Technical Memorandum

Upper Petaluma River Watershed Flood Control Project Scoping Study

Subject:	**Project Strategy Memorandum**
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1 Introduction

The Sonoma County Water Agency (Water Agency) is presently developing the Upper Petaluma River Watershed Project (Project) in order to provide regional flood mitigation and groundwater recharge benefits within the Upper Petaluma River Watershed. It is anticipated that the Scoping Study for the Project will be followed up by a Feasibility Study and subsequent Project Implementation.

This memorandum summarizes the findings of the Scoping Study, outlines the scope of the Feasibility Study and discusses project implementation strategies that should be considered at this juncture in the Project development.

1.1 Project Setting

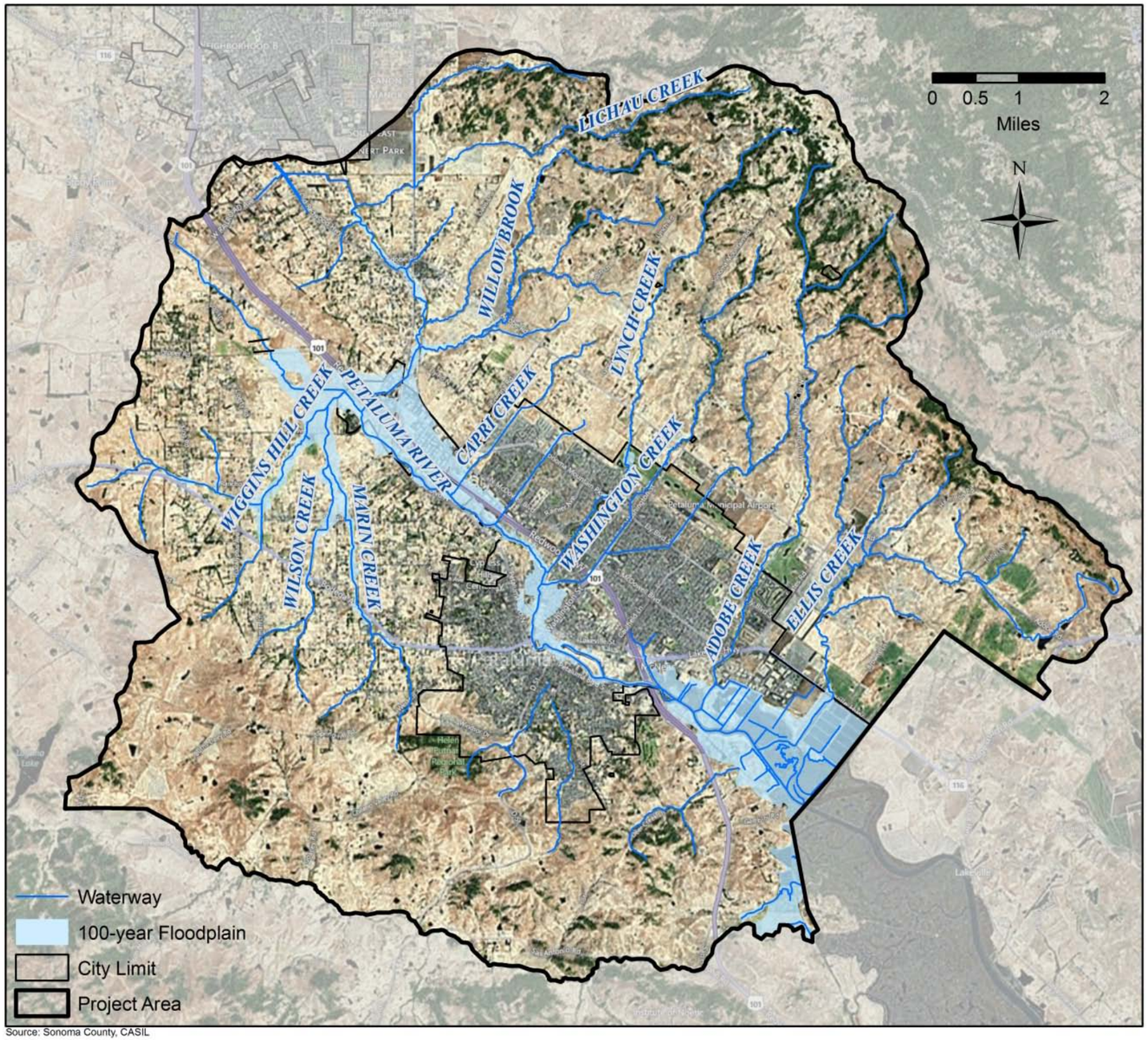
The Project area, Sonoma County's Flood Zone 2A, is the upper portion of the Petaluma River watershed. Zone 2A is approximately 90 square miles. Elevations vary from nearly sea level in the southwest corner of Zone 2A to over 2,200 feet in the northeast corner of Zone 2A.

Major tributaries, shown in **Figure 1**, to the Petaluma River include Marin Creek, Willow Brook, Capri Creek, Lynch Creek, Washington Creek, Adobe Creek, and Ellis Creek. Zone 2A mean annual precipitation ranges from about 22.5 inches to about 45 inches (CA Department of Forestry and Fire Protection), with the higher rainfall averages falling in the higher elevation areas in the northeast.

As shown in **Figure 1**, there are extensive 100-year floodplains for the Petaluma River and many of its tributaries within the study area. Since there is little demand for additional flood control projects downstream of the City of Petaluma (City) and several flood control projects to alleviate flooding within city limits are planned, the focus of flood protection alternative identification will be upstream of the confluence between the Petaluma River and Lynch Creek although potential project opportunities have also been identified by the City of Petaluma on Thompson and Kelly creeks. Of particular importance to the Project are the developed areas within the 100-year floodplain along Highway 101 and Petaluma River tributaries including Lichau Creek, Liberty Creek, Wiggins Creek, Wilson Creek, and Marin Creek.

The project area overlies the Petaluma Valley Groundwater Basin, a northwest-trending structural depression in the southern part of the Coast Ranges of northern California. The basin is bounded on the west by the Mendocino Range, on the east by the Mayacamas and Sonoma Mountains, and on the south by San Pablo Bay. As discussed later in this memorandum, there are portions of the study areas that may be suitable for enhanced groundwater recharge.

Figure 1: Upper Petaluma River and Tributaries



Source: Sonoma County, CASIL

2 Scoping Study Summary

The Scoping Study aimed to first develop project objectives, assess potential project issues, and then to identify and prioritize potential project concepts. Through a collaborative process with stakeholders and project partners, several conceptual project alternatives were recommended for further evaluation in the Feasibility Study. The "Tier 1" conceptual project alternatives that will be evaluated in the Feasibility Study are offstream detention basins and floodplain modifications. Additionally, three "enhancement concepts" – floodplain management, low impact development and policy review – were also recommended for parallel evaluation.

The sections below provide further details on the steps taken during the Scoping Study. As delineated in Section 2.4, documents produced for the Scoping Study are included as appendices to this memorandum.

2.1 Key Project Purpose and Project Objectives

The Key Project Purpose is:

> *Develop a stormwater management/groundwater recharge project(s) that will provide flood hazard reduction and groundwater benefits within the Upper Petaluma River Watershed.*

This is a broad purpose consistent with the Water Agency's *Water Supply Strategies Action Plan* (2010). The Key Project Purpose was the starting point for this project and is the basis for the core objectives which are simply stated as flood hazard reduction and groundwater recharge.

Many of the types of projects that will fulfill the Key Project Purpose will offer opportunities to provide additional benefits. To more formally consider such benefits, a set of "supporting objectives" were also delineated. The core and supporting objectives were initially reviewed with stakeholders at the first stakeholder meeting on April 28, 2011 (**Appendix A**). Stakeholder comments were incorporated into the *Project Objectives Report* (**Appendix B**). Core and supporting objectives are summarized below in **Table 1**.

Table 1: Core and Supporting Objectives

Core Objectives
Flood Hazard Reduction - Improve management of stormwater that contributes, directly or indirectly, to reduced flood hazards.
Groundwater Recharge - Increase beneficial recharge of groundwater, whether or not that recharged groundwater is directly accessible as water supply.
Supporting Objectives
Water Quality - Protect or improve water quality of surface water (Petaluma River, its tributaries and the San Francisco Bay) and groundwater.
Water Supply - Increase or improve water supply availability, reliability and flexibility for domestic, municipal, industrial, agricultural, and environmental use.
System Sustainability - Support energy and water efficiency and climate change resiliency of water management systems and developed supplies; provide for channel stability and sedimentation control; and consider the long-term viability of implemented project and impact on affected systems.
Ecosystem - Improve ecosystem function and/or habitat enhancement, especially for listed species.
Agricultural Land - Preserve agricultural land use.
Undeveloped Land - Preserve and/or enhance open space and undeveloped land.
Community Benefits - Create and/or enhance recreation, public access, education, etc.

While not critical to achieving the Key Project Purpose, consideration of the supporting objectives may help address many of the project challenges and constraints that were described within the "Issues Assessment" portion of the Scoping Study (see Section 2.2 below).

2.2 Issues Assessment

The purpose of the Issues Assessment portion of the Scoping Study was to outline the benefits and challenges expected to be encountered if the efforts to address the Project's core and supporting objectives. An awareness of these potential benefits and challenges informs the Conceptual Alternatives Development (see Section 2.3) as well as the eventual Project strategy (see Section 3). A summary of potential benefits and constraints is provided below while a more detailed discussion of benefits and constraints was provided in the *Issues Assessment* (**Appendix C**).

2.2.1 Benefits

The core and supporting project objectives each have associated benefits. The matrix below outlines benefits expected to be realized by pursuing each of the project objectives. Benefits have been organized into "triple bottom line" categories. A summary of the association between objectives and benefits is provided below in **Table 2.** Further explanation of the potential benefits that could be realized by addressing the various objectives is provided in the *Issues Assessment*.

Table 2: Benefits Associated with Objectives

Objectives	Social Benefits			Environmental Benefits			Economic Benefits		
	Public Health & Safety	Property Protection	Public Amenities	Local Env. Enhancement	Regional Env. Enhancement	Global Env. Enhancement	Regulatory Streamlining	Community Viability	Maintenance Efficiency
Flood Hazard Reduction	X	X		X				X	
Groundwater Recharge	X				X	X		X	
Water Quality	X			X	X		X		
Water Supply	X			X	X	X		X	
System Sustainability	X	X		X	X	X	X	X	X
Ecosystem			X	X	X	X		X	
Agricultural Land		X		X	X	X		X	
Undeveloped Land		X	X	X	X	X			
Community Benefits			X	X	X			X	X

2.2.2 Challenges and Constraints

The project will encounter challenges and constraints in association with pursuing each of the project objectives. Acquiring funding is one of the most significant challenges/constraints. Balancing the different project objectives is one key to a successful funding strategy.

Additional anticipated challenges and constraints associated with each project objective are summarized in **Table 3** and are further discussed in the *Issues Assessment*.

Table 1: Challenge Matrix for Objectives

	Expected Challenges/Constraints			
	Stakeholder Agreement	Aligning Project Partners	Regulatory Approval	Technical Challenges
Core Objectives				
Flood Hazard Reduction	X			X
Groundwater Recharge		X	X	X
Supporting Objectives				
Water Quality				X
Water Supply		X	X	X
System Sustainability				X
Ecosystem	X	X		
Agricultural Land	X			
Undeveloped Land	X	X		
Recreation & Education	X	X		

2.3 Conceptual Alternatives Development

After having established the Project's core and supporting objectives, the Scoping Study moved on to identifying, screening and prioritizing project concepts.

2.3.1 Identification of Geographic Focus Areas

As detailed in the *Project Concepts Identification and Description* (**Appendix E**), focus areas where flood and recharge project elements would be considered potentially feasible were identified as part of the Scoping Study.

Flood Hazard Reduction Focus Areas

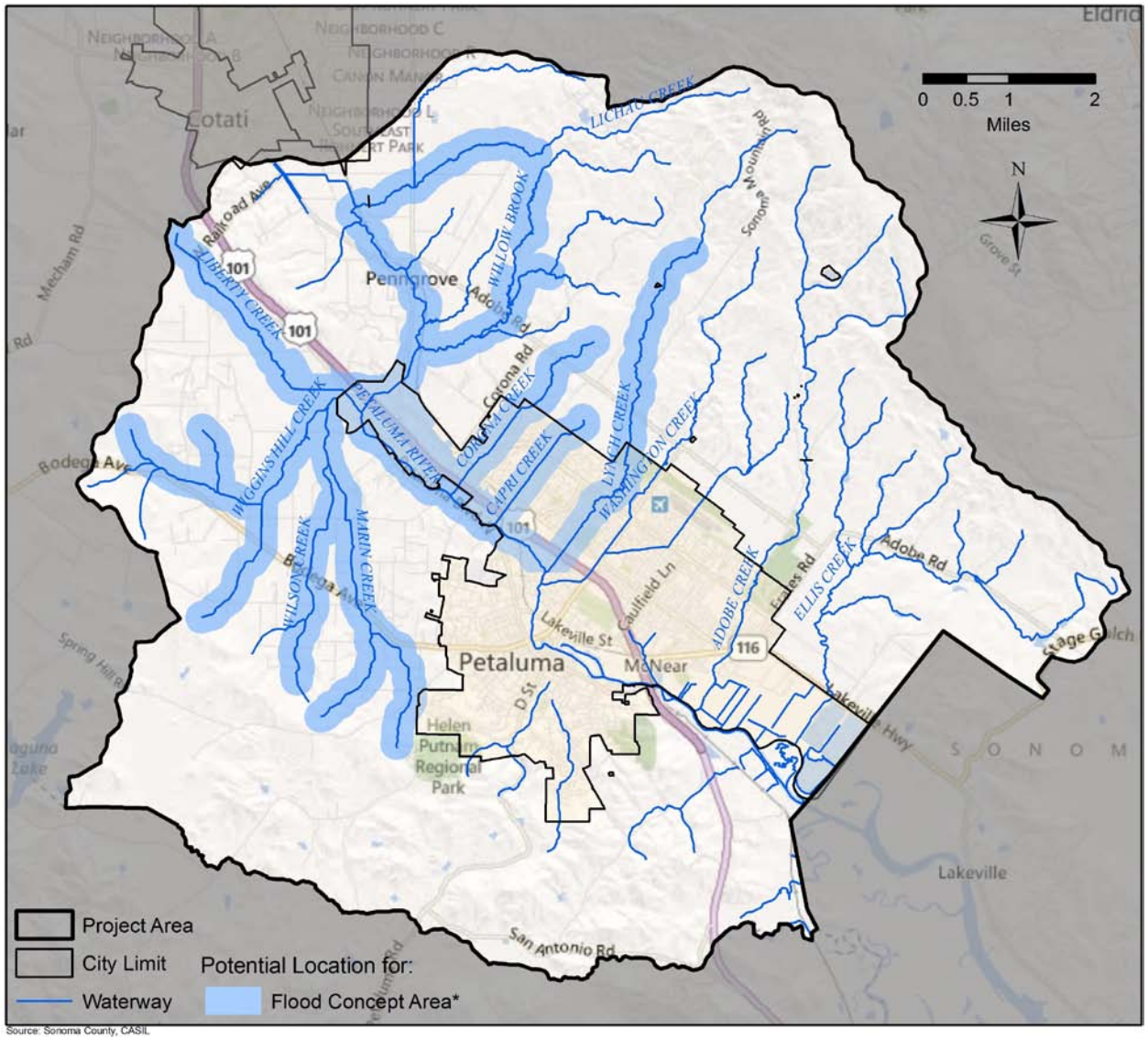
Flood reduction benefits are achieved through one or more of the following strategies:

- Increased channel hydraulic capacity; and
- Reduction in peak flows.

Most flood hazard reduction concepts utilizing the above strategies are tied to the flood pathways. For the purposes of this memorandum, the FEMA 100-year floodplain and creeks with a defined 100-year floodplain will be used to focus the area to be evaluated for flood hazard reduction project concepts.

Recognizing that not all flood hazard reduction project types are done in-stream, the focus area is broadened to include a 1,000-foot area around the streams. Stream reaches with smaller tributary areas and the upper reaches of some streams were removed from the focus area where it appeared that downstream concepts could be more effective. As established by the Water Agency, the focus of the flood hazard reduction element for this scoping study was upstream of and including the confluence of the Petaluma River and Lynch Creek. The final concept focus area, shown in **Figure 2**, reflects all of these assumptions and conditions.

Figure 2: Flood Hazard Reduction Project Element Focus Area



* Note that the flood concept area may be expanded to accommodate some specific concepts with flood benefits.

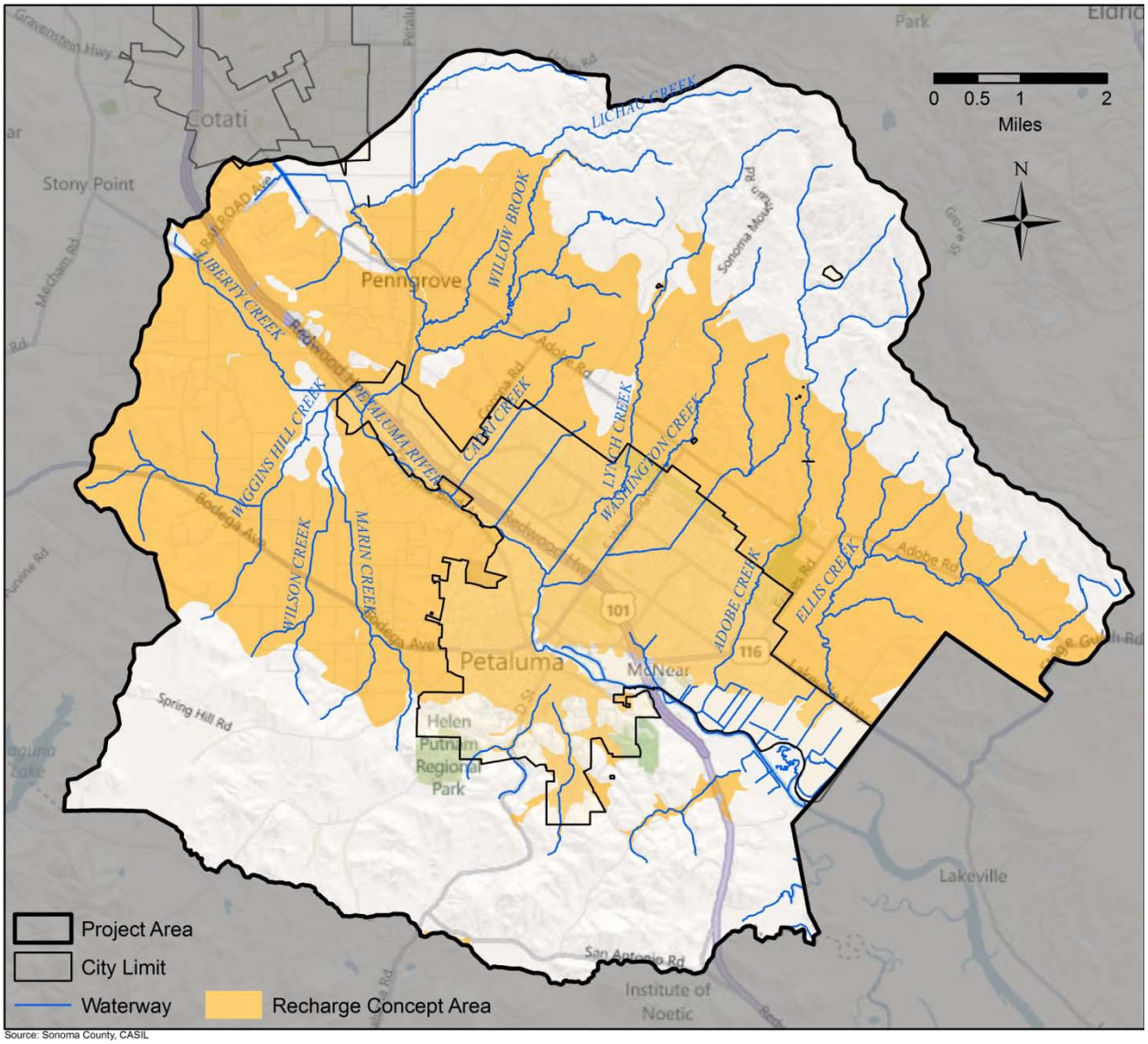
The flood hazard reduction focus area shown in **Figure 2** is intended to help identify, at a conceptual level, those areas that could play a role in providing flood hazard reduction benefits both locally and regionally. In future phases of the Project, it is possible that more suitable or efficient locations will be found or that some of the areas will be eliminated from project siting consideration for one or more reasons, including but not limited to, willing landowner participation, zoning restrictions, or

environmental limitations. Some project concepts are more regional in nature. In these cases, the focus area would not apply.

Groundwater Recharge Focus Areas

The groundwater recharge focus areas, shown below in **Figure 3**, are intended to help identify, at a conceptual level, those areas that could play a role in providing groundwater recharge benefits both locally and regionally. In all locations, site-specific investigations (including geologic borings and soil testing) and other analyses such as water quality tests will be required to further determine the suitability of each location for groundwater recharge or to eliminate it from further consideration for one or more reasons, including but not limited to environmental or hydrogeologic limitations, willing landowner participation, or zoning restrictions.

Figure 3: Groundwater Recharge Project Element Focus Areas

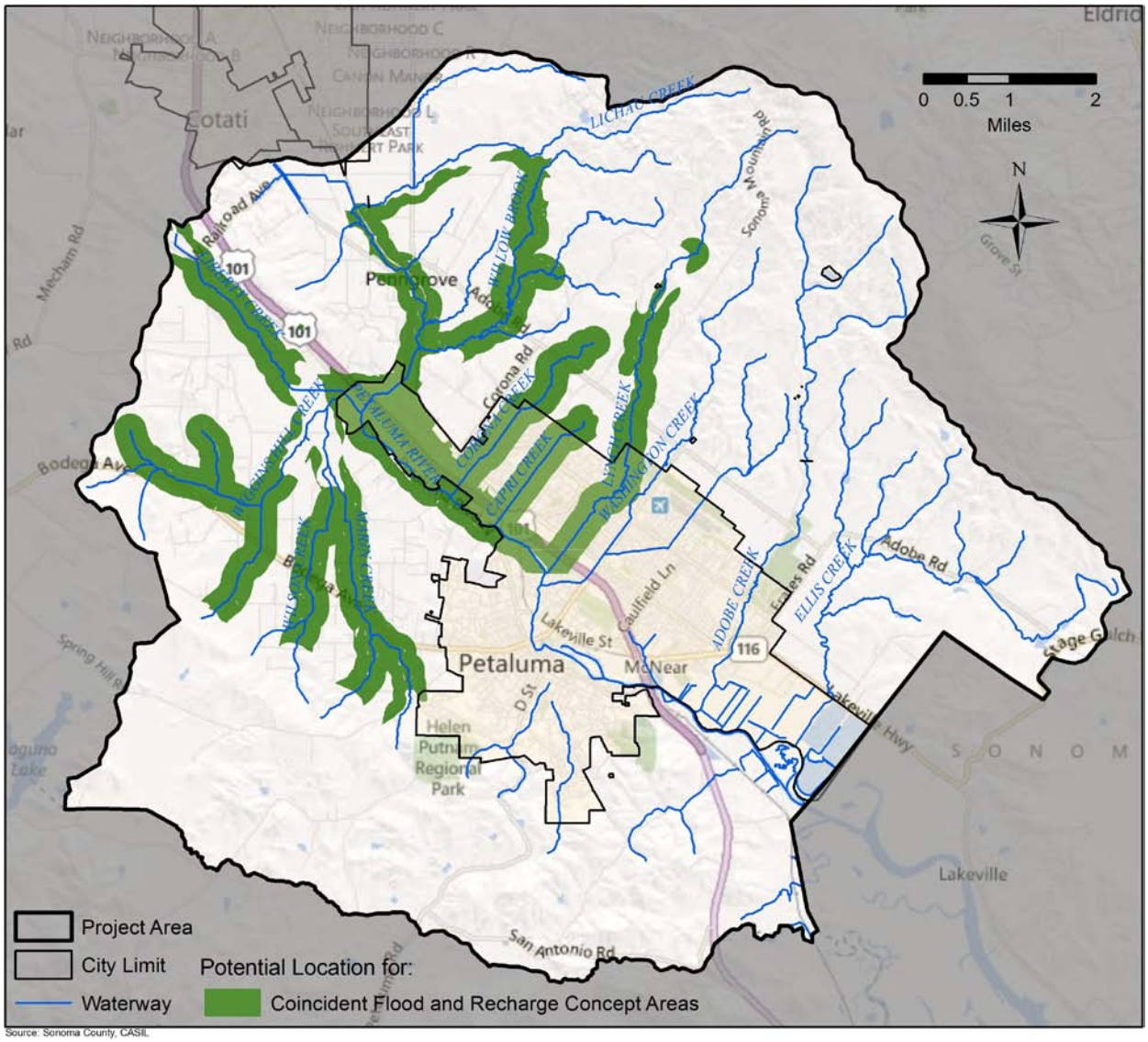


Opportunity for Coincident Flood Hazard Reduction and Groundwater Recharge

Figure 4 highlights the overlap areas for both the flood hazard reduction and groundwater recharge focus areas. Project concepts sited in these areas will have the opportunity for coincident flood hazard reduction

and groundwater recharge. Outside of these areas though, project elements in different locations will need to be paired to achieve both of the primary objectives of the Key Project Purpose.

Figure 4: Coincident Flood Hazard Reduction and Groundwater Recharge Focus Areas



2.3.2 Concept Identification

Within the Scoping Study's *Project Concepts Identification and Description*, eleven project concepts were identified and evaluated in terms of ability to address core and supporting objects as well as potential for significant challenges and constraints. The concepts are:

- Managed floodplain – Floodplain project concept that maintains existing floodplains in their current condition to preserve existing flood protection benefits.
- Off-stream detention basin – Off-stream project concept that temporarily stores excess flood waters and reduces downstream peak flows.
- In-stream detention basin – In-stream project concept that temporarily stores excess flood waters and reduces downstream peak flows.

- Floodplain modification – Floodplain project concept that increases the storage capacity of existing floodplains and triggers use of the floodplain more frequently.
- Levee/floodwall – Top of bank project concept that reduces floodplain area by creating a barrier to flood flows.
- Channel modification – In-stream project concept that increases the carrying capacity of the waterway.
- Bypass channel – Off-stream project concept that provides a parallel flow path to an existing waterway, thus increasing overall capacity of the reach.
- Bridge improvement and debris removal – In-stream project concept that reviews and improves the flow approach to bridges and removes existing debris caught at the bridges.
- Low impact development – Off-stream project concept that is not directly connected with the waterway, but reduces runoff that would otherwise lead to increased flow.
- Policy review and development – Non-construction project concept that examines, and potentially supplements, existing policies that impact flood hazard reduction and groundwater recharge.
- Direct recharge wells – Off-stream project concept that uses wells to recharge aquifers with storm water.

These concepts were reviewed at a public meeting on October 5, 2011 (**Appendix D**). Comments were incorporated as appropriate into *Project Concepts Identification and Description*.

2.3.3 Concept Screening

These eleven concepts were then screened with respect to the Key Project Purpose. Project concepts that did not provide both flood hazard reduction and groundwater recharge benefits were not moved forward to the prioritization process. **Table 4** lists the eleven concepts and summarizes the results of this screening process. See the *Conceptual Alternatives Screening Evaluation* (**Appendix F**) for further details about the screening process.

Table 2: Project Concepts and Screening Process Results

Concept	Advanced to Prioritization Process	Notes
Managed Floodplain	Yes	
Off-stream Detention Basin	Yes	
In-stream Detention Basin	Yes	
Floodplain Modification	Yes	
Levee/Floodwall	No	The concept does not address the Groundwater Recharge objective**.**
Channel Modification	Yes	
Bypass Channel	Yes	
Bridge Improvement & Debris Removal	No	The concept does not address the Groundwater Recharge objective.
Low Impact Development	Yes	
Policy Review & Development	Yes	
Direct Recharge Wells	No	The concept does not address the Flood Hazard Reduction objective.

Based on this evaluation, eight of the eleven identified concepts were considered in the prioritization process.

2.3.4 Concept Prioritization

Concepts that passed the initial screening were prioritized with respect to the nine previously established objectives (two core objectives and seven supporting objectives). In order to do this, two assessments were conducted:

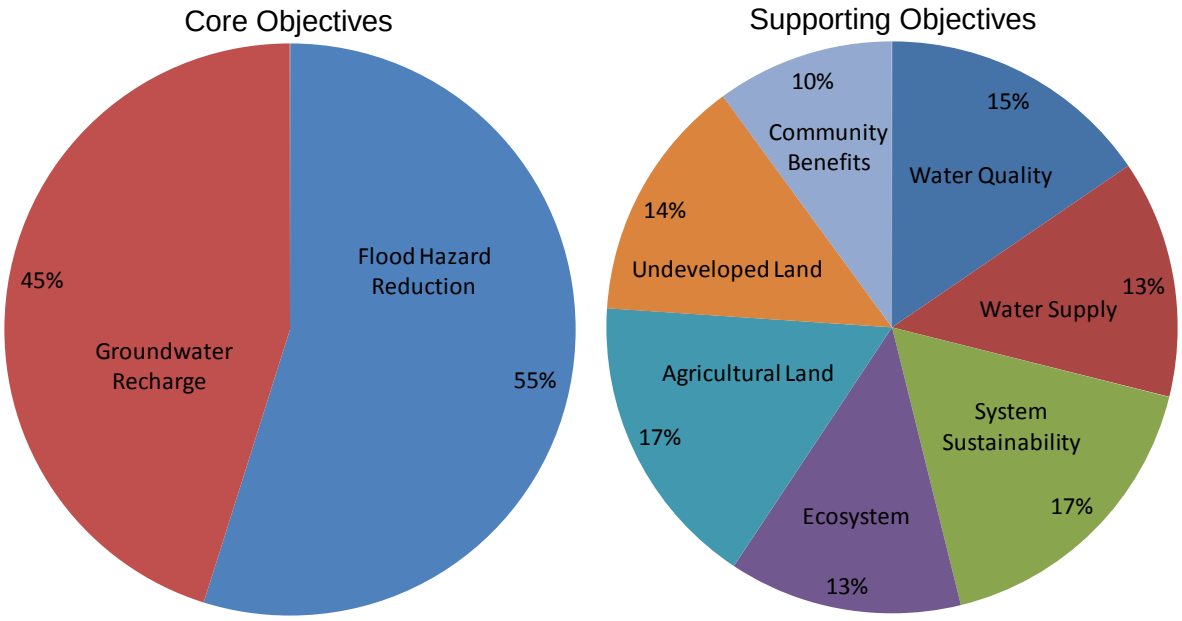
- Weighting of relative importance of the objectives resulting in a percentage importance being assigned to each objective; and
- Evaluation of ability of each concept to address each objective resulting in a numeric score for each objective.

As further described below, the objective weighting and the concept evaluation were combined in order to prioritize or rank the project concepts relative to each other.

Objective Weighting

Weighting of the objectives was based on a poll of attendees at the October 5, 2011 public workshop. Attendees were asked to prioritize (high, medium, low) elements of the two core objectives and seven supporting objectives. **Figure 5** summarizes the results, which are based on 28 responses, and represents relative objective importance.

Figure 5: Public Input on Relative Objective Weights



Note: Percentages may not sum to 100% due to rounding.

As this Project will primarily support the Key Project Purpose, the core objectives were assigned 50% of the overall weighting and the supporting objectives share the remaining 50% of the overall weighting.

Concept Evaluation

As part of the prioritization process, each concept was assigned a score to indicate how well it could be expected to satisfy each of the nine objectives. Since specific proposals and locations have not yet been developed, this portion of the prioritization process was necessarily qualitative. Further details about the concept evaluation scoring are provided in the *Conceptual Alternatives Screening Evaluation*.

Prioritization Results and Project Concept Ranking

These objective weightings and the concept evaluation scores were combined by multiplying an objective's percentage importance by its numeric score within each project concept. A total score or rank for each project concept was then produced by adding the nine objectives.

Through this prioritization process, the eight projects concepts that made it through the screening process were ranked and divided into four tiers. The first tier includes the project concepts that best address the core and support objectives of the Project. Concepts in this tier should form the basis of the project concepts developed during the Feasibility Study. The second tier includes concepts that could be used to support project concepts based on the first tier concepts. The third tier includes concepts that would not normally be considered for implementation through this Project. The enhancement tier includes concepts that could be paired with concepts implemented as part of the Project to bring additional benefits. The recommended tiers for concept prioritization are:

- First Tier
  - Floodplain modification
  - Off-stream detention basin (surface)
- Second Tier
  - Channel modification

  - Bypass channel (surface)
- Third Tier
  - Off-stream detention basin (buried)
  - Bypass channel (buried)
  - In-stream detention basin
- Enhancement Tier
  - Managed floodplain
  - Low impact development
  - Policy review and development

The Tier 1 concepts, floodplain modification and surface off-stream detention basins, are anticipated to be the primary methods through which to achieve flood hazard reduction and groundwater recharge through the Project. The Tier 2 concepts of channel modification and surface bypasses were envisioned to be used as a solution to local flooding, as opposed to a regional solution. As such, they can potentially be used to supplement the protection benefits of the overall project.

The three concepts included in the enhancement tier are fundamentally different from the construction projects in the first three tiers. These concepts are not recommended to be the basis of future feasibility work. They do however provide benefits and could be used to supplement other projects. The results of the prioritization process were presented at a public workshop on December 8, 2011 (**Appendix G)**.

Review of Previously Developed Project Proposals

As one of the concluding steps in the Scoping Study, six previously developed project proposals were reviewed to evaluate whether any of the proposals should be included in the next steps of the Project. Three of the six project proposals were recommended for at least partial consideration in the Feasibility Study. This analysis of previously developed project proposals is presented in the *Zone 2A Concept Evaluation* (**Appendix H**).

2.4 Scoping Study Documentation

As shown in **Table 5**, several reports/memoranda and three public workshops were conducted as part of the Scoping Study. The reports/memoranda and meeting minutes from the workshops are included as appendices to this memorandum.

Table 3: Scoping Study Documentation

Appendix	Scoping Study Document	Comments
A	Meeting Minutes – Stakeholder Meeting #1	Discussion of draft core and supporting objectives and potential project concepts
B	*Final Project Objectives Report*	Discussion of draft core and supporting objectives and potential project concepts
C	*Issues Assessment*	Summary of key issues, strategies, and supporting objectives
D	Meeting Minutes - Stakeholder Meeting #2 (Zone 2A Advisory Committee Meeting)	Discussion of project concepts and screening/prioritization process.
E	*Project Concepts Identification and Description*	Described project concepts and summarized regional hydrology and hydrogeology
F	*Conceptual Alternatives Screening Evaluation*	Created a prioritized list of project concepts by applying a screening and prioritization process
G	Meeting Minutes – Stakeholder Meeting #3 (Zone 2A Advisory Committee Meeting)	Discussion of project concepts and screening/prioritization process.
H	*Zone 2A Concept Evaluation*	Review of previously developed projects alternatives for consistency with the Project objectives and potential inclusion in the Feasibility Study
I	*Feasibility Study Scope of Work*	Outline of anticipated tasks for the Feasibility Study. See Section 3 below for discussion.
J	*Feasibility Study Data Needs*	Summary of data needs for the Feasibility Study

3 Feasibility Study Overview

The Feasibility Study is anticipated to extend over approximately one year. The Feasibility phase will include data gathering and compilation, hydraulic and hydrologic modeling, field investigations including geotechnical, hydrogeologic and geomorphology investigations, and design concept refinement and analysis. Through the Feasibility Study, the Tier 1 project concepts will be developed into several project alternatives that have enough specificity in scope and location to allow focused field investigations. Using data gathered through the field investigations, a single project alternative will be identified and advanced to implementation. The steps to be undertaken in the Feasibility Study are summarized below and further detail about the plans for the Feasibility Study is provided in the *Feasibility Study Scope of Work* (**Appendix I**) and the *Feasibility Study Data Needs* (**Appendix J**).

Tasks to be undertaken in the Feasibility Study include:

- **Data Collection and Analysis –** Through coordination with Water Agency staff and other entities, as directed, existing data relevant to the Tier 1 (and to a lesser extent the Tier 2) project concepts will be collected and analyzed.
- **Hydraulic Model Update –** As part of its Surface Water Management Master Plan, the City of Petaluma recently developed a 1D/2D surface water hydraulic model using XP-SWMM. Under this task, the XP-SWMM model will be updated to prepare it for evaluation of project alternatives.
- **Establish Standards and Criteria –** Project-specific standards and criteria need to be established to provide the basis by which alternatives developed will be evaluated. Potential categories of standards and criteria include design and performance standards and regulatory compliance criteria. Additionally, the core and supporting objectives will be revisited to update language as necessary for application to the Feasibility Study.
- **Preliminary Alternative Identification and Evaluation –** A limited number of preliminary project alternatives will be developed. Preliminary alternatives will be developed considering identification of a willing site owner or availability of publically-owned parcel(s), site suitability, and other similar criteria. Hydraulic modeling and recharge modeling will be conducted to further refine the project alternatives to the degree that compliance with the key Project Purpose is ensured and anticipated performance data are available for evaluation. The preliminary alternatives identified will be developed to the extent necessary to apply the standards and criteria developed previously and will be site-specific. This alternative development will be at a general level (i.e. general sizing of ponds using existing industry standards and templates).

  The standards and criteria will be applied to the alternatives developed along with a triple-bottom line analyses to capture the benefits each alternative provides. Results of the evaluation will be summarized in a matrix, ranking the alternatives based on the scoring results. The matrix will also include a qualitative summary of impact and/or benefits resulting from the alternatives. Based on the evaluation process and input from Water Agency staff, select alternatives will be carried forward into more-detailed evaluation in the later tasks of the Feasibility Study.
- **Feasibility-Level Field Work –** Field work will be conducted to collect data necessary to conduct detailed analyses on the alternatives recommended in the previous task of the Feasibility Study. Anticipated field surveys include geology and permeability testing, groundwater elevation and quality data collection, surface water quality data collection, flow monitoring, geotechnical testing and reconnaissance-level cultural surveys. See Appendix I for additional detail on potential field work.

- **Alternatives Update –**The recommended alternatives for detailed analysis will be updated using data obtained from the field work. The descriptions of the selected alternatives will be modified with respect to various site factors such as site suitability and surrounding environment. Hydraulic and/or recharge modeling will also be conducted, as appropriate to confirm results previously achieved or to refine alternative concepts. Each of the alternatives updated in this task will also be evaluated with respect to associated potential environmental impacts using the CEQA Initial Study Checklist and permitting requirements.

  The updated alternatives will be re-evaluated using the previously developed standards, triple-bottom line analyses and other relevant information, including a preliminary cost estimate. Alternatives will also be evaluated with respect to potential environmental impacts, permitting requirements and other similar project implementation criteria. A recommended alternative will result from the evaluation process.

- **Outreach –** Outreach will be performed through formal settings (i.e. workshops), informal settings (e.g. meetings with land owners), and media (e.g. website, flyers, print media).

A successful Feasibility Study will help to establish a foundation for Project implementation. Through the Feasibility Study described above, the Water Agency will identify the preferred project alternative to advance to implementation. The section below outlines an implementation framework in order to highlight implementation strategies that should be considered as the Feasibility Study begins.

4 Implementation Components

The implementation process consists of final design, environmental documentation, permitting, obtaining funding, outreach and finally construction and related construction support. An overview of the scope of work for each of these tasks is provided in this section while Section 5 describes how these tasks likely intersect with respect to the project schedule and Section 6 discusses implementation challenges, constraints and related strategies.

4.1 Final Project Design

The primary purpose of final project design is to develop plans, specifications, and estimates (PS&E) that are adequate for a contractor to bid and build the preferred project. The sections below describe the design work items as well as some thoughts on potential issues that would need to be addressed as part of final design.

4.1.1 Preliminary Design Report

The goal of the Preliminary Design Report is to set design criteria to avoid expensive re-work during final design. This report transitions the project alternative from the focus of a study to a project in design and memorializes the intent of the project, the goals of the project, and the major features around which the design will be based. Depending on the needs of, and opportunities available to, the Project, the Preliminary Design Report may be completed as part of the Feasibility Study in order to better position for funding opportunities.

The Preliminary Design Report will:

- Identify knowledge gaps;
- Establish Water Agency design criteria;
- Establish regulatory agency design criteria;
- Confirm assumptions made during Feasibility Study; and
- Document project to be designed.

4.1.2 30% Design Submittal

The goal of the 30% design submittal is to lay the foundation for the remainder of the design. This includes completion of any remaining data collection, establishing project boundaries and general form, and starting to assemble the PS&E which will be the basis of the project bid.

Work at this stage will likely include:

- Supplement feasibility-level geotechnical information;
- Supplement feasibility-level geological information;
- Supplement available geomorphological data;
- Conduct design-level topographic and feature survey and mapping;
- Refine hydraulic and recharge analysis;
- Conduct Right-of-Way (ROW) mapping;
- Utility basemap preparation and initial relocation discussions with owners;
- Define footprint of project;
- Consult with regulatory agencies – develop rough mitigation requirements, initiate permitting discussions;
- Prepare construction plan set;
- Prepare specifications outline;
- Prepare engineer's construction cost estimate;
- Prepare preliminary construction schedule; and
- Conduct design review workshop.

4.1.3 60% Design Submittal

The goal of the 60% design submittal is to finalize the form of the project and complete the majority of the discipline design.

Work at this stage will likely include:

- Address comments from 30% design review;
- Refine hydraulic and recharge analysis;
- Prepare construction plan set;
    - Civil - survey control, topography and demolition plans, grading plan and profiles, typical sections, plans and sections, roads, contractor laydown areas, temporary and permanent right-of-way drawings.
    - Structural - hardscape design (if any)
    - Traffic – contractor routes, traffic control and diversions
    - Landscape - revegetation plans, irrigation/temporary irrigation plans and planting and irrigation details
    - Electrical and Instrumentation/Control (if needed) – very sensitive to project type but could include process and instrumentation diagrams, control diagrams, and site plans
- Prepare technical specifications– draft of all applicable specification sections;
- Prepare draft front end specifications;
- Update construction cost estimate;
- Update engineer's construction schedule;

- Coordinate with utilities on timing of utility relocation and responsibilities for design and construction;
- Consult with regulatory agencies to determine final mitigation requirements;
- Conduct design review workshop; and
- Conduct value engineering session.

4.1.4 90% Design Submittal

The goal of the 90% design submittal is to develop a biddable package, including most of the text and detail call-outs on the drawings. Other work will support successful implementation of the project based on the state of the design at this stage.

Work at this stage will likely include:

- Plats and legal descriptions for permanent and temporary project right-or-way acquisition (based on 60% plans);
- Refine hydraulic and recharge analysis;
- Prepare construction plan set – completion of all drawings including utility relocation (if not to be completed by the utility owner) and mitigation requirements;
- Prepare draft final specifications - incorporate comments on 60% front end and technical specifications;
- Update engineer's construction cost estimate;
- Update construction schedule;
- Develop draft operations and maintenance plan;
- Regulatory consultation to confirm application of mitigation requirements; and
- Conduct design review workshop.

4.1.5 100% Design Submittal

The goal of the 100% design submittal is to finalize the biddable package. Other work will support successful implementation of the project based on the state of the design at this stage.

Work at this stage will likely include:

- Finalize hydraulic and recharge analysis;
- Finalize construction plan set;
- Finalize specifications;
- Finalize engineer's construction cost estimate;
- Update construction schedule;
- Finalize operations and maintenance plan; and
- Finish property acquisition (if possible).

4.2 Environmental Documentation

Any project that includes concepts such as those recommended by the Scoping Study (floodplain modification, off-stream detention basins and potentially others) is unlikely to be exempt from the California Environmental Quality Act (CEQA). Compliance with the National Environmental Policy Act (NEPA) may also be required depending on the funding sources to be pursued. Summaries of anticipated tasks related to the CEQA document are provided below along with a discussion of the additional work that would need to be conducted for NEPA documentation.

