sonoma County Russian River: 1:24,000 geologic mapping in many areas. From: U.S. Geological Survey (USGS) and Ca. Geological Survey.	Mapping detail in mountainous areas of Mendocino County very low resolution but probably sufficient for hydrologic modeling. Mapping of faults sufficient but hydraulic properties of faults for ground and surface water movements largely unknown.		Not a priority study
Geology	Subsurface geology-wells, geophysical data (magnetic and gravity)	Well logs provide lithologic descriptions but are not generally available to the public	Well logs from well drillers may be inconsistent, locations unclear, sometimes illegible. Geophysical data are most valuable for regional geology but some surface geophysical methods could be useful in hydrologic studies such as the effects of faults on groundwater flow and other hydrologic evaluations.	More detailed description and measurements of soils and rocks in the subsurface in groundwater basins and tributary valleys is needed	See groundwater
Groundwater	Groundwater Level Monitoring.	DWR well monitoring program since 1960s. Now called CASGEM.	Groundwater level monitoring only done twice a year in spring and fall. Useful for basic water table configuration, groundwater movement direction and estimates of groundwater storage changes.	Inventory of well features including elevation of first screen, diversion volume and timing is needed. Continuous groundwater monitoring needed in alluvial valleys and confined alluvial, semiconfined alluvial and dissected alluvium channel types. Groundwater temperatures also need to be monitored.	
Groundwater	Well logs	Well logs showing lithologies with depths and hydraulic properties, areas with high density of wells can create generalized subsurface map of geology and depths of valley fill and bedrock. Groundwater level data recorded at time of well completion. Specific capacity data in well driller reports.	Well logs are prepared by well drillers and may use inconsistent terms, locations unclear and well testing inconsistent. Some groundwater level measurements of limited value – precision and accuracy unknown, state of well (pumping or static) not provided. Very limited well testing done to determine transmissivity (T) and storage coefficient (S) for aquifers in the watershed. Specific capacity values could be converted to estimate transmissivity through		

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Groundwater	Continuous Groundwater Level Monitoring	USGS is adding continuous recording groundwater monitoring wells to surface water gaging sites along the Russian River in Alexander Valley.		The questions new groundwater monitoring will answer include: In selected alluvial channel types (semiconfined, confined, unconfined alluvial and dissected alluvium) how do groundwater levels change over the seasons, with changes in surface flow and with groundwater extraction? How do groundwater temperatures change? How does surface flow in unconfined alluvial tributaries change with changes in flow in the Russian River channel? In the alluvial valleys (Redwood, Ukiah, Hopland and Alexander) how does the groundwater table change with changes in flow in the entrenched Russian River channel? In the alluvial valleys, how do dry season releases from Lake Mendocino effect the groundwater level in the adjacent valley?	For the valley aquifers in Redwood/Ukiah, Hopland and Alexander Valleys, a series of 30-40 wells/valley need to be identified for installation of continuous monitoring pressure transducers. These would be existing wells in the Quaternary Alluvium. The selection of well locations should consider available information sources on surficial geology and subsurface features. The wells should be spatially distributed over each valley. The selection of wells should also take into account the depth and use of the well. Evaluation of drilling log information should be consulted to provide an indication of alluvial depth and thereby guide monitoring well selection. Monitoring wells provide superior data over supply wells as data from supply wells records groundwater levels before, during, and after use. The cost to install numerous monitoring wells is high. Therefore, supply wells can be used as long as detailed pumping records are maintained. Continuous level monitoring would also provide information on the effects of pumping and recovery time to static water levels. Unused wells may also serve as monitoring wells depending on location and construction. Wells near stream flow gaging stations allow for comparisons between the data from each gage. Each well included in the network needs to be surveyed to a benchmark of known elevation so the data from different wells can be compared. Data can be collected on hourly intervals. Securing the pressure transducer in the well can be tricky so several attachments to the casing or ground may be needed. The transducer should be set to measure water temperature as well as water level. For the alluvial channel types (confined alluvial, semiconfined alluvial, unconfined alluvial, dissected alluvium and alluvial fan) in each subarea one or more existing wells should be monitored. These wells should also have pressure transducers installed to monitor groundwater levels over an annual cycle and in relationship to water diversions, rainfall and stream flow levels. Groundwater and surface water monitoring locations should be coordinated.