4.2.1 Project Description and Initial Study

The CEQA process can begin as soon there is enough certainty about the Project to develop a project description that satisfies CEQA requirements. It is anticipated that a sufficient project description can be created at the conclusion of the Feasibility Study and in conjunction with development of the Preliminary Design Report.

Using the project description, a CEQA Initial Study (IS) can be completed to determine if significant environmental impacts are likely to result from the Project. If impacts can mitigated, a Mitigated Negative Declaration (MND) can be adopted. If impacts cannot be mitigated, an Environmental Impact Report (EIR) must be prepared. The Initial Study is a formal means of reviewing potentially significant impacts in relation to the eighteen environmental factors shown below in **Table 6**. The IS can be skipped if the Project will clearly have significant environmental impacts and an EIR will be prepared.

Table 6: CEQA Environmental Factors

CEQA Environmental Factors		
Aesthetics	Greenhouse Gas Emissions	Population and Housing
Agricultural and Forestry Resources	Hazards and Hazardous Materials	Public Services
Air Quality	Hydrology/Water Quality	Recreation
Biological Resources	Land Use and Planning	Transportation and Traffic
Cultural Resources	Mineral Resources	Utilities and Service Systems
Geology and Soils	Noise	Mandatory Findings of Significance

In addition to the guidance provided by the Initial Study, the determination of whether to prepare an EIR or an IS/MND should also take into account various strategic considerations. IS/MNDs are generally less time-consuming to prepare but may also be more vulnerable to legal challenges. For example, IS/MNDs are sometimes challenged on the grounds that an EIR should have been carried out.

After the Feasibility Study, it should also be considered whether a Program EIR is appropriate for the project. A Program EIR outlines the overall scope of a project or program and evaluates its impacts, while specific project initiatives are later detailed as addenda to the Program EIR or as IS/MNDs that tier off the Program EIR. The Water Agengy may elect to develop a programmatic EIR if the Feasibility Study recommends that the Project consist of work at several sites or if there is potential for substantial coordination between the Upper Petaluma Flood Control Project and other Water Agency initiatives such as flood control projects in neighboring watersheds.

4.2.2 Background Studies and Field Surveys

As part of the CEQA process, several background studies and field surveys are likely to be required in order to assess the significance of potential environmental impacts. The types of background studies and field surveys needed will be highly dependent on the nature and location of the Project. **Table 7** presents a preliminary assessment of the types of background studies and field surveys that may be needed as part of the CEQA process. Field surveys are shown in bold text.

Table 7: CEQA Background Studies and Field Surveys

CEQA Environmental Factor	Background Studies or Field Surveys
Aesthetics	**Photographic documentation of existing conditions** Renderings of post-construction site appearance
Agricultural and Forestry Resources	No field surveys anticipated. Desktop review of existing land uses and soil types
Air Quality	No field surveys anticipated. Desktop review of anticipated construction air quality impacts
Biological Resources	**Field surveys for special status species**
Cultural Resources	**Field surveys for cultural resources** Coordination with Native American Heritage Commission
Geology and Soils	No field surveys anticipated to support CEQA process. Soils data gathered as part of the Feasibility Study can be discussed as appropriate.
Greenhouse Gas Emissions	No field surveys anticipated. Desktop review of anticipated construction greenhouse gas emissions
Hazards and Hazardous Materials	**Phase I Environmental Site Assessment followed by Phase II Environmental Site Assessment if Phase I reveals potentials for soil or groundwater contamination** (not required for CEQA, may be deferred to design process)
Hydrology/Water Quality	**Wetland delineation**
Land Use and Planning	Desktop review of zoning/potential future land use
Mineral Resources	No field surveys anticipated.
Noise	No field surveys anticipated. Desktop review of anticipated construction noise impacts.
Population and Housing	No field surveys anticipated.
Public Services	No field surveys anticipated.
Recreation	No field surveys anticipated.
Transportation and Traffic	No field surveys anticipated.
Utilities and Service Systems	No field surveys anticipated.
Mandatory Findings of Significance	Not applicable.

4.2.3 Draft Environmental Document and Public Comment

The various background studies are used to prepare the draft CEQA document. Although the process for an IS/MND differs substantially from the process for an EIR, both processes require a public review period of the draft CEQA document as well as consideration of comments. The EIR process requires both issuance of a Notice of Preparation at the beginning of the CEQA process and preparation of a formal response to comments document after circulation of the Draft EIR. Public involvement in the CEQA process should be considered as part of the overall Project outreach strategy.

4.2.4 Final Environmental Document

If significant changes are made to the draft CEQA document after the original public draft, recirculation of the draft CEQA document for additional public review may be required. After the additional public comment period and subsequent response to (and incorporation of) comments, the Water Agency may finalize the CEQA document by either adopting the MND or certifying the EIR. Per CEQA guidelines (California Code of Regulations, Title 14, Division 6, Chapter 3 Section 15092:

> A public agency shall not decide to approve or carry out a project for which an EIR was prepared unless either:
>
> (1) The project as approved will not have a significant effect on the environment, or
>
> (2) The agency has:
>
> (A) Eliminated or substantially lessened all significant effects on the environment where feasible as shown in findings under Section 15091, and
>
> (B) Determined that any remaining significant effects on the environment found to be unavoidable under Section 15091 are acceptable due to overriding concerns as described in Section 15093.

4.2.5 NEPA Considerations

If funding from federal agencies such as the U.S. Army Corps of Engineers (USACE) is to be pursued, the project will need to comply with NEPA. The preparation of a joint CEQA/NEPA document does not typically require a substantially greater level of effort than the preparation of CEQA document, although additional consultation with federal agencies is required. For NEPA compliance, additional documentation beyond CEQA requirements may include:

- **Finding of No Significant Impact (FONSI).** This document that outlines the reasons why the Project will not have a significant effect on the human environment and for which an EIS will not be prepared. The FONSI will present conclusions substantiating why the impacts are not significant and will identify mitigation measures that would be adopted.
- **Environmental Justice Analysis.** This document assesses any potential disproportionate impacts to low-income or minority populations of the proposed project in accordance with Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." The analysis will present census tract data and describe the ethnic composition and income characteristics of the study area.
- **Indian Trust Assets.** The NEPA document would need to identify whether any Indian Trust Assets would be affected by the project.
- **Compliance with Section 7 of the Endangered Species Act.** If the project would affect federally listed species this would require preparation of Biological Assessment and obtaining Biological Opinions from both the U.S. Fish and Wildlife Service and NOAA Marine Fisheries.
- **Compliance with Section 106 of the National Historic Preservation Act.** A cultural resources report would need to be prepared and submitted to the State Historic Preservation Officer.
- **Air Quality Conformity Report.** The air quality analysis would have to address conformity with the Clean Air Act.

4.3 Permits and Regulatory Approvals

Although the Project location(s) has not yet been selected, any of the potential Project concepts are likely to require a variety of environmental permits. Obtaining these permits will be a significant effort and will require close coordination with all other portions of the implementation process. The sections below outline significant steps in the permitting process for the project.

4.3.1 Identification Permitting and Regulatory Coordination Needs

The types of permits and regulatory approvals needed for the Project will be dependent on the Project location, Project preliminary design and the results of various field surveys. The permits and regulatory approvals likely to be needed are listed in **Table 8**. Associated field surveys are noted in bold and are largely the same as field surveys to support the CEQA process.

In addition to the permits and regulatory approvals listed below, the Project will also require coordination with the California Department of Public Health (CDPH) and the Sonoma County Department of Health Services – Environmental Health and Safety regarding groundwater recharge. An anti-degradation analysis, overseen by the RWQCB, may have to be prepared.

Table 8: Summary of Potential Permits and Approvals

Agency	Permits/Regulatory Approvals	Potential Project Need and Associated Field Surveys
FEDERAL		
U.S. Fish and Wildlife Service	• Federal Endangered Species Act Compliance (Section 7 Consultation)	Required if federally listed species or species habitat identified by the **special-status species surveys** or if Project area is known to include habitat for special-status species
National Oceanic and Atmospheric Administration (NOAA) /National Marine Fisheries Service (NMFS)	• Federal Endangered Species Act Compliance (Section 7 Consultation)	Required if work will impact streams supporting listed anadromous fish, including salmonids or green sturgeon.
U. S. Army Corps of Engineers	• Clean Water Act, Section 404, Nationwide Permit(s).	Required for work in Waters of the United States as established by the **wetland delineation**
STATE		
California Department of Fish & Game (Region 5)	• State Endangered Species Act Compliance	Required if state listed species or species habitat identified by the **special-status species surveys**
	• Section 1600 Streambed Alteration Agreement	Required for work in Water of the State as established by the **wetland delineation**
San Francisco Bay Area Regional Water Quality Control Board (Region 2)	• Clean Water Act, Section 401, Water Quality Certification	Required if 404 permit or other federal action is needed
	• National Pollutant Discharge Elimination System, Construction General Permit	Required if Project disturbs >1 acre of land
State Historic Preservation Office	• Section 106 Consultation in compliance with the National Historic Preservation Act	Required for NEPA compliance. **Cultural resources field surveys** would be required to determine whether there are resources in the project area that meet the listing criteria National Register of Historic Places listing criteria.
California Department of Water Resources, Division of Safety of Dams	• California Water Code, Section 6000	May be required if embankment heights, where used, exceed minimum standards
LOCAL*		
Sonoma County Permit Resource Management Division	• Grading permit • Roiling permit	Required for grading/ground disturbance Required to manage stream turbidity due to construction

*Note that much of Sonoma County is within Biotic or Scenic Resource Zones for which special set backs and zoning permit regulations apply.

4.4 Funding

Acquiring funding is one of the most significant challenges/constraints for the Project. As there is currently no specific (quantitative) design goal or regulatory driver for the Project, the amount of funding potentially available will likely be a significant factor in determining the overall scope and scale of the Project.

4.4.1 State Funding Options

As summarized **Table 9**, the Project may be able to secure funding from a variety of State grant or loan programs. A discussion of each of these programs is provided below. In addition to these ongoing funding programs, the Project team should be following changes in statewide grant and loans programs as the Project moves forward. Of particular interest is the $11 billion California Water Bond that may be on the November 2012 ballot; this bond measure may provide a significant level of funding in the near future for water infrastructure.

Integrated Regional Water Management (IRWM) Grants

As a multi-benefit stormwater management effort, the Project is well-suited for grant funding administered by the Department of Water Resources (DWR) via the Integrated Regional Water Management program.

Projects applying for Proposition 84 or Proposition 1E grants must be incorporated in the Bay Area Integrated Regional Water Management Plan (IRWMP). The Bay Area IRWMP is a nine-county effort to coordinate and improve water supply reliability, protect water quality, manage flood protection, maintain public health standards, protect habitat and watershed resources, and enhance the overall health of the bay.

The Bay Area IRWM Group accepts submittals for new projects on a continuous basis. The submittal process includes completing a template available on the Bay Area IRWM website that requests project information such as:

- Water management strategies addressed (ex. flood management, groundwater management, recreation and public access)
- Project benefits (ex. “Planning and implementation of multipurpose flood management programs”)
- Purpose and need
- Project status and schedule
- Readiness to proceed
- Integration with other activities
- Cost and financing
- Benefits and impacts
- Disadvantaged communities/environmental justice
- Environmental compliance strategy
- Statewide priorities
- Stakeholder involvement and coordination
- Documentation of feasibility
- Detailed project description

Table 9: Summary of Potential State Funding Options

Agency	Program	Maximum Award	Application Deadlines
Department of Water Resources	IRWM Implementation Grant (Proposition 84)	No project maximum	March 2013 -Round 2 $20M total available
		No project maximum	Spring 2014 - Round 3 (*final round*) $74M total available
	IRWM Stormwater Flood Management Grants (Proposition 1E)	No project maximum	December 2012 - (Round 2) $46M - $91M total available
	Local Groundwater Assistance Grant Program (Assembly Bill 303)	$250,000	June 2012 $4.7M total available
	Proposition 82 Local Water Supply Construction or Feasibility Study Loans	$5,000,000	Applications accepted continuously.
State Water Resources Control Board	Stormwater Grant Program (Proposition 84)	$10,000,000	Round 2 in 2013 or 2014. $31M anticipated to be available.
	Clean Water State Revolving Fund Loans	$50,000,000	Applications accepted continuously.
CA Infrastructure and Economic Development Bank	Infrastructure State Revolving Fund Loans	$10,000,000	Applications accepted continuously.

At the appropriate time relative to DWR guidelines and schedules, the Bay Area IRWMP Project Screening Subcommittee will review the submitted projects and make a recommendation to the Bay Area IRWMP Coordinating Committee (CC) for projects to be included in the IRWMP and future grant applications. The CC will make the final determination on adding the project to the Bay Area IRWMP.

In general, Projects applying for IRWM-related grants will be incorporated into the IRWMP provided that they meet DWR eligibility criteria. Projects will then compete independently for the grants. Applications for the final round of Stormwater Flood Management Grants are due in December 2012. The Upper Petaluma River Flood Control Project may not be developed to a sufficient level to allow the submittal of a grant application in 2012. Future applications should be considered however since the Project is likely to meet eligibility criteria for future stormwater and flood management program.

IRWM Implementation Grants are secured on a regional, rather than project-specific, basis and as a project must be prioritized by the Bay Area IRWM Group in order to receive Proposition 84 funding. The Project should consider participating in the Round 3 funding (applications due Spring 2014).

Local Groundwater Assistance Grants

Local Groundwater Assistance grants provide local public agencies with up to $250,000 to conduct groundwater studies or carry out groundwater monitoring and management activities. Approximately $4.7 million in funding from Proposition 84 is anticipated for the fiscal year 2011-2012 Local Groundwater Assistance Grant Program. Future rounds of funding may occur but no schedule or budget has yet been established.

The absence of a Groundwater Management Plan for the Petaluma Valley Groundwater Basin will severely limit the Project's ability to obtain funding under this program and, as such, it may not be worthwhile to submit an application.

Local Water Supply Construction or Feasibility Study Loans (Proposition 82)

The Local Water Supply Construction and Feasibility Study loan program provides low-interest loans to local public agencies for water supply projects such as a canals, dams, reservoirs, groundwater extraction facilities or other construction or improvements. As the Project is not intended to have a specific link to groundwater extraction or development of a new water supply, it is unlikely that this loan program will be suitable for the Project.

Storm Water Grant Program (Proposition 84)

Storm Water Grant Program funds are used to provide matching grants to local public agencies for the reduction and prevention of stormwater contamination of rivers, lakes, and streams, specifically as it applies to priority pollutants (e.g. those for which a water quality objective has been established). The project may be eligible for funding under this program depending on the project design and the degree to which it addresses water quality. The next round of funding for this program is anticipated in 2013 or 2014.

Clean Water State Revolving Fund Loans

The Clean Water State Revolving Fund (CWSRF) program offers low interest financing agreements for water quality projects. Annually, the program disburses between $200 and $300 million to eligible projects.

Although CWSRF loans are used primarily for projects like wastewater treatment plant improvements that are explicitly directed toward water quality improvements, the Project may be eligible for CWSRF loans depending on the degree to which it protects or improves water quality. This is, however, a loan program rather than a grant program and its potential usefulness to the Project should be evaluated once a better understanding of potential grant funding and internal Water Agency budgets has been established.

Infrastructure State Revolving Fund Loans

The Infrastructure State Revolving Fund (ISRF) Program provides low-cost financing to public agencies for a wide variety of infrastructure projects. ISRF Program funding is available in amounts ranging from $250,000 to $10,000,000, with loan terms of up to 30 years. Eligible project categories include drainage, water supply and flood control, and environmental mitigation measures as well as city streets, county highways, state highways, educational facilities, parks and recreational facilities, port facilities, public transit, sewage collection and treatment, solid waste collection and disposal, water treatment and distribution, defense conversion, public safety facilities, and power and communications facilities.

Like CWSRF, ISRF is a loan program and its potential usefulness to the Project should be evaluated once a better understanding of potential grant funding and internal Water Agency budgets has been established.

4.4.2 Potential for Federal Funding

One avenue for federal funding is through the USACE. The Water Agency and City of Petaluma have recent experience with the USACE project process and should account for their experience and lessons learned when deciding whether to pursue USACE funding support. If the Agency decides to pursue USACE funding, the project would follow a different track regarding feasibility and implementation, and the time period for implementation would likely be significantly extended. The USACE process is to complete the Project in the following proscribed manner, with each study being carried out by USACE staff. The local partners may not wish to relinquish this much of the local control.

- **Step 1: Reconnaissance Phase** – The Reconnaissance Phase lays out project concepts and planning level cost estimates. The purpose of this study is to determine if there is Federal interest in proceeding with a second phase, the Feasibility Phase. The Reconnaissance Phase is 100% USACE funded with a cost limit of $100k, and would take approximately 1-2 years to complete.
- **Step 2: Feasibility Phase** – The USACE Feasibility Phase is similar to the Feasibility Study as scoped by RMC. The purpose of the Feasibility Phase is to determine if project implementation is feasible and develop a planning level design. The USACE funds 50% of this study. This study has an estimated timeframe of 2-3 years.
- **Step 3: Preconstruction Engineering and Design Phase (PED)** – The PED is similar to the scope of work for design that is laid out in this memorandum, with some additional requirements such as a Design Documentation Report. The design phase is 75% funded by the USACE, and has an estimated timeframe of 2-3 years for a project this size.
- **Step 4: Construction Phase** – The USACE will pay for up to 50-65% of the construction cost elements. Several items that are not covered by USACE funding include right-of-way land acquisition, utility relocation, and hazardous materials disposal. Federal funding would allow the Water Agency to access State subvention funds to cover some of these costs, however.

In total, the USACE will not fund more than 50-65% of the total project. While USACE projects do not typically focus on groundwater recharge, the groundwater recharge element that is part of the Upper Petaluma River Watershed Flood Control Project will make the project more attractive for USACE funding because it provides multiple benefits for the watershed.

If the Water Agency is interested in pursuing USACE funding, the first step would be to review the "Partnership Kit" from USACE, available online at

http://www.lrn.usace.army.mil/pao/outreach/pdf/ProjectPartnershipKit.pdf.

4.5 Outreach and Institutional Support

As discussed in Sections 2 and 3, outreach as been an essential part of the Scoping Study and will continue to be prioritized within the Feasibility Study. The sections below present initial thoughts on how to continue the outreach process through the implementation phase.

4.5.1 Develop Communications Plan

It is recommended that a Communications Plan be developed to highlight strategies for maintaining political and public support throughout the course of the Project. The Communications Plan will also include protocols and approaches to internal and external communications and methods of coordination with the Agency and Project Team. Overall strategies to be developed in the Communications Plan may include:

- Maintain database of interested parties
- Identify and point out local, existing flood-recharge projects that are operating successfully
- Convey technical information such as findings from modeling efforts and field studies in workshops and on website
- Provide schedule and milestones information often through project website
- Build strong relationships
- Understand and support policy makers

There are numerous examples of local flood control projects. Within the Bay Area, flood projects that meet both flood hazard reduction goals along with providing a groundwater recharge benefit can be found in Santa Clara (Santa Clara Valley Water District, Church Percolation Ponds) and Alameda Counties (Zone 7 Water Agency, Lake I). Educating the public on these and other existing and successful projects is a key element of the outreach approach.

4.5.2 Conduct Public Workshops

Two public workshops are recommended as part of the Feasibility Study. It is recommended that at least three public workshops be conducted to present Project design concepts and facilitate discussion of public interests and concerns during the design phase. One or more of these workshops could be coordinated with the CEQA public review process. A brief outline of the intent of these is provided below:

Feasibility Phase Workshops

- Public Workshop #1: Conduct prior to feasibility-level field work after data collection, hydraulic model verification, the setting of standards and criteria and the preliminary alternative evaluation. During this workshop, the preliminary alternatives developed will be presented and the evaluation process summarized.
- Public Workshop #2: Prior to finalizing alternatives, the updated alternatives should be presented and the evaluation process summarized in a Detailed Alternatives Evaluation Workshop.

Design Phase Workshops

- Public Workshop #1: Conduct after the Feasibility Study and CEQA studies, prior to starting the 30% designs. Listen and gather public concerns and gauge community opinions. Present a summary of work completed to date.
- Public Workshop #2: Prior to 60% design, gauge any additional changes or elements needed to improve public support. Present image boards with variations on design that meet project engineering criteria and identify areas for refinement in order to gain public/City/Agency approval. Present a summary of work completed to date.

- Public Workshop #3: Prior to 90% design present the final concept and work completed to date.

4.6 Project Construction

The construction phase of the project will proceed after completion of design, environmental review and documentation, permitting, land acquisition, and final budgeting for construction. The construction phase can be broken down into several steps, as described below. Sometimes owners will choose to pre-qualify the contractors but that is not anticipated to be necessary for the types of projects likely to come out of the Project. The following tasks are typically completed during the construction phase.

4.6.1 Bid Period

The goal of the bid period is to identify, select, and award the construction contract to a qualified contractor. The bid period is an opportunity to educate contractors so that they are able to accurately estimate their proposed cost for the project to be constructed. Work at this stage will likely include:

- Advertise the project in one or more contractors forums;
- Conduct pre-bid conference and site visit;
- Review contractor bid inquiries and issue contract document addenda;
- Receive and open contractor bids; and
- Review bids and award contract.

4.6.2 Preconstruction

The goal of the preconstruction period is to start to work with the contractor to get the major construction period off to a smooth start. Work at this stage will likely include:

- Create conformed contract document – assimilate addenda into the bid documents;
- Conduct preconstruction meeting;
- Conduct preconstruction surveys as required by Environmental review process; and
- Receive and review contractor's table of rates, schedule, and other documents as required by the contract.

4.6.3 Construction

The goal of the construction period is to construct the project according to the contract documents. The type of construction will vary based on the project alternative but heavy earthwork will likely be a significant portion of the work.

Work at this stage will likely include:

- Construct project according to contract documents – probable construction includes
    - Excavation, soil disposal, grading;
    - Utility relocation;
    - Seeding and revegetation;
    - Limited concrete work;
- Perform construction management;
- Review and respond to contractor submittals and requests for information;
- Issue clarifications and change orders as appropriate; and
- Perform biological monitoring.

4.6.4 Post Construction

The goal of the post construction period is to close out the project and set up the operations phase.

Work at this stage will likely include:

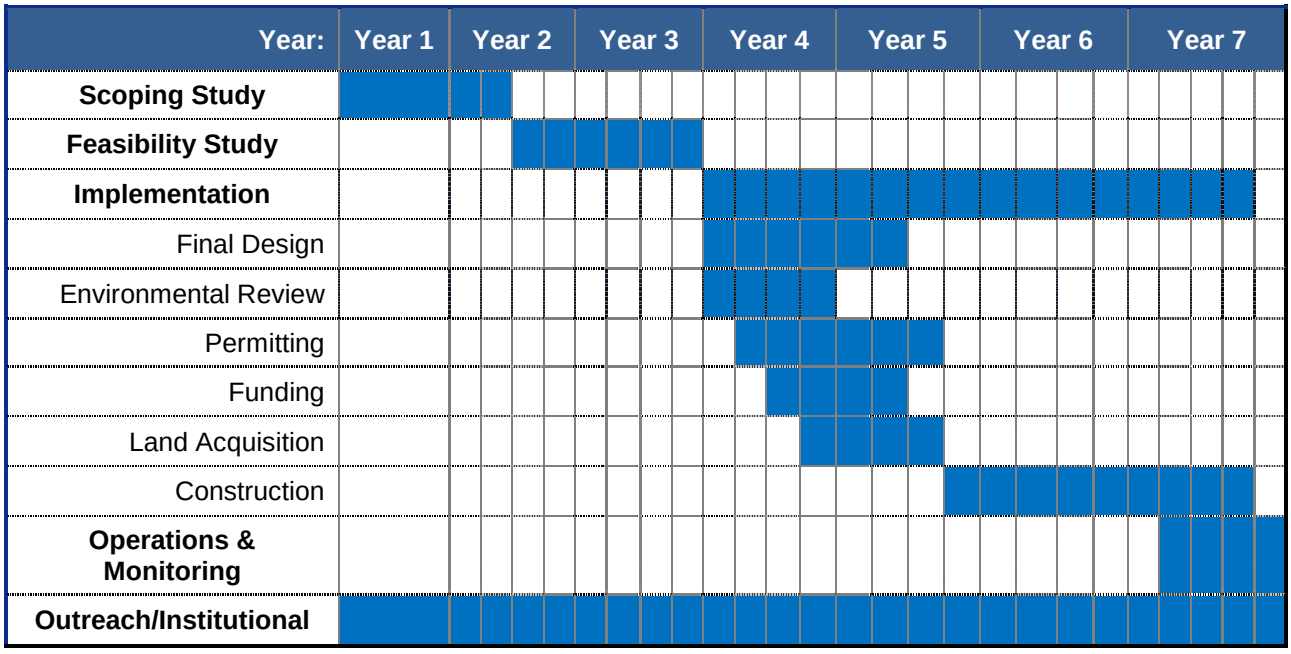
- Perform post construction surveys;
- Monitor revegetation establishment; and
- Prepare record drawings.

Project monitoring and initial operations will likely overlap slightly with the end of the construction period.

5 Implementation Schedule

Project design, environmental documentation, permitting, funding and outreach are parallel and interdependent parts of Project implementation. Coordinating the various aspects of project implementation is one of the most significant Project challenges. **Figure 6** below shows a possible Project schedule:

Figure 6: Project Schedule Estimate



The potential schedule shown above represent a "design at risk" scenario wherein the design process is carried out in tandem with the environmental review and permitting efforts. Such a strategy can compress the overall project schedule but also can also lead to redesign of significant project elements based on CEQA mitigation requirements or public comments gathered through the CEQA process. As a more conservative approach, most of the design work could be halted after the Preliminary Design Report until the CEQA document is certified.

Most permits cannot be issued until the CEQA document has been certified. However, in coordination with the regulatory agencies, permit applications could be prepared in advance of the CEQA document being certified to facilitate review. As permit review periods can be long, it is advisable the permit applications be submitted as soon as possible.

Preliminary agreements with land owners should ideally be in place prior to final design. Final transfer of fee title or establishment of easements should be completed as early in the design process as possible. A good, ongoing partnership with the land owners should be maintained when possible.

The construction schedule is sensitive to the type of project, construction funding availability, and environmental requirements set during the implementation phase so it is difficult to predict the actual construction duration. For planning purposes however, an estimate of 1.5 – 2.5 years is reasonable assuming the following durations:

- Bid Period – 2 months
- Preconstruction – 2 months
- Construction – 1-2 years
- Post Construction – 2 months

6 Implementation Challenges, Constraints and Strategies

In advance of the Feasibility Study, it is difficult to predict the challenges and constraints that will be encountered during the implementation phase of the Project, however, there are some typical challenges that many flood control and groundwater recharge projects face.

The key to overcoming challenges and constraints in implementation is consistent, strategic direction from the Scoping Study, to the Feasibility Study, and into the design phase and other parallel implementation aspects. Understanding the relationships between the implementation steps and the data needs, as well as good communication and planning, will help to mitigate many of the challenges that can be anticipated in implementation.

If there are significant outstanding data gaps identified at the beginning of the implementation phase, it may not be efficient or in some cases even possible to proceed with many tasks until those gaps are filled. Some datasets that may take longer to obtain include design level survey, geotechnical data, sediment transport data, and utility information. There may also be additional data needs identified during the design but these will likely not halt progress on significant portions of the design.

One of the main purposes of all of the effort that goes into the implementation steps leading up to construction is to minimize the construction challenges and constraints. Ideally, there are minimal surprises during construction, which will allow the work to progress smoothly, on schedule, and according to the contracted budget. Deviations from the contracted work are handled through change orders, resulting in a change in fee or schedule or both.

Some of the construction challenges that may be encountered include:

- Unanticipated ground conditions – Geotechnical soil conditions could change the construction approach in some areas but the geotechnical design work should be able to characterize the overall conditions and bracket the risks associated with those conditions.
- Unanticipated species – Biological review and surveys would be performed prior to the start of construction to help understand the mitigation for and procedures for avoiding impacts to sensitive species. Should a sensitive species, plant or animal, be found during construction it could impact the construction schedule and potentially require additional monitoring, special procedures, and/or a review of the project design. Unanticipated species could also impact the construction schedule by limiting the seasonal work windows in sensitive areas.
- Utility conflicts – Unknown utilities could be encountered during construction. Should this be the case, construction could be delayed while coordination with the utility owner occurs to determine how, where, and when the utility should be relocated.

- Funding – Part of the lead-up to construction is ensuring that adequate funding is in place to pay for the construction work. Should the funding be rebudgeted, construction progress will suffer. Also, change orders may increase overall cost.

Appendix A

Meeting Minutes from Stakeholder Meeting #1

Draft Meeting Summary

Upper Petaluma River Watershed Flood Control Project Scoping Study

Subject: Stakeholder Meeting #1

Prepared For: Sonoma County Water Agency

Attendees: See Sign-in Sheet

Prepared By: RMC

Date/Time: April 28, 2011; 3-5 pm

Location: Lucchesi Park Community Center, Petaluma

Meeting Objectives:

- Introduce project to stakeholders
- Discuss and obtain feedback on core and supporting objectives
- Develop an understanding of priority objectives for study
- Discuss project concepts

Attachments

Attachment A: Meeting Agenda

Attachment B: Draft Objectives Handout

Attachment C: Meeting Attendees

Discussion Items

A. Greetings and Introduction

Meeting attendees introduced themselves and briefly stated their affiliations.

B. Overview of the Scoping Study

Kent Gylfe explained that this Project is consistent with the Water Agency's Water Supply Action Plan, which was adopted last fall by the Water Agency's Board of Directors and identifies, as strategy #4, the pursuit of combined flood control and water supply projects. It is anticipated that this Project will also align with local integrated regional water management plans (IRWMPs) and multiple funding opportunities.

There are three similar studies being performed, one each in the Laguna/Mark West watershed, the Sonoma Valley watershed, and the Petaluma watershed. The projects are currently at a scoping stage and will be followed by a feasibility stage and a design/implementation stage. To help with the Project scoping, some of the objectives of this workshop are to obtain feedback on both the draft project objectives as well as project concepts that may be implemented.

Kent reviewed the core project objectives as well as the proposed overall schedule of the scoping phase of work.

C. Issues and Needs within the Upper Petaluma River Watershed

Christy Kennedy introduced Randy Raines and Tim Harrison and explained their roles on the Project as part of the consultant team.

Christy summarized the focus area of the Study and described the Zone 2A area. She noted that the flood protection focus would be upstream of Lynch Creek since the City of Petaluma and Corps of Engineers had been doing work within City limits and especially the downtown area.

Christy reviewed the Key Project Purpose and explained that this Project was particularly interested in concepts that provided both flood protection and groundwater recharge. She also reviewed the current status of the Project and explained that the Scoping Study is in the initial phases.

Christy explained that, based on a review of existing documents, there are three primary issues within the Project area that could be addressed, consisting of flooding, a need for recharge, and water quality improvements.

Christy showed the FEMA 100-year floodplain map for Zone 2A and highlighted flooding issue areas including the Marin-Wiggins watershed, the Penngrove area and the Denman area. Christy made a request for photographs of flooding within Penngrove to better understand where it floods as well as the impacts of that flooding.

Groundwater information has come from the 1982 Department of Water Resources study, and there has been limited groundwater work that is available for the Zone 2A area. The USGS in partnership with the Water Agency and City is planning a groundwater study that is scheduled to commence in 2012. The scope of that study has not been determined yet. The City's 2005 Urban Water Management Plan and pumping data from the Water Agency suggest that groundwater pumping by the City of Petaluma has been increasing since 2006. The City is primarily supplied by surface water from the Water Agency and utilizes its wells to meet peak demands, for emergencies, and to meet supply shortfalls.

Nitrates have been found in the past in the northwestern portion of the Project area. It will be important to consider the effects of mobilization that could result from a recharge project. There are also some salinity issues at the southern end of the watershed due to seawater intrusion but these are generally outside the Project limits. The Petaluma River is listed on the SWRCB 303d list for several constituents including diazinon, nutrients, pathogens, sediment, trash, and nickel.

After presenting on watershed issues and needs, stakeholders were asked to comment on this topic. Comments received from stakeholders (consolidated where common opinions were voiced) include:

- Meeting Notification
    - Concern regarding the notification process for the meeting. This meeting was not publicly noticed. This topic was discussed at length and stakeholders felt that there was a need for public noticing for future meetings, and expanded outreach and notification to all stakeholders and landowners in order to build consensus early on in the process.
- Land Needs
    - Required project land should be obtained from willing landowners only.
- Groundwater Recharge
    - There needs to be an understanding of underground water storage versus recharge.
    - A recommendation was made that recharge areas throughout the Project area should be preserved, including within City limits.

- It was noted that findings show the Petaluma groundwater basin is connected to the Santa Rosa groundwater basin where water levels have dropped significantly.
- It was noted that it is unlikely that enough land could be set aside for recharge to make a measurable difference in the aquifer.
- Concern was raised regarding the feasibility of groundwater recharge. It was noted that some local septic systems sometimes will not leach.

- Water Supply
  - Groundwater should not be used to offset Petaluma surface water supply. The city should focus on addressing growth, rather than getting water from rural areas.
  - Concern was raised regarding the sale of water to Marin Municipal Water District and how that affects local supply.
- Funding
  - Funding is critical to this Project and outside funding measures should be considered.
  - A question was raised regarding if a multi-benefit project including recharge was a legitimate use of Zone 2A flood control funds. The Water Agency explained that it was, given the overarching flood control benefits of the project.
- Coordination
  - The need for partnerships between the County and City was discussed.
  - A question was raised to ascertain if any Zone 9 (Petaluma watershed south of Zone 2A) meetings were planned on the same topic. The Water Agency explained that no similar project or meetings are planned for the area south of Zone 2A.
  - A stakeholder asked if RMC was the same team that conducted a study of detention ponds for the City. It was noted that RMC was not the same firm (named RMI). RMI finished their scope of work for the City and RMC has been selected as the consultant to move the Scoping Study forward for the Water Agency.

D. Review of Draft Objectives

Tim Harrison with RMC reviewed the draft core and supporting objectives with meeting attendees. Draft objectives include:

- Flood Hazard Reduction – Projects providing up to 100-year flood protection will be considered so we are interested in stakeholder's opinions on small vs. large projects.
- Groundwater Recharge – Recharge will be used to supplement existing groundwater supply.
- Water Quality – Water quality considerations include impacts and benefits to both groundwater and surface water resources.
- Water Supply – Use of non-potable stormwater is one method to offset potable water demand.
- System Sustainability – This objective incorporates consideration at both a macro (i.e. regional and global) and local scale. Project should be geomorphically stable and designed for long-term viability.

- Ecosystem – Project concepts should consider the existing environment, habitat, and species but also potentially improve conditions.
- Agricultural Land – Agricultural land is a valuable resource. Some project concepts are able to provide enhanced benefit to agricultural lands while still maintaining existing agricultural practices and meeting project objectives.
- Open Space – Open space is a valuable resource. Open space can be preserved and potentially enhanced with some project concepts.
- Community Benefits – Educational and recreation facilities could be incorporated into some project concepts.

Comments received from stakeholders included:

- Avoid the word "take" in both the Agricultural Land and Open Space supporting objectives; consider the word "use" instead. Clarification was asked for to determine if this meant utilizing "eminent domain". The Water Agency noted that at these initial phases of the Scoping Study, all ideas were open for consideration, but that this would be further defined in the conceptual alternatives development process. *[Post Meeting Clarification - The Water Agency desires projects that will be based upon collaborative partnerships and is not interested in implementing projects that are known or likely to require eminent domain procedures.]*
- Clarification of open space lands – this was clarified to mean lands zoned as open space. It was noted that modifying designated open space lands may not provide an enhancement.

E. Potential Project Concepts

Tim shared several project concepts with the attendees and invited input on these concepts as well as others that stakeholders would want to investigate. The presentation included an example of a multi-benefit project, an in-stream detention basin, an off-stream detention basin, an underground recharge and storage basin, and a managed natural floodplain.

Comments received from stakeholders were limited because the group was behind in the agenda and sufficient time for break out session was needed. Comments included the following, but the group was encouraged to provide input on project concepts during the small-group break out session as well:

- A concern for the feasibility of passive recharge given the relatively deep level of aquifers was noted. RMC responded that both passive (spreading basins) and active methods (injection wells) could be looked at in the concept phase, but that active recharge had much more stringent regulatory requirements and more intensive operations and maintenance. The Water Agency also noted that active recharge methods were considered an unlikely project candidate given the higher power usage, operations and maintenance, and regulatory requirements associated with them versus passive recharge methods.
- It was noted that requesting amendments for existing conservation easements should be looked at cautiously.
- It was noted that a funding source was needed before providing increased access to project areas for maintenance and recreation.

F. Small Group Break-Out Session

Meeting attendees split themselves into three groups with the objectives of:

- Reviewing the current draft objectives and offering proposed language changes;
- Understanding priorities within the proposed objectives; and
- Getting feedback on proposed project concepts and hearing about other potential project concepts.

After the small group sessions, the following input was reported back from each group to the larger group:

- Stakeholders would like to see partnerships between landowners and the public agencies promoted as part of this project, in addition to partnerships between the City and County
- Recommendation to eliminate the consideration of eminent domain
- The Agricultural Land supporting objective should be elevated in importance
- The language in both the Agricultural Land and Open Space supporting objectives should be revised to remove the word "take"
- Land for agricultural purposes should be preserved
- Water Supply for agricultural and rural areas should be considered, but increasing water supply for municipalities was not a priority
- Prioritize recharge locations
- The Community Benefits supporting objective is acceptable as a supporting objective only if practices are fiscally sustainable
- Consider the issue of nitrates in groundwater
- Include looking at "super-regional" projects (i.e. large projects that could solve all flooding issues in one location rather than a number of smaller projects)
- Opposition to using agricultural land for projects was voiced
- The project should scrutinize the planned Lowe's project in Petaluma to increase recharge and consider Low Impact Development (LID) measures
- Some land owners are amenable to periodic flooding on their lands
- Detention ponds should also be looked at to provide a water supply to landowners
- More options for project concepts should be considered, including LID measures
- Water storage under public rights of way should be considered
- Future meetings should be publically noticed and outreach/notification of the meetings should be expanded
- Tidal impacts should be considered to understand flooding
- An overarching Plan for implementation should be developed rather than piecemeal implementation of projects
- Some stakeholders had an interest in evaluating smaller projects
- Maintenance of projects should be considered
- Recommendation to delete "Component A" from Agricultural Land supporting objective
- Recommendation to revise "Component B" in the Agricultural Land supporting objective to read "Preserve and enhance agricultural lands"
- An additional component to the Agricultural Land supporting objective should be to "provide additional water for irrigation and frost protection"

- Recommendation to delete "Component A" from the Open Space supporting objective
- The question was asked if the Baylands are within the project study. The Water Agency answered that this area was not within the study area.
- Consider incorporating recreational features such as ball fields into projects concepts
- Look for retention pond location within City limits
- Consider establishing a baseline for groundwater quality and quantity
- A stakeholder noted that the Water Agency should stay away from utilizing rural lands
- Provide the group with some successful detention basins examples
- Utilize the Zone 2A committee for information dispersal and future meetings
- It was noted that the Water Agency should consider stopping water exports to Marin County
- Urban recharge areas should be preserved rather than built upon
- Prohibit LAFCO from allowing the annexation of rural lands for development
- Notify public television access station of meetings in advance

G. Next Steps

The Water Agency invited attendees to submit comments on the presented materials through May 12th. Comments should be provided to Tim Harrison at tharrison@rmcwater.com.

Attachment A: Meeting Agenda

Meeting Agenda

RMC Water and Environment

Upper Petaluma River Watershed Flood Control Study

Subject: Petaluma Area Stakeholder Meeting
Prepared By: RMC
Requested Attendees: Various
Date/Time: April 28, 2011; 3-5pm
Location: Lucchesi Park Community Center, 320 N. McDowell Blvd, Petaluma

The Sonoma County Water Agency is conducting scoping studies in three areas: Laguna-Mark West, Petaluma and Sonoma Valley. The purpose of the studies is to identify potential projects that will reduce flooding risks and provide groundwater recharge benefits. This meeting will focus on the Upper Petaluma River Watershed.

Meeting Agenda

A. Greetings and Introduction
B. Overview of the Scoping Study
C. Issues and Needs within the Upper Petaluma River Watershed
D. Review of Draft Objectives
E. Potential Project Concepts
F. Small Group Break-Out Session
G. Next Steps

Attachments:

A. Draft Issues Assessment
B. Draft Project Objectives Report
C. Draft Project Objectives Definition Sheet

Page 1 of 1

Attachment B: Draft Objectives Handout

Upper Petaluma River Watershed Flood Control Project – Scoping Study Objectives Summary Sheet

Draft Core Objectives

Objective	Component
Flood Hazard Reduction	
Improve management of stormwater that contributes, directly or indirectly, to reduce flood hazards.	A. Manage up to a 100-year storm event B. Coordinate projects within and downstream of project area C. Consider "green" methods
Groundwater Recharge	
Increase beneficial recharge of groundwater, whether or not that recharged groundwater is directly accessible as water supply.	A. Provide recharge B. Provide water supply offset from floods

Draft Supporting Objectives

Objective	Component
Water Quality	
Protect or improve water quality of surface water and groundwater.	A. Help eliminate impaired water body designations B. Provide adequate water quality to sustain aquatic life C. Facilitate long-term operations & maintenance permitting D. Avoid aquifer degradation E. Improve aquifer water quality
Water Supply	
Increase or improve water supply availability, reliability and flexibility for domestic, municipal, industrial, agricultural and environmental use.	A. Offset use of groundwater and potable surface water by utilizing storm flows in excess of the recharge potential for water supply
System Sustainability	
Support energy and water efficiency and climate change resiliency of water management systems and developed supplies; provide for channel stability and sedimentation control; and consider the long-term viability of implemented project and impact on affected systems.	A. Minimize use of imported energy at the project site B. Ensure water is used efficiently C. Implement improvements to eliminate or mitigate effects of erosion and sedimentation D. Implement improvements that facilitate permitting for long-term O&M
Ecosystem	
Improve ecosystem function and/or enhance habitat, especially for listed species.	A. Integrate environmental habitat requirements into project B. Promote sustainable, native habitats where possible C. Preserve and enhance stream buffers and riparian areas D. Facilitate long-term O&M permitting
Agricultural Land	
Preserve agricultural land use.	A. Minimize use of agricultural lands B. Preserve and enhance agricultural lands
Open Space	
Preserve and/or enhance open space.	A. Minimize use of open space lands B. Preserve and enhance open space lands C. Restore degraded open space lands
Community Benefits	
Create and/or enhance recreation, public access, education, etc.	A. Provide educational opportunities B. Cooperate with local agencies to implement recreational features C. Protect or enhance visual resources

5/19/2011

Attachment C: Meeting Attendees

Petaluma Watershed Meeting #1 - April 28, 2011	
Attendee Name	**Organization/Affiliation**
Kent Gylfe	Sonoma County Water Agency
Grant Davis	Sonoma County Water Agency
Jay Jasperse	Sonoma County Water Agency
Ann DuBay	Sonoma County Water Agency
Rem Scherzinger	City of Petaluma
Pamela Torliatt	
Mike Healy	City of Petaluma; Water Advisory Committee
Pamela Tuft	City of Petaluma; Water Advisory Committee
Teresa Barrett	City of Petaluma; Zone 2A Flood Control Advisory Committee
Ted Cabral	Zone 2A Flood Control Advisory Committee
Corbin Johnson	Sonoma County Regional Parks
Susan Haydon	Southern Sonoma County RCD
Leandra Swert	Southern Sonoma County RCD
Tito Sasaki	North Bay Agriculture Alliance
Gerald Moore	Petaluma Wetlands Alliance
Arnie Riebli	Farmer
Jim Riebli	Riebli Dairy
Tom Altenreuther	
Bill Bennett	Resident
Christopher Ward	KOA Campground
Betty (last name unreadable)	Homeowner
Heidi Rhymes	IAS & SCIF
John King	Resident
Margaret Kullberg	Resident
Joe Tambe	
Susan Kirks	P.L.A.N.
Jenny Sterling	Resident
Jim Groverman	Pumpkin Patch
Bob Krieger	
Moises Velazquez	Public Access TV Filmcrew
Diane Reilly Torres	Public Access TV Filmcrew
Randy Raines	RMC Water & Environment
Christy Kennedy	RMC Water & Environment
Tim Harrison	RMC Water & Environment
**Additional Attendee, unable to read name from sign-in sheet.	