Groundwater	Groundwater Basin Studies.	DWR and USGS – mapping and estimates of specific yield of 11 groundwater basins in the watershed.			
Surface Water Hydrology	Stream Flow Gaging	USGS: 9 stream flow gages on main stem Russian River, 1 gage on West Fork Russian River, 2 gages on Big Sulphur Creek, 1 gage on Maacama Creek, 3 gages on Dry Creek, 8 gages in Laguna de Santa Rosa watershed, 1 gage on Mark West Creek, 1 gage on Austin Creek. Historic USGS gages on Feliz, Franz, Mark West and Maacama Creeks and West Fork Russian River. UC Berkeley installed a number of very short term gages (18-24 months). Center for Ecological Management and Restoration (CEMAR) maintains gages on Green Valley, Upper Mark West, Mill and others. Ca. Land Stewardship Institute (CLSI) maintains nested gaging networks on Redwood Creek, McNab Creek and Dooley/McDowell Creek.	Many tributaries lack flow gages. Due to the high level of geologic heterogeneity and topographic variability, it is problematic to extrapolate flow data to ungaged basins.	Gaging networks need to be designed to answer water management and fish habitat questions, be installed and maintained according to established protocols and remain active for numerous years to produce long-term records. It is especially important to gage low flow conditions. In tributaries nested systems of stream flow gages can be used to detect the effect of diversions and determine if there are serious impacts to flow. Tributary gaging can be coordinated with groundwater monitoring to determine if changes in water use could create improved flow conditions.	With the variation in geology and topography in each tributary, gaging is needed in all major creeks to characterize stream flows. Stream flow gaging should include continuous measurement of the stage of the stream with a pressure transducer or similar instrument as well as completion of discharge measurements at various flow levels near each gage. Both types of data, continuous stage measurement and discharge measurements, are needed to determine stream flows in cubic feet per second (cfs). Developing complete hydrologic data sets allows for analysis of the effects of water diversions. Stream flow is difficult to measure accurately. Choosing a good location for a gage is the most important step. A fairly straight reach of channel with no major tributaries and a stable hydraulic control downstream that creates a suitable pool in which to place the gage and measure stage is needed. The reach should be fairly stable so that scour and deposition at the control are minimized. Flow measurements are made at a nearby cross section with conditions most favorable for accurate measurement of discharge, typically a different location from that chosen for the gage. The recording gage should also have an outside staff gage from which stage can be manually read which provides a quality check on the readings of the pressure transducer. Low flow conditions can be challenging to measure and may require the temporary installation of a Parshall flume to take accurate discharge measurements. Most pressure transducers used for stage measurement also measure water temperature. This gaging should be coordinated with local gaging efforts under the State Water Board's Frost Regulation. Numerical model will use the monitoring data to simulate the relationship of well pumping and stream flow.
Surface Water Hydrology	Stream Flow Gaging	National Marine Fisheries Service (NMFS) and State Water Resources Control Board (SWRCB) have gages on a few creeks.	There have been quality control problems with NMFS and SWRCB gages on Dooley and McNab Creeks; installations limit data accuracy.		

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Geomorphology	Channel Topographic Surveys	There are no recent surveys (last 10 years) of the river channel in Mendocino County. In the Alexander Valley and Russian River Valley reaches of the Russian River gravel mining companies complete channel surveys.		The questions geomorphic surveys and analyses need to answer include: How much has the main stem river channel aggraded (built-up) or degraded (downcut) since the last survey was done? Is the incision process continuing and at what rate? How are tributary streams in the alluvial valleys adjusting to the incision of the main stem?	A topographic survey of the river channel would allow for comparisons with the 1990s and earlier topographic data to evaluate the ongoing entrenchment of the channel. Collection of this topographic data could be done through a combination of an aerial LiDAR flight and conventional surveying of channel cross sections and a longitudinal profile of the lowest point in the channel (thalweg). If possible the locations of previously surveyed cross sections should be re-occupied so the two data sets can be directly compared. The cross sections should be 500 feet apart or less, capture topographic details of the channel from top of bank to top of bank and be tied to an established benchmark. Major tributary channels should also be included to monitor the upstream propagation of incision into the tributaries and effects on infrastructure. The ISRP recommends a thorough analysis of the effects of flood operations of Coyote Dam using up-to-date topographic surveys of the river channel. Using a hydraulic model calibrated with up-to-date geomorphic data analyze the effects of flood releases from Coyote Dam on channel erosion and geomorphology under different flow scenarios.