Appendix B

Project Objectives Report

Project Objectives Report

Upper Petaluma River Watershed Flood Control Project - Scoping Study

Subject: Project Objectives Report

Date: August 24, 2012

The purpose of this memorandum is to conceptually describe the Key Project Purpose and core objectives, as well as proposed supporting objectives. The current objectives have been established with input from the Sonoma County Water Agency (Water Agency) and the City of Petaluma (City) in project kick-off meetings held in November and December 2010 as well as additional meetings and communications with the Water Agency. The objectives described in this memorandum are consistent with goals described in the Petaluma Watershed Enhancement Plan (PWEP; Goal B, Goal D) and the General Plans for the City and the County of Sonoma (Petaluma – 4-G-1, 8-G-6, 8-G-8 and 8-G-9; Sonoma County – OSRC-8, WR-1, WR-2, WR-4 and WR-6).

Identification of objectives for the Upper Petaluma River Watershed Flood Control Project is a fundamental step in developing a multidisciplinary flood control program with multi-benefit projects. The objectives outlined below will be further refined with stakeholder input in upcoming workshops, and will then serve as a guide for the project from scoping through implementation.

The established objectives and their components will be used to provide specific focus to conceptual project development by answering the question "What are we trying to accomplish?" In this manner, the objectives provide a qualitative description of desired future conditions, and objective components provide measurable conditions that will define projects.

The Scoping Study process is based on first identifying objectives for the study area, then identifying conceptual project alternatives that aid in meeting the objectives as appropriate.

1 Key Project Purpose

The Key Project Purpose for the Upper Petaluma River Watershed Flood Control Project (Project) is:

> *Develop a stormwater management/groundwater recharge project(s) that will provide flood hazard reduction and groundwater benefits within the Upper Petaluma River Watershed.*

This is a broad purpose consistent with the Water Agency's *Water Supply Strategies Action Plan* (2010) that, when achieved, will:

- Reduce flooding and associated flood damages; and
- Increase groundwater recharge and improve water supply reliability.

The project, or suite of projects, that is implemented to achieve the Key Project Purpose is intended to include both flood protection and groundwater recharge elements. Many of the types of projects that will fulfill

Project Example:
A detention basin is a facility that can be in-stream or off-stream where velocities are reduced and has a passively controlled outlet. Located over soils with a high infiltration rate, such a basin would provide flood protection through peak attenuation and additional groundwater recharge while the water was detained. Depending on design features, a detention basin could also improve surface water quality, remove sediment, provide additional habitat, and be a destination for educational opportunities and interpretation.

the Key Project Purpose will offer the opportunity to provide additional benefits such as:

- Improving surface water quality;
- Stabilizing the Petaluma River and its tributaries with regards to erosion and sedimentation;
- Improving habitat and the potential for habitat; and
- Providing for recreation and educational opportunities.

These benefits are further described in the sections below as well as descriptions of the core and supporting objectives that will help to achieve these benefits.

2 Core Objectives

Per the Key Project Purpose, this Project will lead to a project with two Core Objectives:

- Flood Hazard Reduction
- Groundwater Recharge

As detailed below, the objectives and their objective components (i.e. aspects of the objective that contribute to its full achievement) are provided below for the focus areas of flood hazard reduction and groundwater recharge. These core objectives are critical to the success of the Project and the achievement of the Key Project Purpose. The objective components provide a more tangible concept that can be used to measure how well each project alternative meets the objective.

2.1 Flood Hazard Reduction

Flood hazard reduction is one of the drivers for the Project. Based on a review of 100-year floodplain maps created by the Water Agency and Federal Emergency Management Agency (FEMA), 100-year inundation areas include both rural and undeveloped land as well as highly developed properties, including some commercial areas. It is important to balance the need for property protection and safety from floods with the many benefits that floodplains provide, not only related to flood flows but also other areas such as habitat and water quality. It is not the intent of this objective to eliminate all of the floodplains, but rather to utilize or enhance them where possible and reduce them only where required. A flood hazard reduction objective and three objective components are proposed in **Table 2-1**.

Table 2-1: Flood Hazard Reduction Objective

Core Objective: Improve management of stormwater that contributes, directly or indirectly, to reduced flood hazards.	
Objective Component	Comments
A. Implement improvements to flood protection system necessary to manage up to the 100-year storm event at General Plan land use conditions for private properties	Evaluate role of natural flood plains for accommodating projected 100-year storm events. Consider both detention and conveyance type projects. Implement best management practices. Consider projects sized for more frequent events.
B. Promote coordination of flood protection projects within and downstream of the Project area	Ensure that implementation of one project does not adversely impact other projects or areas.
C. Design and maintain streams and flood protection facilities to convey design flows while supporting natural ecosystem functions to the greatest extent possible	Develop projects that incorporate environmentally sensitive approaches such as biotechnical bank stabilization, meandering channels, shade, connectivity, wildlife, and fish passage.

2.2 Groundwater Recharge

Water supply is a significant concern to the Water Agency, the Water Agency's contractors, and the Water Agency's partners, particularly due to the changed strategies and long term outlook brought about by the Russian River Biological Opinion (2008), the recent economic downturn, and other long-term considerations such as climate change. Based on these changes, groundwater recharge is another driver of the Project. Groundwater resources can supplement surface water supplies and alternative supplies, such as recycled water. Recharging the local aquifers with stormwater whenever possible will enhance water supply reliability. **Table 2-2** proposes a groundwater recharge objective for the Project and two objective components.

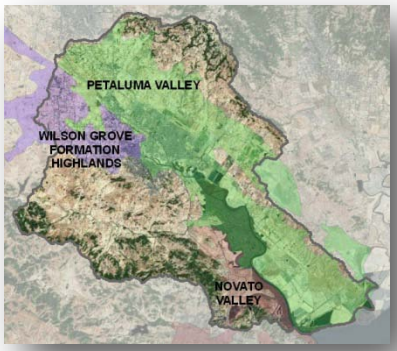


Table 2-2: Groundwater Recharge Objective

Core Objective: Increase beneficial recharge of groundwater, whether or not that recharged groundwater is directly accessible as water supply.	
Objective Component	Comments
A. Provide recharge opportunities to enhance aquifer storage	Utilize available stream flow to recharge the aquifer.

3 Supporting Objectives

While not critical to achieving the Key Project Purpose, a multi-benefit project can be created by also considering:

- Water Quality
- Water Supply
- System Sustainability
- Ecosystem
- Agricultural Land
- Undeveloped Land
- Community Benefits

Proposing and implementing multi-benefit projects will help address many of the project challenges and constraints, described in the *Draft Issues Assessment* (RMC, 3/11), including:

- Stakeholder agreement;
- Project partnering;
- Public support;
- Regulatory approval; and
- Funding.

The sections below propose objectives and objective components, supporting the core objectives, which will help to qualify and quantify the additional benefits associated with developing the Project's flood protection and groundwater recharge project alternatives.

3.1 Water Quality

The Petaluma River has been identified by the San Francisco Bay Area Regional Water Quality Control Board as an impaired water body on the 303d list for:

- Diazinon
- Nutrients
- Pathogens
- Sediment
- Trash; and
- Nickel.

Many of these pollutants can be traced to runoff from the watershed and will need to be addressed as part of a response to upcoming TMDL limits, coordination with regulatory agencies, and good watershed stewardship. Because there are zones of high infiltration, it is reasonable to expect that mobile pollutants could potentially threaten groundwater quality in addition to surface water quality. If stormwater is expected to be a higher quality than the groundwater though, then stormwater infiltration could improve overall groundwater quality. Recharge can also help to prevent saline intrusion and side effects of overdraft such as additional geothermal contributions and undesirable migration of constituents. **Table 3-1** proposes a water quality objective for the Project and five objective components.

Table 3-1: Water Quality Objective

Supporting Objective: Protect or improve water quality of surface water (Petaluma River, its tributaries and the San Francisco Bay) and groundwater.	
Objective Component	Comments
A. Help to eliminate impaired water body designations	Implement project elements that help to reduce pollutant loads.
B. Provide adequate water quality to sustain aquatic life	Manage pollutants, including temperature, sediments, and pesticides, to support seasonal habitat requirements.
C. Facilitate permitting for long-term operations/maintenance	Implement project elements that will reduce additional requirements and negotiations with permitting agencies such as RWQCB and CDPH.
D. Avoid degradation of aquifer water quality due to infiltration of surface runoff constituents	Design and operate projects so as to avoid aquifer degradation, consistent with the California Antidegradation Policy (Resolution No. 68-16).
E. Improve aquifer water quality	Use high quality stormwater for recharge to mitigate saline intrusion and overdraft effects.

3.2 Water Supply

Water supply is a significant concern to the Water Agency, the Water Agency's contractors, and the Water Agency's partners, particularly due to the changed strategies and long term outlook brought about by the Russian River Biological Opinion (2008), the recent economic downturn, and other long-term considerations such as climate change. Some of the increasing demands for potable water can be offset by using stormwater where high quality water may not be necessary. **Table 3-2** proposes a water supply objective for the Project and one objective component.

Table 3-2: Water Supply Objective

Supporting Objective: Increase or improve water supply availability, reliability and flexibility for domestic, municipal, industrial, agricultural, and environmental use.	
Objective Component	Comments
A. Offset use of surface water.	Utilize high stream flow for direct recharge. Storage is not an option.

3.3 System Sustainability

System sustainability, in both local and larger contexts, is extremely important to the Water Agency. The Water Agency recognizes that water and energy efficiency are critical components to ensuring that the resources are available for future generations. System sustainability also refers to physical processes. Channel stability and sedimentation is a concern for the Water Agency and other organizations associated with Petaluma River. Not only can sedimentation impact hydraulic conveyance capacity but it has impacts on other areas such navigation, habitat, and water quality. Erosion and sedimentation also impact maintenance and operation budgets because of the need to repair channels and remove sediment. **Table 3-3** proposes a system sustainability objective for the Project and four objective components.

Table 3-3: System Sustainability Objective

Supporting Objective: Support energy and water efficiency and climate change resiliency of water management systems and developed supplies; provide for channel stability and sedimentation control; and consider the long-term viability of implemented project and impact on affected systems.	
Objective Component	Comments
A. Minimize use of imported energy at the project site	Develop projects with low energy requirements. Use renewable energy resources (i.e. wind, solar) where feasible.
B. Ensure water is used efficiently	Captured water should be used completely and as soon as possible. Efficient water use will reduce dependence on imported water and its related energy requirements.
C. Implement improvements necessary to eliminate or mitigate the effects of erosion and sedimentation on flooding, water quality, and native habitats	Develop stormwater detention, grade control and bank stabilization strategies to minimize streambed erosion and undesirable sediment accumulation.
D. Implement improvements that facilitate a streamlined permitting process for long-term operational and maintenance strategies for stream systems	Develop projects that incorporate sediment management strategies. Environmentally sensitive approaches such as biotechnical bank stabilization are preferable.

3.4 Ecosystem

Part of the Water Agency mission is to manage water resources in an environmentally sensitive manner. The Water Agency shares the responsibility for environmental stewardship with other local and regional agencies. **Table 3-4** proposes an ecosystem objective for the Project and four associated objective components.

Table 3-4: Ecosystem Objective

Supporting Objective: Improve ecosystem function and/or habitat enhancement, especially for listed species.	
Objectives	Comments
A. Integrate environmental and habitat requirements into project	Provide water quantity and quality to sustain native fisheries and other aquatic life. Consider flow regimes, water temperature, and passage in a manner that reflects environmental and habitat requirements and constraints.
B. Promote sustainable, native habitats wherever possible	Identify opportunities for restoration and enhancement. Identify and restore, where appropriate, habitats affected by non-native invasive species.
C. Preserve and enhance stream buffers and riparian areas	Identify remaining stream buffers and riparian areas for preservation and candidate areas that can be restored to a more natural function. Develop riparian areas to provide shade for habitat improvement.
D. Facilitate permitting for long-term operations/maintenance of stream systems	Implement project elements that will reduce additional permit requirements and negotiations with permitting agencies such as National Marine Fisheries Service (NMFS), California Department of Fish and Game (CDFG), and U.S. Fish and Wildlife Service (FWS).

3.5 Agricultural Land

Agricultural land and the industries that it supports are important resources in Sonoma County and the Petaluma River Watershed. It is a supporting objective of this Project to protect existing agricultural land to the extent possible. **Table 3-5** proposes an agricultural land objective for the Project and two objective components.

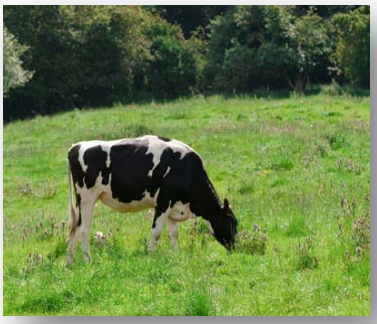


Table 3-5: Agricultural Land Objective

Supporting Objective: Preserve agricultural land use.	
Objective Component	Comments
A. Minimize use of agricultural lands	Develop projects that are not located in currently agricultural lands.
B. Preserve and enhance agricultural lands	Promote projects that provide benefits to agricultural lands such as improved water supply reliability (quality and quantity), channel stabilization, flood relief and TMDL compliance. Incorporate agricultural characteristics into the project design.

3.6 Undeveloped Land[1]

Open space and undeveloped land are a valuable and oftentimes underappreciated resource. Within the Petaluma River Watershed it can provide the opportunity for recreation for residents and visitors as well as habitat for local and migratory species. **Table 3-6** proposes a water supply objective for the Project and three objective components.

Table 3-6: Undeveloped Land Objective

Supporting Objective: Preserve and/or enhance open space and undeveloped land.	
Objective Component	Comments
A. Minimize use of open space and undeveloped lands	Develop projects that are not located in currently open space or undeveloped lands.
B. Preserve and enhance open space and undeveloped lands	Incorporate open space characteristics into the project design.
C. Restore degraded open space and undeveloped lands	Improve quality of open space and undeveloped lands.

[1] This objective has been updated since the draft memorandum to reflect input received from members of the public.

3.7 Community Benefits

Projects in and around the Petaluma River and tributary streams in the Petaluma Watershed provide a unique opportunity for local agencies to provide recreation, education, and access to different parts of the watershed. **Table 3-7** proposes a community benefits objective for the Project and three associated objective components.

Table 3-7: Community Benefits Objective

Supporting Objective: Create and/or enhance recreation, public access, education, etc.	
Objective Component	Comments
A. Provide educational opportunities for students and the general public.	Provide interpretive resources at project sites.
B. Cooperate with local and regional agencies to implement appropriate recreational features along streams and the Petaluma River.	Provide appropriate recreational features to encourage public appreciation of the natural environment without constraining, or adversely affecting the natural environment, or flood protection function of streams.
C. Protect or enhance visual resources.	Identify and accommodate public concerns for stream and riparian aesthetics within the range of ecologically appropriate improvements.

4 Summary and Next Steps

This memorandum has proposed core and supporting objectives that will lead to the identification of multi-benefit project alternatives. For each objective, several objective components are proposed that will help lead to better fulfillment of the objective and ultimately the Key Project Purpose. The proposed objectives are:

- Core Objectives
  - Flood Hazard Reduction - Improve management of stormwater that contributes, directly or indirectly, to reduced flood hazards
  - Groundwater Recharge – Increase beneficial recharge of groundwater, whether or not that recharged groundwater is directly accessible as water supply.
- Supporting Objectives
  - Water Quality - Improve water quality of surface water and/or groundwater
  - Water Supply - Increase or improve water supply availability, reliability and flexibility for domestic, municipal, industrial, agricultural and environmental use
  - System Sustainability - Support energy and water efficiency and climate change resiliency of water management systems and developed supplies; Provide for channel stability and sedimentation control; and Consider the long-term viability of implemented project and impact on affected systems.
  - Ecosystem- Improve ecosystem function and/or habitat enhancement, especially for listed species
  - Agricultural Land - Preserve agricultural land use
  - Undeveloped Land - Preserve and/or enhance open space and undeveloped land
  - Community Benefits - Create and/or enhance recreation, public access, education, etc.

An initial stakeholder meeting to review the Project with stakeholders and solicit their input on the issues and objectives identified to date has been scheduled. Also at this meeting, the Project team will solicit stakeholder input on problem areas within the Project boundary related to the Project scope (i.e. flood hazard reduction and groundwater recharge) as well as conceptual project alternatives. Based on feedback from the stakeholders, the issues and objectives will be refined. After development of the conceptual project alternatives, the revised objectives will be used to evaluate the project alternatives via a process to be described in a future memorandum.

Appendix C

Issues Assessment

Issues Assessment

Upper Petaluma River Watershed Flood Control Project - Scoping Study

Subject: **Issues Assessment**

Date: **August 24, 2012**

1 Introduction

The Sonoma County Water Agency (Water Agency) is presently undertaking a Scoping Study within the Upper Petaluma River Watershed (Project) to identify stormwater management/groundwater recharge projects that provide flood hazard reduction and groundwater benefits (Key Project Purpose). The Scoping Study is in its initial phase of developing a set of project objectives, assessing potential project issues, and designing a stakeholder coordination process. As part of this first phase, a Preliminary Issues Assessment table was developed and shared with the Water Agency at a project kick-off meeting held on November 15, 2010, and a subsequent meeting with the City of Petaluma (City) on December 14, 2010.

The purpose of this memorandum is to elaborate on and refine key issues, strategies, and supporting objectives related to the Key Project Purpose.

2 Key Project Issues

Since development of the Preliminary Issues Assessment (table), the RMC project team has held a kick-off meeting with the Water Agency and one meeting with the City. Information from these meetings as well as information obtained from review of reference reports gathered for this project has helped to expand upon and refine the issues to date.

The overarching project issues identified include the following:

- Objectives Definition/Prioritization
- Watershed Understanding
- Stakeholder Coordination
- Project Integration
- Regulatory Constraints
- Funding Identification
- Effective Communication

Each of these project issues is discussed in detail below.

2.1 Objectives Definition & Prioritization

Defining and prioritizing objectives is a critical component of any successful project. Objectives definition and prioritization is especially important for this Scoping Study because at this early stage there are many different directions in which the project could go. Well-defined objectives will allow the project to proceed efficiently.

2.1.1 Learned to Date

The Water Agency initiated the objectives definition process in identifying the need for the project and in issuing the request for qualifications. As discussed below, the project objectives have been refined since then via the combined efforts of the Water Agency, the RMC team, and the City of Petaluma. The

project's primary objective, proposed supporting objectives and next steps in objectives definition and prioritization are discussed below.

Core Objectives

As described above, the Key Project Purpose is to identify stormwater management/groundwater recharge projects that provide flood hazard reduction and groundwater benefits within the Upper Petaluma River Watershed. To that end, the Water Agency has established two core objectives for the Project, as follows:

- **Flood Hazard Reduction** – Improve management of stormwater that contributes, directly or indirectly, to reduced flood hazards.
- **Groundwater Recharge** – Increase beneficial recharge of groundwater, whether or not that recharged groundwater is directly accessible as water supply.

Based on discussions with Water Agency staff, it is understood that these core objectives still hold unless it becomes clear during the course of the Project that one of the core objectives does not apply to the Petaluma River watershed. The City is also supportive of the Project's purpose and core objectives. Some points of clarification that were brought up in the Kick-Off Meeting, the meeting with the City, or the Preliminary Objectives Report meeting include:

- The geographic focus area of the scoping study for flood hazard reduction should be the Upper Petaluma River Watershed. The Upper Petaluma River Watershed is considered to be the watershed for the Petaluma River upstream of and including the confluence with Lynch Creek. The City has several planned or ongoing projects within city limits but would be appreciative of upstream projects that could help alleviate flooding within the City. Groundwater recharge projects will be considered throughout the Project area (within the approximate boundary of Zone 2A).
- The eventual project to be recommended at the conclusion of the Scoping Study and subsequent Feasibility Analysis may be a suite of projects that can be implemented at several locations within the study area.
- Flood mitigation and groundwater recharge are understood to be of approximately equal weight within the Key Project Purpose. It is noted, however, that outside funding may be more available for initiatives that have significant flood mitigation benefits. It is also noted that project components that achieve the core objectives may be geographically disconnected.

Proposed Supporting Objectives

The proposed supporting objectives for the Project are:

- Water Quality;
- Water Supply;
- System Sustainability;
- Ecosystem;
- Agricultural Land;
- Undeveloped Land[1]; and
- Community Benefits.

These supporting objectives have been developed in conjunction with the Agency and in coordination with similar watershed studies being conducted by the Agency within the Sonoma Valley and Laguna Mark West watersheds. The City has also endorsed a multi-benefit approach and the proposed supporting objectives.

[1] This objective has been updated since the draft memorandum to reflect input received from members of the public.

The proposed supporting objectives along with the core objectives are generally defined in the **Table 2-1** below.

Table 2-1: Core and Supporting Objectives

Core Objectives
Flood Hazard Reduction - Improve management of stormwater that contributes, directly or indirectly, to reduced flood hazards.
Groundwater Recharge - Increase beneficial recharge of groundwater, whether or not that recharged groundwater is directly accessible as water supply.
Supporting Objectives
Water Quality - Protect or improve water quality of surface water (Petaluma River, its tributaries and the San Francisco Bay) and groundwater.
Water Supply - Increase or improve water supply availability, reliability and flexibility for domestic, municipal, industrial, agricultural, and environmental use.
System Sustainability - Support energy and water efficiency and climate change resiliency of water management systems and developed supplies; Provide for channel stability and sedimentation control; and Consider the long-term viability of implemented project and impact on affected systems.
Ecosystem - Improve ecosystem function and/or habitat enhancement, especially for listed species.
Agricultural Land - Preserve agricultural land use.
Undeveloped Land - Preserve and/or enhance open space and undeveloped land.
Community Benefits - Create and/or enhance recreation, public access, education, etc.

Benefits Associated with the Objectives

The core and supporting project objectives each have associated benefits. The matrix below outlines benefits expected to be realized by pursuing each of the project objectives. Benefits have been organized into "triple bottom line" categories. A summary of the association between objectives and benefits is provided below in **Table 2-2** and the following bullet points further develop the primary benefits that could be realized by implementing a project that fulfills the associated objective.

Table 2-2: Benefits Associated with Objectives

Objectives	Social Benefits			Environmental Benefits			Economic Benefits		
	Public Health & Safety	Property Protection	Public Amenities	Local Env. Enhancement	Regional Env. Enhancement	Global Env. Enhancement	Regulatory Streamlining	Community Viability	Maintenance Efficiency
Flood Hazard Reduction	X	X		X				X	
Groundwater Recharge	X				X	X		X	
Water Quality	X			X	X		X		
Water Supply	X			X	X	X		X	
System Sustainability	X	X		X	X	X	X	X	X
Ecosystem			X	X	X	X		X	
Agricultural Land		X		X	X	X		X	
Undeveloped Land		X	X	X	X	X			
Community Benefits			X	X	X			X	X

Flood Hazard Reduction: The most significant benefits associated with the flood mitigation objective have been identified as follows:

- **Social Benefits**
    - Public Health and Safety: Aspects of the project that address the flood mitigation objective will provide the benefit of protecting public health and safety by preventing or lessening flooding in publicly accessible areas (including roads) as well as private property.
    - Property Protection: Working toward the flood mitigation objective will protect public and private properties from damage from flood waters.
- **Environmental Benefits**
    - Local Environmental Enhancement: Although flooding is a "natural" process, flooding can also be harmful to individual animal species and to habitats and ecosystems as a whole in areas where the environment is not adapted to intermittent flooding.
- **Economic Benefits**
    - Community Viability: Flooding can cause significant economic impacts within affected communities. Cleaning up after floods is expensive and a community that is at risk of flooding may also be restricted in its ability to retain and attract businesses. Flood mitigation helps to lessen these potential costs while providing economic benefits in the form of increased property values and reduced insurance rates.

Groundwater Recharge: The most significant benefits associated with the groundwater recharge objective have been identified as follows:

- **Social Benefits**
    - Public Health and Safety: Reliable high-quality water supply is a critical public health and safety issue. Communities that have more than one water supply source (for example a surface water source supplemented by groundwater) guard themselves against catastrophic events such as infrastructure failure as well as longer-term changes in supply availability such as those that may result from climate change.
- **Environmental Benefits**
    - Regional Environmental Enhancement: Enhancing groundwater recharge could allow for decreased reliance on surface water for water supply. Reducing reliance on surface water supplies allows greater flexibility in the management of surface water supplies to meet environmental goals such as the protection of endangered salmonid species.
    - Global Environmental Enhancement: Relying on water supplies that are close to end users could result in energy savings and reduced carbon emissions due to reduced pumping needs.
- **Economic Benefits**
    - Community Viability: Reliable water supplies are essential to the economic viability of any community. Additionally, as conditions change, groundwater may become increasingly the more economically attractive water source.

Water Quality: The project alternatives can be formulated so as to protect or improve the quality of surface water and groundwater. For example, upstream detention basins that provide flood mitigation and allow for groundwater recharge can also be designed to protect water quality by trapping sediment. To

the extent that water quality enhancement is pursued as a supporting objective, the follow benefits are likely to result:

- **Social Benefits**
    - Public Health and Safety: Excellent water quality is a critical public health issue in terms of drinking water and recreational use of waterways.
- **Environmental Benefits**
    - Local and Regional Environmental Enhancement: Improving water quality is beneficial to species and the ecosystem in the immediate areas of projects and in downstream areas.
- **Economic Benefits**
    - Regulatory Streamlining: Explicitly pursuing objectives related to water quality may speed up the regulatory approval process and result in reduced project costs associated with permitting efforts.

Water Supply: The most significant benefits associated with the water supply objective have been identified as follows:

- **Social Benefits**
    - Public Health and Safety: Reliable high-quality water supply is a critical public health and safety issue. Communities that have multiple water sources and flexibility in their use are more likely to weather infrastructure failure and long-term changes while being able to provide for multiple uses.
- **Environmental Benefits**
    - Local, Regional and Global Environmental Enhancement: Diversifying the water supply portfolio and supplies will enable more efficient use and distribution of available resources.
    - Global Environmental Enhancement: Relying on water supplies that are close to end users could result in energy savings and reduced carbon emissions due to reduced pumping needs.
- **Economic Benefits**
    - Community Viability: Reliable water supplies are essential to the economic viability of any community.

System Sustainability: Flood control projects can oftentimes be designed so as to increase channel stability and decrease excess sedimentation in associated waterways. Groundwater recharge can be an efficient way to utilize episodic water resources to improve water supply and prevent subsidence. Addressing system sustainability through the project is likely to result in the following benefits:

- **Social Benefits**
    - Public Health and Safety: Improving channel stability provides public safety benefits.
    - Property Protection: Improving channel stability and maintaining hydrostatic pressure in the aquifer provides property protection benefits.
- **Environmental Benefits**
    - Local and Regional Environmental Enhancement: Controlling excess sedimentation is beneficial to species and the ecosystem in the immediate areas of projects and in downstream areas. Utilizing passive groundwater recharge methods requires minimal

amounts of imported energy, requiring a smaller carbon footprint than an alternative, more power intensive water supply.

- **Economic Benefits**
  - Regulatory Streamlining: Minimizing the amount of maintenance will reduce the regulatory requirements and oversight of operations.
  - Maintenance Efficiency: To the extent that flood control/groundwater recharge projects can meet channel stability objectives, these projects will provide benefits to the overall efficiency of stream maintenance activities.

Ecosystem: The flood control/groundwater recharge projects can potentially be designed so as to enhance habitats/ecosystems and improve conditions for native species.

- **Social Benefits**
  - Public Amenities: Improved habitat for birds, fish and other species results in improved conditions for bird watches, fishing hobbyists, and nature enthusiasts.
- **Environmental Benefits**
  - Local, Regional and Global Environmental Enhancement: Protecting and restoring habitat benefits species that live within the immediate area of the project as well as migratory birds and insects that may rest within the enhanced habitats on their way to other parts of the world.
- **Economic Benefits**
  - Community Viability: Enhanced habitats and wildlife populations have the potential to attract additional tourism and business to the project areas.

Agricultural Land: With consideration for preserving agricultural lands, the implemented project could achieve the following benefits.

- **Social Benefits**
  - Property Protection: Preserving land as agricultural will protect the property from short and long term land use changes.
- **Environmental Benefits**
  - Local, Regional and Global Environmental Enhancement: Agricultural lands can provide benefits to local animals as well as provide stop-over points for migratory birds.
- **Economic Benefits**
  - Community Viability: Continued agricultural land use brings jobs and income to the community.

Undeveloped Land: With consideration for preserving or enhancing undeveloped land and open space, the implemented project could achieve the following benefits.

- **Social Benefits**
  - Property Protection: Preserving or establishing new land as open space or undeveloped land will protect the property from short and long term land use changes.
  - Public Amenities: Open space and undeveloped land can be established as parks or vistas.

- **Environmental Benefits**
    - Local, Regional and Global Environmental Enhancement: Open space and undeveloped land can provide habitat to local and regional animals as well as provide stop-over points for migratory birds.
- **Economic Benefits**
    - Community Viability: Continued agricultural land use brings jobs and income to the community.

Community Benefits: The flood control/groundwater recharge projects can potentially be designed to provide for recreational and educational opportunities. For example, trails with information signage can be incorporated into projects.

- **Social Benefits**
    - Public Amenities: Providing recreational and educational opportunities will be beneficial to the community.
- **Environmental Benefits**
    - Local and Regional Environmental Enhancement: Educational and recreational opportunities incorporated within the project can help to improve public understanding of environmental issues and public willingness to participant in environmental enhancement activities.
- **Economic Benefits**
    - Community Viability: Enhanced recreational and educational opportunities make for a stronger, more economically viable community.

Challenges and Constraints Associated with the Objectives

The project will encounter challenges and constraints in association with pursing each of the project objectives. Acquiring funding is one of the most significant challenges/constraints. Balancing the different project objectives is one key to a successful funding strategy.

Additional anticipated challenges and constraints associated with each project objective are summarized in **Table 2-3** and are further discussed in following pages.

Table 2-3: Challenge Matrix for Objectives

	Expected Challenges/Constraints			
	Stakeholder Agreement	Aligning Project Partners	Regulatory Approval	Technical Challenges
Core Objectives				
Flood Hazard Reduction	X			X
Groundwater Recharge		X	X	X
Supporting Objectives				
Water Quality				X
Water Supply		X	X	X
System Sustainability				X
Ecosystem	X	X		
Agricultural Land	X			
Undeveloped Land	X	X		
Recreation & Education	X	X		

Flood Hazard Reduction: The most significant anticipated challenges associated with the flood mitigation objective have been identified as follows:

- **Stakeholder Agreement:** Stakeholders agree that flooding is problematic, especially on their own property. However, selecting, prioritizing and obtaining stakeholder endorsement of flood control project locations may be challenging.
- **Technical Challenges:** Numerous technical considerations are involved in planning flood mitigation projects.

Groundwater Recharge: The most significant anticipated challenges associated with the groundwater recharge objective have been identified as follows:

- **Aligning Project Partners:** Determining the roles of different project partners and stakeholders with respect to recharge objectives is likely to be challenging.
- **Regulatory Approval:** Water supply in general and groundwater recharge in particular is often subject to intense regulatory scrutiny.
- **Technical Challenges:** Establishing the necessary understanding of hydrogeologic conditions can be challenging.

Water Quality: The most significant anticipated challenges associated with the water quality objective have been identified as follows:

- **Technical Challenges:** Maximizing water quality improvements through the project will require careful considerations of technical issues.

Water Supply: The most significant anticipated challenges associated with the water supply objective have been identified as follows:

- **Aligning Project Partners:** Determining the roles of different project partners and stakeholders with respect to water supply objectives is likely to be challenging.
- **Regulatory Approval:** Water supply is often subject to intense regulatory scrutiny.
- **Technical Challenges:** Meeting water demands and developing ways to store and move water to where it is needed in an effective and efficient manner, consistent with the other objectives of the Project, can be challenging.

System Sustainability: The most significant anticipated challenges associated with the system sustainability objective have been identified as follows:

- **Technical Challenges:** Maximizing channel stability and sedimentation improvements through the project will require careful considerations of technical issues.

Ecosystem: The most significant anticipated challenges associated with the ecosystem objective have been identified as follows:

- **Stakeholder Agreement:** While some stakeholders may be strongly supportive of efforts to enhance ecosystems through the project, others may consider such efforts a "waste of money".
- **Aligning Project Partners:** Potential project partners involved in environmental enhancement efforts are likely to be a diverse group with minimal previous interactions with water resources projects.

Agricultural Land: The most significant anticipated challenges associated with the agricultural land objective have been identified as follows:

- **Stakeholder Agreement:** While some stakeholders may be strongly supportive of efforts to preserve agricultural land, identifying willing land owners from which to acquire easements or titlesmay be difficult.

Undeveloped Land: The most significant anticipated challenges associated with the undeveloped land objective have been identified as follows:

- **Stakeholder Agreement:** While some stakeholders may be strongly supportive of efforts to preserve or enhance open space and undeveloped land, identifying willing land owners from which to acquire easements or titles may be difficult.
- **Aligning Project Partners:** Identifying a project partner to operate and maintain the open space and undeveloped land may be difficult, as could be developing documentation regulating its operation and permissible uses.

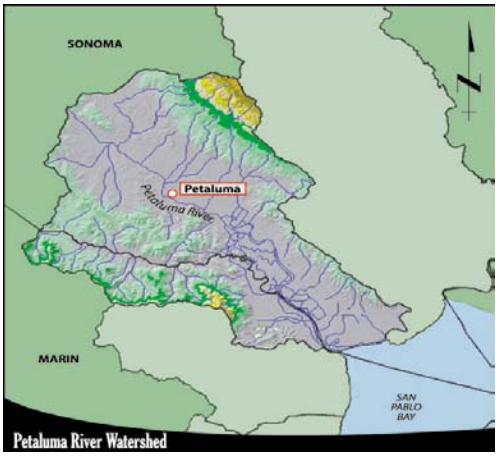
Community Benefits: The most significant anticipated challenges associated with the recreation and education objective have been identified as follows:

- **Stakeholder Agreement:** While some stakeholders may be strongly supportive of efforts to improve recreation and education opportunities through the project, others may consider such efforts a "waste of money".
- **Aligning Project Partners:** Potential project partners involved with recreational and educational opportunities are likely to be a diverse group with minimal previous interaction with water resources projects.

2.1.2 Issue Strategy & Next Steps

Although agreement on project objectives is an important first step of any project, project objectives need not remain unchanged throughout the course of the project. Objectives should be flexible enough to allow

for moderate modifications as a greater understanding of the study area needs is developed. In particular, the relative importance of various objectives will need to be prioritized.



2.2 Watershed Understanding

Understanding the characteristics of the Upper Petaluma River Watershed is a critical issue in the process of development of project objectives and later, project alternatives. Watershed characteristics that are being studied include:

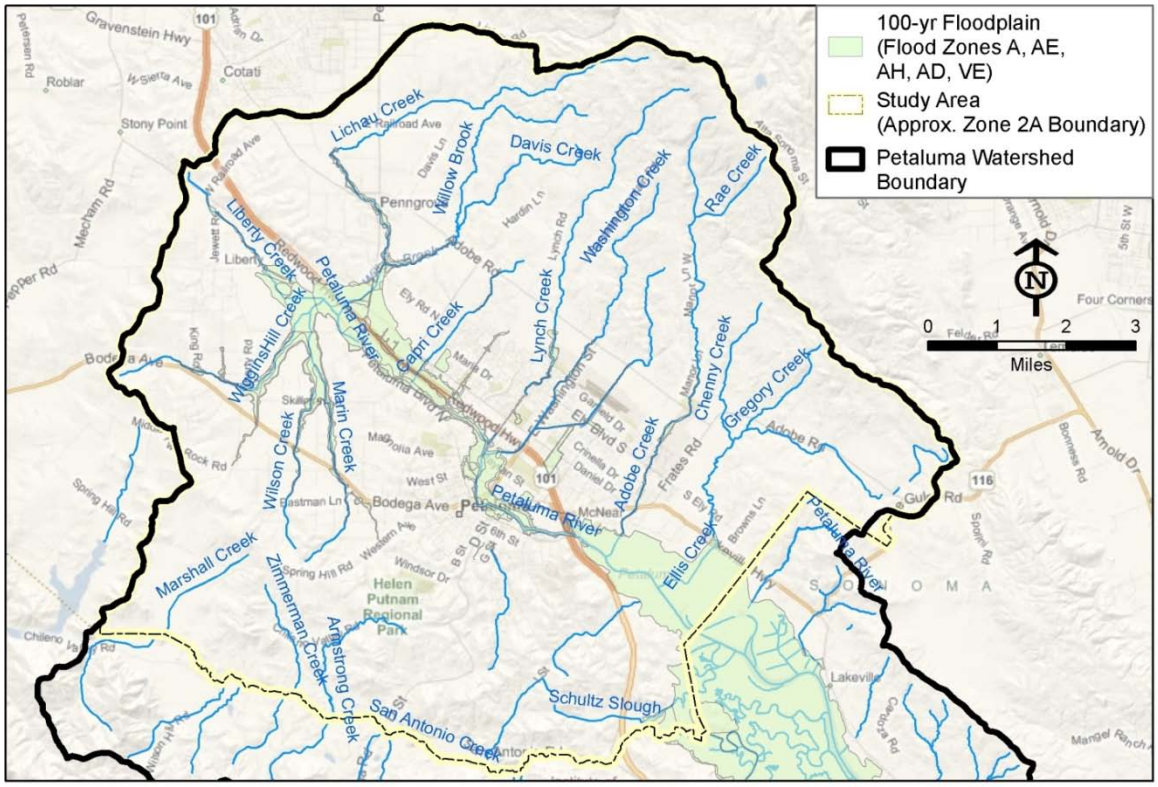
- Flooding in Petaluma (history, degree and frequency)
- Water supply and groundwater conditions
- Watershed geography, land use, soils and geology
- Understanding of the Petaluma Watershed model

2.2.1 Learned to Date

Flooding Conditions

As can be seen in the figure below, there are extensive 100-year floodplains for the Petaluma River and many of its tributaries within the study area. Since there is little demand for additional flood control projects downstream of the City and the City has planned several flood control projects to alleviate flooding within city limits, the focus of flood protection alternative identification will be upstream of the confluence between the Petaluma River and Lynch Creek. Noted exceptions to this are projects that have been identified by the City on Thompson and Kelly creeks. Of particular importance to the Project are the developed areas within the 100-year floodplain along Highway 101and Petaluma River tributaries including Lichau Creek, Liberty Creek, Wiggins Creek, Wilson Creek, and Marin Creek.

Figure 2-1: Flooding within Study Boundary



Existing and Planned Flood Control Projects

The City and US Army Corps of Engineers (USACE) have been working together to complete the Petaluma Flood Improvement Project in the Payran neighborhood to control flooding in the downtown area of Petaluma. Most of this project has been completed, removing the downtown area from the 100-year flood plain. Three remaining pieces of the downtown project to be finished include modification of the existing sheet-pile wall, rip rap, I-cap removal and replacement.

The City has implemented and planned many other flood control projects. For example, the City has implemented the Denman Reach Flood Management Project along the Petaluma River, which relieves flooding pressure within Zone 2A through implementation of benched terraces. Additionally, the City has utilized its watershed model to develop a list of 26 planned flood management projects which are primarily sediment basin and terracing projects. The Zone 2A Flood Control Advisory Committee has also been and will continue to be an active proponent of flood control and stream maintenance projects. Current or recently completed projects include work in Ellis Creek, Marin Creek, Adobe Creek, Lichau Creek, Lynch Creek, Petaluma River (Denman and Corona Reaches), Capri Creek, Washington Creek and Kizer Creek. Zone 2A is also currently planning projects for Ellis Creek, Adobe Creek, Capri Creek, Petaluma River, Kelly Creek, and Washington Creek.

There are six projects, described in **Table 2-4** below, that will be evaluated in a separate memorandum. The purpose of the memorandum will be to determine whether the projects are feasible and whether they should be considered for implementation.

Water Supply and Groundwater Conditions

The current state of groundwater supplies is currently unknown. Per the Petaluma River Master Drainage Plan (SCWA, 2003):

> … Natural topographic constraints prevent the Petaluma Valley ground water basin from filling more than the 84 percent [1,420,000 acre feet] indicated by the DWR's computer program… The [1982 DWR] report concludes, "The Petaluma Valley basin is therefore, in effect, completely filled at the present time.

The City currently has 20 wells in service (as well as several other off-line wells) and is planning to develop additional well capacity to provide water supply reliability. The City has also increased pumping over the past several years to offset potable surface water use. A current analysis must be performed to determine whether there is capacity in the aquifer to justify a recharge project in the Petaluma Valley groundwater basin. This analysis should also include a review of the existing water quality in the basin. Historical contaminants are nitrates, manganese, and salts. The USGS also plans to conduct a comprehensive study of the groundwater basin starting in 2012.

At this time, the sites preliminarily identified as having the greatest beneficial recharge potential are located in the high infiltration rate zones northwest of the City. Additional recharge sites will be investigated along the eastern edge of the Petaluma Valley basin.

Table 2-4: Projects to Be Evaluated in Separate Strategy Memorandum

Previously Identified Projects	Objective
Marin, Wilson and Wiggins Creek Channel Maintenance and Revegetation Project	To prevent flooding to residents adjacent to the creeks and reduce erosion that contributes sediment to the Petaluma River
Holm Rd. Ditch Extension Feasibility Study	Relieve flooding in the Corona/N.McDowell area. To provide a bypass channel, designed to convey storm waters that would have originally flowed overland into the Petaluma River prior to construction of the railroad and Hwy 101
Corona Reach Linear Overflow Channel Feasibility Analysis	Allow continuation of existing linear channel to capture, contain and direct storm flows within grass lined swales toward the Petaluma River. Provide a containment, filtration and sediment/debris settling period prior to storm flows entering the Petaluma River
Willowbrook Flood Reduction Feasibility Analysis	Meet goal and objectives of the Petaluma General Plan 2025 and the Sonoma County General Plan pertaining to reduction of peak storm flow impact and preservation of groundwater resources within the Petaluma Watershed
Lichau Creek Hydraulics and Vegetation Management	To identify projects to accommodate winter storm flows, benefit groundwater recharge and enhance fish habitat. To maintain revegetation with irrigation while installing additional native vegetation over successive years
Marin Creek/Denman Flats Drainage Study	To investigate the hydrology, hydraulics, routing, right-of-way and environmental issues in the drainage area and propose a drainage improvement project

Petaluma Watershed Model

The XP-SWMM watershed model developed by the City is currently under review by FEMA and will not be released to the Water Agency until the review is completed and the model approved. The current model is focused within the Urban Growth Boundary, with limited nodes outside of the boundary. The Water Agency has an early version of the model, but it does not account for more recent changes the City has made to the model, including a 13% increase in the design storm. A draft hydraulic/hydrologic study (H/H Study) was prepared by the Water Agency utilizing this previous version of the model. The intent of the draft H/H study was to "conduct a hydrologic/hydraulic analysis of the Upper Petaluma River Watershed [using the XP-SWMM model]. The study identifies and evaluates potential flood mitigation alternatives, with a focus on detention basins, which may provide regional flood reduction benefits." (H/H Study, 2010) The H/H Study identifies the top five alternatives for flood mitigation (of twenty alternatives studied) and makes several recommendations for further work including refinement of the five recommended alternatives, consideration of low impact development (LID) strategies, and additional refinement of the basin hydrology within the model.

2.2.2 Issue Strategy & Next Steps

Data gaps remain due to the need to obtain the Petaluma River Watershed Model and other technical documents that have not yet been released by the City or the USACE.

Further substantial development of the watershed understanding will be conducted within the project alternatives development process.

2.3 Stakeholder Coordination

One of the keys to a successful project will be building consensus around the project objectives and eventual project alternatives developed during the Scoping Study. Early and effective stakeholder coordination is the basis on which this consensus is developed.

2.3.1 Learned to Date

Through the Kick-off Meeting and subsequent meeting with the City, RMC has developed a draft list of stakeholders to engage for the Scoping Study. Stakeholder workshops will be a part of the scoping study process and will be a forum for discussion and collective input on project objectives, screening criteria and project alternatives.

Issues may arise if stakeholders do not feel a part of the process, either through lack of communication and notification, or not including stakeholder input in the final work product. The Water Agency has developed an outreach strategy that facilitates contact with project proponents, watershed stakeholders, and regulatory agencies. RMC will work closely with the Water Agency to engage stakeholders early in the project screening process, and use visioning tools in workshops to develop ideas as a team, thus building consensus for multi-objective project alternatives.

2.3.2 Issue Strategy & Next Steps

Next steps for stakeholder engagement include identifying the appropriate contacts and notifying stakeholders of the project and planned stakeholder process. An initial stakeholder workshop has been scheduled for late March 2011 to notify stakeholders of the project; and receive input on the project development process, draft project objectives and considerations for identification of potential project alternatives.

2.4 Project Integration

Project implementation can affect the performance of other flood hazard reduction and groundwater recharge projects elsewhere in the same stream system and groundwater basin. The impacts and benefits of the projects must therefore be considered as a system, rather than as individual projects.

2.4.1 Learned to Date

As described in the sections above, many projects have been identified as providing potential flood hazard reduction and groundwater recharge benefits. Some projects, such as 26 City projects, are known to exist in some state, but no additional details are known. The RMC team will work with the Water Agency to determine how best to capture planned projects or projects where implementation is underway within the Scoping Study Report.

2.4.2 Issue Strategy & Next Steps

RMC will utilize available planning work to assess how these projects may integrate or relate to one another. The potential for packaging projects will also be assessed to determine if benefits to the watershed and stakeholders can be improved.

2.5 Regulatory Constraints

Regulatory drivers will be a key issue in developing project objectives, screening criteria and project alternatives. By developing projects with multi-benefit objectives, regulatory aspects and requirements can be more easily interwoven with project concepts. In order to develop feasible projects, the RMC team will develop a permitting strategy early on in the feasibility analysis, and will begin engaging with regulators even earlier as part of the stakeholder group.

2.5.1 Learned to Date

The Petaluma River has draft 303d listings for the following constituents:

- Diazinon (a pesticide)
- Nutrients
- Pathogens
- Sediment
- Trash – (notably a key concern for the City)
- Nickel

Other regulatory constraints within the watershed are related to listed species including:

- California Freshwater Shrimp, Red-Legged Frog, and Tiger Salamander
- Foothill Yellow-Legged Frog
- Western Pond Turtle
- Central California Coast Steelhead

2.5.2 Issue Strategy & Next Steps

Regulatory agencies will be engaged as part of the stakeholder process. The degree to which regulatory constraints will be an issue for the project is dependent on location and type of project selected. Specific regulatory issues will come to light as project alternatives are identified.

2.6 Funding Identification

While there are many funding opportunities available through local, state and federal programs, the challenge will be finding grant programs that best fit the project and therefore have the highest potential for success.

2.6.1 Learned to Date

A number of local, state and federal grants have been identified which may be applicable to the project. The upcoming Proposition 1E (Prop 1E) grant funding through the California Department of Water Resources is a potential source of funding, however, the Petaluma project is still in the scoping phase and specific implementation projects have not been determined at this time. Prop 1E assigns a higher score to projects that are ready to be implemented rather than those in the feasibility phase, therefore the Petaluma project may not score as highly as other Sonoma County projects that are further in their development process. For this reason, Round 1 funding for Prop 1E is not being pursued by the project at this time.

Other funding opportunities are shown in **Table 2-5** below.

Table 2-5: Potential Funding Opportunities

Agency	Program	Timeline
SWRCB	Clean Water State Revolving Fund (SRF) Loans	Ongoing
DWR	Prop 84 (North Coast and Bay Area): Planning Grant	Round 2 – 6/11
	Prop 1E (North Coast and Bay Area)	Round 1 – 4/11 Round 2 - TBD
	AB303 Local Groundwater Assistance	May 2011
	Prop 82 Local Water Supply Construction or Feasibility Study Loans	Continuous
	Prop 84 California River Parkways Grants	Dependent
US Army Corps	Water Resources Development Act	Continuous
CA Infrastructure and Economic Development Bank	Infrastructure State Revolving Fund	Continuous
Coastal Conservancy	Coastal Conservancy Grant	Ongoing
Sonoma Open Space District	Coordination with District regarding land preservation	Open

Most of these funding opportunities do not have a specific deadline and allow continuous project submittal. Once the Scoping Study has generated project alternatives, prioritizing funding will be a focus area.

2.6.2 Issue Strategy & Next Steps

The most immediate next step is to determine applicability and timing of submitting the project to the Bay Area Integrated Water Resources Management Plan (IRWMP). This will be an important next step if the project is suitable for Round 2 of Prop 1E or Prop 84 funding. Having the project align with Bay Area IRWMP management objectives and be consistent with the Plan will allow for greater funding opportunities through the State outside of the Prop 1E and Prop 84 processes.

Other next steps include soliciting stakeholder input on funding opportunities, reviewing other grant/loan funding deadlines and requirements, and then prioritizing which to pursue.

2.7 Effective Communication

The Petaluma project is one of three similar projects being pursued by the Water Agency within Sonoma County. Due to overlap of certain stakeholders (primarily regulatory), and the process of objectives development, screening and alternatives development; many efficiencies may be realized through effective, interwatershed coordination.

2.7.1 Learned to Date

The Water Agency is the driver for coordination between watersheds. The Water Agency has made Kick-Off Meeting minutes and Preliminary Issues Assessments for all three watersheds available for review. Each watershed is in the process of objectives development and beginning to consider screening criteria.

2.7.2 Issue Strategy & Next Steps

As each watershed Scoping Study begins the process of stakeholder engagement, it will be useful to develop a strategy with the Water Agency to engage regulators and other stakeholders that span multiple watersheds.

3 Overall Project Strategies

Efforts to date on the project have confirmed that strategies for developing a successful project include the following.

- Commitment to the multi-benefit approach
- Early and effective stakeholder coordination with particular emphasis on partnership with the City of Petaluma
- Consider potential funding opportunities throughout project development

Strategies will be further refined and updated through the project development process.

Appendix D

Meeting Minutes from Stakeholder Meeting #2 (Zone 2A Advisory Committee Meeting)

Meeting Summary

Upper Petaluma River Watershed Flood Control Project Scoping Study

Subject: Stakeholder Meeting #2

Prepared For: Sonoma County Water Agency

Prepared By: RMC

Date/Time: October 5, 2011; 6 pm

Location: Rooster Run Golf Course, Petaluma

Attendees: See Sign-in Sheet

Meeting Objectives:

- Review project with stakeholders
- Discuss and obtain feedback on project concepts
- Introduce and obtain feedback on prioritization process and study area priorities

Attachments

Attachment A: Meeting Agenda

Attachment B: Presentation Slides

Attachment C: Concept Prioritization Worksheet

Attachment D: Meeting Attendees

Discussion Items

1. Opening/Introductions

Zone 2A Committee Chair Ted Cabral opened the meeting.

2. Approval of Minutes

Committee voted 4-0 to table approval of the July 21, 2011 committee meeting minutes until the next meeting.

Cabral invited Andrea Krout to say a few words on behalf of Supervisor David Rabbitt. Andrea apologized on behalf of Rabbitt that he wasn't able to be at the meeting. He was in Washington D.C. meeting with various committees and individuals to try to obtain additional funds for Sonoma County. If any attendees have questions or comments for the Supervisor, he or she should feel free to contact him directly.

Cabral addressed meeting attendees and explained that he understood that there were differing opinions in the room about the Upper Petaluma River Flood Control Project (Project) and he would give everyone an opportunity to share their opinion. He asked though that everyone be civil and treat others with respect.

3. Upper Petaluma River Flood Control Project

A. Overview and Review of Project/Scoping Study

Kent Gylfe introduced himself as Sonoma County Water Agency's project manager for the scoping study being conducted for the Upper Petaluma River Flood Control Project. This is the second outreach meeting for the Project and he views the meeting as an opportunity to share information developed to date about the Project and receive comments and feedback on the Project. Gylfe made some additional points including:

- The Project area (Zone 2A) has an established flooding problem which the Water Agency and City are working to address. Additionally, recent droughts, regulatory requirements, and a reliability study have shown vulnerability in the water supply reliability. The Water Agency Board adopted a Water Supply Strategies Action Plan which identified joint flood control and water supply projects as opportunities to address both flooding and water supply reliability.
- There are several funding avenues that are available now and in the coming years. It is not clear that these funds will be available in the future once the current programs expire. Being able to take advantage of the current programs could help fund portions of the Project.
- There are three watersheds within Sonoma County that are undergoing similar studies. All of the watersheds have the same core objectives and nearly identical supporting objectives.
- At the first workshop on April 28, 2011, the Water Agency heard a variety of helpful comments, including the following themes:
    - Workshops should be publicly noticed;
    - Eminent domain should not be considered as an option;
    - Multiple benefits is good, but flood control benefits need to be significant and cannot be lost among the other multiple benefits; and
    - Some attendees felt that the Project would provide benefits to the City of Petaluma at the expense of rural land owners, and this was unacceptable, especially if it were to support development.
- At a subsequent Zone 2A meeting in July, the Water Agency heard additional comments that reiterated that public noticing for the next workshop was important.
- Outreach efforts for this Zone 2A meeting included:
    - Making the workshop part of a publicly noticed Zone 2A meeting;
    - Placing advertisements for the meeting in two print newspapers and one on-line newspaper;
    - Sending 5,500 postcards advertising the meeting to properties located within or nearby areas that might be most directly affected by an implemented project;
    - Emailing invitations to past meeting attendees and project participants with encouragement to distribute invitations to other potentially interested parties as desired; and
    - Hosting a field tour of some existing multi-benefit facilities in the Santa Rosa area.

B. Presentation of Draft Project Concepts

Randy Raines, with RMC Water and Environment, introduced posters that had been prepared for the workshop and described the Frequently Asked Questions handout that had been prepared in response to comments and questions received after the April 28, 2011 workshop. Raines re-emphasized that this was the initial phase of the Project and was intended only to help narrow the range of project options that would be considered at the feasibility level of detail. Quantitative details would be developed in the feasibility phase. Raines also explained that the plan was to host another public meeting in early December to follow-up on the prioritization work that was being introduced at this workshop. Randy then continued the presentation by discussing the eleven concepts that had been identified for the Project. An overview of the flood hazard reduction and recharge criteria and location opportunities are available in Attachment B. During the discussion Randy explained the project concepts and graphics provided. Not all locations in the prepared maps on the slides would be considered during the feasibility phase due to additional implementation criteria; the maps therefore only give a sense for the general areas where the concept might be considered. The following are questions from attendees on the concepts:

- Concept 1 (Managed Floodplain) -
    - Q: This concept would not change the land use or land form at all?
        - A: No it would not. The idea is to preserve the existing conditions.
- Concept 2 (Off-stream Detention)
    - Q: What are the locations shown on the maps?
        - A: They are potential locations where the project might be implemented based on a preliminary set of criteria.
    - Q: Will this concept put dams on creeks?
        - A: No, off-stream detention diverts high flow away from creeks and does not require in-stream dams.
    - Q: Does this concept provide just flood control?
        - A: No, this concept could provide recharge and many other benefits, depending on location and project design.
    - Q: How long would water be detained?
        - A: Water would be reintroduced once high flows in the creek have subsided.
- Concept 3 (In-stream Dentention)
    - No questions.
- Concept 4 (Floodplain Modification)
    - No questions.
- Concept 5 (Levee/Floodwall)
    - Raines explained that this concept would likely not provide additional recharge opportunity.
    - Q: Would this project be an extension of the existing floodwall by Lynch Creek?
        - A: It could be. Specific locations of projects have yet to be identified.

- Concept 6 (Channel Modification)
    - No questions.
- Concept 7 (Bypass Channel)
    - Q: Wouldn't a concept like this overwhelm downstream flood protection projects?
        - A: The concept needs to be studied further and designed to ensure that this wouldn't happen.
    - Q: How is there recharge if the concept is to use a buried channel?
        - A: That could be a challenge and would have to be researched and designed.
    - Q: What is recharge?
        - A: Recharge provides additional groundwater. This can then be used for things like water supply reliability or environmental benefits.
- Concept 8 (Bridge Improvement and Debris Removal)
    - Two attendees noted that they have requested multiple times that a bridge in Penngrove be cleaned and maintained. Gylfe requested that they talk to him after the meeting about that. Another attendee noted that this type of work was generally in the Public Works department purview.
- Concept 9 (Low Impact Development)
    - No questions.
- Concept 10 (Policy Review and Development)
    - No questions.
- Concept 11 (Direct Injection)
    - No questions.

C. Discussion of Draft Project Concepts

Raines introduced screening and prioritization processes. The screening process eliminates concepts that do not achieve the Key Project Purpose, namely to provide both flood hazard reduction and groundwater recharge. Of the eleven concepts, the eliminated concepts were Levee/Floodwall, Bridge Improvement and Debris Removal, and Direct Injection. Raines emphasized that these are not bad concepts, but don't fit the Project. The Water Agency may pursue these project concepts through other avenues.

The following are general questions and comments offered by attendees:

- Q: The bypass channel should also be eliminated from consideration as it doesn't work as a stand-alone concept. It would need a partner project like detention to not overwhelm downstream projects.
    - A: Feasibility phase modeling will address questions and concerns like this. The concern is noted though that induced flooding is generally not acceptable.
- Q: How does percolation occur in LID projects? Isn't there high compaction during construction that would prevent percolation? Wouldn't recharge undermine buildings?

  - A: LID projects are included in the overall development design so there are areas set aside for percolation. Impacts to buildings due to percolation are considered in the overall site design and individual structure design.

- Q: Have any calculations been done to determine how much land is required for this Project? We need to understand how much land is required.
  - A: No, required land area has not been evaluated at this time. This type of evaluation will certainly be performed at the Feasibility Phase. We are still in the initial Scoping Phase of the Project.
- Q: What is the driving force behind the study?
  - A: The primary driving force is the need to reduce damages from flooding.
- Q: Is development of the existing floodplain the goal?
  - A: The focus of the study is reduction of existing damages. Development of existing floodplain is not a goal of this work.
- Q: How does this Project address water supply issues?
  - A: Project will lead to additional infiltration of stormwater into the ground and thus increase groundwater reliability.
- Q: Debris removal from bridges is very cost efficient.
  - A: Agreed.

Raines described the Concept and Prioritization Worksheet and requested that attendees fill it out and return it to RMC staff at the meeting. Attendees can take additional forms and distribute them as they wish. Raines asked that the forms be returned by mail or email to Raines or Ann DuBay with the Water Agency by October 14, 2011. Contact information is at the end of the presentation and in notification emails that have been distributed.

D. Next Steps

Raines announced that the next Project stakeholder meeting is tentatively planned for early December to present the results of the Project screening and prioritization process. The highest ranked concepts would then be recommended for more detailed feasibility analysis following after this initial scoping study.

4. Public Comment

The following are comments received from meeting attendees and committee representatives:

- Bill Bennett
  - Bennett sent a letter to Grant Davis dated 5/16 and received no response.
  - Bennett has been trying to get Marin Creek cleaned since the City developed some upstream land. He was told that long-term permits were expensive and time consuming to obtain. Bennett does not understand how there is funding for RMC to do the scoping study but not obtain a permit. The Water Agency should be clearing creeks as one of its functions.

  - Bennett has lots of questions about the Frequently Asked Questions responses provided. He feels that the response regarding funding of the work is misleading.

- Martin Sessi
  - Sessi introduced himself as a Penngrove property owner and builder.
  - Sessi is confused about what we are doing with this Project and wants confirmation that the Corps project is going to work.
  - Sessi wants clear building regulations.
  - Sessi is worried about the impacts of the downstream work on upstream areas.
- William Saladin
  - Saladin wanted to come and see what was going on with the Project.
- Pamela Torliatt
  - Torliatt felt that the responses to the questions posed were inadequate. She is particularly concerned about the funding sources and what moneys are available for this Project.
  - Torliatt is wondering what this Project is all about and whether it will achieve its goals.
  - Torliatt feels that the Zone 2A funds are only adequate for some maintenance and that Zone 2A funds should be spent on maintenance.
  - Torliatt has not received the maintenance plan that she requested at the last Zone 2A committee meeting.
- John King
  - King stated that there was a report done in 1999 that did not get the input of the public. This Project and that report identify some of the same lands as potential project locations.
  - King believes that the postcard that was sent out to residents didn't adequately convey the importance of this Project and the need for public input on it.
  - King stated that the Water Agency is exporting 6 billion gallons of groundwater from the county.
  - King helped develop the County General Plan. Based on his involvement in that, he feels that additional recharge won't provide benefits to the area.
  - King feels that this Project is all about flooding within Petaluma.
- Taryn Obaid
  - Obaid said that she lives in Petaluma and got the postcard.
  - Obaid is particularly interested in understanding the big picture and transparency. For example, what are the other benefits that will be achieved with this Project? What are the criteria for the final project and location selection?
  - Obaid recommended sound analytics behind the outreach process.
- Susan Kirks
  - Kirks had to leave the meeting early but left a written comment: Kirks questions if the SCWA is working with the Occidental Arts & Ecology Center on realistic concepts for managing water run-off and groundwater recharge. And if not, she highly recommends doing so.

[Committee Member Comments]

- Teresa Barrett
    - Barrett believes that the Project is trying to address 100-year flood event. To fully evaluate the concepts though, she needs to know details for each concept such as how much water is involved and how long it would be detained.
    - Barrett believes the Policy Review and Development concept needs to be a high priority and should be implemented in a coordinated fashion.
- Craig Jacobsen
    - Jacobsen feels that there needs to be big benefits to land owners for them to participate in a project like this.
    - Jacobsen doesn't see how the multi-benefit approach can work on privately owned property.
    - Jacobsen feels that the Project should be located way out toward the edge of the watershed rather than in the middle. Multiple locations will likely be needed.
    - Jacobsen feels that the Project is overwhelming at this point.
- Ned Orrett
    - Orrett feels that there needs to be better framing of the issues.
    - Orrett would rather get the concept details up front, rather than later.
    - Orrett believes that there needs to be equity between the upstream and downstream areas for this Project to be successful.
    - Orrett requested that micro projects, such as LID, were given consideration as they more closely mimic natural processes.
    - Orrett requested that more quantitative and qualitative information be provided. This would help evaluate the value of maintenance vs. capital projects.
- Ted Cabral
    - Cabral stated that it appeared to him that solutions to downstream flooding could rely on upstream lands.
    - Cabral believes that there needs to be a change in Petaluma's development practices.
    - Cabral believes that projects on agricultural lands should improve agricultural practices.
    - Cabral requested additional educational opportunities, such as workshops, to help the committee better understand the details of the concepts.
    - Cabral felt that the Water Agency tour of the three detention basins was very helpful to developing a better picture of what the Project could be.
    - Cabral requested that attendees continue to come to Zone 2A meetings and participate in the process.

5. Next Meeting

The next meeting will be scheduled and announced, but is tentatively anticipated to occur in early December

Attachment A: Meeting Agenda

AGENDA

ZONE 2A ADVISORY COMMITTEE MEETING
October 5, 2011, 6:00 P.M.

1. OPENING/INTRODUCTIONS
   Opening comments and introductions by committee chairman

2. APPROVAL OF MINUTES
   Committee approval of the July 21, 2011 committee meeting minutes

3. UPPER PETALUMA RIVER FLOOD CONTROL PROJECT

   A. Overview and review of Project/Scoping Study (SCWA staff)

   B. Presentation of Draft Project Concepts (RMC)

   C. Discussion of Draft Project Concepts (RMC facilitated)

   D. Next Steps (RMC/SCWA)

4. PUBLIC COMMENT (3 minutes per person)
   Public comment on agenda and non-agenda items

5. NEXT MEETING
   The next meeting date of the Zone 2A advisory committee to be announced

PUBLIC COMMENT: The committee invites public comment, as indicated above. Additional public comment is welcome during committee discussion of individual agenda items, at the discretion of the chair.

AGENDA DOCUMENTS: Any writings or documents provided to a majority of the Zone 2A Advisory Committee regarding any item on this agenda will be made available for public inspection at the office of the Sonoma County Water Agency located at 404 Aviation Boulevard, Santa Rosa, during normal business hours.

Attachment B: Presentation Slides

10/5/2011

Upper Petaluma River Watershed Flood Control Project

Kent Gylfe, SCWA
Randy Raines, RMC

SONOMA COUNTY WATER AGENCY

www.sonomacountywater.org
www.scwa.ca.gov/stormwater-groundwater/

Meeting Agenda

A. Greetings and Introduction
B. Project Overview
C. Concepts
D. Concept Prioritization
E. Next Steps

1

10/5/2011

Meeting Purpose

- Discuss flood and groundwater project concepts
- Discuss screening and prioritization process
- Solicit input on concepts, concept locations, and concept prioritization

Project Overview

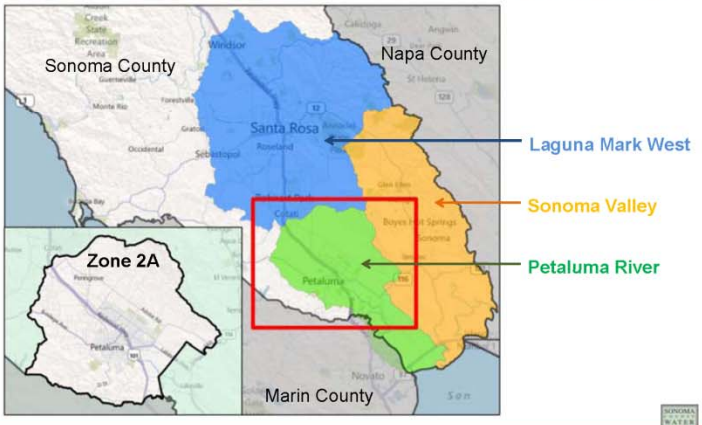
2

10/5/2011

Project Basis

- Two core objectives
  - Provide up to 100-year flood protection
  - Increase groundwater recharge potential
- Seven supporting objectives
  - Water quality
  - Water supply
  - System Sustainability
  - Ecosystem
  - Agricultural land
  - Undeveloped land
  - Community benefits
- Projects are multi-benefit
  - Improve likelihood of outside funding
  - Provide additional implementation value
- Projects reflect input of partners, stakeholder groups, regulators and study area residents
  - Multiple workshops
  - Project tour
- Consistent with Water Agency mission and initiatives

Similar Project in Three Watersheds



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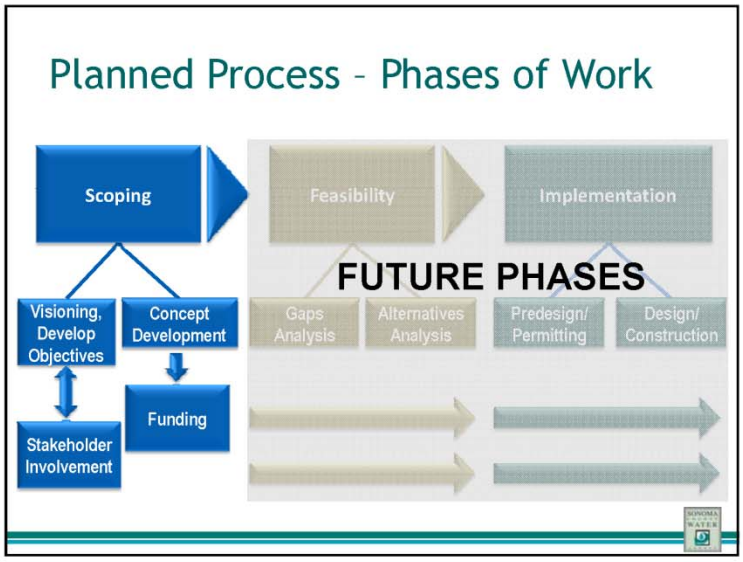
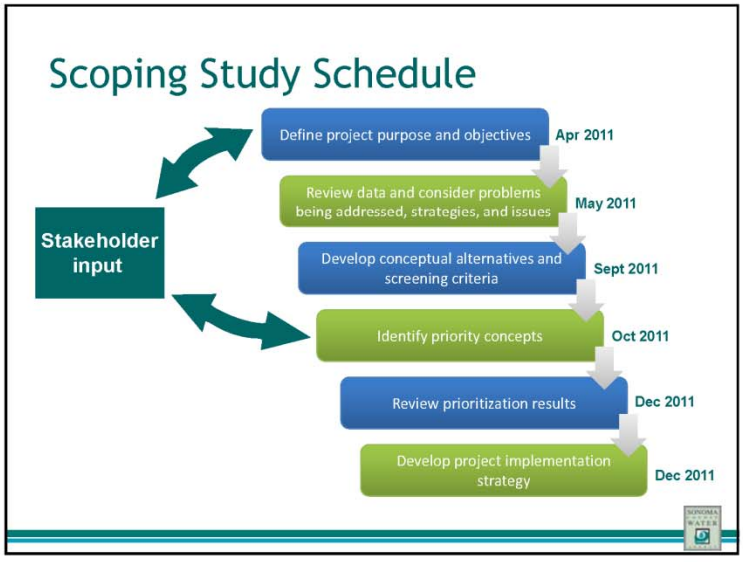
10/5/2011


Planned Process – Phases of Work
Scoping
Feasibility
Implementation
FUTURE PHASES
Visioning, Develop Objectives
Concept Development
Funding
Stakeholder Involvement
Gaps Analysis
Alternatives Analysis
Predesign/ Permitting
Design/ Construction


Scoping Study Schedule
Stakeholder input
Define project purpose and objectives
Apr 2011
Review data and consider problems being addressed, strategies, and issues
May 2011
Develop conceptual alternatives and screening criteria
Sept 2011
Identify priority concepts
Oct 2011
Review prioritization results
Dec 2011
Develop project implementation strategy
Dec 2011

4

10/5/2011

Project Participants

SOLICITING INPUT FROM…

Study Area Residents	North Bay Agricultural Alliance	Sonoma Mountain Preservation Group
City of Petaluma	United Anglers	Western United Dairymen
Sonoma County Zone 2A	OWL Foundation	River Clean-up Committee
Friends of the Petaluma River	Southern Sonoma County RCD	KOA Campground
Petaluma River Council	The Bay Institute	P.L.A.N.
North Bay Watershed Association	Petaluma Wetlands Alliance	Regulatory Agencies
	LandPaths	
	Sonoma Land Trust	

RMC Water and Environment

Sonoma County Water Agency

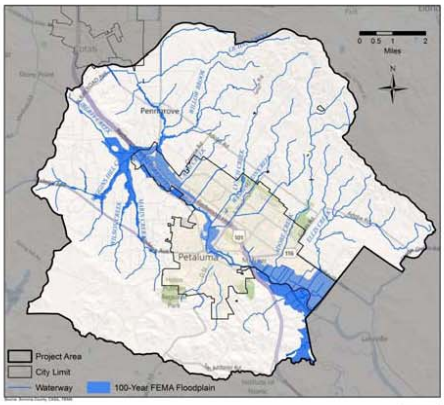
Project Concepts

5

10/5/2011

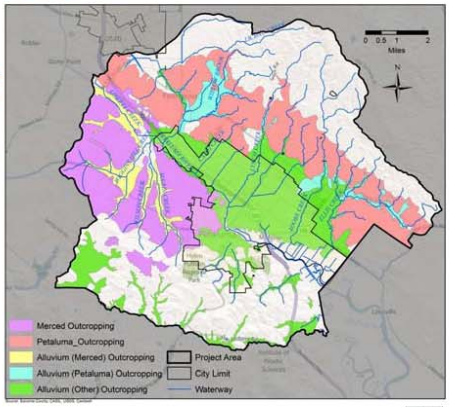
Flood Hazard Reduction Criteria

- Need to:
  - Reduce peak flows OR
  - Increase hydraulic capacity
- Impacts to downstream projects to be determined in feasibility phase
- Waterways upstream of and including Lynch Creek confluence
- Areas within 100-year floodplain are principal recipients of benefits



Recharge Criteria

- Merced Formation and Petaluma Formation are most effective for water supply recharge
- Alluvium above Merced and Petaluma also considered viable for water supply recharge
- Other alluvium could provide benefits other than water supply recharge

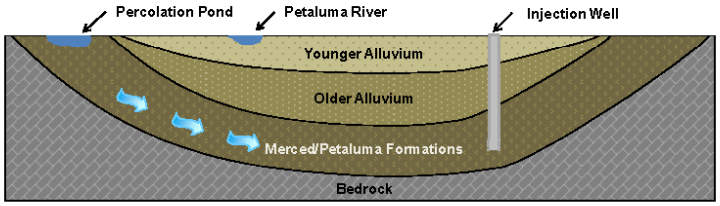


6

10/5/2011

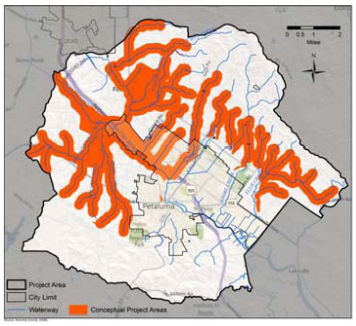
Geologic Layers

- Layers bent when mountains created
- Sands and gravels allow water to move
  - Merced Formation
  - Petaluma Formation
  - Older Alluvium
- Silts and clays do not allow water to move as well
  - Younger alluvium
- Infiltration recharge methods need to be located where water can percolate
- Wells can puncture impermeable layers



Conceptual Locations

- General concept location criteria
  - Undeveloped land
  - Relatively flat
  - Relatively close to waterway or floodplain
  - Relative location to geologic formation
- Individual concepts have unique considerations
- Preferred project locations to be confirmed during Feasibility Phase based on additional criteria



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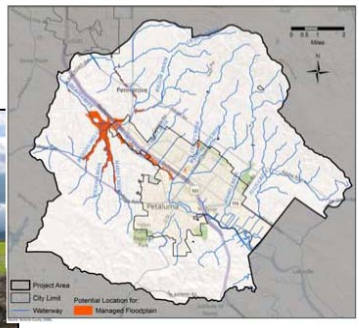
10/5/2011

Concept 1: Managed Floodplain

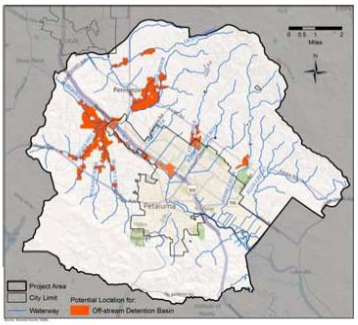
Goal: Maintain flood protection and recharge benefits provided by existing floodplain



Continued effectiveness of downstream flood projects depends on avoiding upstream attenuation degradation

Concept 2: Off-stream Detention

Goal: Divert high flows to temporary holding ponds for flood reduction and recharge



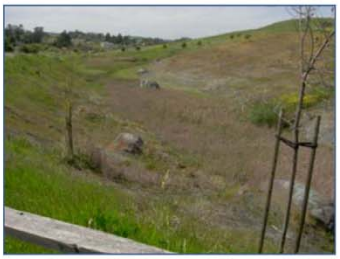
Concept keeps low flows in the channel to maintain environmental conditions and sediment transport characteristics

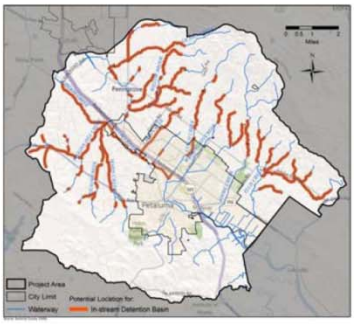
8

10/5/2011

Concept 3: In-stream Detention

Goal: Detain high flows for flood reduction and recharge using the existing stream as a basis

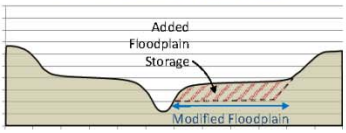


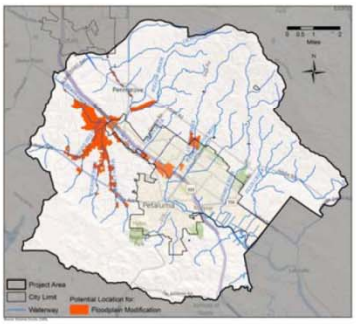


Possible to integrate multiple basin uses with waterway.

Concept 4: Floodplain Modification

Goal: Create additional storage volume and potential recharge area using existing floodplains as a basis





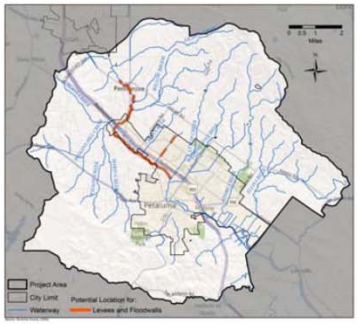
Same concept as Petaluma's Denman Terracing Project

9

10/5/2011

Concept 5: Levee/Floodwall

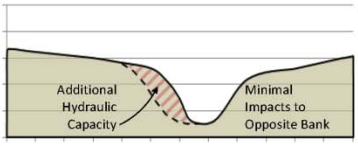
Goal: Constrain flows to a narrower pathway than the existing floodplain

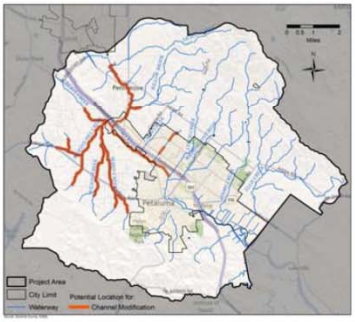


Project impact area directly correlated with benefit area

Concept 6: Channel Modification

Goal: Reshape channel section for increased capacity and recharge area





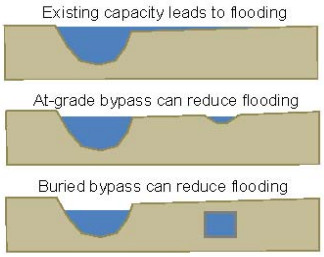
Project impact area directly correlated with benefit area

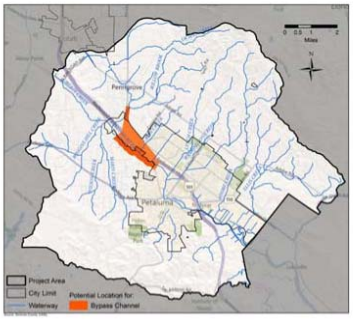
10

10/5/2011

Concept 7: Bypass Channel

Goal: Divert high flows to parallel channel for flood reduction and potential recharge

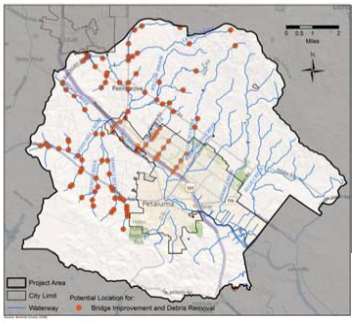




Concept keeps low flows in the channel to maintain environmental conditions and sediment transport characteristics

Concept 8: Bridge Improvement and Debris Removal

Goal: Improvement of bridge areas to reduce potential for flooding due to debris build-up



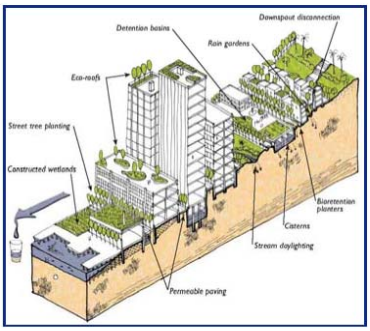
Concept could lead to less emergency operations and maintenance

11

10/5/2011

Concept 9: Low Impact Development

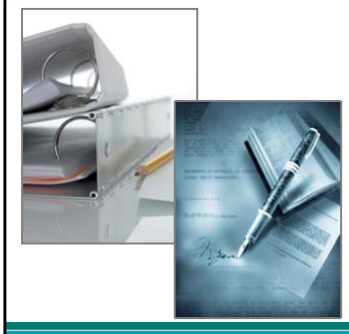
Goal: Reduce development-related runoff and provide opportunity for recharge



Many LID practices improve runoff water quality

Concept 10: Policy Review and Development

Goal: Identify policies that impact flood hazards and groundwater recharge and update as necessary



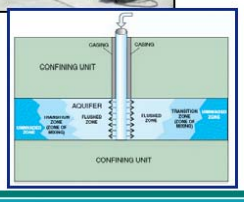
Collaborative concept could be applied at local or county-wide scales.

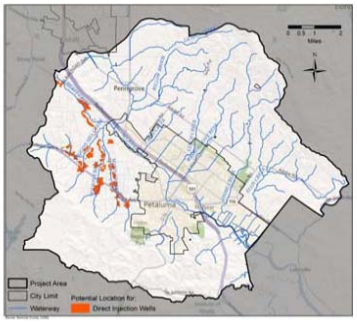
12

10/5/2011

Concept 11: Direct Injection

Goal: Pump water directly into aquifers





Better control of water quality entering aquifers than percolation methods

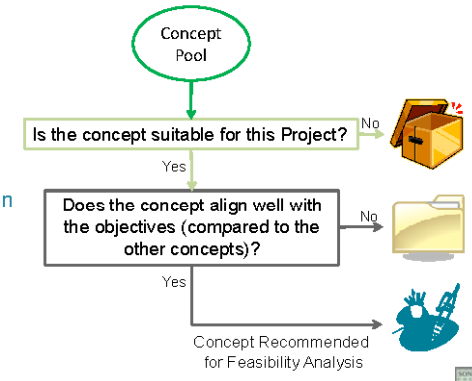
Concept Prioritization

13

10/5/2011

Prioritization Process

- 2 Stages
  - Screening
  - Prioritization



Screening Process

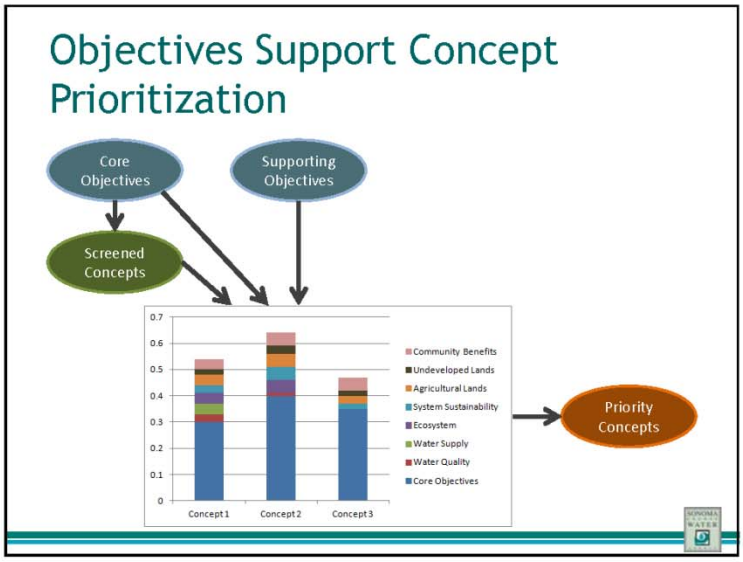
Does the Concept Provide Flood Hazard Reduction and Groundwater Recharge (Key Project Purpose)?

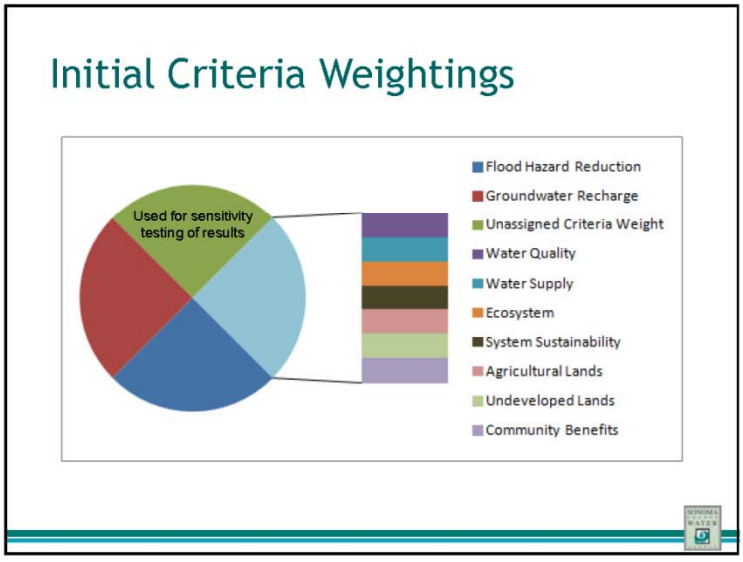
- Yes = Advanced to the prioritization process
- No = Not advanced to the prioritization process
  - Water Agency could consider participation through other venues

Concept	Response
1. Managed Floodplain	Yes
2. Off-stream Detention	Yes
3. In-stream Detention	Yes
4. Floodplain Modification	Yes
~~5. Levee/Floodwall~~	~~No~~
6. Channel Modification	Yes
7. Bypass Channel	Yes
~~8. Bridge Improvement & Debris Removal~~	~~No~~
9. Low Impact Development	Yes
10. Policy Review and Development	Yes
~~11. Direct Injection~~	~~No~~

14

10/5/2011


Objectives Support Concept Prioritization
Core Objectives
Supporting Objectives
Screened Concepts
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Concept 1
Concept 2
Concept 3
Community Benefits
Undeveloped Lands
Agricultural Lands
System Sustainability
Ecosystem
Water Supply
Water Quality
Core Objectives
Priority Concepts

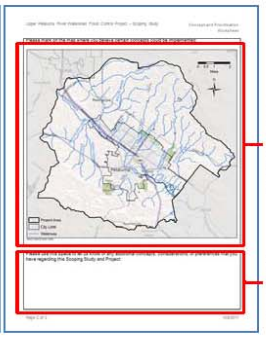

Initial Criteria Weightings
Used for sensitivity testing of results
Flood Hazard Reduction
Groundwater Recharge
Unassigned Criteria Weight
Water Quality
Water Supply
Ecosystem
System Sustainability
Agricultural Lands
Undeveloped Lands
Community Benefits

15

10/5/2011

Concept and Prioritization Worksheet

Indicate your preferences by marking in the boxes provided or placing a sticker.



Indicate where you think certain concepts would be appropriate.

Share any other thoughts or preferences.