Water Quality	Water Temperature	North Coast Regional Water Quality Control Board – Surface Water Ambient Monitoring Program (SWAMP) – monitors a suite of parameters. Mendocino County Water Agency completed summer temperature monitoring in 15 locations on river and in tributaries for a few years. Sonoma County Water Agency – water temperature monitoring on main stem Russian River, lower watershed and estuary. Stream flow gages often measure water temperatures. Community Clean Water Institute Monitors a variety of parameters.		A network of water quality and dissolved oxygen stations is needed to evaluate fish habitats. All water quality monitoring must follow strict QA/QC (Quality Assurance/Quality Control) measures to be useful. The SWAMP program provides standard operating procedures for water quality monitoring.	Additional water temperature and dissolved oxygen monitoring is needed in the tributaries and the river below Coyote Dam.
Climate Change	Global Climate Models (GCM)	USGS and SCWA have developed a downsized GCM for the Russian River watershed. In 2015, two data sets were completed including unimpaired mean daily flow under historic conditions (1910-2013) and mean daily flow under projected future climate (2001-2099).		There is a need to evaluate future water temperatures in tributaries to focus restoration efforts in locations where cold water is mostly likely to occur.	The questions important to answer for future climate change studies include: What will future water temperatures be in specific tributary locations under various climate change scenarios? Can we prioritize restoration efforts in tributaries where cold water may be more prevalent? How will increased future water demands for urban, rural residential and agricultural land use fare under predicted future climate scenarios? Will there be adequate flows for human uses and fish and aquatic life?
Water Demand and Use	Water Rights Data	State Water Resources Control Board (SCWA) eWRIMs database lists approved and pending appropriative water rights as well as "claimed" riparian rights.	Face value for pending rights is usually incorrect as pending rights have several potential points of diversion proposed and all are added together for the face value. When the permit is issued it will have one point of diversion. Face values in the database for permitted and licensed water rights do not incorporate restrictions on diversion rates, season of diversion and place of use included in the permit. Analysis of water use	Lack of complete water use reporting records is a data gap.	The questions important to answer for future water demand and use studies include: What are the volumes of surface water and groundwater used by each type of diverter (vineyards, marijuana, rural residential, municipal) as well as the location and timing of diversions? How will water demand change quantitatively and spatially with various climate change scenarios?
Water Demand and Use	Municipal water use data – surface water.	SCWA, cities	Fairly complete water diversion and use records.		
Water Demand and Use	Rural residential water use data– surface water	No reporting available. Estimated for Green Valley Creek watershed at 0.207 acre feet per year per residence and for Upper Mark West Creek at 0.135 acre feet per six month dry season.	SWRCB passed emergency regulations over water use for rural residences in Green Valley, Mark West, Mill and Dutch Bill Creek watersheds to protect Coho salmon. Water use reporting is required.	Lack of reporting for rural residential water use is a major data gap.	
Water Demand and Use	Agricultural water use data – surface water	All appropriative and riparian water diverters must report annually to the SWRCB. Under Russian River Frost Regulation, farmers must report water use.		Water use records need to be kept by all water uses.	
Water Demand and Use	Groundwater use data	Groundwater use is not reported unless well owner has applied for an appropriative water right for the well.	Sustainable Groundwater Management Act (SGMA) passed in 2015 requires preparation of a sustainable groundwater plan for medium and high priority basins. In the Russian River watershed, these are Redwood/Ukiah Valley and Santa Rosa Plain. These plans may require groundwater use reporting.	Lack of groundwater use data is a major data gap.	
Water Demand and Use	Marijuana production water use data	Marijuana growers rarely have permitted water rights. These are mostly illegal diversions and are not reported.	Recent laws will require growers to demonstrate compliance with environmental laws including water rights. Water use quantities are not known but are believed to effect flow in upstream areas of tributaries.	Water diversions for marijuana cultivation need to be quantified and locations identified.	