Next Steps

Develop conceptual alternatives and screening criteria — **Sept 2011**

Identify priority concepts — **Oct 2011**

- Review worksheet input and comments
- Update concept descriptions and prioritization
- Identify focus locations for feasibility study
- Final public Scoping Study workshop

Develop project implementation plan — **Dec 2011**

Phase 2: Feasibility Study

16

10/5/2011

Upper Petaluma River Watershed Flood Control Project

Kent Gylfe, SCWA
Randy Raines, RMC
rraines@rmcwater.com

SONOMA COUNTY WATER AGENCY

www.sonomacountywater.org
www.scwa.ca.gov/stormwater-groundwater/

17

Attachment C: Concept Prioritization Worksheet

Upper Petaluma River Watershed Flood Control Project – Scoping Study Concept Prioritization Worksheet

Contact Information: _____ (Name) _____ (Phone Number) _____ (Email Address)

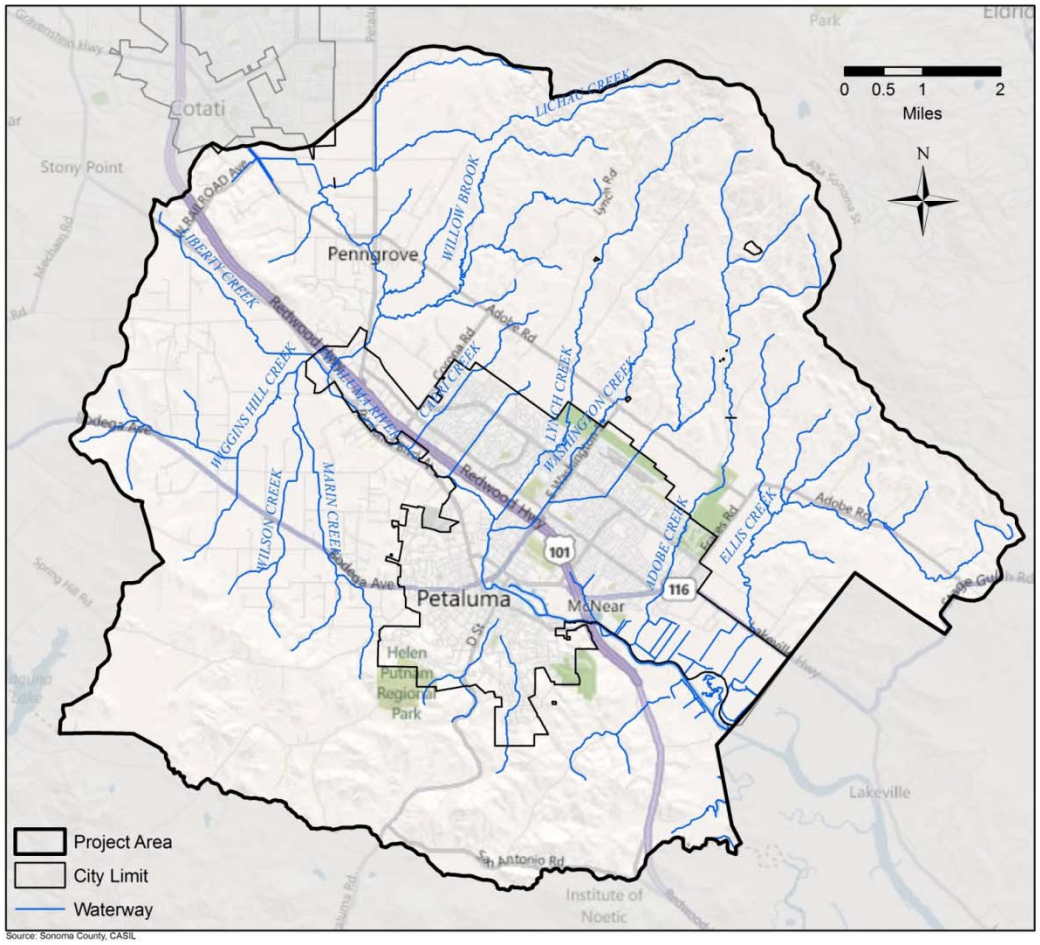
Please indicate the relative importance of the following 14 project concept evaluation criteria by placing one check mark per line.

Concept Evaluation Criteria	High	Medium	Low
1. Reduce flood hazards			
2. Increase groundwater recharge			
3. Protect or improve surface water quality			
4. Protect or improve groundwater quality			
5. Protect or improve water supply reliability			
6. Reduce channel erosion and sediment deposition			
7. Protect or improve aquatic and upland habitat conditions			
8. Preserve or enhance stream buffers and riparian areas			
9. Preserve or enhance existing agricultural land uses			
10. Preserve or enhance existing undeveloped lands			
11. Preserve or enhance designated open space			
12. Provide public access to project site			
13. Include educational features as part of project			
14. Include recreational features as part of project			

Page 1 of 2 10/5/2011

Upper Petaluma River Watershed Flood Control Project – Scoping Study Concept Prioritization Worksheet

Please mark on the map where you believe certain concepts could be implemented:



Please use this space to let us know of any additional concepts, considerations, or preferences that you have regarding this Scoping Study and Project:

Page 2 of 2 10/5/2011

Attachment D: Meeting Attendees

Flood Zone 2A Meeting – October 5, 2011	
Attendee Name	**Organization/Affiliation**
Ted Cabral	Zone 2A
Ned Orrett	Zone 2A
Craig Jacobsen	Zone 2A
Teresa Barrett	Zone 2A/City of Petaluma
Pam Tuft	City of Petaluma
Chris Cheek	Property Owner
Bill Kortum	Property Owner
Jim Riebli	Jim Riebli Dairy
Eugene Camozzi	Eugene Camozzi Dairy
Suzette Morshead	
J Garrett	Homeowner
Jaylean Osborn	
Rich Tavernetti	
Richard Tavernetti	
Jim Schroeder	Electrical Equipment Co. Inc.
Mike Orton	TW-Resident of Petaluma
John King	Penngrove Area
Louisa Craviotto	
Tito Sasaki	North Bay Ag Alliance
Taryn Obaid	Petaluma Resident
Alberta Montgomery	
David E. Swang	
S S Ellis	
William Saladin	
Susan Kirks	
Martin Sessi	
Tom Brondal	V. Dolan Trucking Inc.
Garrett Hill	X2NSAT
Jason Sweeney	SSCRCD
Susan Haydon	SSCRCD
Henriette Lillund	
Andrea Krout	County of Sonoma
Bill Bennett	
Pamela Torliatt	
Kent Gylfe	SCWA
Ann DuBay	SCWA
Mike Thompson	SCWA
Marcus Trotta	SCWA
Randy Raines	RMC Water and Environment
Tim Harrison	RMC Water and Environment
Christy Kennedy	RMC Water and Environment
Sheri Avoux	RMC Water and Environment

Appendix E

Project Concepts Identification and Description

Technical Memorandum

Upper Petaluma River Watershed Flood Control Project Scoping Study

Subject: **Project Concepts Identification and Description**

Prepared For: Kent Gylfe, SCWA

Prepared by: Tim Harrison and Leslie Dumas, RMC

Reviewed by: Randy Raines, RMC

Date: August 24, 2012

1 Introduction

The Sonoma County Water Agency (Water Agency) is presently undertaking a Scoping Study within the Upper Petaluma River Watershed (Project) to identify stormwater management/groundwater recharge projects that provide flood hazard reduction and groundwater benefits (Key Project Purpose). The Project is in its initial scoping study phase of developing a set of project objectives, assessing potential project issues and concepts, and designing a stakeholder coordination process.

The purpose of this draft memorandum is to identify project concepts that help to achieve the Key Project Purpose and to describe the concepts to a level that enables comparison, screening, and prioritization of the concepts. Regional hydrology and hydrogeology are introduced here as they set the foundation upon which the project concepts are based.

1.1 Regional Hydrology

The Project area, Sonoma County's Flood Zone 2A, is the upper portion of the Petaluma River watershed. Zone 2A is approximately 90 square miles. Elevations vary from nearly sea level in the southwest corner of Zone 2A to over 2,200 feet in the northeast corner of Zone 2A.

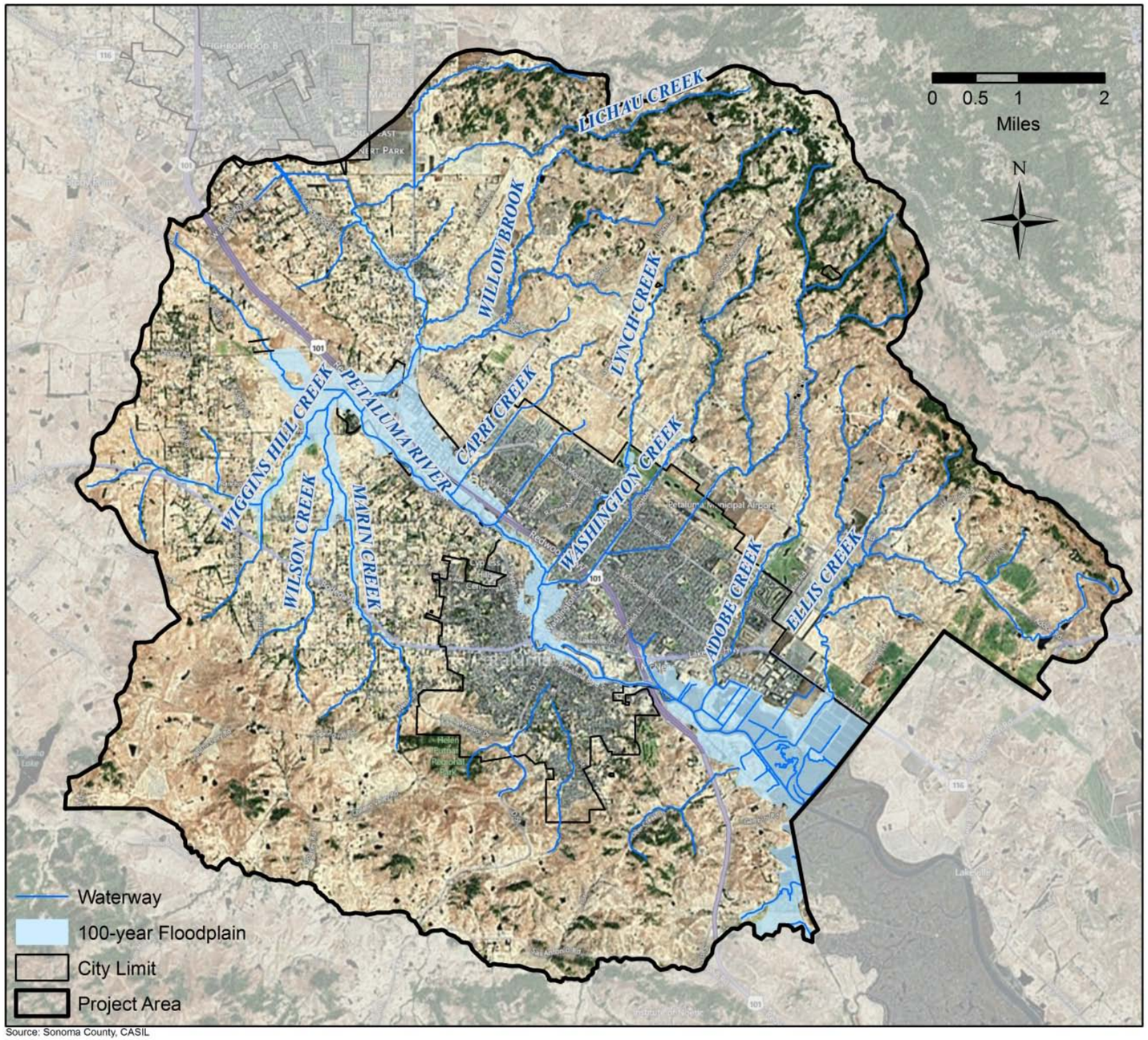
Major tributaries, shown in **Figure 1**, to the Petaluma River include Marin Creek, Willow Brook, Capri Creek, Lynch Creek, Washington Creek, Adobe Creek, and Ellis Creek. Zone 2A mean annual precipitation ranges from about 22.5 inches to about 45 inches (CA Department of Forestry and Fire Protection), with the higher rainfall averages falling in the higher elevation areas in the northeast. Stream flow is summarized in **Table 1**.

Table 1: Sample Flow Rates for Zone 2A

Waterway	Location	10-year Event	50-year Event	100-year Event
Wiggins Creek	U/S of Marin Creek	1,073 cfs	1,405 cfs	1,559 cfs
Marin Creek	U/S of Petaluma River	1,829 cfs	2,400 cfs	2,659 cfs
Lichau Creek	U/S of Willow Brook	1,738 cfs	2,310 cfs	2,543 cfs
Willow Brook	U/S of Petaluma River	2,250 cfs[1]	2,560 cfs[1]	2,560 cfs[1]
Petaluma River	D/S of Willow Brook	2,580 cfs	4,200 cfs	5,220 cfs
Capri Creek	U/S of Petaluma River	547 cfs	720 cfs	790 cfs
Lynch Creek	U/S of Petaluma River	1,223 cfs	1,595 cfs	1,754 cfs
Petaluma River	D/S of Lynch Creek	3,670 cfs	5,680 cfs	6,750 cfs

Source: From Table 4 of *Flood Insurance Study for Sonoma County, CA and Incorporated Areas* (FEMA, 2008)
Footnote: [1] Reduced flows due to upstream losses.

Figure 1: Upper Petaluma River and Tributaries



Source: Sonoma County, CASIL

1.2 Regional Hydrogeology

The project area overlies the Petaluma Valley Groundwater Basin, a northwest-trending structural depression in the southern part of the Coast Ranges of northern California. The basin is bounded on the west by the Mendocino Range, on the east by the Mayacamas and Sonoma Mountains, and on the south by San Pablo Bay.

The Petaluma Valley contains about 45 square miles of alluvial plain. It is approximately 16 miles long, and two to three miles wide over most of that length. Most of the upper part of the Petaluma Valley is between sea level and an altitude of 50 feet, while most of the lower part of the valley is at or as much as three feet below sea level. The Valley is drained primarily by the Petaluma River and its tributaries. It is tidal from its mouth to the city of Petaluma, the greater part of its length. Flow in the reach above tidewater is seasonal, generally beginning in the period from October to December and continuing until the following July.

In general, the Petaluma Valley is underlain by alluvial deposits of gravel, sand, silt and clay ranging in age from Pliocene to Recent. Underlying the valley fill are volcanic, continental, estuarine and marine rocks ranging in age from Jurassic to Pliocene. In general, the rock units underlying the Petaluma Valley and the adjacent Santa Rosa Valley have been divided into three classes, largely based on their relative capacity to hold and yield water (Cardwell, 1958):

- Consolidated rocks of the Jurassic and Cretaceous age which yield some water from joints and other fractures and are the poorest water-yielding rocks. This unit contains, in upward succession, the Franciscan formation, the Knoxville formation and the Novato conglomerate.
- Sedimentary and volcanic rocks of Tertiary age which are water-bearing in part but are not a major part of the groundwater basin. This unit contains, in upward succession, the Tolay volcanics, the Petaluma formation, and the Sonoma volcanics.
- Unconsolidated or poorly consolidated deposits of Tertiary and Quaternary age, which yield appreciable quantities of water and comprise the majority of the groundwater basin formations. This unit includes, in upward succession, the Wilson Grove (formerly Merced) formation, the older alluvium and the younger alluvium.

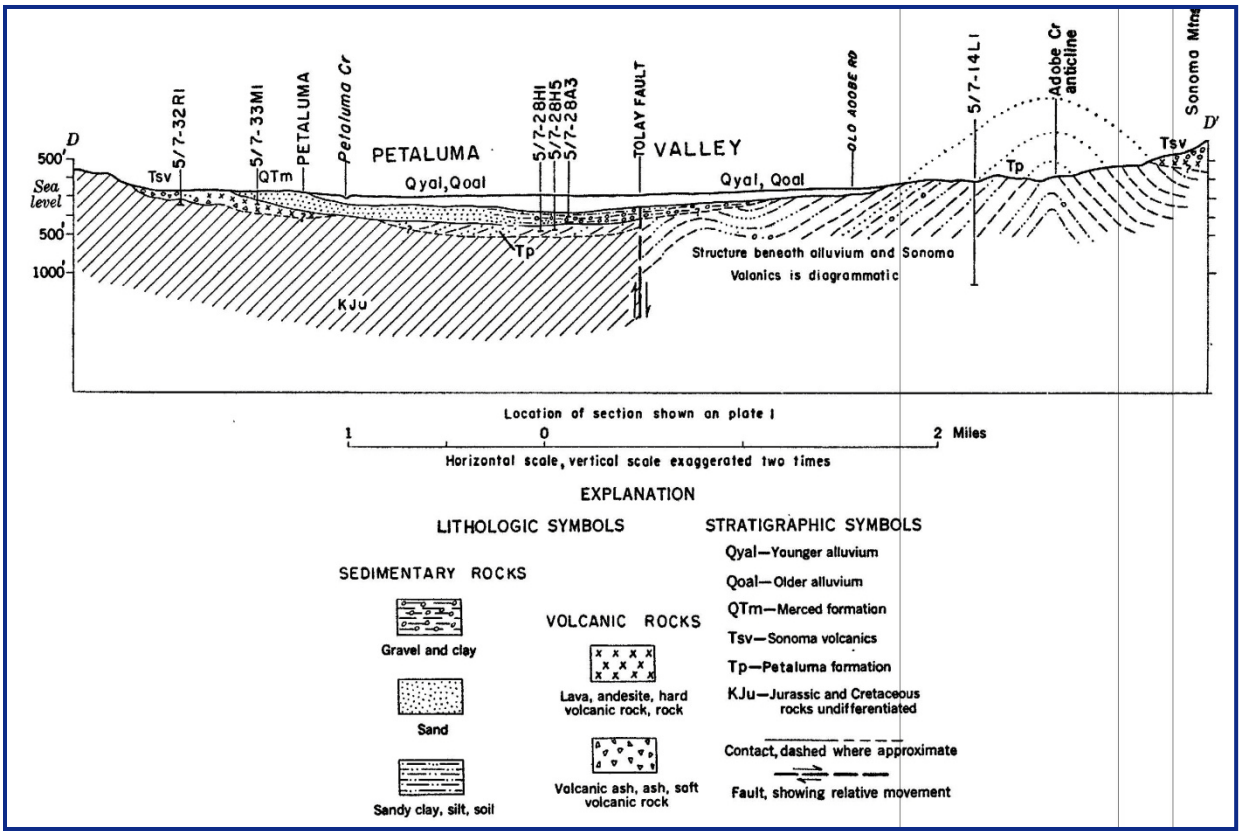
The following is a brief discussion of those units/formations found within the Petaluma Valley as described by Cardwell (1958) and DWR (1982):

- Younger alluvium - In general, the younger alluvium consists of stream-channel and flood-plain deposits, predominantly silt and clay but containing small discontinuous gravel lenses. The younger alluvium formation in the Petaluma Valley overlies the older alluvium, and typically has thicknesses up to 300 feet. The thickest part of the formation is in the southern part of the valley; however, proximity to San Pablo Bay makes part of this groundwater formation unusable as a water supply. In the northern part of the Petaluma Valley, groundwater yields from this unit are small to moderate, and most large wells penetrate the younger alluvium and are screened in the older alluvium or Wilson Grove (Merced) formation or both
- Older alluvium - The older alluvium is composed predominantly of unconsolidated deposits of silty or sandy clay, sand, and gravel that outcrop only locally on the northeastern side of the valley, but extend across the valley beneath the younger alluvium where they overlap deposits of the Wilson Grove (Merced) formation. The estimated maximum thickness of this formation is approximately 200 feet. The older alluvium yields moderate amounts of groundwater, however specific capacities are low. Additionally, water in the older alluvium is essentially unconfined, although the lenticularity and heterogeneity of the deposits causes poor interconnection and locally may produce slight confinement or zonation within the basin .

- Wilson Grove (formerlyMerced) formation - The Wilson Grove formation is the principal aquifer in the upland areas northwest of Petaluma, in the northwestern part of the valley and on the northeastern flank of the lower valley. This formation is composed predominantly of medium- to fine-grained fossiliferous marine sand, sandstone and silty clay with minor interbedded gravel and pebbly beds and is thought to be as much as 1,500 feet thick at its deepest. The Wilson Grove formation is known to be confined in the northern part of Petaluma Valley and is thought to be confined in other areas of the valley, such as near the bay. The upper portion of the formation has good yields and is tapped by most irrigation or other deep wells on the west side of the valley. The lower part of the formation is more generally compact and somewhat cemented, but can yield adequate domestic supplies.
- The Sonoma volcanics, generally underlying the Wilson Grove and Petaluma formations, are interbedded lava flows, tuff, tuff breccias and agglomerate. More permeable rock units in this formation can yield moderate amounts of water to wells, with excellent local yields from the tuffs. This formation has the highest yields in the area and is the formation most suitable for recharge. Except in the immediate vicinity of outcrops, volcanic rocks are not encountered in wells beneath the alluvial plain.
- Petaluma formation - The Petaluma formation consists of continental and brackish-water clay, shale, sand, and sandstone found on the east side of the Petaluma River. This formation can yield moderate quantities of water to wells where appreciable thicknesses of sand are penetrated. In general, though most of the wells in this formation are for domestic use, there have been several wells in this formation that have produced greater volumes of water. Considerable confinement or separation of water-bearing strata occurs in the Petaluma formation and heads in wells can vary significantly between locations.
- Basement formations – The basement formations (the Tolay volcanic and Franciscan Formation) are, respectively, volcanic rocks and consolidated sandstone, shale and chert, and yield little to no water.

Figure 2 shows a generalized geologic cross-section in the Petaluma Valley.

Figure 2: Generalized Geologic Cross-Section – Petaluma Valley



Source: Cardwell, 1958

2 Project Zones

As mentioned above, the two primary objectives of the Key Project Purpose are to provide flood hazard reduction and groundwater recharge. The sections below describe focus areas where flood and recharge project elements would be considered potentially feasible.

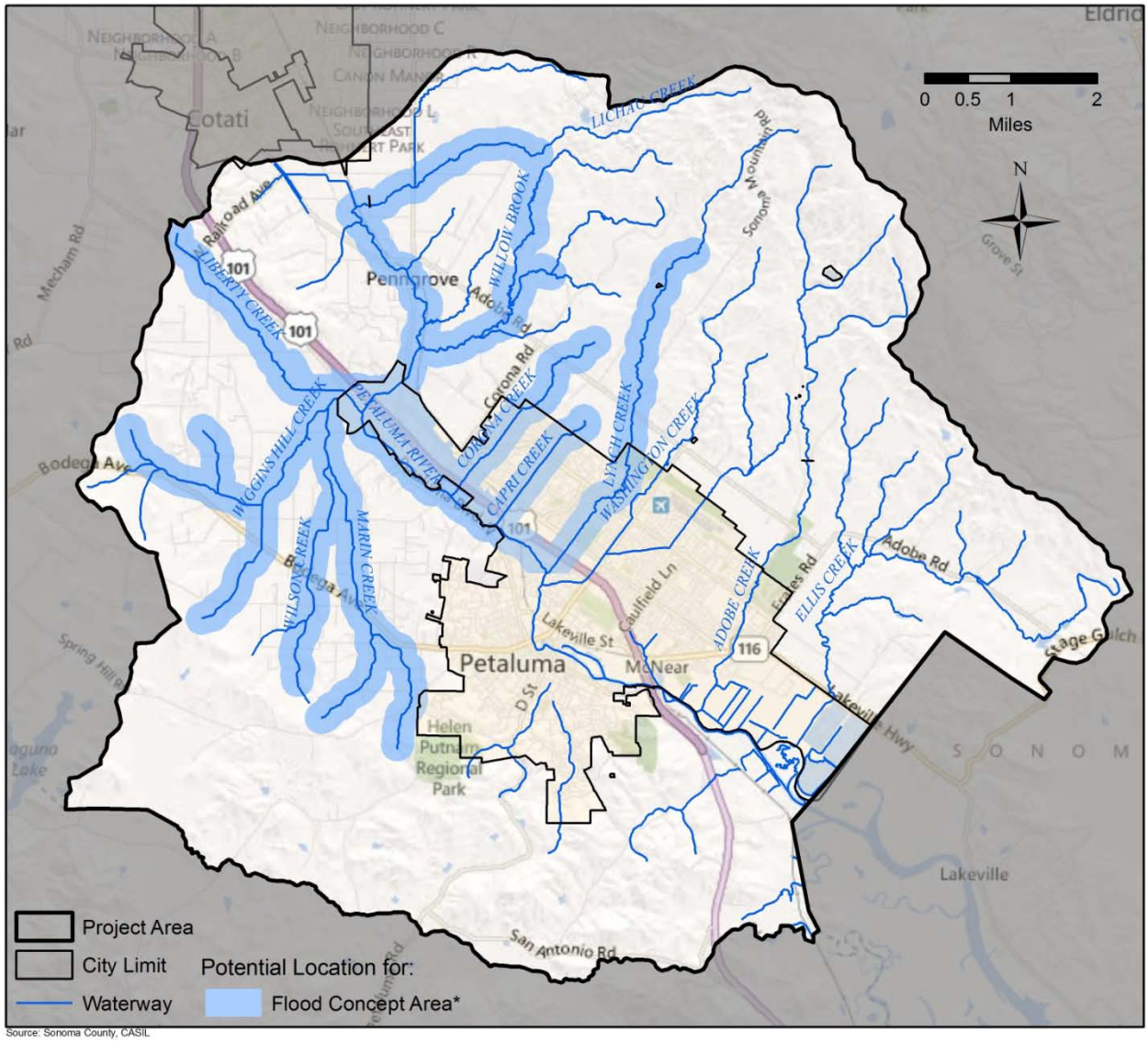
2.1 Flood Hazard Reduction Project Elements

Flood reduction benefits are achieved through one or more of the following strategies:

- Increased channel hydraulic capacity; and
- Reduction in peak flows.

Most flood hazard reduction concepts utilizing the above strategies are tied to the flood pathways. For the purposes of this memorandum, the FEMA 100-year floodplain and creeks with a defined 100-year floodplain will be used to focus the area to be evaluated for flood hazard reduction project concepts. Recognizing that not all flood hazard reduction project types are done in-stream, the focus area is broadened to include a 1,000-foot area around the streams. Stream reaches with smaller tributary areas and the upper reaches of some streams were removed from the focus area where it appeared that downstream concepts could be more effective. As established by the Water Agency, the focus of the flood hazard reduction element for this scoping study was upstream of and including the confluence of the Petaluma River and Lynch Creek. The final concept focus area, shown in **Figure 3**, reflects all of these assumptions and conditions.

Figure 3: Flood Hazard Reduction Project Element Focus Area



* Note that the flood concept area may be expanded to accommodate some specific concepts with flood benefits.

The flood hazard reduction focus area shown in **Figure 3**, above, is intended to help identify, at a conceptual level, those areas that could play a role in providing flood hazard reduction benefits both locally and regionally. In future phases of the Project, it is possible that more suitable or efficient locations will be found or that some of the areas will be eliminated from project siting consideration for one or more reasons, including but not limited to, willing landowner participation, zoning restrictions, or environmental limitations. Some project concepts identified in this memorandum are more regional in nature. In these cases, the focus area would not apply.

2.2 Groundwater Recharge Project Elements

Groundwater recharge benefits are achieved by directly or indirectly promoting the infiltration and percolation or movement of surface or stormwater through the ground surface into the underlying groundwater basin aquifers. Groundwater recharge can be achieved via one of two general methods:

- **Percolation** – Recharge via percolation involves the surface application of water, typically through ponding or managed releases of groundwater, retaining or detaining water to allow for percolation into the subsurface. Percolation can be achieved in specially-designed percolation ponds, by increasing floodplain detention, through in-stream or off-stream detention basins, and/or by promoting recharge via Low Impact Development (LID) projects,
- **Direct Recharge** – Direct groundwater recharge involves placing surface or storm water directly into the underlying groundwater aquifers through the use of recharge wells.

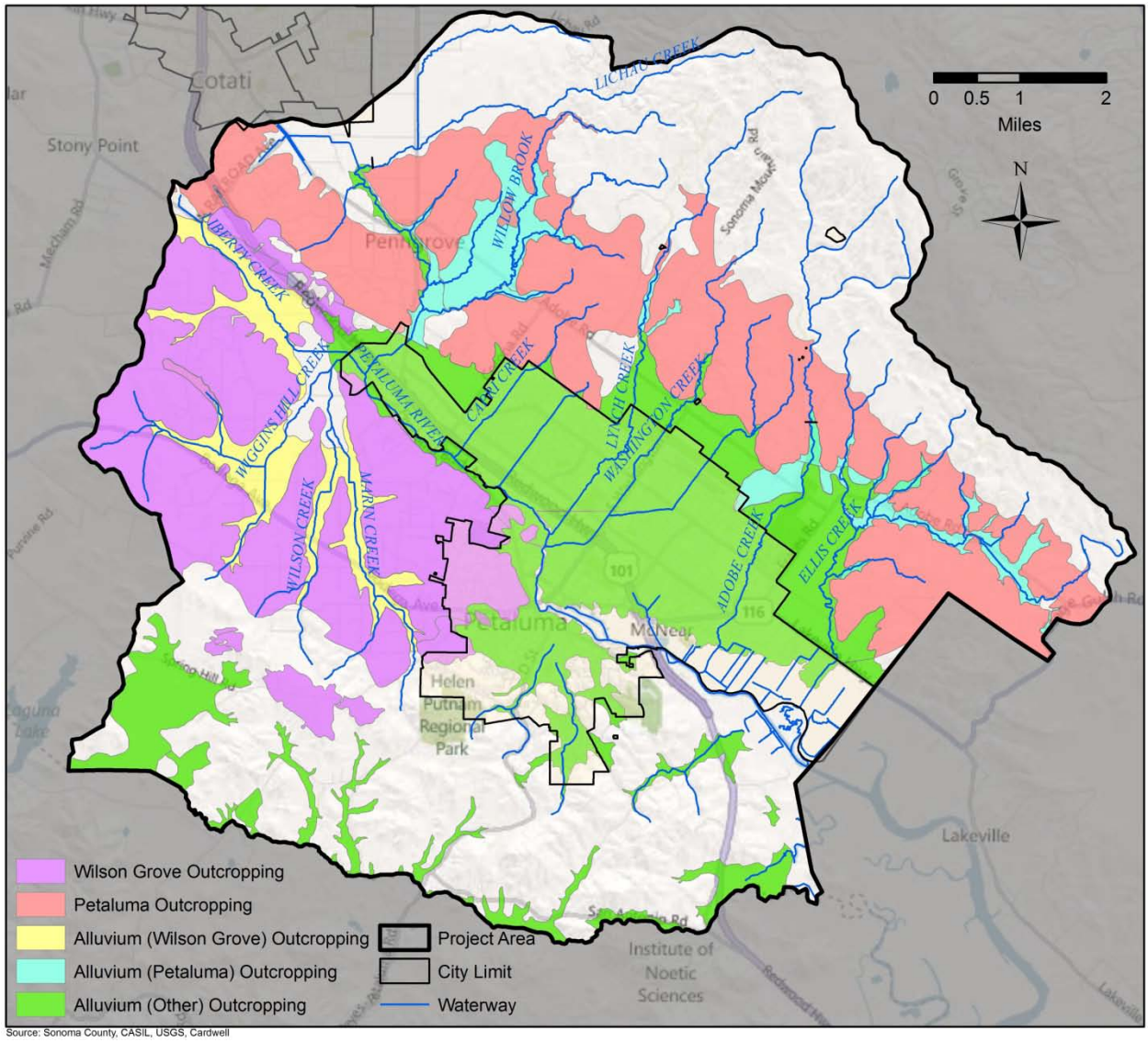
For the percolation of stormwater to be successful as a groundwater augmentation strategy for water supply, it is imperative that the infiltrating water reach the aquifers that are used for water supply. For the Petaluma Valley Groundwater Basin, the principal water-bearing deposits are the younger and older alluvium and the Wilson Grove formation, while locally, water-bearing formations are also found in the Petaluma formation (when an appreciable thickness of sand and gravel is encountered) and in the Sonoma volcanics (Cardwell, 1958). For the most part, the larger municipal wells in the valley are screened in the Wilson Grove formation.

For direct recharge for groundwater augmentation, the surface expression of a water-bearing formation is not required as wells are used to directly place the water into the selected formation for storage and later recovery. Key issues relating to direct recharge that are not, for the most part, as significant an issue for percolation, are the potential for water quality interactions between the recharge water and ambient groundwater and for the potential introduction of contaminants such as bacteria, into the subsurface.

Groundwater in the Petaluma Valley is recharged in large part by the deep infiltration of rainfall, but seepage loss from streams overlying permeable deposits also contribute to recharge. Groundwater in the basin typically moves from the northeast and southwest toward Petaluma Creek and downstream towards the tidal sloughs. For the purposes of this project, the principal water-bearing formations need to be targeted to make groundwater augmentation for water supply viable; however, even groundwater augmentation targeted at the shallower formations may be of benefit as these aquifers potentially contribute to the baseflows of streams and may percolate vertically to deeper formations (in areas where impeding aquitards are absent). Enhancing recharge of the shallower formations may also aid in combating potential saltwater intrusion in the southern portions of the valley, which has been observed historically in the alluvial fan deposits. To this end, all of the identified water-bearing formations in the Petaluma Valley (the younger and older alluvium, Wilson Grove formation, Sonoma volcanic and Petaluma formation) were considered for this study, save the Sonoma volcanic formation. This formation was eliminated from further consideration due to its structure (fractured formation) and low local yields.

As the key project purpose is to identify stormwater management/groundwater recharge projects that provide flood hazard reduction and groundwater benefits, those formations with surface expressions are of particular interest as these are the locations where surface recharge is likely to be feasible (that is, the percolation must occur over the surface exposures (outcrops) of these formations). **Figure 4** shows the locations of the Wilson Grove and Petaluma formation outcrops and the overlying younger and older alluvium in the study area.

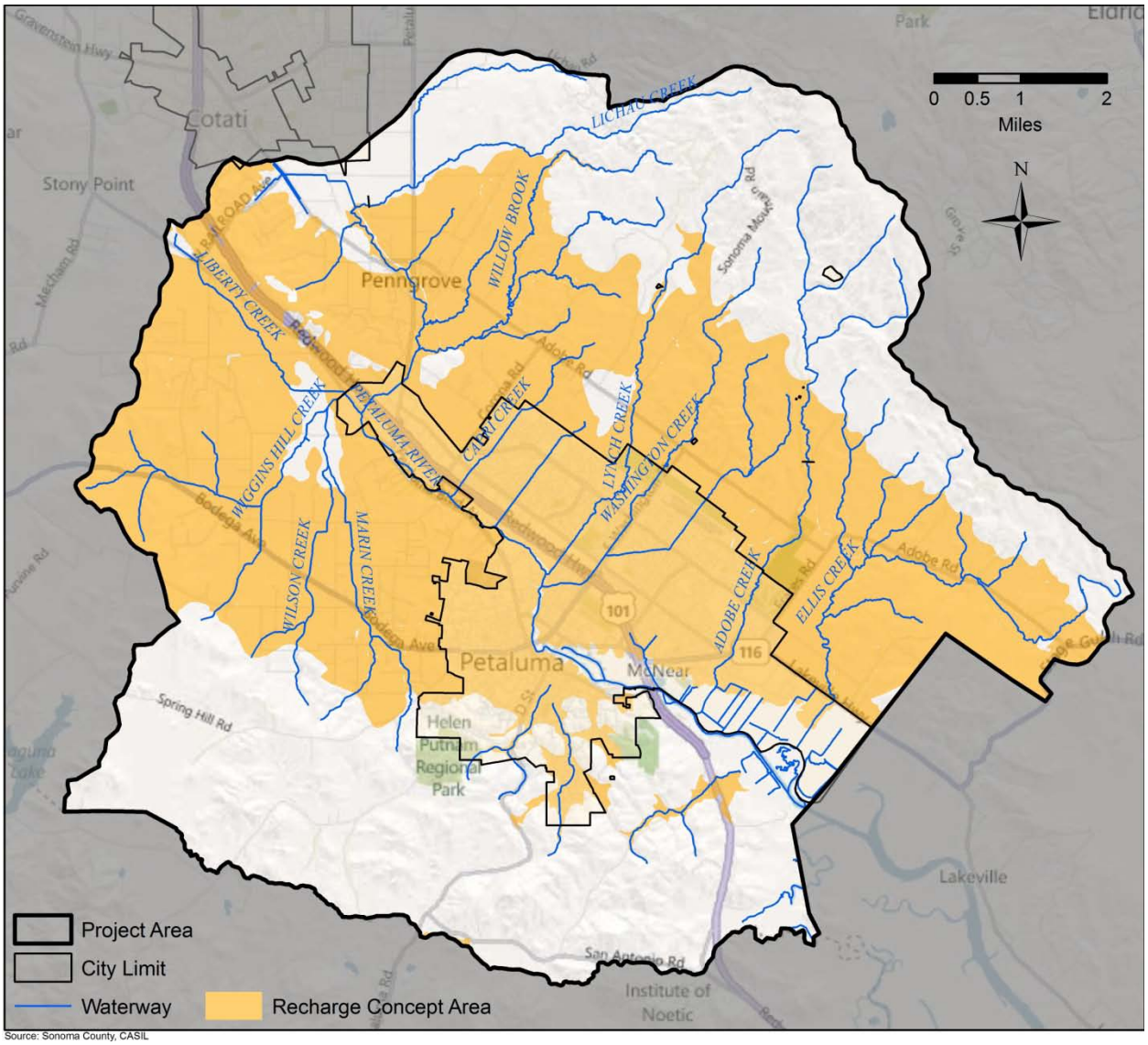
Figure 4: Surface Expressions of Upper Petaluma Formations



Ref: USGS geology reports and Cardwell

The groundwater recharge focus areas, shown in **Figure 5**, are intended to help identify, at a conceptual level, those areas that could play a role in providing groundwater recharge benefits both locally and regionally. In all locations (and especially in those areas intended to target the Petaluma formation for storage), site-specific investigations (including geologic borings and soil testing) and other analyses such as water quality tests will be required to further determine the suitability of each location for groundwater recharge or to eliminate it from further consideration for one or more reasons, including but not limited to environmental or hydrogeologic limitations, willing landowner participation, or zoning restrictions.

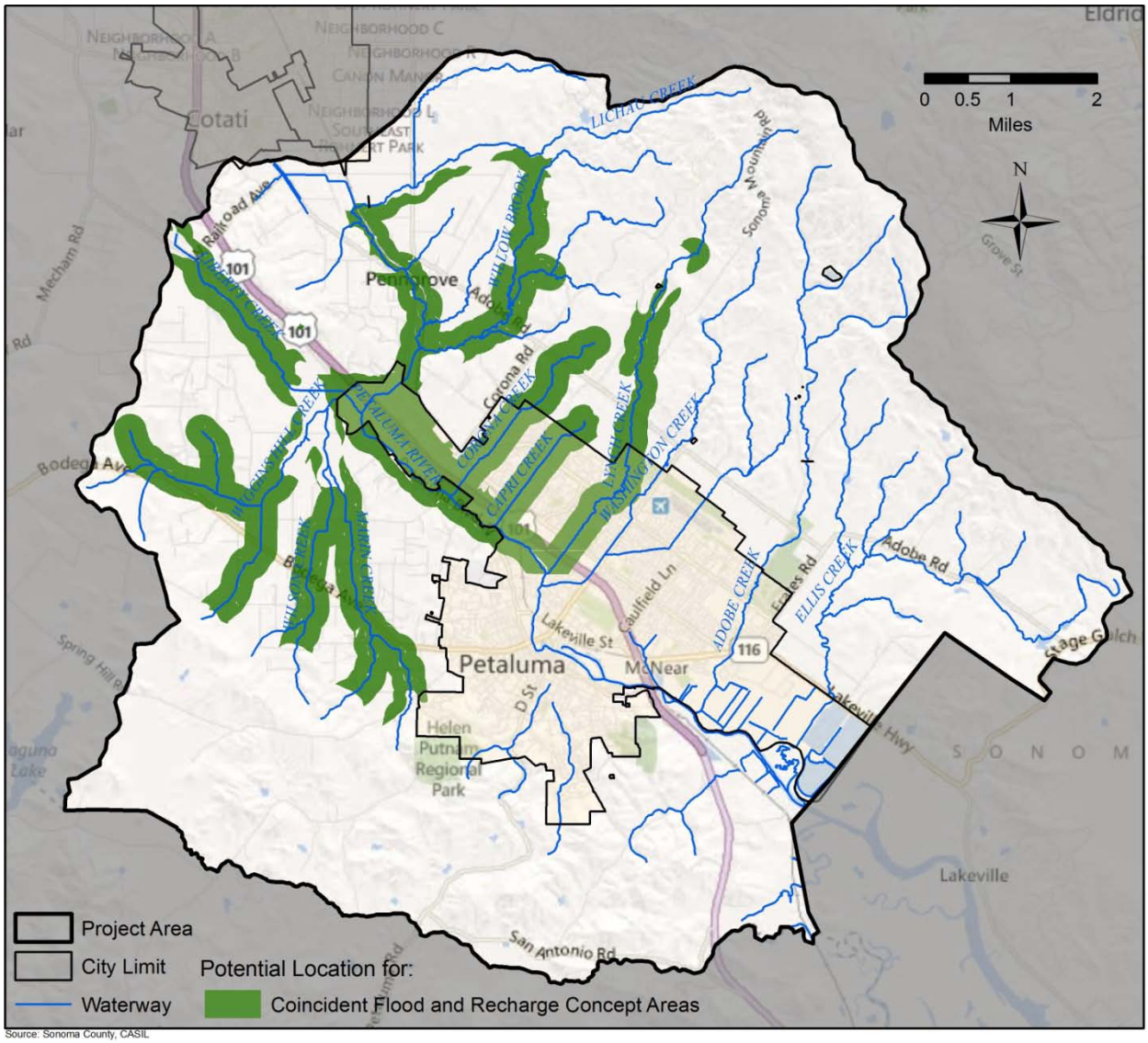
Figure 5: Groundwater Recharge Project Element Focus Areas



2.3 Opportunity for Coincident Flood Hazard Reduction and Groundwater Recharge

Figure 6 highlights the overlap areas for both the flood hazard reduction and groundwater recharge focus areas. Project concepts sited in these areas will have the opportunity for coincident flood hazard reduction and groundwater recharge. Outside of these areas though, project elements in different locations will need to be paired to achieve both of the primary objectives of the Key Project Purpose.

Figure 6: Coincident Flood Hazard Reduction and Groundwater Recharge Focus Areas



3 Concept Identification

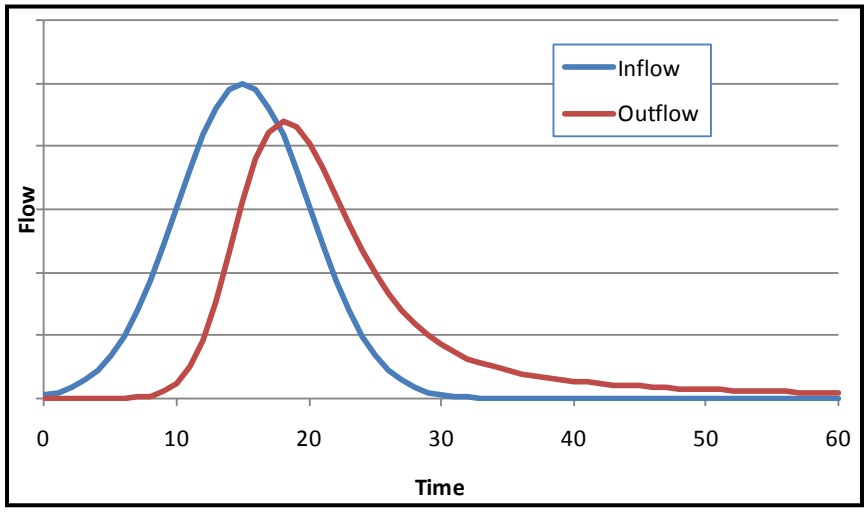
Flood hazard reduction concepts and groundwater recharge concepts are identified in this section based on potential ways to achieve the Key Project Purpose. Some concepts address both core objectives of the Key Project Purpose while others only address either flood hazard reduction or groundwater recharge. In the latter case, the concepts can potentially be co-located at a site or located in different sites. In this section of the memorandum, a wide range of concepts are identified at a high level. The next section describes the concepts as they could be applied to the Project area.

3.1 Flood Hazard Reduction Concepts

Flood reduction can occur either through increased hydraulic capacity or reduced peak flows. One way to increase hydraulic capacity is by altering the existing channel to increase the available cross-sectional area available for flow or by reducing the overall roughness of the channel. Another way to achieve the same benefit is to create a new contained pathway for flood waters. A number of the concepts described below achieve flood hazard reduction through increased hydraulic capacity.

Several additional identified concepts achieve flood hazard reduction by reducing peak flows. Surface water runoff volume can be reduced by allowing additional water to infiltrate by, for example, reducing the amount of impervious area. Attenuation, or the reduction in the hydrograph peak, affects the magnitude of the flood flows as well as the timing of the peak flows. Reduction in peak flow forces the hydrograph to extend since the overall volume of water carried by the flood is the same. However, it is important to note that extending the duration of hydrographs can be considered to be just as undesirable as the high peaks (particularly near the channel-forming flow range) and therefore any modification to the hydrographs will have to be considered closely on a project-basis. **Figure 7** shows this potential hydromodification effect.