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Aquatic Communities	Qualitative stream habitat surveys.	Ca. Dept. of Fish and Wildlife (CDFW)	These surveys provide general information on a creek but are based on a one-day visit so do not provide comprehensive or quantitative data.	The watershed lacks a comprehensive monitoring program for aquatic communities. Existing monitoring programs which focus almost exclusively on Coho salmon are limited in their extent. There is no population data and very little presence/absence data on steelhead trout. Conservation of anadromous fish populations also requires an ecological understanding of interactions amongst species. The effects of natural and human caused stressors (floods, droughts, water diversions, dams, land use changes, pollution) on aquatic communities cannot be evaluated if there is little to no information on the aquatic community in a particular impacted creek. Similarly no priorities can be established between tributaries without a clear understanding of the aquatic community in each tributary. The questions new studies need to answer include: What is the assemblage and abundance of native fish and aquatic life in each tributary? What channel types in each tributary provide rearing habitat for salmonids, spawning habitat and migratory corridors?	To adequately characterize aquatic communities a coordinated, comprehensive, adaptive, and consistent biological research program covering the entire watershed is needed. This program should be coordinated (i.e. not piecemeal) and consider the whole watershed. It should be comprehensive, in that it includes multiple taxonomic groups of aquatic biota (fish, amphibians, reptiles, invertebrates), and that it focuses on both community and population level interactions. The first phase should include a study examining the distribution of aquatic biota across all major tributaries and main stem reaches. A second phase would then establish a series of long-term ecological monitoring sites to better understand population and community dynamics of target species. Finally, the program should be consistent, and use established and repeatable methodologies that are tailored to this system and the research questions under scrutiny. The goal of the first phase of this program is to understand distribution of aquatic organisms across the watershed. For fish, the program could use the EPA Rapid Bioassessment Protocol (Barbour et al. 1999). This protocol has the advantages that it can be used in most streams and it is an efficient way to rapidly survey fish biodiversity. However, it is not necessarily the best approach to use for answering questions from the second phase of the program that deal with population dynamics. Phase two of the program will require a consistent method of examining target taxa populations and life stages. A rough estimate for the initial number of sampling locations needed to develop an understanding of aquatic species distributions throughout the watershed is approximately 150. This would provide for sampling throughout the main stem river and 2-5 sites in every major tributary stream. Sites would be located on all channel types in the stream typology, and would include the full range of stream habitats and flow regimes, including intermittent streams.
	Video monitoring of adult salmonids at Mirabel Diversion Dam fish ladder	SCWA			
	Spawning surveys of main stem Coyote Dam to Alexander Valley	SCWA			
	Spawning surveys, smolt traps and juvenile surveys in Dry and Green Valley Creek and other lower river tributaries.	Russian River Coho Salmon Captive Broodstock Program	This program installed PIT (passive integrated transponders) tags into a percentage of released Coho salmon smolts to track migration.		
	Fish Migration Barriers	Passage Assessment Database	Spatial data base of fish passage barriers.		
	Aquatic Invertebrate Surveys	CDFW	One time surveys in 21 lower basin tributaries in 1995-1997 and at 50 randomly selected sites in tributaries (1998-2015).		For stream invertebrates, the most commonly used sampling approach in California is the Surface Water Ambient Monitoring Program (SWAMP) procedure (Ode et al. 2005). While this approach would allow consistency and comparison with other regions of the state, it would require extensive resources (i.e. time and money) and would not be as efficient as a more rapid approach. Additionally, the physical habitat (PHAB) sampling approach in the SWAMP protocol would not produce essential data needed to answer our important questions. Finally, the SWAMP protocol does not allow for an understanding of taxonomic preferences for different microhabitats. For these reasons we do not recommend it for the initial phase of work. Instead, we recommend a sampling methodology that will rapidly sample each major habitat type present in a sampling reach and provide for the collection of representative specimens from each habitat. Additionally, some limited sampling of adult aquatic insects (often necessary for species level determinations) will be needed through use of emergence traps, pan traps, or light traps.