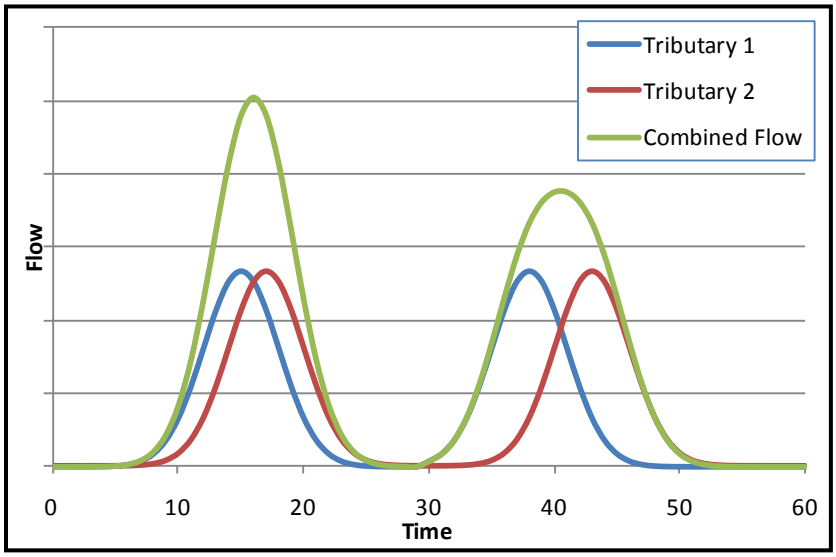
Figure 7: Hydrograph Attenuation



Timing of the peaks also has an impact on flooding since flows from tributary streams are additive. **Figure 8** shows how the timing of two small peaks can impact the resulting hydrographs. Separating the timing of the tributary peak flow contributions will generally lead to a lower peak on the combined hydrograph while the opposite is true as well. While analysis of these effects is beyond the scope of the Scoping Study, they will be studied at the feasibility level as specific project sites and geometries are identified. Past work however has indicated that peaks flows from the major tributary watersheds for the flood focus area (i.e. the Willow Brook and the Marin/Wiggins watersheds) are nearly coincident in

timing (SCWA, 2010). Attenuation therefore in either watershed would likely reduce overall peak flows in the impacted tributary streams and the Petaluma River.

Figure 8: Hydrograph Timing Example



3.2 Recharge Concepts

As mentioned previously in the memorandum, groundwater recharge can occur either through surface percolation of water or through direct recharge. In general, groundwater augmentation via percolation is achieved by simply delaying or retaining the stormwater runoff and allowing time for the water to seep through the ground surface (infiltrate) and move down through the subsurface to the underlying groundwater basin (percolate). For surface percolation, there are several ways of promoting the percolation of stormwater runoff. These include using in-stream and off-stream detention basins, expanding floodplain area, modifying the floodplain, and using Low Impact Development (LID). Direct surface recharge techniques such as these are among the simplest and most widely applied methods for groundwater recharge.

Field studies of spreading techniques have shown that many factors govern the amount of water that will infiltrate and percolate to groundwater; however, two of these, the areas of the recharge and the length of time that the soils are in contact with the water, are key (Todd, 1980). In general, detention or spreading basins (or concepts that utilize the same ideas) for groundwater recharge utilize these two concepts, have relatively low construction costs and are easy to operate and maintain.

Groundwater augmentation via direct recharge, alternatively, conveys water directly into an aquifer. For this type of augmentation project, the quality of the recharge water is of primary concern as recharge water enters the aquifers without the filtration and oxidation that occurs when water percolates naturally through the unsaturated zone. Direct recharge methods access deeper aquifers and require less land than percolation methods, but are more expensive to construct and maintain. (*Source Book of Alternative Technologies for Freshwater Augmentation in Some Countries in Asia*, 2011)

All subsurface methods are susceptible to clogging by suspended solids, biological activities, and chemical impurities. Groundwater-recharge water geochemical interactions are also of key concern for direct recharge as they can result in the clogging of the well screen and/or adjacent formations.

3.3 Project Concepts

3.3.1 Managed Floodplain

Existing floodplains attenuate flood flows naturally. Without existing floodplains, peak flows are expected to be higher and travel times shorter than currently measured. To avoid loss of the attenuation and other benefits of floodplains, one project concept is to preserve the floodplains, either through flood easements or fee title acquisition. Both of these pathways would require partnerships with willing landowners. Additionally, while flooded, there could be recharge opportunities should conditions be appropriate.

3.3.2 Off-Stream Detention Basin

Detention basins are a classic example of attenuation projects. While storing water, the detention basins also provide an opportunity for recharge where geologic conditions are appropriate. Off-stream detention basins would be one or more excavated basins used to divert, slow and detain stormwater runoff to promote infiltration and reduce peak flood flows. The outlet of each basin is constrained in some manner to improve the attenuation effect.

This concept may include single basins that are seasonally scarified or raked (to remove or break up fines that accumulate at the bottom of the basin) or a series of basins in which the first is used to allow stormwater runoff to settle, removing sediments that will clog and reduce the percolation capacity of subsequent, downstream basins.

Off-stream detention basins can also be buried structures allowing other land uses above, such as parks or buildings. These basins would work in a manner similar to that previously described; however, due to the difficulty in maintaining subsurface basins, a settling basin upstream of the detention basins would be recommended to reduce the level of maintenance required.

3.3.3 In-Stream Detention Basin

In-stream detention basins work in a manner similar to the off-stream detention basins. This concept would consist of an engineered constructed basin, located in the riverway, that would slow stormwater runoff, thereby promoting percolation and allowing for sediment removal. Maintenance of the outer portions of the in-stream detention basin would occur during dry periods to help maintain the capacity of basin.

3.3.4 Floodplain Modification

Floodplain modification involves lowering the floodplain elevation to provide additional flow area (hydraulic flow carrying capacity) and/or storage volume. Outlet control would not normally be included in this type of project. This concept is demonstrated in the City of Petaluma's Denman project.

Under appropriate conditions, both flood and recharge benefits are possible with this concept.

3.3.5 Levee/Floodwall

Levees and floodwalls are structural flood hazard reduction options that provide additional hydraulic capacity within the channel or remove an area from a floodplain. In the latter case, this could induce flooding elsewhere as the removed conveyance capacity is replaced by a new area. When levees and floodwalls are built, they allow the hydraulic grade line to increase without flooding surrounding areas. The higher hydraulic gradeline increases the velocity which yields a higher flow rate. These types of projects can either be stand alone projects or can be integrated with other methods at a smaller scale to remove certain areas from the floodplain.

Levees and floodwalls typically do not provide recharge benefits.


3.3.6 Channel Modifications

Channel modifications affect the shape or roughness of the channel, two key components in hydraulic capacity. The channel section can be modified in several ways, including widening the channel, reforming the basic shape and support for the channel walls and bottom (e.g. conversion to a reinforced U-shaped channel), and removal of accumulated sediment. Smoother channels are able to convey more flow than rougher channels. Removal of vegetation and channel straightening reduce overall roughness.

The types of channel modification described above do not typically provide recharge benefits.

Before and after vegetation and sediment removal.


3.3.7 Bypass Channel

This concept increases the hydraulic capacity of a channel by providing a parallel, controlled flowpath. The bypass channel diverts flow upstream of the area to be protected and reintroduces the flow downstream of the area to be protected. The flow is normally reintroduced to the same stream, but in some cases it may not.

Recharge concepts could be designed into a bypass channel as added features; although, a bypass channel typically would not provide recharge opportunities.

3.3.8 Bridge Improvement and Debris Removal

Bridges can create constriction points that can lead to flooding. This problem can be exacerbated by waterway approach and bridge design as well as a low level of maintenance. Realigning channels, implementing structural and programmatic changes for debris management and control, and increasing hydraulic capacity through bridges reduce the likelihood of flooding at crossing structures. Implementation of this concept would require, depending on recommended solutions, significant coordination with bridge owners and local land owners.

It is important to note that any modifications made under this concept are intended to alleviate debris constrictions but not increase the design hydraulic capacity of the bridge itself. This concept would improve conveyance and is not expected to improve recharge.

3.3.9 Low Impact Development

Low impact development (or LID) is a means of designing and constructing a project such that stormwater is collected and detained for reuse and/or for promoting recharge. LID projects are particularly effective at helping to manage stormwater for smaller events, in the 1 to 10-year range. Typical LID components include biodetention, vegetated swales, vegetated (green) rooftops, rain barrels, and permeable pavements. LID projects are generally implemented during initial construction of a structure or area, redevelopment of an area, or retrofit of a structure.

3.3.10 Policy Review and Development

Various city, county, and Water Agency policies can impact both flooding and recharge potential. Policies and practices may be in place to review activities such as development and land use changes with regards to impacts to flood and recharge conditions. Existing policies can be reviewed, new policies can be created, and enforcement of these policies can be refreshed where they may not have been previously.

3.3.11 Direct Recharge Wells

Direct recharge is used to introduce a surface water supply (recharge water) directly into a groundwater basin for storage and eventual reuse. Water is transmitted by recharge wells directly into the groundwater basin, and has the advantage of being able to place the source water directly into deeper formations of interest for storage and recovery (in this case, the Merced and Petaluma formations). One key advantage of this mode of groundwater augmentation is that smaller areas are required for recharge (as wells do not need as much space as percolation ponds). However, this method is typically more expensive to construct and maintain than percolation ponds, and are more easily clogged by untreated recharge water (especially stormwater runoff, which typically contains higher concentrations of suspended sediment and organics).

4 Concept Description

This section applies the concepts identified in the previous section to the Concept areas. Additional detail is provided for each of the concepts discussed, as well as alternative ways to implement the concept. Each concept is also analyzed against project objectives, as described in the *Project Objectives Report* (RMC, 2011), and the relative cost for concept construction as compared to the value of flood protection and increased recharge benefits obtained are provided (and ranked as being high, medium, low or unknown for the base concept). Finally, the additional benefits afforded by the concept and potential concept constraints are evaluated.

Hydraulic modeling and quantification of benefits and impacts have not been performed for this Scoping Study. These analyses will be performed in a later Project phase. Hydraulic modeling will be necessary for any concept or concepts (with potential for hydromodification) to be deemed feasible and to confirm that existing flood protection levels are not reduced within the Project area.

4.1 Managed Floodplain

Concept Elements and Alternatives

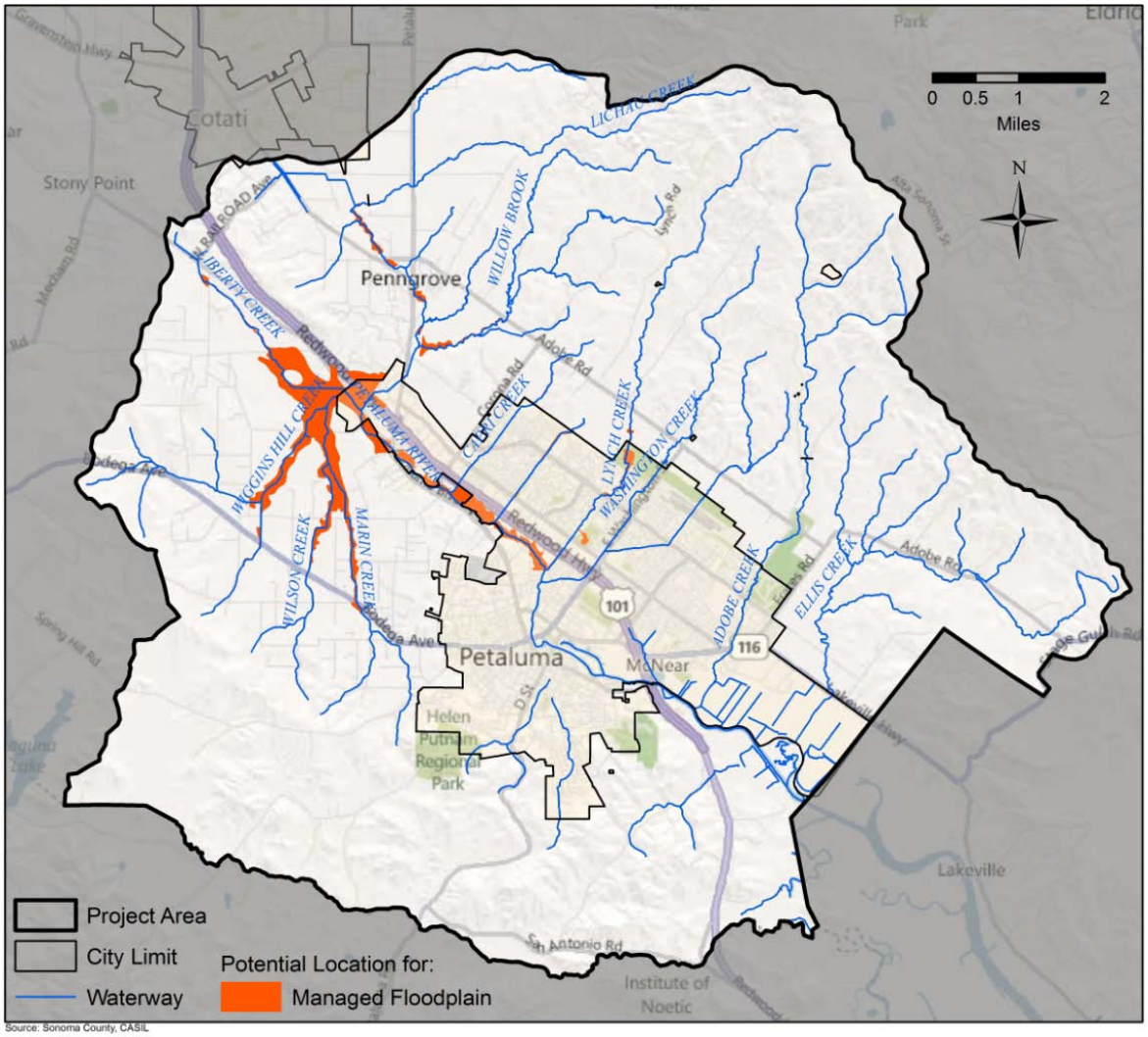
The concept area, as shown in **Figure 9**, is generally the 100-year floodplain but does not include land with existing structures. The goal of this concept is to partner with willing landowners to preserve the attenuation characteristics of the existing floodplain in undeveloped and agricultural areas. This would be achieved through flood easements (which would allow land owners to continue use of the land) or fee title acquisitions. In the latter case, appropriate land use decisions would need to be made in determining whether the acquired parcel would be converted to another use or if it should continue to be used in the same manner as when it was acquired. This concept would not include land form or land use modifications to increase downstream flood hazard reduction benefits.

In certain areas, the 100-year floodplain overlies surface expressions of the Wilson Grove or Petaluma formations, or the alluvial deposits directly overlying these formations. Promoting infiltration in these areas could lead to recharge of key water-bearing formations. In these cases, properties that are flooded more frequently will provide additional recharge benefit. Where permitted, surface treatments such as scarifying will improve the passive percolation rates. Additional testing is needed to confirm the viability of this benefit in these areas.

Where recharge is not an option but the owner is amenable to some grading, pools could be created to provide livestock watering alternatives to groundwater and potable supply use. The pools could also be used to develop varied habitat so long as the additional attenuation provided by the pool was not offset by new vegetation.

Depending on local considerations such as nearby environmental corridors, recreational areas, and concerns of the local landowners, additional features could be included to create multiple benefit projects. Some of these features could include recreational open space, trails, and educational features. Other benefits, such as channel stability at and downstream of the concept site, as well as reduced turbidity in surface waters, are part of the natural function of floodplains.

Figure 9: Potential Locations for Managed Floodplains



Concept Objective Analysis

Table 2 summarizes how managed floodplains achieve or could achieve the core and supporting objectives identified for this Project.

Table 2: Managed Floodplain Concept Objectives

Objective	Objective Achieved	Notes
Flood Hazard Reduction	Limited	The concept maintains the baseline flow condition, making downstream flood management easier.
Groundwater Recharge	Limited	Location dependent.
Water Quality	Unsure	Contaminants such as nitrates may be adsorbed to soil particles. Enhancing percolation could degrade aquifer water quality should the contaminants become mobilized.
Water Supply	Maybe	Feature dependent. Additional testing necessary to confirm.
System Sustainability	Yes	Floodplains can act as natural sediment banks, leading to more stable channels. This concept also requires no imported energy and little to no maintenance.
Ecosystem	Yes	This concept would protect the existing ecosystem within the floodplain and potentially provide some habitat diversity.
Agricultural Land	Yes	The concept preserves existing land use to maintain flood hazard reduction benefits.
Undeveloped Land	Yes	The concept preserves existing land use to maintain flood hazard reduction benefits.
Community Benefits	Maybe	Feature and land owner preference dependent.

Comparison Construction Cost Estimate

The base concept involves acquisition of agricultural and undeveloped land. The cost of this concept relative to increased flood protection is high, as is the cost of this concept relative to increased recharge. This is because the concept only maintains existing benefits and does not increase them.

Additional Benefits and Constraints

Table 3 summarizes additional considerations when evaluating the managed floodplain concept. The description of these considerations is based on the level of detail developed at this conceptual stage.

Table 3: Additional Concept Considerations for Managed Floodplain

Area	Description
Environmental Considerations	Environmental impacts would be relatively minor for this type of project concept, particularly if the existing land use is maintained. There are opportunities for environmental benefits.
Permitting	Permitting would be required only if modifications were made to the existing stream or if there was other off-stream grading or development of concept features.
Right-of-way	Right-of-way would be required for all acquired parcels. Access to the site would need to be obtained as well.
Construction	Construction is dependent on the features that are to be included with the project concept. Construction would likely be limited to earth grading and some light construction for trails and interpretation sites as necessary.
Operations & Maintenance	Very little O&M is required for this concept, particularly if the site is left as is. If soil treatment was necessary to achieve recharge, then some O&M would be scheduled to refresh the conditions. Additional features such as trails and interpretation sites would need to be maintained.
Funding	Funding sources are dependent on the final purpose and features of the project. State grants have been available for concepts of this type in the past. The multi-benefit opportunities of the concept (i.e. inclusion of recreational opportunities) will increase the number of funding sources.
Regulatory	Little to no regulatory agency involvement would be anticipated for this concept. As described above, additional features could trigger additional oversight.
Willing Land Owner	Willing land owners are necessary for this concept to be successful.
Integration with Other Concepts	Downstream projects, such as the U.S. Army Corps of Engineers' Payran flood control project, have identified upstream floodplains and attenuation as key to the success of their project. Loss of the attenuation provided by upstream floodplains would need to be mitigated or the effectiveness of downstream flood hazard reduction projects could be threatened.
Additional Studies	Additional hydraulic studies are necessary to quantify the benefit of the upstream floodplains. Geologic studies are necessary to refine the understanding of recharge potential on a site to site basis. Additional water quality testing is necessary to better understand existing and potential threats to aquifer water quality. Geomorphological studies are required to assess sediment transport characteristics of the system with this concept.

4.2 Off-Stream Detention

Concept Elements and Alternatives

The goal of this concept is to create temporary holding ponds for stormwater runoff during high-flow events; these ponds will reduce the peak hydrograph by temporarily diverting some of the flow that would otherwise create downstream flooding conditions. Detention basin locations would be outside of the direct stream channel, but would be connected to the creeks and floodways via inlet and outlet structures. The basins would be seasonally wetted, and allowed to dry out to permit maintenance. Pond locations would be obtained via flood easements (which would allow land owners to continue use of the land) or fee title acquisitions, and could be designed so as to allow multiple uses throughout the season. For example, the detention basins could be designed and constructed so as to flood in the winter, providing flood management benefits, but be dry in the summer for use as a seasonal park or sports field.

In certain areas, potential off-stream detention basin sites overlie the surface expression of the preferred water-bearing formations in the Petaluma Valley (Alluvium, Wilson Grove and Petaluma Formations). At these locations, seepage from the bottom of the detention basins will percolate downward into the near-surface primary water-bearing formations underlying the Valley, recharging the groundwater basin. The ponds/detention basins created under this scenario would both serve to reduce downstream hydrographs by diverting peak flows from the streams feeding the Petaluma River, while increasing the wetted area in the valley and extending the time over which stormwater runoff is allowed to infiltrate. Additional testing is needed to confirm the viability of this benefit concept in identified concept areas.

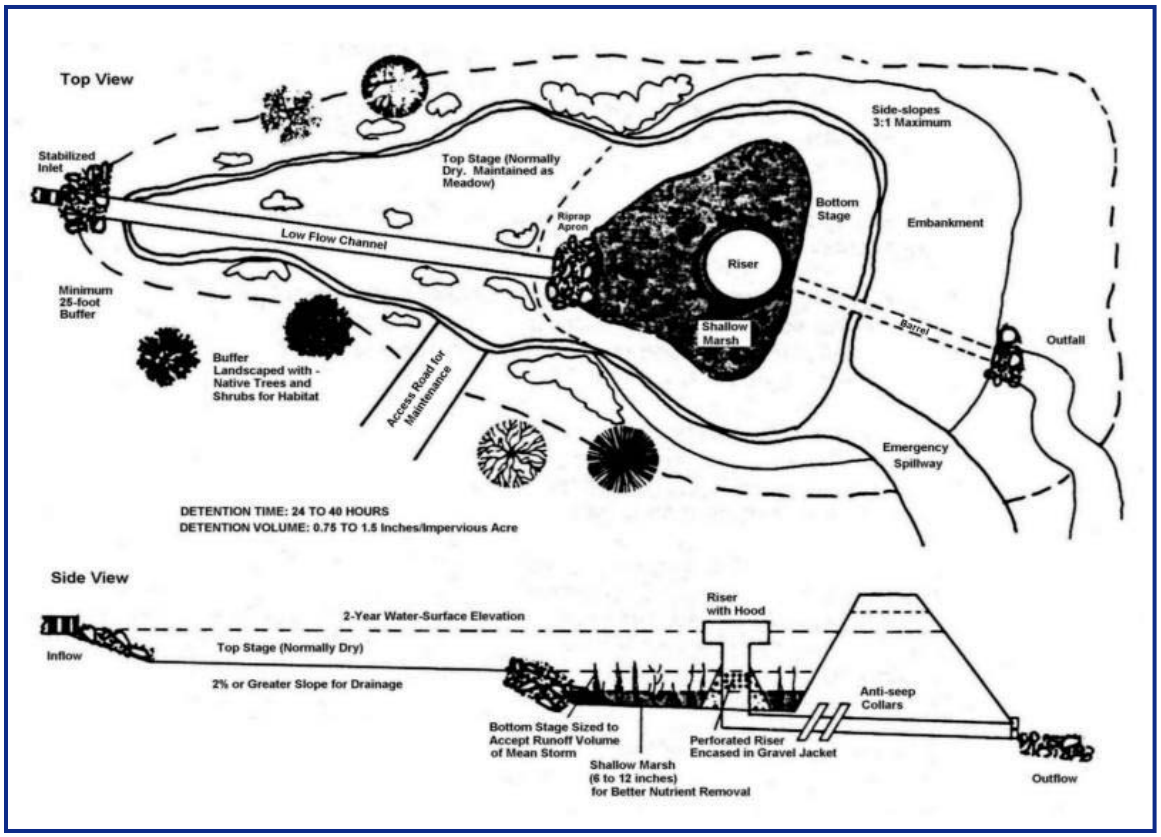
Where recharge is not an option but flooding reduction is the objective and the land owner is amenable to some grading, pools could be created to provide livestock watering alternatives to groundwater and potable supply use. The pools could also be used to develop varied habitat so long as the additional attenuation provided by the pool was not offset by new vegetation.

In all cases, off-stream detention ponds can be designed to provide multiple benefits, including recreational open space, trails, educational features, and wildlife habitat. The addition of such benefits will, however, depend on local considerations such as nearby environmental corridors, recreational areas, and concerns of the local landowners. **Figure 10** is one example of a conceptual design of an at-grade detention basin. Other designs could allow improved sediment transfer.

Another form of off-stream detention basins is the use of sub-surface detention basins. These basins perform similar to at-grade detention basins, but are engineered structures located beneath the ground. As with at-grade detention basins, these basins provide peak hydrograph reductions (reducing downstream flooding potential) and, if placed above the appropriate geologic formations, will provide some groundwater augmentation. It is strongly encouraged to include a settling basin upstream of the storage basin to reduce maintenance required within the structure. The advantage of subsurface detention basins is that they can be placed in areas with existing land use or where there are proposed developments. Typical land uses above subsurface detention basins include sports fields and parking lots but could also include structures. **Figure 11** is an example of a sub-surface off-stream detention basin.

The concept area, as shown in **Figure 12**, depicts areas that are generally relatively flat (around 2% slope or less) and have around 5 acres of land or more within around 1,000 feet of a waterway and without existing structures. If suitable sites for projects cannot be identified in this defined concept area, the range of sites will be expanded to include those with slopes of up to 10%.

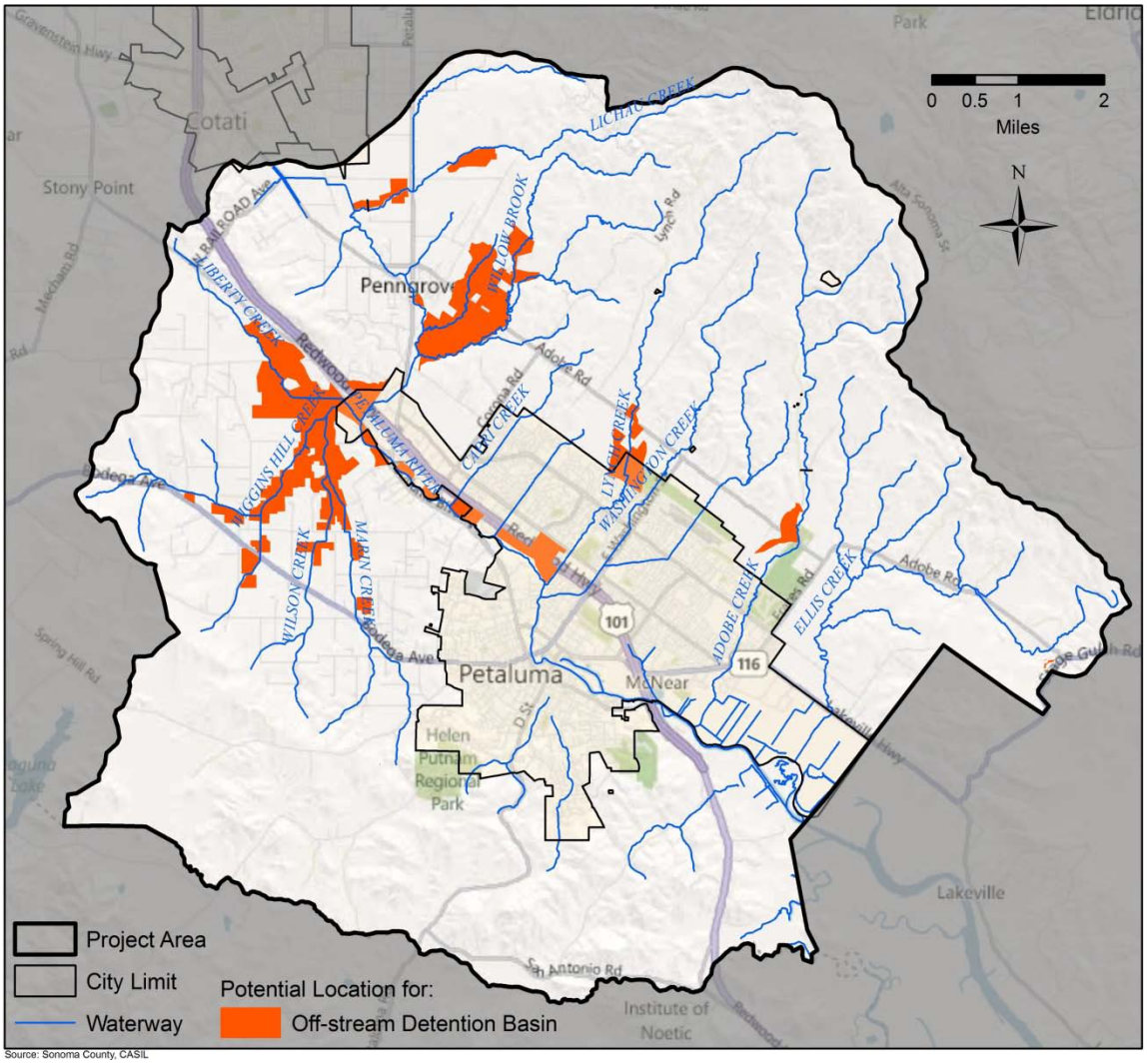
Figure 10: Concept Sketch for At-Grade Off-Stream Detention



Source: Michigan Department of Environmental Quality, 1999

Figure 11: Subsurface Off-Stream Detention Structure

Figure 12: Potential Locations for Off-Stream Detention



Concept Objective Analysis

Table 4 summarizes how off-stream detention basins achieve or could achieve the core and supporting objectives identified for this Project.

Table 4: Off-Stream Detention Concept Objectives

Objective	Objective Achieved	Notes
Flood Hazard Reduction	Yes	The concept would be designed to reduce the peak hydrograph, reducing downstream flooding potential. However, while achieving the flood hazard reduction objective (for a specific area), this concept also needs to be evaluated for the potential to result in flood impacts outside of the concept area.
Groundwater Recharge	Maybe	Location dependent.
Water Quality	Yes	The detention basin will provide settling, reducing some runoff contaminants. Depending on design, the pond may provide other water quality benefits such as biofiltration and uptake of constituents such as nitrates.
Water Supply	Maybe	Feature and location dependent; additional testing necessary to confirm. The concept can be designed to provide seasonal agricultural water supply in addition to groundwater recharge benefits.
System Sustainability	Yes	Detention basins are passive and use no energy to function. Off-stream basins also allow low flow but geomorphically significant flow to continue in the natural channel. Should downcutting be an issue, there is an opportunity to include grade control at the inlet and outlet structures at the creek.
Ecosystem	Yes	The concept can be designed to provide some habitat diversity in the channels to and from the basin, as well as at the basin itself. Passage of low flows in the original channel will help to maintain existing habitat to meet environmental requirements.
Agricultural Land	Maybe	In some cases, basins could be configured to allow agricultural use, especially grazing, to continue, thus minimizing net use of the land. However, design considerations will have to be made (on a site-by-site basis) in these cases to ensure that grazing livestock do not contribute stream instability, erosion or water quality impacts.
Undeveloped Land	Yes	Existing undeveloped land could be preserved or enhanced as designated open space, depending on design features.
Community Benefits	Maybe	Feature and land owner preference dependent.

Comparison Construction Cost Estimate

The base concept will involve the acquisition of agricultural and/or undeveloped land; the amount of land required is dependent on the size of the detention basin and other basin design features that may be selected for a multi-benefit project. The cost of this concept relative to increased flood protection is low for an at-grade basin and high for a sub-surface basin, as is the cost of the concept relative to increased recharge. Detention basins are an effective method to attenuate peak flows and this is reflected in the relative cost of the concept. Burying a structure increases the cost of the concept significantly.

Additional Benefits and Constraints

Table 5 summarizes additional considerations when evaluating the off-stream detention basin concept. This information is based on the level of detail developed at this conceptual stage.

Table 5: Additional Concept Considerations for Off-Stream Detention Basin

Area	Description
Environmental Considerations	Environmental impacts will be dependent on the project size, design and location. There are opportunities for environmental benefits under this concept.
Permitting	Permitting will be required for grading and construction of concept features. Additionally, a Section 404 Permit from the U.S. Army Corps of Engineers, a Section 401 Water Quality Certification from the Regional Water Quality Control Board and a Section 1601 Streambed Alteration Agreement from the California Department of Fish and Game will likely be required as part of the project's outlet and inlet facilities design and construction. Coordination with National Marine Fisheries Service would be necessary on steelhead streams and U.S. Fish and Wildlife Service in other sensitive areas. Coordination with the California Division of Safety of Dams and compliance with dam safety regulations may be required if embankment heights, where used, exceed minimum standards.
Right-of-way	Parcels for the project will need to be acquired, along with necessary right-of-ways for accessing the acquired parcels and/or connecting the detention basin to the creek(s).
Construction	Construction is dependent on the features that are to be included with the concept and will vary depending on the type and design of basin utilized (e.g. at-grade or subsurface). Construction would likely be limited to excavation, hauling, grading, replanting and some light construction for trails and interpretation sites as necessary.
Operations & Maintenance	Regular O&M is required for this concept to maintain its effectiveness, particularly if the basin is to be designed and use for groundwater recharge. Additional features such as trails and interpretation sites would need to be maintained. Subsurface detention basins will require more costly O&M, and may require special training (e.g. confined space entry).
Funding	Funding sources are dependent on the final purpose and features of the concept. State grants have been available for projects of this type in the past. The multi-benefit opportunities of the concept will increase the number of funding sources.
Regulatory	Regulatory agency involvement is anticipated for this concept, especially as it relates to construction of detention basin inlet and outlet facilities. As described above, additional features could trigger additional oversight.
Willing Land Owner	Willing land owners are necessary for this concept to be successful.

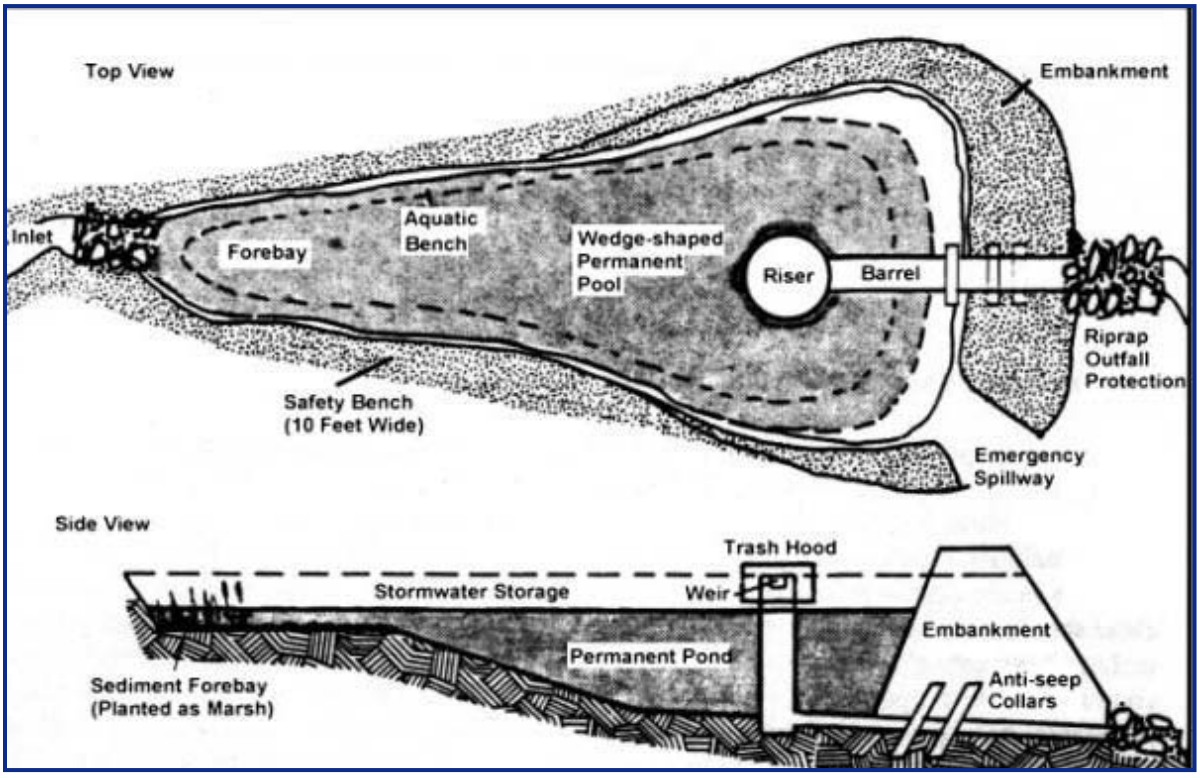
Area	Description
Integration with Other Concepts	This concept can be integrated with other concepts to provide a regionally-comprehensive flood hazard reduction project.
Additional Studies	Hydraulic studies are necessary to quantify the flood benefit of the concept to downstream reaches. Geologic studies are necessary to refine the understanding of recharge potential on a site-by-site basis. Additional water quality testing is necessary to better understand existing and potential threats to aquifer water quality.

4.3 In-Stream Detention

Concept Elements and Alternatives

The goal of this concept is to create temporary in-stream holding ponds for stormwater runoff during high-flow events; this will reduce the peak hydrograph by affecting the timing of the flood peak moving downstream to lessen downstream flood conditions. In-stream detention basins can be constructed by building an embankment across a channel so that a temporary storage pond is formed. Spillways would be incorporated into the storage embankment design to pass large floods exceeding the design runoff without threatening the integrity of the embankment. **Figure 13** is an example sketch of such an in-stream detention basin. Other basin configurations could improve geomorphological processes over the one shown.

Figure 13: Concept Sketch for In-stream Detention



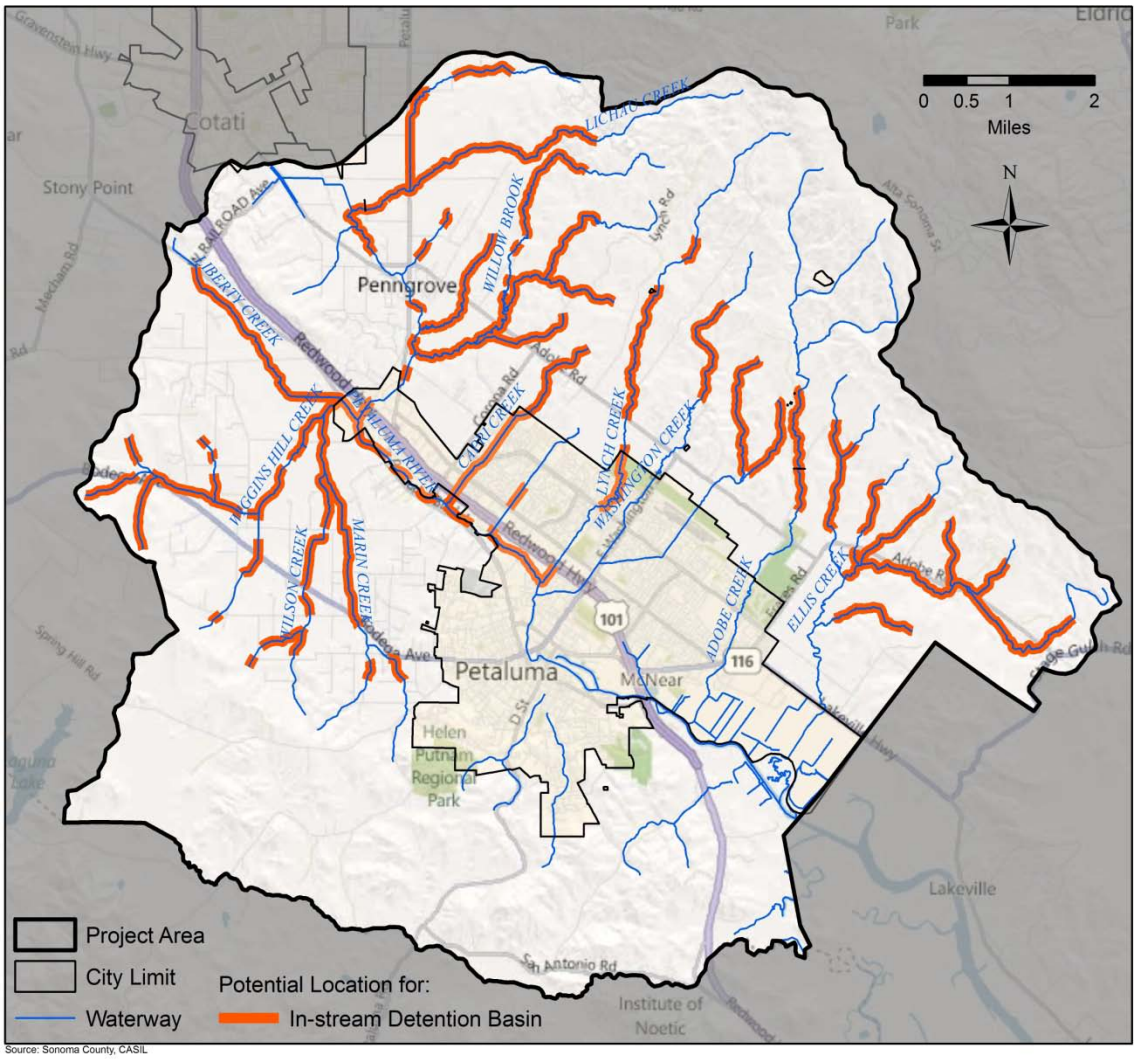
Source: Michigan Department of Environmental Quality, 1999

In-stream detention pond locations would be located within the creek and floodway. For ponds crossing private lands, flood easements (which would allow land owners to continue use of the adjacent land) or fee title acquisitions would be obtained. Additionally, the detention systems could be designed so as to provide recreational facilities (i.e. trail) or allow use as an alternative water source for non-potable uses.

In certain areas, the 100-year floodplain intersects and overlies the surface expression of the preferred water-bearing formations in the Petaluma Valley (Alluvium, Wilson Grove and Petaluma Formations). At these locations, seepage from the bottom of the detention basins will percolate downward into the near-surface primary water-bearing formations underlying the Petaluma Valley, recharging the groundwater basin. The ponds/detention basins created under this scenario would both serve to alter downstream hydrographs by diverting peak flows from the streams feeding the Petaluma River, while increasing the time over which stormwater runoff is allowed to infiltrate. Additional testing is needed to confirm the viability of this benefit in identified concept areas.

Figure 14 shows the potential locations for in-stream detention basins. Identified locations show areas where there appears to be no structure close to the channel and where the basin would provide either flood or recharge benefit.

Figure 14: Potential Locations for In-Stream Detention



Concept Objective Analysis

Table 6 summarizes how in-stream detention basins achieve or could achieve the core and supporting objectives identified for this Concept.

Table 6: In-Stream Detention Concept Objectives

Objective	Objective Achieved	Notes
Flood Hazard Reduction	Yes	The concept would be designed to reduce the peak hydrograph, reducing downstream flooding potential. However, while achieving the flood hazard reduction objective (for a specific area), this concept also need to be evaluated for the potential to result in flood impacts outside of the concept area.
Groundwater Recharge	Maybe	Location dependent. Additional testing necessary to confirm.
Water Quality	Yes	The detention basin will provide settling, reducing some runoff contaminants. Depending on design, the pond may provide other water quality benefits such as biofiltration and uptake of constituents such as nitrates.
Water Supply	Maybe	Feature and location dependent. The concept can be designed to provide seasonal water supply in addition to groundwater recharge benefits.
System Sustainability	Maybe	Detention basins are passive and use no energy to function. Where excessive sedimentation is known to be an issue, in-stream detention basins can also act as sediment traps.
Ecosystem	No	There are some opportunities to create new habitat but the in-stream work will damage the existing ecosystem. If permittable, mitigations could be expected to be high.
Agricultural Land	Maybe	In some cases, basins could be configured to allow agricultural use, especially grazing, to continue, thus minimizing net use of the land. However, design considerations will have to be made (on a site-by-site basis) in these cases to ensure that grazing livestock do not contribute stream instability, erosion or water quality impacts.
Undeveloped Land	Yes	Undeveloped land could be preserved or enhanced, depending on design features.
Community Benefits	Maybe	Feature and land owner preference dependent.

Comparison Construction Cost Estimate

The base concept involves construction within the stream bed. The cost of this concept relative to increased flood protection is medium, as is the cost of the concept relative to increased recharge. Detention basins are an effective method to attenuate peak flows. Permitting and mitigation costs make this concept more expensive than off-stream detention basins.

Additional Benefits and Constraints

Table 7 summarizes additional considerations when evaluating the in-stream detention basin concept. This information is based on the level of detail developed at this conceptual stage.

Table 7: Additional Concept Considerations for In-Stream Detention Basin

Area	Description
Environmental Considerations	Environmental impacts will be dependent on the project size, design and location. As the project would be constructed directly in the stream bed, there will likely be impacts to site and downstream aquatic and riparian habitat.
Permitting	A Section 404 permit will be required from the U.S. Army Corps of Engineers, a 401 Water Quality Certification will be required from the Regional Water Quality Control Board, and a Section 1601 Streambed Alteration Agreement will be required from the California Department of Fish and Game. Coordination with National Marine Fisheries Service would be necessary on steelhead streams and with U.S. Fish and Wildlife Service in other sensitive habitat areas. Additionally, permits will be required for grading and construction of concept features. Coordination with the California Division of Safety of Dams and compliance with dam safety regulations may be required if embankment heights, where used, exceed minimum standards.
Right-of-way	Parcels for the project will need to be acquired, along with necessary right-of-ways for accessing the acquired parcels.
Construction	Construction is dependent on the features that are to be included with the concept. Construction would likely be limited to earth grading, replanting and some light construction for trails and interpretation sites as necessary, in addition to concept features.
Operations & Maintenance	Regular O&M is required for this concept to maintain its effectiveness; typically, sediment removal could be expected on a periodic basis. Additional features such as trails and interpretation sites would need to be maintained.
Funding	Funding sources are dependent on the final purpose and features of the project. State grants have been available for projects of this type in the past. The multi-benefit opportunities of the concept will increase the number of funding sources.
Regulatory	Regulatory agency involvement is required for this concept, especially as it relates to construction of detention basin inlet and outlet facilities. As described above, additional features could trigger additional oversight.
Willing Land Owner	Willing land owners are necessary for this concept to be successful.
Integration with Other Concepts	This concept can be integrated with other concepts to provide a regionally-comprehensive flood hazard reduction project.

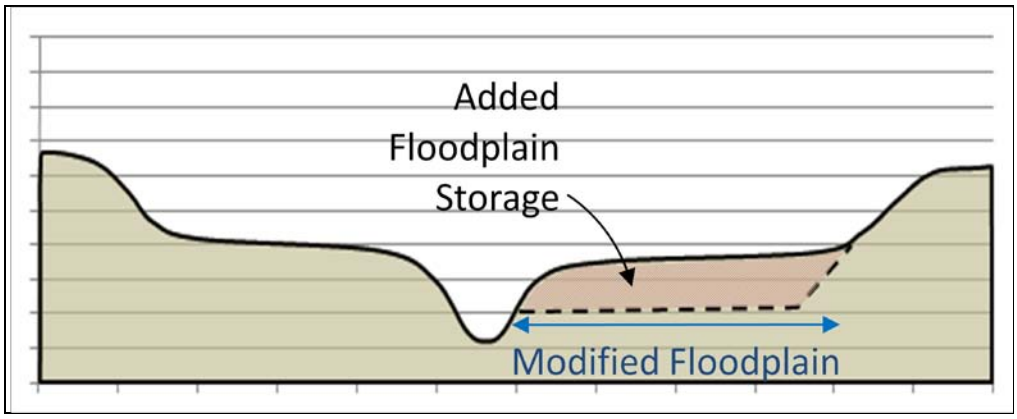
Area	Description
Additional Studies	Additional hydraulic studies are necessary to quantify the flood benefit of the project to downstream reaches. Geologic studies are necessary to refine the understanding of recharge potential on a site-by-site basis. Geomorphological studies are required to assess sediment transport characteristics of the system with this concept. Additional water quality testing is necessary to better understand existing and potential threats to aquifer water quality. Biological surveys will be required to determine the potential extent of aquatic and riparian impacts resulting from construction and operation of the project.

4.4 Floodplain Modification

Concept Elements and Alternatives

The floodplain modification concept is similar to the in-stream detention concept in that the flood management occurs within the creek and floodplain, but differs in that there is not a controlled outlet structure (i.e. embankment). The goal of this concept is to create additional storage volume for stormwater runoff during high-flow events. The concept involves modifying the floodplain areas to provide a larger cross-sectional area. These modifications may include lowering and widening the floodplain to create depressions for temporary flow storage, as shown in **Figure 15**.

Figure 15: Floodplain Modification Concept Section

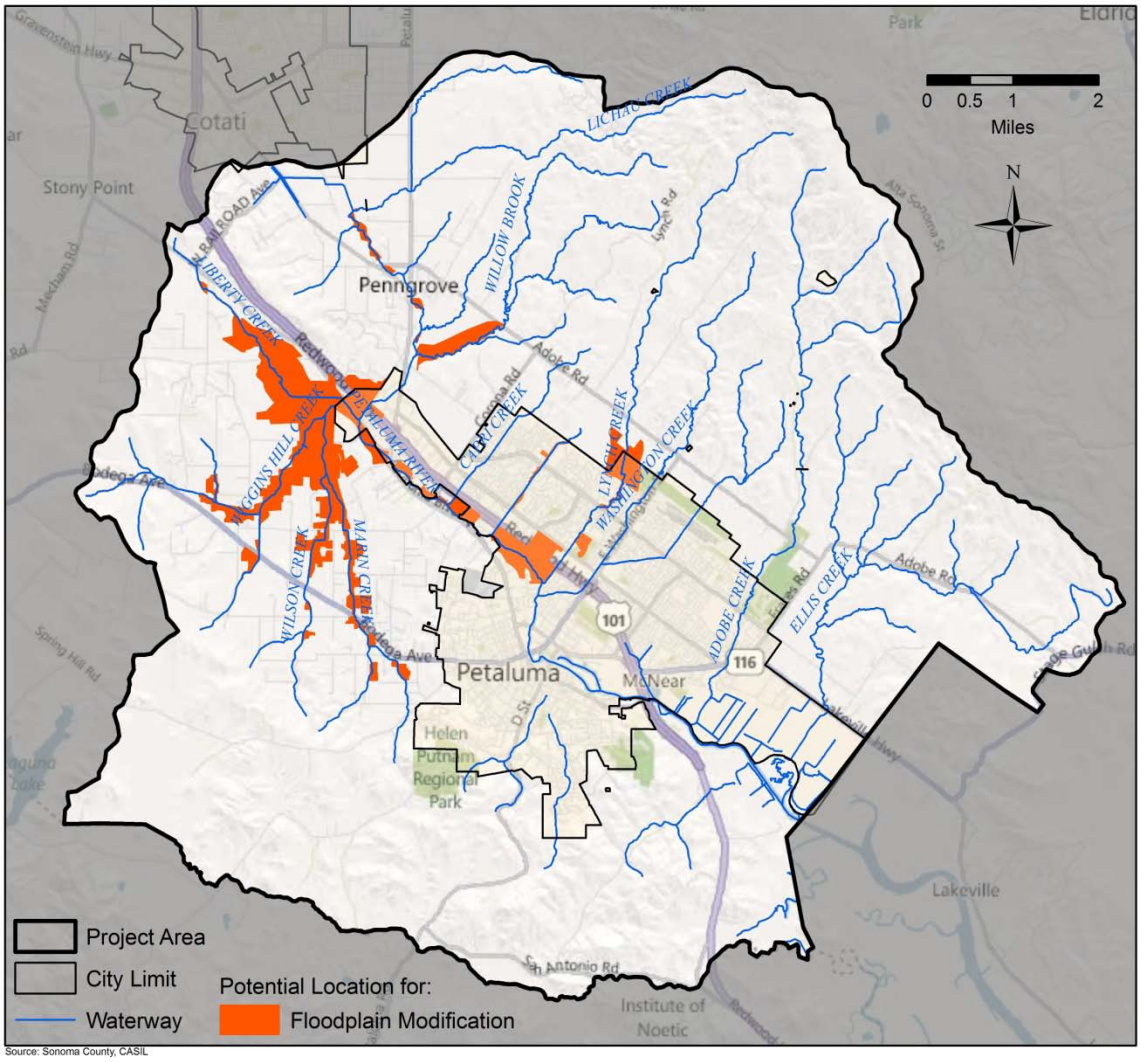


For modifications crossing private lands, flood easements (which would allow land owners to continue use of the adjacent land) or fee title acquisitions would be obtained. Additionally, the modified floodplains could be designed so as to provide recreational facilities, parks, or improved or enlarged habitat.

In certain areas, the 100-year floodplain intersects and overlies the surface expression of the preferred water-bearing formations in the Petaluma Valley (Alluvium, Wilson Grove and Petaluma Formations). At these locations, seepage from the bottom of areas where runoff is retained will percolate downward into the near-surface primary water-bearing formations underlying the Valley, recharging the basin. The additional flooded areas created under this scenario would both serve to alter downstream hydrographs by attenuating peak flows, while increasing the time over which stormwater runoff is allowed to infiltrate. Additional testing is needed to confirm the viability of this benefit in identified concept areas.

Figure 16 shows the potential locations identified for potential floodplain modifications. These locations are generally extensions of existing floodplains in relatively flat areas (about 2% slope or less) that do not overlie existing structures. If a suitable project site cannot be found within this concept area, the concept area will be extended to include areas with slopes up to 10%. Some areas may be outside of the 1,000-foot zone applied to other concepts.

Figure 16: Potential Locations for Floodplain Modifications



Concept Objective Analysis

Table 8 summarizes how floodplain modifications achieve or could achieve the core and supporting objectives identified for this Project.

Table 8: Floodplain Modification Concept Objectives

Objective	Objective Achieved	Notes
Flood Hazard Reduction	Yes	The concept would be designed to reduce the peak hydrograph, reducing downstream flooding potential. However, while achieving the flood hazard reduction objective (for a specific area), this concept also need to be evaluated for the potential to result in flood impacts outside of the concept area.
Groundwater Recharge	Yes	The modified floodplain concept will increase the wetted area in the streambed, thereby promoting additional groundwater recharge.
Water Quality	Yes	The modified floodplain will provide opportunity for additional settling, reducing some runoff contaminants. Depending on design, the lower floodplain may provide other water quality benefits such as biofiltration and uptake of constituents such as nitrates.
Water Supply	Maybe	.Floodplain modification may have the potential to recharge groundwater by providing a greater wetted area for recharge and slowing flows such that there is an extended period of time over which recharge may occur. Extent of recharge for supply is location dependent.
System Sustainability	Yes	This long-term solution could be designed to enhance sediment management and transport within the system by acting as a sediment bank (sediments deposited on the created bench would be available for entrainment by future high flows with sediment transport capacity).
Ecosystem	Yes	While there could be some riparian impacts they would be relatively high on the channel banks, reducing overall impact. What was lost could be mitigated for with new plantings and habitat creation in the benched floodplain. Impacts are only on one side of the channel.
Agricultural Land	Yes	The concept would not require agricultural lands for implementation unless they were within the identified area for protection. Once lowered, the floodplain could potentially be returned to agricultural use.
Undeveloped Land	Yes	The concept would not require undeveloped land unless they were within the identified area for protection. Once lowered, the floodplain could be maintained as a designated open space.
Community Benefits	Maybe	Feature and land owner preference dependent.

Comparison Construction Cost Estimate

The estimated construction cost for this concept will vary, to some degree, by who owns the aquatic and riparian lands at and immediately adjacent to the proposed project site. The base concept involves construction within the riparian corridor. The cost of this concept relative to increased flood protection is medium, as is the cost of the concept relative to increased recharge. Floodplain modification is anticipated to provide fewer additional benefits than detention basins for approximately the same cost.

Additional Benefits and Constraints

Table 9 summarizes additional considerations when evaluating the floodplain modifications concept. This information is based on the level of detail developed at this conceptual stage.

Table 9: Additional Concept Considerations for Floodplain Modification

Area	Description
Environmental Considerations	Environmental impacts will be dependent on the project size, design and location.
Permitting	A Section 404 permit will likely be required from the U.S. Army Corps of Engineers, and a Section 401 Water Quality Certification will likely be required from the Regional Water Quality Control Board. Further, a Section 1601 Streambed Alteration Agreement may also be required from the California Department of Fish and Game. Coordination with National Marine Fisheries Service would be necessary on steelhead streams and with U.S. Fish and Wildlife Service in other sensitive habitat areas. Additionally, permits will be required for grading and construction of concept features.
Right-of-way	Parcels for the project would need to be acquired as either easement or fee title, along with necessary right-of-ways for accessing the acquired parcels.
Construction	Construction is dependent on the features that are to be included with the concept. Construction would likely be limited to earth grading, replanting and some light construction for trails and interpretation sites as necessary, in addition to concept features.
Operations & Maintenance	Minimal O&M is required for this concept to maintain its effectiveness. Additional features such as trails and interpretation sites would need to be maintained.
Funding	Funding sources are dependent on the final purpose and features of the project. State grants have been available for project of this type in the past. The multi-benefit opportunities of the concept will increase the number of funding sources.
Regulatory	Regulatory agency involvement is anticipated for this concept. As described above, additional features could trigger additional oversight.
Willing Land Owner	Willing land owners are necessary for this concept to be successful.
Integration with Other Concepts	This concept can be integrated with other concepts to provide a regionally-comprehensive flood hazard reduction project.

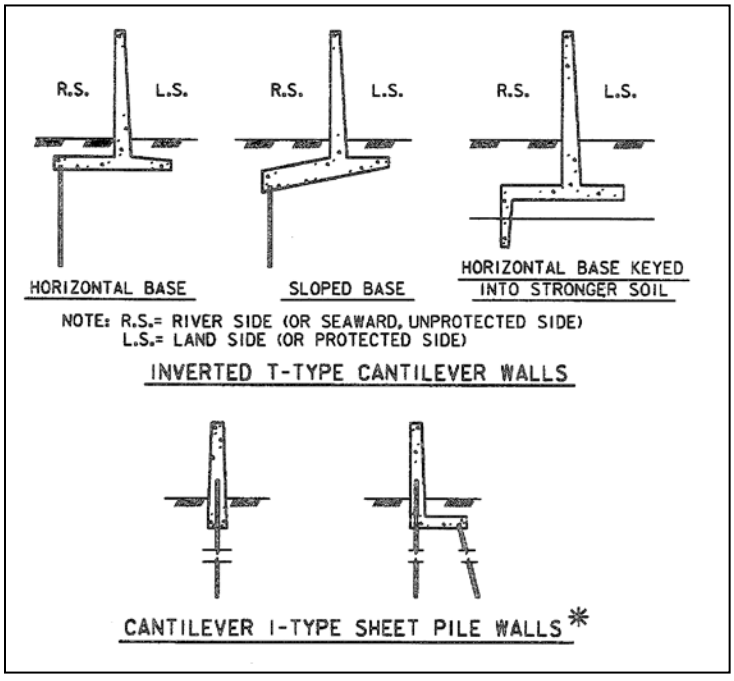
Area	Description
Additional Studies	Additional hydraulic studies are necessary to quantify the benefit of the project to downstream reaches. Geologic studies are necessary to refine the understanding of recharge potential on a site-by-site basis. Geomorphological studies are required to assess sediment transport characteristics of the system with this concept. Additional water quality testing is necessary to better understand existing and potential threats to aquifer water quality. Biological surveys will also be required to determine the potential extent of aquatic and riparian impacts resulting from construction of the project.

4.5 Levee/Floodwall

Concept Elements

Levees and floodwalls constrain flow to a narrower pathway than the existing floodplain. Levees are earthen structures that are generally trapezoidal in shape. A road is often located on the top of the levee for both observation purposes and maintenance access to both sides of the structure. Recreational trail access could be included by designing the road to be dual function. Floodwalls have a smaller overall footprint than levees. Access roads for maintenance and potentially trails would be located next to the flood wall. **Figure 17** show a cross section for several types of floodwalls. The location of the levee or floodwall relative to the waterway is dependent on the limitations of the surrounding area. Where constricted, the structures can be placed closer to the channel. Where there is a local floodplain where flooding is acceptable, setback levees are a good option to minimize riparian impacts and potentially offer additional benefits. Channel stability would need to be examined as part of the design process and likely improved. This could be through bio-technical stabilization methods or less natural methods where necessary.

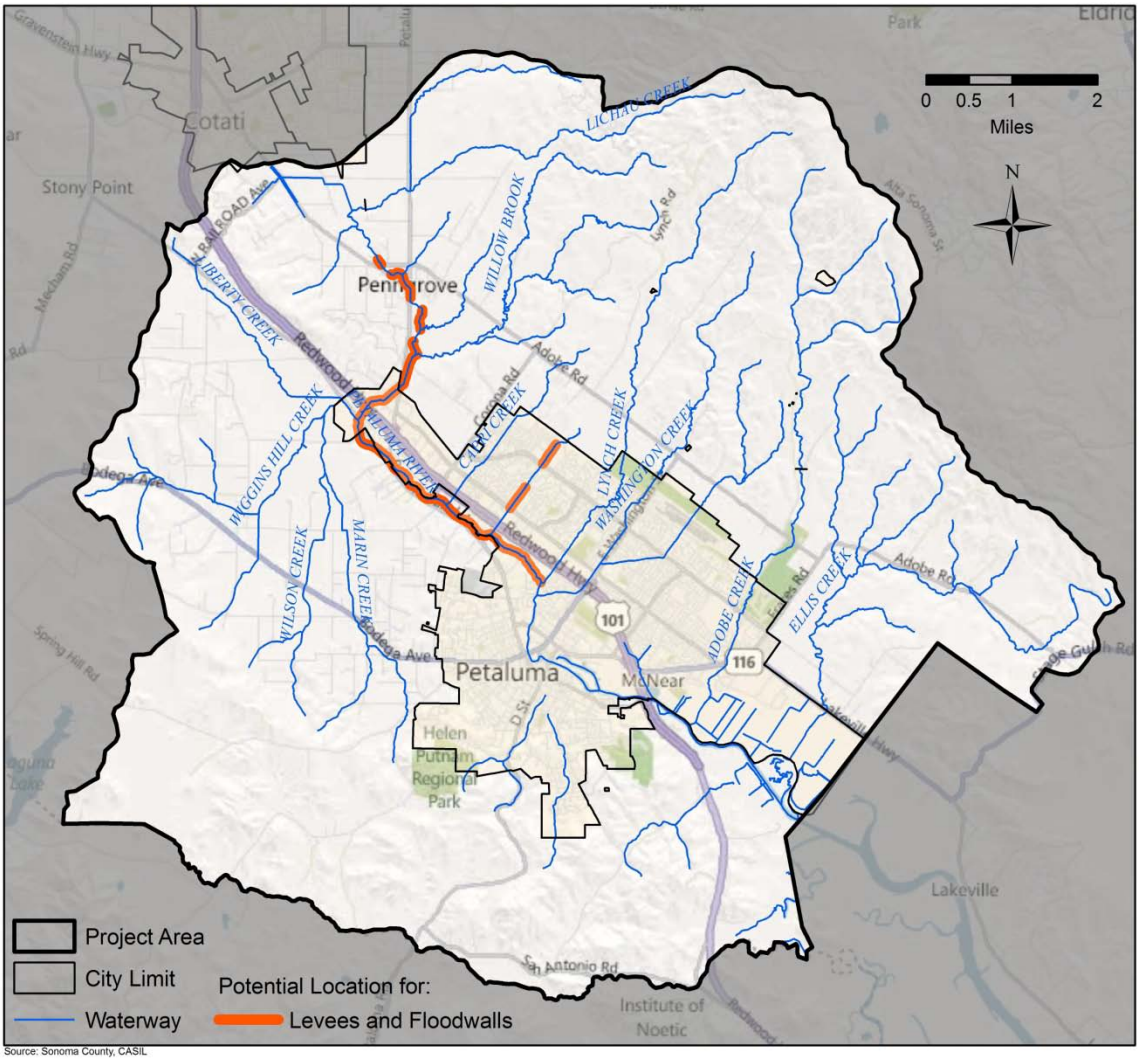
Figure 17: Common Types of Floodwalls



Source: Army Corps of Engineers, 1989

While it is possible to travel longitudinally along this concept, it is difficult to cross a levee, and especially a floodwall. Therefore levees and floodwalls are least disruptive where crossings are more controlled, such as via bridges. Pasture lands and farms that cross waterways are typically not ideal locations for levees and floodwalls. **Figure 18** shows potential locations where levees or floodwalls could be considered for this Project. These are generally areas with identified 100-year floodplains and within an urban area.

Figure 18: Potential Locations for Levees and Floodwalls



Concept Objective Analysis

Table 10 summarizes how levees and floodwalls achieve or could achieve the core and supporting objectives identified for this Concept.

Table 10: Levees and Floodwalls Concept Objectives

Objective	Objective Achieved	Notes
Flood Hazard Reduction	Yes	The level of flood hazard reduction and the areas with reduced flooding hazards would depend on the location of the project and the design. However, while achieving the flood hazard reduction objective (for a specific area), this concept also need to be evaluated for the potential to result in flood impacts outside of the concept area.
Groundwater Recharge	No	The concept does not provide additional infiltration surface, improve surface characteristics for recharge, or detain water for additional percolation time.
Water Quality	Maybe	In areas where water is conveyed more quickly, it is possible that fewer contaminants would be mobilized in the ground due to infiltrated groundwater.
Water Supply	No	Recharge and offsetting water supplies are not envisioned to be a part of this concept.
System Sustainability	Yes	Stabilization of the channel would be an important component of the concept. Geomorphological processes would be considered during design. No imported energy is necessary for this concept to function.
Ecosystem	Maybe	Setback levees and floodwalls could provide for additional habitat if land use were converted within the concept area. .
Agricultural Land	Yes	The concept would likely not require agricultural lands as they are not the identified protection area.
Undeveloped Land	Yes	The concept would likely not require undeveloped land as they are not likely to be within the identified protection area.
Community Benefits	Maybe	Trails and other recreational and educational features could be incorporated into levee design.

Comparison Construction Cost Estimate

The estimated construction cost for this concept will vary based on the type of structure selected (levee versus floodwall) and the cost of the land required for its location. The base concept involves construction within the riparian corridor. The cost of this concept relative to increased flood protection is low. The cost of this concept relative to increased recharge is, however, very high as there are no recharge benefits associated with this concept. Levees and floodwalls are anticipated to have relatively low cost compared to the earthwork required to provide the same conveyance capacity through enlarging the channel.

Additional Benefits and Constraints

Table 11 summarizes additional considerations when evaluating the levees and floodwalls concept. The description of these considerations is based on the level of detail developed at this conceptual stage.

Table 11: Additional Concept Considerations for Levees and Floodwalls

Area	Description
Environmental Considerations	Current standards often limit vegetation around both levees and flood walls. This could have serious implications on the amount and quality of habitat near the waterway as well as in-stream conditions. The concept can also potentially impact the movement of some species. Floodwalls, as they are constructed vertical structures, are particularly susceptible to this.
Permitting	Construction and regulatory permits would be required for this concept. Some regulatory agencies that would require permits include California Department of Fish and Game, Regional Water Quality Control Board, and the US Army Corps of Engineers. Coordination may also be required with the National Marine Fisheries Service and U.S. Fish and Wildlife Service.
Right-of-way	Right-of-way would be required for at least the footprint of the levee/floodwall and the creek in between the opposing structures for maintenance purposes.
Construction	Construction would require large earth moving and grading equipment for levees and floodwalls. Depending on materials, floodwalls may require additional equipment to work with the metals or concrete.
Operations & Maintenance	Levees and floodwalls would need to be inspected and maintained regularly. Sediment and vegetation within the conveyance area would need to be maintained and sometimes removed. Use of appropriate design concepts would minimize the need for extreme maintenance except under special circumstances.
Funding	Funding may be available for this concept under some state funding programs such as Proposition 1E..
Regulatory	Placement of the levees and floodwalls can determine the amount and types of impacts that the concept would create, thus adjusting the amount of regulatory scrutiny. This concept would generally involve significant regulatory agency participation.
Willing Land Owner	A willing land owner is necessary for this concept. Since there is a change in land form and responsibility for maintenance, fee title acquisition would be preferred as opposed to an easement.
Integration with Other Concepts	Implementation may or may not induce flooding elsewhere depending on site specific conditions. If it is shown to do so, due to the reduction of attenuation, the concept could be paired with an attenuation-type project to offset the impacts downstream. This concept can be integrated with other concepts to provide a regionally-comprehensive flood hazard reduction project.

Area	Description
Additional Studies	Additional modeling is necessary to confirm that downstream flooding is not induced through implementation of this concept. Geomorphological studies are required to assess sediment transport characteristics of the system with this concept. Biological surveys will also be required to determine the potential extent of aquatic and riparian impacts resulting from construction of the project.

4.6 Channel Modifications

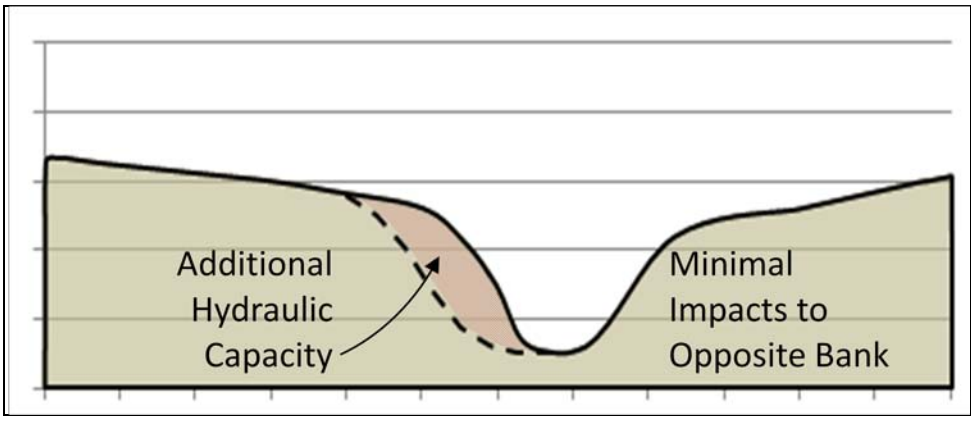
Concept Elements

This concept is assumed to be expansion of the channel rather than vegetation or sediment removal. Vegetation and sediment removal are considered maintenance activities and should be performed regularly according to the permitted maintenance plan.

Channel expansion involves excavation of the channel or reshaping of the channel section to provide additional hydraulic capacity. Since flood hazard reduction activities for this Project are focused on areas where channel width is not overly restricted (e.g. outside of downtown Petaluma), it is preferable to expand the channel in a more natural shape and maintain earthen banks rather than create smoother, more vertical walls as in a U-shaped channel. This will facilitate better sediment balance and opportunity for vegetation and habitat maintenance or improvement.

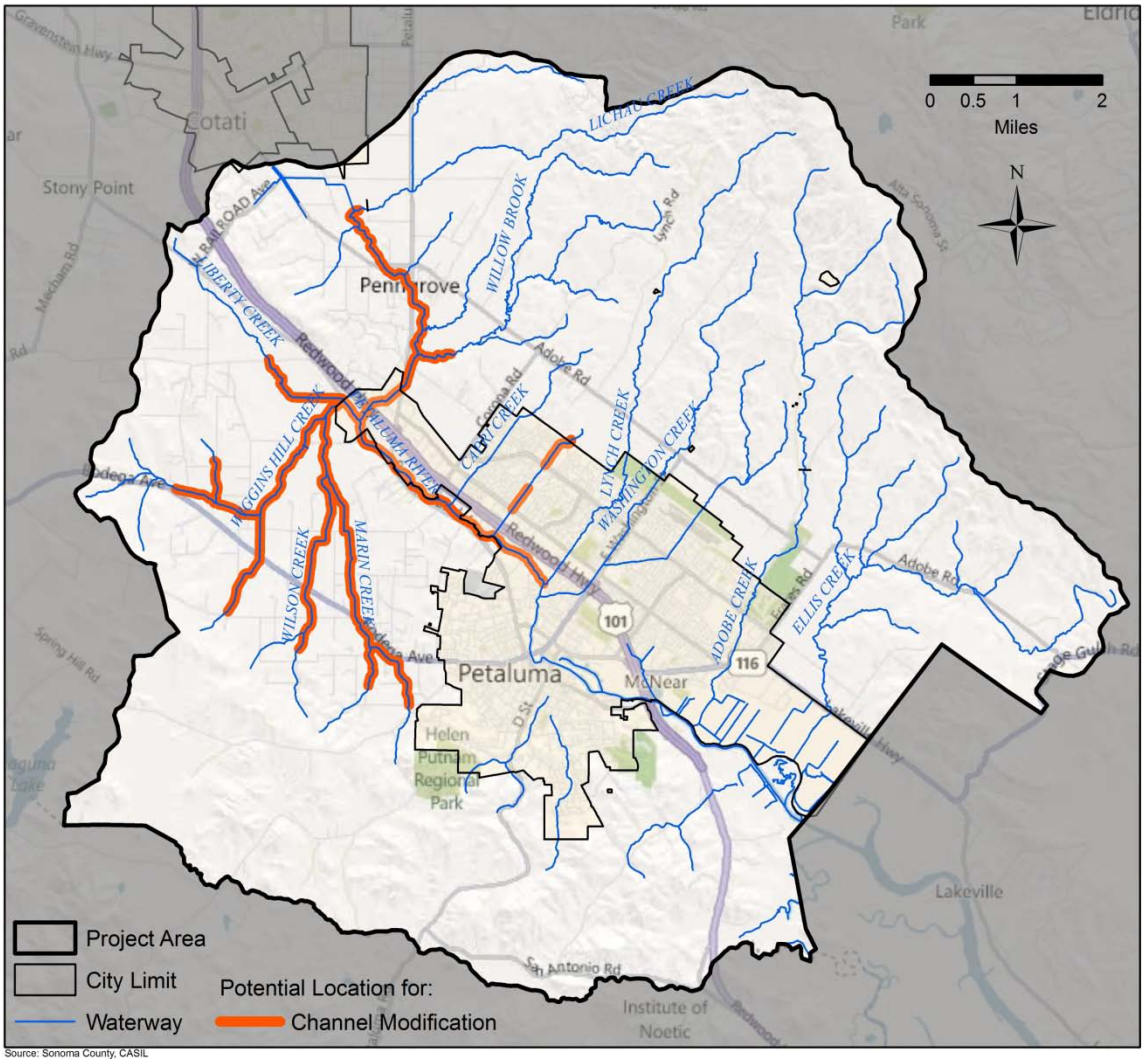
Expanding the channel will increase its cross-sectional area and provide for increased hydraulic capacity. Channel widening is achieved through excavation. By excavating on only one side of the channel it is possible to minimize impacts to resources on the opposite bank, such as the existing vegetation, as shown in **Figure 19**. There is also an opportunity to establish grade control or adjust channel slope over short distances to adjust sediment transport characteristics of the channel. Maintenance roads are an important tool to maintain the channel. A high maintenance road will allow access during all flow conditions and a good observation point during high flows. A low maintenance road provides access to the lower parts of the channel during low flows and provides access without damaging vegetation during creating of new access roads. One or more of the access roads could be used as a trail.

Figure 19: Channel Modification Concept Section



This concept is hydraulically feasible in any location with flooding. **Figure 20** shows channels within in the 100-year floodplain in the flood protection focus area where there may be an opportunity to expand the channel.

Figure 20: Potential Locations for Channel Modifications



Concept Objective Analysis

Table 12 summarizes how channel modifications achieve or could achieve the core and supporting objectives identified for this Project.

Table 12: Channel Modification Concept Objectives

Objective	Objective Achieved	Notes
Flood Hazard Reduction	Yes	The concept would be designed to reduce the peak hydrograph, reducing downstream flooding potential. However, while achieving the flood hazard reduction objective (for a specific area), this concept also need to be evaluated for the potential to result in flood impacts outside of the concept area.
Groundwater Recharge	Maybe	Channel modification may have the potential to recharge groundwater by providing a greater wetted area for recharge and slowing flows such that there is an extended period of time over which recharge may occur..
Water Quality	Maybe	In areas where water is conveyed more quickly, it is possible that fewer contaminants would be mobilized in the ground due to infiltrated groundwater.
Water Supply	Maybe	Channel modification may have the potential to recharge groundwater by providing a greater wetted area for recharge and slowing flows such that there is an extended period of time over which recharge may occur. The degree to which a water supply benefit is achieved is location dependent.
System Sustainability	Yes	Sediment transport and channel stability would be considered during design. No imported energy is necessary for this concept to function.
Ecosystem	Maybe	Excavation on one side of the channel will minimize impacts to existing vegetation. Channel improvements such as shade and in-stream features could improve habitat.
Agricultural Land	Yes	The concept would not require agricultural lands unless they were within the identified protection area.
Undeveloped Land	Yes	The concept would not require undeveloped land unless they were in the identified protection area.
Community Benefits	Maybe	Trails could be incorporated into the concept design.

Comparison Construction Cost Estimate

The estimated construction cost for this concept assumes that channel modifications will occur within the public right-of-way, and therefore there will be no associated land acquisition costs or easements necessary. The cost of this concept relative to increased flood protection is medium while the cost of this concept relative to increased recharge is high. Channel modification is anticipated to have a cost:value ratio comparable to the floodplain modification concept for flood hazard reduction. Recharge benefits are anticipated to be lower however.

Additional Benefits and Constraints

Table 13 summarizes additional considerations when evaluating the channel modification concept. The description of these considerations is based on the level of detail developed at this conceptual stage.

Table 13: Additional Concept Considerations for Channel Modifications

Area	Description
Environmental Considerations	The excavation and removal of existing vegetation will need to be mitigated based on conversations and negotiations with regulatory agencies.
Permitting	A Section 404 permit will likely be required from the U.S. Army Corps of Engineers, and a Section 401 Water Quality Certification will likely be required from the Regional Water Quality Control Board. Further, a Section 1601 Streambed Alteration Agreement may also be required from the California Department of Fish and Game. Coordination may also be required with the National Marine Fisheries Service and U.S. Fish and Wildlife Service. Additionally, permits will be required for grading and construction of concept features.
Right-of-way	Right-of-way would be required for the existing and widened creek sections for maintenance purposes.
Construction	Construction would likely be limited to earth grading, replanting and some light construction for trails and interpretation sites as necessary, in addition to concept features.
Operations & Maintenance	Channel wall stability would need to be inspected and maintained. Sediment and vegetation within the conveyance area would need to be maintained and sometimes removed. Use of appropriate design concepts would minimize the need for extreme maintenance.
Funding	Funding may be available for this concept under some state funding programs such as Proposition 1E.
Regulatory	This concept would generally involve significant regulatory agency participation.
Willing Land Owner	A willing land owner is necessary for this concept. Since there is a change in land form, fee title acquisition would be preferred as opposed to an easement.
Integration with Other Concepts	Implementation should not induce flooding elsewhere. If it is shown to do so, due to the reduction of attenuation, the concept could be paired with an attenuation-type project to offset the impacts downstream.
Additional Studies	Additional hydraulic studies are necessary to quantify the benefit of the project to downstream reaches. Geomorphological studies are required to assess sediment transport characteristics of the system with this concept. Biological surveys will also be required to determine the potential extent of aquatic and riparian impacts resulting from construction of the project.

4.7 Bypass Channel

Concept Elements and Alternatives

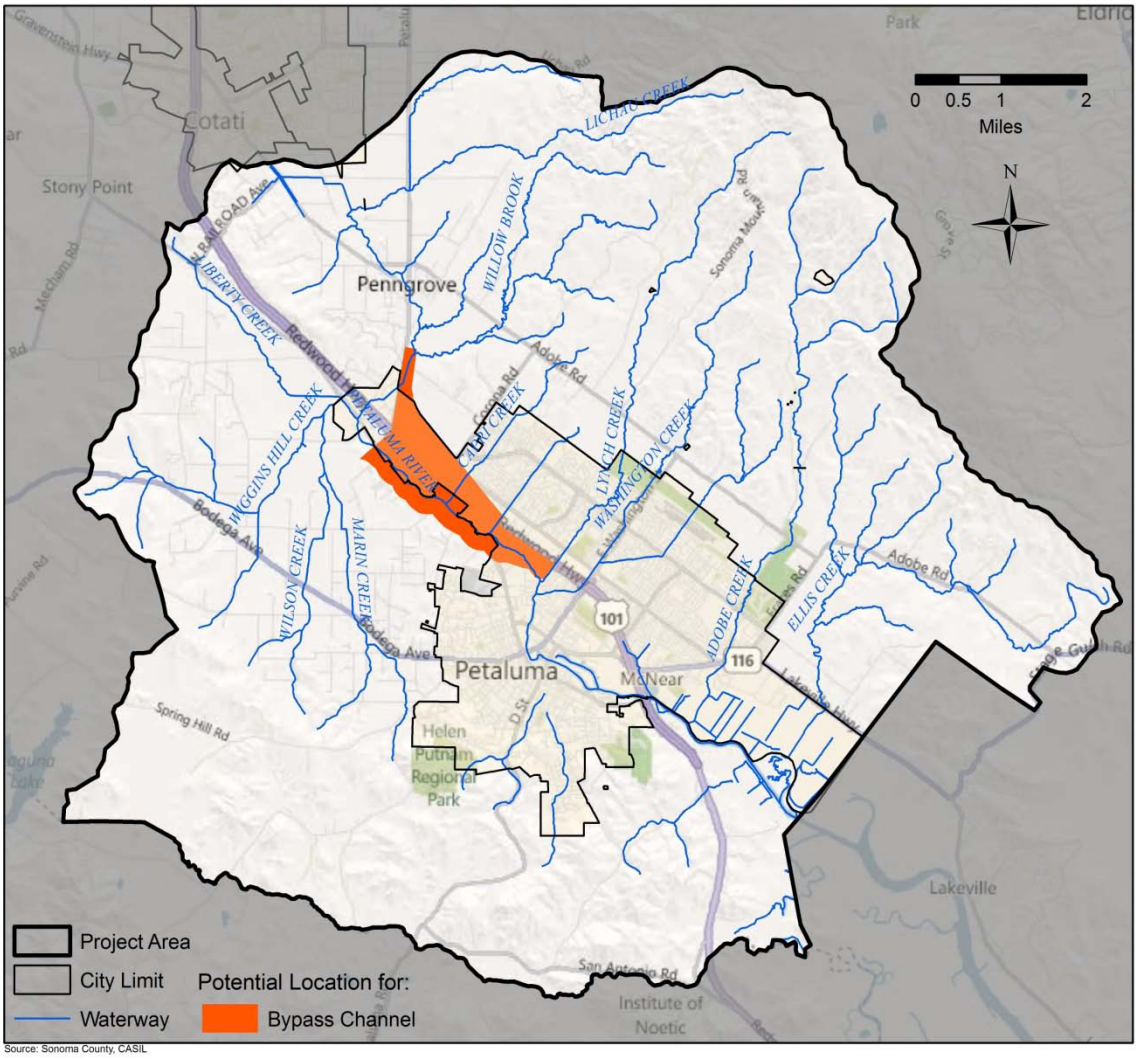
A bypass channel could be constructed to add additional hydraulic capacity to the waterway system. The concept would be limited to a high flow bypass. This means that use of the capacity of the existing stream would be maximized and the bypass would only be used to convey the additional flow that would have caused flooding. This arrangement continues to allow environmental flows in the existing channel. A passive weir structure would set the water surface elevation that triggers use of the high flow bypass. Depending on fish stranding concerns, an exclusion device could be located at the downstream end of the bypass.

The concept would be realized differently in developed and rural areas as described:

- Developed – The bypass channel would be a buried culvert. It would likely be located in a public right-of-way, for example underneath a street. This configuration would allow surface uses to continue after construction of the bypass. Utility relocation is an added cost that is dependent on the location and size of the culvert as well as the type of utility. The actual bypass would likely be constructed from a precast reinforced concrete box culvert to minimize the time necessary for the street to be open. The box culvert, as opposed to a circular culvert, would also facilitate maintenance.
- Undeveloped – The bypass channel would be an open cut channel. In agricultural areas, channel banks with shallow slopes would allow continued joint use for livestock or mowing. In undeveloped areas, the footprint of the channel could be increased to allow both the necessary hydraulic capacity as well as new habitat that would benefit from periodically inundated conditionsAt least one maintenance/access road would be needed, depending on the size of the channel and local conditions.

Figure 21 shows potential locations for bypass channels in a relatively urban area. The location shown is in a floodplain with undeveloped land and/or roads near the river and creeks. Bypass locations in rural areas are not shown due to the potential impacts to existing land uses.

Figure 21: Potential Locations for Buried Bypass Channels



Concept Objective Analysis

Table 14 summarizes how bypass channels achieve or could achieve the core and supporting objectives identified for this concept.

Table 14: Bypass Channel Concept Objectives

Objective	Objective Achieved	Notes
Flood Hazard Reduction	Yes	The concept would be designed to reduce the peak hydrograph, reducing downstream flooding potential. However, while achieving the flood hazard reduction objective (for a specific area), this concept also need to be evaluated for the potential to result in flood impacts outside of the concept area..
Groundwater Recharge	Maybe	Depending on design and location, there may be an opportunity for recharge, particularly in rural areas. However, the degree to which recharge may be achieved is small due to the design of the bypass channel as a conveyance structure rather than a detention structure.
Water Quality	Yes	The bypass could be oversized to allow for reduced vegetation clearing in the original channel. This would allow additional sedimentation and surface runoff contaminants, particularly trash, to be caught closer to the point of entry into the water system.
Water Supply	Maybe	A bypass channel may have some potential to recharge groundwater, provided the bottom is unlined, due to the additional wetted area available for recharge.
System Sustainability	Yes	Sediment transport and channel stability would be considered during design, both in the original channel and the bypass. No imported energy is necessary for this concept to function.
Ecosystem	Yes	The bypass could be oversized to allow for reduced vegetation clearing in the original channel. This would allow additional habitat preservation and lower maintenance requirements in the original channel.
Agricultural Land	Yes	The concept would not require agricultural lands unless they were within the identified protection area. Partnering with neighboring land owners on design concepts could allow joint use.
Undeveloped Land	Yes	The concept would not require undeveloped land unless they were in the identified protection area. Oversizing the channel could lead to enhancements by providing additional space for riparian habitat.
Community Benefits	Maybe	Trails could be incorporated into the concept design. The diversion and re-entry points of the bypass channel would be good locations for interpretive signs, particularly in developed areas.

Comparison Construction Cost Estimate

Land costs associated with this concept will vary considerable based on the size, location, and type of bypass channel constructed. The cost of this concept relative to increased flood protection is medium, as is the cost of this concept relative to increased recharge. The cost:value ratios are anticipated to be comparable to those of the floodplain modification concept.

Additional Benefits and Constraints

Table 15 summarizes additional considerations when evaluating the bypass channel concept. The description of these considerations is based on the level of detail developed at this conceptual stage.

Table 15: Additional Concept Considerations for Bypass Channels

Area	Description
Environmental Considerations	Environmental considerations will be different between a buried culvert bypass in a developed setting vs. an open cut bypass in a rural setting. A rural open cut channel has a higher potential for environmental impacts as the developed area has already impacted the natural environment. Since the bypass will be for high flows only, in-stream environmental conditions (e.g. minimum flow rates, temperature limits, etc) will be maintained.
Permitting	Construction and regulatory permits would be required for this concept, especially as they related to the inlet and outlet of the bypass channels. A Section 404 permit will likely be required from the U.S. Army Corps of Engineers, and a Section 401 Water Quality Certification will likely be required from the Regional Water Quality Control Board. Further, a Section 1601 Streambed Alteration Agreement may be required from the California Department of Fish and Game. Additional permits and/or coordination may be required from/with National Marine Fisheries Service and U.S. Fish and Wildlife Service.
Right-of-way	In developed areas, the bypass would be located in public rights-of-way, such as roads, or private property, such as parking lots. This concept reduces the amount of acquisition necessary In rural areas, right-of-way would be required for the channel and access along the channel. Both easement or fee title could be acceptable.
Construction	In developed areas, construction would require excavation equipment and cranes to assemble the precast culvert pieces. There would likely be some impact to local businesses and residents depending on the alignment. In rural areas, construction would require large earth moving and grading equipment.
Operations & Maintenance	Operations and maintenance would be based on regular visual inspections to confirm that hydraulic capacity is available in the bypass and original channel. Some sediment removal could be necessary from the bypass, but use of appropriate design concepts would minimize the need for extreme maintenance.
Funding	Funding may be available for this concept under some state funding programs such as Proposition 1E.

Area	Description
Regulatory	Regulatory participation would be dependent on the alignment of the bypass and the associated impacts. The diversion and re-entry points would likely draw much of the attention of the regulatory agencies as those are the points where the stream would be impacted by the project.
Willing Land Owner	A willing land owner is necessary for this concept.
Integration with Other Concepts	Implementation should not induce flooding elsewhere. If it is shown to do so, due to the reduction of attenuation, the concept could be paired with an attenuation-type project to offset the impacts downstream.
Additional Studies	Additional hydraulic studies are necessary to quantify the benefit of the project to downstream reaches. Geologic studies are necessary to refine the understanding of recharge potential on a site-by-site basis. Geomorphological studies are required to assess sediment transport characteristics of the system with this concept. Biological surveys will also be required to determine the potential extent of impacts resulting from construction of the project.

4.8 Bridge Improvement and Debris Removal

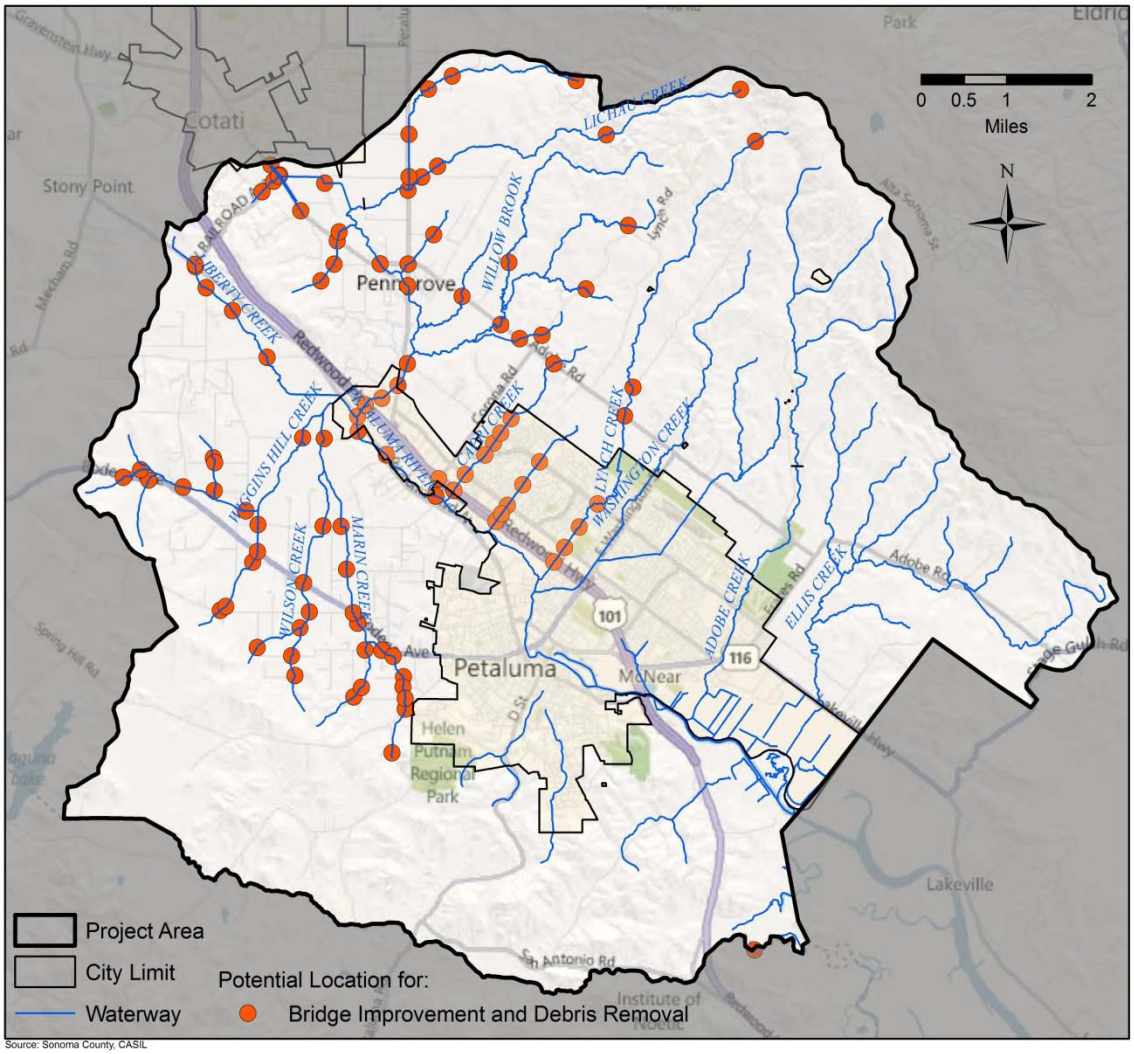
Concept Elements and Alternatives

Bridges sometimes collect debris (e.g. sediment, vegetation, trash) which can limit their hydraulic capacity so much that flooding is induced. Where this occurs, the problem can be addressed either through more regular maintenance or reforming the bridge approach, adding upstream debris collectors, or changing the shape and design of the bridge piers. This concept assumes that existing maintenance is not adequate to address the flooding issues.

Implementation of the concept would involve inspection and review of bridges within the Project area for evidence of recent flooding due to debris build-up. Review would include the collection and analysis of anecdotal data, identification of high water marks, and maintenance records in addition to hydraulic modeling to predict how the bridge would function without debris. Where there was evidence of flooding due to debris build-up, the bridge and upstream channel would be examined to identify potential solutions to reduce the build-up of debris. Potential solutions include addition of pier noses (shown in **Figure 22**), redistribution of piers, channel straightening, or construction of barriers to large debris. **Figure 23** shows the location of crossings over creeks in the watershed upstream of the Lynch Creek and Petaluma River confluence.

Figure 22: Pier Noses

Figure 23: Potential Locations for Bridge Improvement and Debris Removal



Concept Objective Analysis

Table 16 summarizes how bridge improvement and debris removal achieves or could achieve the core and supporting objectives identified for this Project.

Table 16: Bridge Improvement and Debris Removal Concept Objectives

Objective	Objective Achieved	Notes
Flood Hazard Reduction	Yes	Local flooding due to debris build-up would be addressed. However, while achieving the flood hazard reduction objective (for a specific area), this concept also need to be evaluated for the potential to result in flood impacts outside of the concept area.
Groundwater Recharge	No	The concept does not provide additional infiltration surface, improve surface characteristics for recharge, or detain water for additional percolation time.
Water Quality	No	This concept is not envisioned to significantly change either the surface water quality or groundwater quality.
Water Supply	No	Enhancement of water supply reliability is not envisioned to be a part of this concept.
System Sustainability	Yes	This concept could lead to easier passage of sediment, restoring a more natural geomorphological balance. This concept could also lead to less intensive maintenance activities.
Ecosystem	No	This concept does not improve ecosystem function.
Agricultural Land	Yes	This concept would require little, if any, agricultural land. If it did require the use of any agricultural land it would likely be for the benefit of the upstream agricultural land.
Undeveloped Land	Yes	It is not envisioned that this concept would be required at undeveloped land and would therefore not require any open space or undeveloped land.
Community Benefits	Yes	This concept could improve aesthetics at bridges where unsightly trash and debris impact peoples' appreciation of the stream.

Comparison Construction Cost Estimate

The estimated construction cost for this concept assumes that all bridge improvements will occur within the public right-of-way, and therefore there will be no associated land acquisition costs or easements necessary. Although the benefits associated with debris removal are local only, the cost for such activities relative to increased flood protection is relatively low. Recharge benefits are not expected with this concept. .

Additional Benefits and Constraints

Table 17 summarizes additional considerations when evaluating the bridge improvement and debris removal concept. The description of these considerations is based on the level of detail developed at this conceptual stage.

Table 17: Additional Concept Considerations for Bridge Improvement and Debris Removal

Area	Description
Environmental Considerations	Channel straightening and installation of debris collectors upstream of bridges could have significant environmental impacts.
Permitting	Permitting would vary depending on the recommended solutions, but in most cases a permit would be required from California Department of Fish and Game, Regional Water Quality Control Board, National Marine Fisheries Service, U.S. Fish and Wildlife Service and U.S. Army Corps of Engineers. Where there are modifications to bridge structures or within crossing easements, additional permits would be required from the bridge owner, such as Caltrans, the County, or the City.
Right-of-way	Right-of-way would be necessary for any in-stream feature and for the channel itself for maintenance. Right-of-way would be necessary for realignment of the channel. Changes to the bridge structure would require only temporary construction right-of-way, except where the bridge footprint was increased.
Construction	Construction will vary based on the recommended solution. Concrete work and excavation would likely be necessary for the bridge modifications and upstream debris collectors. Channel straightening would require large earth moving and grading equipment. This work would likely be done primarily in a wet environment.
Operations & Maintenance	Operations and maintenance responsibilities would need to be established on a case-by-case basis and clarified at the inception of this concept. The Water Agency would need to decide whether it is willing to assume responsibility for debris removal from the bridges. This concept does not change the amount of debris in the system but it does change the location of the collected debris. For the debris collectors, O&M would likely increase slightly since it would not be possible to remove debris directly from the bridge piers and some additional transport would be necessary. Debris passed through the bridge would likely be caught elsewhere in the system but potentially in a location that does not require it to be removed, at least in the short term.
Funding	Bridge owners are a potential source of funding for this concept.
Regulatory	This concept would generally involve significant regulatory agency participation.
Willing Land Owner	A willing land owner would be necessary for any channel work. Any bridge work would require the cooperation of and partnership with the bridge owner.
Integration with Other Concepts	Implementation should not induce flooding elsewhere. If it is shown to do so, due to the reduction of attenuation, the concept could be paired with an attenuation-type project to offset the impacts.

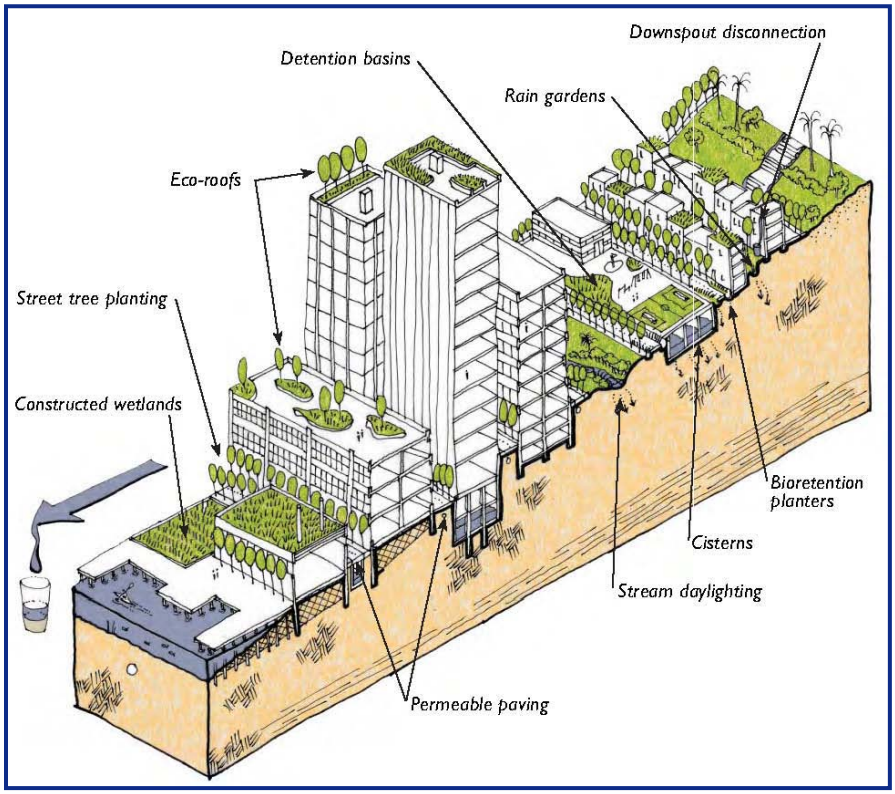
Area	Description
Additional Studies	Geomorphological studies are required to assess sediment transport characteristics of the system with this concept. Biological surveys will also be required where construction is recommended to determine the potential extent of aquatic and riparian.

4.9 Low-Impact Development

Concept Elements and Alternatives

Low impact development (LID) is the term used to describe a land planning and engineering design approach to sustainably manage stormwater runoff. LID emphasizes conservation and use of onsite natural features to protect water quality and encourage stormwater reuse by replicating or restoring natural watershed functions and/or addressing targeted watershed goals and objectives. LID's goal is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. Techniques are based on the premise that stormwater management should not be seen as stormwater disposal. Instead of conveying and managing/treating stormwater in large, costly end-of-pipe facilities located at the bottom of drainage areas, LID addresses stormwater through small, cost-effective landscape features located at the parcel level. These landscape features, known as Integrated Management Practices (IMPs) are the building blocks of LID. Many components of the urban environment have the potential to serve as an IMP, including designated open spaces or undeveloped lands, rooftops, streetscapes, parking lots, sidewalks and medians. Examples of IMPs include the use of porous pavement, bioretention facilities, grass swales and filter strips. **Figure 24** shows some examples of IMPs.

Figure 24: Concept Sketch for Low Impact Development



Source: *Low Impact Design Toolkit*, San Francisco Public Utilities Commission, 2007.

LID has numerous benefits and advantages over conventional stormwater management approaches. It uses environmentally sound technology and is designed to enhance the local environment, protect public health and improve community livability. However, LID is intended to use decentralized site-based source controls to manage more frequent or micro-storms that occur on a regular basis and does not typically control 10- and 100-year storms unless paired with more traditional flow control management techniques. LID's primary strategy of restoring the built area's natural rainfall-runoff relationship is more suitable to the more frequent events. Where there are known flooding problems, a hybrid approach is typically recommended (combining LID BMPs with traditional flow control management techniques) to reduce liability and provide a sense of safety. In fact, the LID national design manual recommends hybrid systems if site constraints warrant it and additional detention is necessary.

While LID techniques, by their nature, are intended to promote infiltration, LID is incorporated into developed areas (through retrofits) or to-be-developed areas (as part of the development process). For this concept, these are areas that typically overlie the younger alluvium at the floor of the valley, and as such, implementation of this concept would limit groundwater augmentation to this formation.

Concept Objective Analysis

Table 18 summarizes how Low Impact Developments achieve or could achieve the core and supporting objectives identified for this Project.

Table 18: Low Impact Development Concept Objectives

Objective	Objective Achieved	Notes
Flood Hazard Reduction	Limited	If broadly implemented, LID has the potential to reduce flood hazards, but may need to be combined with traditional flood hazard reduction techniques (a hybrid approach), if necessary, to address larger flows. The effects of this concept should be evaluated for the potential to result in flood impacts outside of the concept area.
Groundwater Recharge	Yes	Location and scale dependent. While groundwater recharge is achievable through LID, it will be limited to the younger alluvium underlying the valley floor, unless implemented with new development in areas overlying outcroppings of other formations.
Water Quality	Yes	LID BMPs will provide physical, biological and chemical treatment processes that filter pollutants and reduce the loading of some contaminants to downstream flood waters.
Water Supply	Yes	Reuse of stormwater locally will offset potable and groundwater demands, increasing reliability of other water supplies. Additionally, enhanced infiltration resulting from LID implementation may augment the local groundwater supply, though the degree to which this is achieved is scale and location dependent.
System Sustainability	Yes	LID is a sustainable approach to stormwater runoff management.
Ecosystem	Maybe	Use of LID can improve ecosystem habitats under the right circumstances.
Agricultural Land	Yes	Agricultural land use would be preserved with this concept, particularly as the identified concept area is more urban settings.
Undeveloped Land	Yes	Undeveloped land would be preserved with this concept, particularly as the identified concept area is more urban settings.
Community Benefits	Maybe	Feature and land owner preference dependent.

Comparison Construction Cost Estimate

LID IMPs are typically comparable to traditional stormwater management infrastructure in cost, but saves in long-term operations and maintenance costs. The cost of this concept relative to increased flood protection is medium, and the cost of this concept relative to increased recharge is low.

This concept has high value relative to many of the supporting objectives but relatively low value for the primary objectives, particularly flood hazard reduction. Construction costs associated with this concept are anticipated to be offset or paid for by developers during construction. They can also be included in other municipal projects for relatively low cost..

Additional Benefits and Constraints

Table 19 summarizes additional considerations when evaluating the LID concept. This information is based on the level of detail developed at this conceptual stage.

Table 19: Additional Concept Considerations for Low Impact Development

Area	Description
Environmental Considerations	Environmental impacts resulting from implementation of LID are typically minimal, as the objective of LID is to restore the pre-developed watershed characteristics. Environmental benefits may result from concept implementation.
Permitting	Permitting for concept implementation is likely limited to building and grading permits.
Right-of-way	Right-of-ways are not typically required for LID implementation; however, cooperation of the site owner is required and may include the need for temporary easements or encroachment permits.
Construction	Construction is dependent on the features that are to be included with the concept. Construction would likely be limited to earth grading, replanting and some light construction for concept features.
Operations & Maintenance	LID IMPs have been shown to reduce O&M costs over conventional approaches to stormwater management through reduced infrastructure and site preparation work. Cost estimates and pilot programs show at least a 25% to 30% reduction in costs associated with site development, stormwater fees, and maintenance for residential developments that use LID IMP techniques. These savings are achieved through reductions in clearing, grading, pipes, ponds, inlets, curbs and paving. The IMPs would need to be maintained regularly by the owner however to realize these savings.
Funding	Funding sources are dependent on the final purpose and features of the project. State grants have been available for projects of this type in the past. The multi-benefit opportunities of the concept will increase the number of funding sources.
Regulatory	Regulatory agency involvement is anticipated to be minimal for this concept.
Willing Land Owner	Willing land owners are necessary for this concept to be successful.
Integration with Other Concepts	LID IMPs are intended for smaller, more frequent storm events. A hybrid approach is typically recommended for flood management from infrequent larger storm events (i.e. 100-year flood management).
Other	LID IMP use is limited predominantly to developed sites and those to be developed.

4.10 Policy Review and Development

Concept Elements

This concept would involve the following elements:

- Identify entities that can impact flooding and groundwater recharge;
- Identify policies of those entities that impact flooding and groundwater recharge;
- Review of how those policies are implemented and enforced;
- Consider community input on the policies, implementation, and enforcement;
- Revise existing policies and develop new policies as necessary to reduce flood hazards and protect or improve groundwater recharge; and
- Establish a funding mechanism to support any additional effort to implement policies.

This concept is collaborative in nature as it would involve multiple public entities to maximize its effectiveness. It is assumed that most of the policies relating to flood and recharge have to do with land use and development in general rather than specific projects. Policies in different jurisdictions should be complementary so that land use and development on one side of a political boundary does not offset the efforts on the other side of the political boundary.

This concept could be applied to a larger area than just Zone 2A as the Water Agency and County jurisdictions are county-wide.

Concept Objective Analysis

Table 20 summarizes how policy development achieves or could achieve the core and supporting objectives identified for this Project.

Comparison Cost Estimate

While there are no construction costs associated with this concept, implementation will require legislative and legal analyses and public outreach. The cost of this concept relative to increased flood protection and relative to increased recharge is unknown. The concept is anticipated to have a relatively low cost compared to the construction concepts identified in this memorandum. Benefits associated with the primary objectives are dependent on the findings of the review and any new policies developed as a part of the concept implementation.

Additional Benefits and Constraints

Table 21 summarizes additional considerations when evaluating the policy development concept. The description of these considerations is based on the level of detail developed at this conceptual stage.

Table 20: Policy Review and Development Concept Objectives

Objective	Objective Achieved	Notes
Flood Hazard Reduction	Maybe	Achieving this objective is dependent on the policies reviewed and updated or developed. The project concept would serve to remind staff and the public of existing policies that help to reduce flood hazards even if new policies are not required.
Groundwater Recharge	Maybe	Achieving this objective is dependent on the policies reviewed and updated or developed. The project concept would serve to remind staff and the public of existing policies that help to improve recharge even if new policies are not required.
Water Quality	Maybe	Achieving this objective is dependent on the policies reviewed and updated or developed. It is considered likely that policies affecting water quality could be tied to flood reduction and increased recharge.
Water Supply	Maybe	Achieving this objective is dependent on the policies reviewed and updated or developed. It is considered likely that policies affecting water supply could be tied to flood reduction and increased recharge.
System Sustainability	Maybe	Achieving this objective is dependent on the policies reviewed and updated or developed. It is considered likely that policies affecting system sustainability could be tied to flood reduction and increased recharge.
Ecosystem	Maybe	Achieving this objective is dependent on the policies reviewed and updated or developed. It is considered likely that policies affecting ecosystem function and habitat could be tied to flood reduction and increased recharge.
Agricultural Land	Maybe	It is uncertain how the policies and policy updates will impact agricultural land. It is highly likely though that agricultural land will continue to be a valuable asset to the concept area.
Undeveloped Land	Maybe	It is uncertain how the policies and policy updates will impact undeveloped land. It is highly likely, though, that undeveloped land will continue to be a valuable asset to the concept area and could be designated as permanent open space.
Community Benefits	Maybe	Achieving this objective is dependent on the policies reviewed and updated or developed. It is considered likely that policies affecting community benefits could be tied to flood reduction and increased recharge.

Table 21: Additional Concept Considerations for Policy Review and Development

Area	Description
Environmental Considerations	Environmental considerations would be one of the primary review elements for the concept.
Permitting	No permitting is necessary for this concept.
Right-of-way	No right-of-way is necessary for this concept.
Construction	No construction is necessary for this concept.
Operations & Maintenance	No operations and maintenance is necessary for this concept.
Funding	Funding for this concept would likely be through existing budgets of the participating agencies.
Regulatory	Coordination with regulatory agencies may be involved to clarify positions on existing and new policies.
Willing Land Owner	No lands are necessary for this concept. It is envisioned that there would be an opportunity for residents within the concept area to participate in the project.
Integration with Other Concepts	This concept does not need to be integrated with other concepts.
Additional Studies	Additional studies may be required to support the development of new policies.

4.11 Direct Recharge Wells

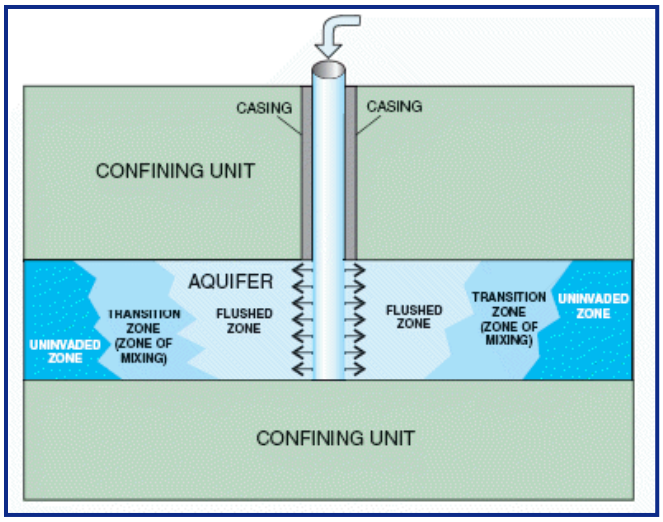
Concept Elements and Alternatives

In brief, direct recharge is where recharge water is put directly into the underground water-bearing formations for storage and subsequent retrieval and reuse, as shown in **Figure 25**. Direct recharge is suitable for areas where the large infiltration/percolations basins are not feasible or where the primary water-bearing formations are not in direct connection to the overlying land.

In the direct recharge concept, recharge wells are used to place stormwater runoff into the underlying basin aquifers. Key to a successful direct recharge project is the quality of the recharge water. In many cases (especially with surface water), the recharge water is treated sufficiently prior to recharge to ensure that the well screens and/or the adjacent aquifer formations do not plug with particulates or organic material and to ensure that the aquifer itself is not contaminated.

A typical recharge well site includes facilities for delivering the recharge water plus the wells and wellhead facilities required for the recharge process itself. Often included at the site are pre-treatment facilities and recovery facilities (in the form of extraction wells and or dual-purpose wells). A settling basin is recommended to improve stormwater quality prior to placement. The basin would also serve as a storage unit to capture the flashy flood flows to increase the amount of volume available for recharge at a steady rate.

Figure 25: Concept Sketch for Direct Recharge



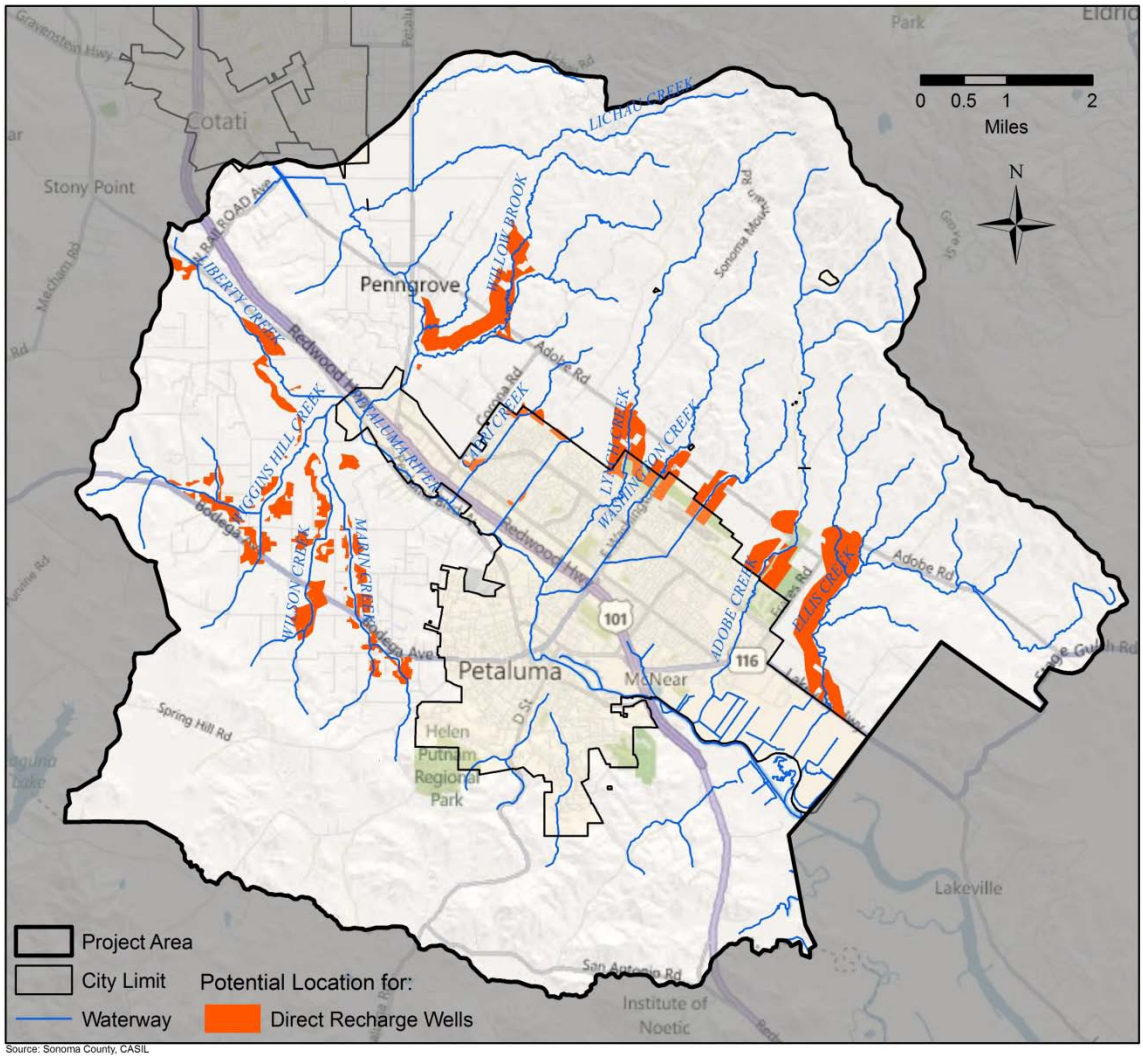
Source: United States Geological Survey as viewed at http://www.netl.doe.gov

Figure 26 shows the potential locations identified for potential direct recharge. These areas are outside of the 100-year floodplain, in relatively flat areas (around 2% slope or less), over the assumed location of the Wilson Grove and Petaluma formations (not limited to their outcroppings) or local alluvium, and within around 1,000 feet of the waterway without impacting existing structures. If an appropriate project site cannot be identified in this defined area, the area will be expanded to include areas with slopes up to 10%.

Concept Objective Analysis

Table 22 summarizes how direct recharge achieves or could achieve the core and supporting objectives identified for this Project.

Figure 26: Potential Locations for Direct Recharge



Source: Sonoma County, CASIL

Table 22: Direct Recharge Concept Objectives

Objective	Objective Achieved	Notes
Flood Hazard Reduction	No	Direct recharge is for groundwater augmentation; it will have no significant flood hazard reduction effects.
Groundwater Recharge	Yes	Direct recharge allows for the placement of recharge water directly into the water-bearing formations of interest.
Water Quality	Maybe	This concept does have the potential to create water quality impacts. The level of these impacts will be depend on the quality of water used for recharge and the potential for geochemical reactions resulting from the subsurface mixing of recharge waters and ambient groundwater.
Water Supply	Yes	All water captured under this concept would be used for direct recharge and will therefore augment aquifers currently utilized as water supply.
System Sustainability	No	Individual sites for this concept have a high likelihood of fouling due to particulates and organics in the source water. When this happens and maintenance fails to clear the fouling the site would be abandoned. The concept is also not a passive system (as the other concepts are) but solar energy could be explored.
Ecosystem	No	This concept would not improve ecosystem function or habitat.
Agricultural Land	No	The well site and settling basin could require some agricultural land depending on location.
Undeveloped Land	No	The well site and settling basin could require some undeveloped land for implementation, depending on location.
Community Benefits	Maybe	Well site tours could be hosted as a part of water supply education.

Comparison Construction Cost Estimate

Groundwater recharge projects vary considerably based on water quality, depth to the target formation and the relative need for facilities. The cost of this concept relative to increased flood protection is not applicable as this concept does not provide any flood protection benefits. The cost of this concept relative to increased recharge is low as this concept is the most effective at recharging the basin relative to construction cost.

Additional Benefits and Constraints

Table 23 summarizes additional considerations when evaluating the Direct Recharge concept. This information is based on the level of detail developed at this conceptual stage.

Table 23: Additional Concept Considerations for Direct Recharge

Area	Description
Environmental Considerations	Environmental impacts resulting from implementation of direct recharge are primarily related to groundwater quality changes. This can include both the introduction of contaminants into the subsurface as part of the recharge process and/or geochemical processes resulting from the mixing of recharge water with ambient groundwater.
Permitting	Key permits for direct recharge include the Federal Class V Underground Injection Control Permit from the U.S. Environmental Protection Agency, and Waste Discharge Requirements from the Regional Water Quality Control Board. Other permits will include a well construction permit from Sonoma County. Grading and building permits may also be required for wellhead facility construction. Additional permits associated with species and waterways could be necessary based on the diversion location and design.
Right-of-way	Right-of-ways may be required depending on project design. Additionally, right-of-ways may be required for project operation.
Construction	Construction is dependent on the features that are to be included with the concept. Construction would likely be limited to well construction, grading, and building for wellhead facilities plus the associated settling basin/facilities.
Operations & Maintenance	Regular operations and maintenance is required to maintain the performance capabilities of the facilities. O&M activities include maintenance of wellhead facilities, periodic redevelopment of the well, and maintenance/cleaning of the associated settling basin.
Funding	Funding sources are dependent on the final purpose and features of the project. State grants have been available for projects of this in the past.
Regulatory	Regulatory agency involvement for this concept (well development) is primarily with the Regional Water Quality Control Board.
Willing Land Owner	Willing land owners are necessary for this concept to be successful. Typically, the well site is purchased for such a project.
Integration with Other Concepts	There are limited opportunities to integrate this concept with other concepts.
Additional Studies	Hydrogeologic investigations and pilot studies are imperative for the success of this concept. Additional water quality testing is necessary to better understand existing and potential threats to aquifer water quality. Biological surveys will also be required to determine the potential extent impacts resulting from construction of the project.
Other	Stormwater runoff typically contains elevated levels of sediment and organics. This is detrimental to a recharge well, and pre-treatment of stormwater runoff prior to recharge is recommended.

5 Next Steps

The concepts described in this memorandum will undergo a screening and evaluation process to focus on those concepts that best fit the goals and objectives of the Project and are likely to be the most feasible to implement. The initial screening will remove concepts from consideration that are not feasible or not appropriate for this Project. The secondary evaluation will compare the concepts to the goals and objectives of the Project as well as other criteria that impact feasibility.

Based on the results of the screening and evaluation, the preferred concepts will be moved forward to a feasibility level evaluation, where additional project details will be developed as well as packaging of various concepts to provide a defined level of flood hazard reduction and groundwater recharge.

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Appendix F

Conceptual Alternatives Screening Evaluation

Technical Memorandum

Upper Petaluma River Watershed Flood Control Project Scoping Study

Subject: **Conceptual Alternatives Screening Evaluation**

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Reviewed by: Leslie Dumas, Randy Raines RMC

Date: March 29, 2012

1 Introduction

The Sonoma County Water Agency (Water Agency) is presently undertaking a Scoping Study within the Upper Petaluma River Watershed (Project) to identify stormwater management/groundwater recharge projects that provide flood hazard reduction and groundwater recharge benefits (Key Project Purpose). The Scoping Study is in its initial phase of developing project objectives, assessing potential project issues, designing a stakeholder coordination process, and identifying and prioritizing potential project concepts.

The purpose of this memorandum is to summarize the screening and prioritization process for the Study and apply that process to the project concepts identified in the memorandum entitled *Project Concepts Identification and Description*. The goal of the screening and prioritization process is to create a prioritized list of project concepts to carry forward into the feasibility study phase of the Project. These selected concepts will form the basis of projects to be evaluated for implementation feasibility. Other project elements are anticipated to be included in the project description to potentially improve public and regulatory acceptance and to increase opportunities for receiving outside funding.

2 Screening and Prioritization Process

A two-step screening and evaluation process is proposed for the Study. The goal of the first step is to identify which, if any, project concepts are not appropriate for this Project. The goal of the second step is to prioritize the remaining concepts to identify the preferred concepts for further consideration during the feasibility study phase of the Project.

2.1 Step 1: Screening

In the first step of the screening and evaluation process, project concepts are evaluated with regards to the Key Project Purposes, flood hazard reduction and groundwater recharge benefits. In brief, projects to be considered for inclusion in the feasibility study phase of the Project must provide benefit for both flood hazard reduction and groundwater recharge. Project concepts that do not provide benefits in both of these areas are not included in the prioritization process. It is important to note that exclusion from the prioritization process does not necessarily mean that the concept is without merit or that the Water Agency shouldn't pursue the concept outside of this Project or support the efforts of other entities to pursue the concept. It simply indicates that the concept is not suitable for implementation through this Project. **Table 1** summarizes the results of this screening process.

Table 1: Screening Process Results

Concept	Advanced to Prioritization Process	Notes
Managed Floodplain	Yes	
Off-stream Detention Basin	Yes	
In-stream Detention Basin	Yes	
Floodplain Modification	Yes	
Levee/Floodwall	No	The concept does not address the Groundwater Recharge objective. The concept does not provide additional infiltration surface, improve surface characteristics for recharge, or detain water for additional percolation time.
Channel Modification	Yes	
Bypass Channel	Yes	
Bridge Improvement & Debris Removal	No	The concept does not address the Groundwater Recharge objective. The concept does not provide additional infiltration surface, improve surface characteristics for recharge, or detain water for additional percolation time.
Low Impact Development	Yes	
Policy Review & Development	Yes	
Direct Recharge Wells	No	The concept does not address the Flood Hazard Reduction objective. Water diverted for recharge through wells is inconsequential compared to the flood flows.

Based on this evaluation, eight of the eleven identified concepts are considered in the prioritization process.

2.2 Step 2: Prioritization

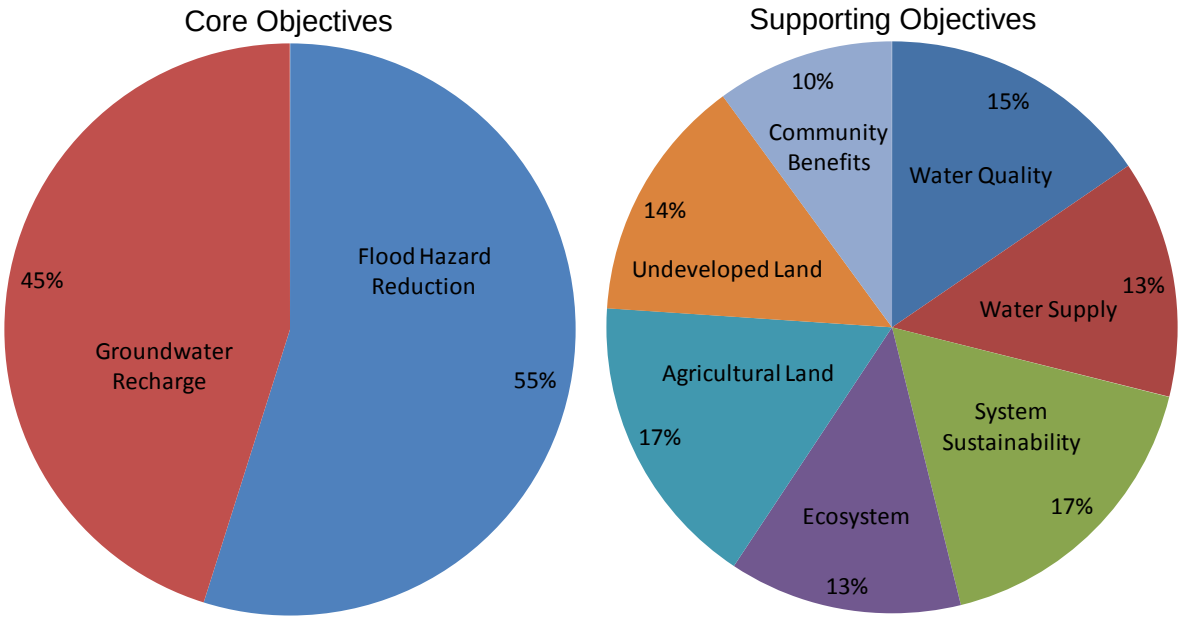
Concepts that passed the initial screening are prioritized utilizing the objectives described in the *Project Objectives Report*. In order to do this, two separate evaluations must take place:

- Weight of objective importance relative to other objectives; and
- Ability of each concept to fulfill the objective relative to the other concepts.

2.2.1 Objective Weighting

Weighting of objectives can be highly subjective and influenced by the evaluator's own biases. Ideally the objective weighting should reflect the interests of the region for which the project is intended. To get a sense of public interests, RMC polled attendees of the October 5, 2011 public workshop. Attendees were asked to prioritize (high, medium, low) elements of the two core objectives and seven supporting objectives. High ratings were given a score of three; medium ratings were given a score of two; low ratings were given a score of one; and no responses were given a score of zero. **Figure 1** summarizes the results, which are based on 28 responses, and represents relative objective importance.

Figure 1: Public Input on Relative Objective Weights



Note: Percentages may not sum to 100% due to rounding.

As indicated by **Figure 1**, the survey is not used to relate the importance of the core and supporting objectives to one another; rather, to evaluate each independently. As this Project will primarily support the Key Project Purpose, the core objectives will receive 50% of the overall weighting and the supporting objectives share the remaining 50% of the overall weighting. **Table 2** summarizes the initial weighting scheme of each objective.

Table 2: Screening Process Results

Objective	Classification	Poll Weight	Objective Baseline Weight
Flood Hazard Reduction	Core Objective	55%	27.5%
Groundwater Recharge	Core Objective	45%	22.5%
Water Quality	Supporting Objective	15%	7.5%
Water Supply	Supporting Objective	13%	6.5%
System Sustainability	Supporting Objective	17%	8.5%
Ecosystem	Supporting Objective	13%	6.5%
Agricultural Land	Supporting Objective	17%	8.5%
Undeveloped Land	Supporting Objective	14%	7.0%
Community Benefits	Supporting Objective	10%	5.0%

Note: Percentages do not sum to 100% due to rounding.

2.2.2 Concept Evaluation

To prioritize the concepts, it is necessary to evaluate how well each concept satisfies the nine objectives. It is important to note that for the Scoping Study, the concepts have a low level of detail available for evaluation. Since specific proposals and locations are not being evaluated, this portion of the prioritization process must be done at a high level, equivalent to the level of detail available about each concept. The ability of a concept to fulfill an objective is quantified using the following system:

- 3 - Provides a high level of benefit associated with the objective;
- 2 - Partially meets the objective;
- 1 - Uncertain ability to fulfill intent of objective; and
- 0 - Does not fulfill objective.

Uncertain ability to fulfill intent of the objective at this stage of concept development could be due to high dependence on location or project features (details to be developed following the Scoping Study) or the nature of the concept is open ended at this time. This uncertainty reflects the options that need to be tailored on a case-by-case basis to fit the local environment and conditions.

Table 3 summarizes the scores attributed to each concept and objective pairing.

Table 3: Concept-Objective Evaluation Summary

Objective	Managed Floodplain	Off-stream Detention Basin	In-stream Detention Basin	Floodplain Modification	Channel Modification	Bypass Channel	Low Impact Development	Policy Review and Development
Flood Hazard Reduction	1[1]	3	3	3	3	3	1	1
Groundwater Recharge	1[1]	1[3]	1[3]	1[3]	1[3]	1[2]	1[3]	1
Water Quality	1	2	2	2	1	1[2]	2	1
Water Supply	1[3]	1[3]	1[3]	1[3]	1[3]	1[3]	2	1
System Sustainability	3	3	1[2]	3	2	2	3	1
Ecosystem	3	3	0	2	1	3	1	1
Agricultural Land	3	1	1	2	2	1[4]	3	1
Undeveloped Land	3	2	2	2	2	1[4]	3	1
Community Benefits	1[2]	1[2]	1[2]	1[2]	1[2]	1[2]	1[2]	1

Footnotes:

[1] Maintains existing benefit. In the case of flood hazard reduction, the benefit has been deemed critical to the success of downstream flood control projects.

[2] Score due to dependency on project features that may or may not be part of the implemented project.

[3] Score due to dependency on project location that has yet to be determined.

[4] Score assumes a surface bypass.

2.2.3 Baseline Prioritization Results

RMC used Criterium Decision Plus (CDP) to evaluate the concept priorities. CDP is a visual decision tool that allows users to select and modify criteria to evaluate concepts. For this Project, CDP utilizes user inputs, such as the objective weightings and concept scores described above, to generate a prioritization score for each concept. The scores are then used to understand how well the concept is aligned with the objectives and overall priorities of the Project. Concepts with high scores better fit the objectives of the Project than concepts with low scores. **Table 4** summarizes the results of the simulation and ranks each concept.

Table 4: Baseline Prioritization Results

Rank	Concept	Score
1	Floodplain Modification	0.67
1	Off-stream Detention Basin	0.67
3	Channel Modification	0.6
4	Bypass Channel	0.59
5	In-stream Detention Basin	0.54
5	Managed Floodplain	0.54
5	Low Impact Development	0.54
8	Policy Review & Development	0.33

3 Prioritization Confirmation

The preliminary prioritization results are a good indication of how the eight concepts might be ranked against one another; however, several checks were performed prior to moving forward with a recommendation for concepts to be included in the Feasibility Study. These checks addressed uncertainty in the objective weighting, cost implications, and significant hurdles that would need to be overcome in the implementation stage of the project.

3.1 Sensitivity to Objective Weighting

RMC performed sensitivity analyses on the results of the baseline prioritization by varying the weighting of the objectives. Five additional simulations were performed as follows:

- Core Objective Emphasis – Increase relative weight of the core objectives to 65% and decrease the relative weight of the supporting objectives to 35% (as opposed to the baseline 50%-50% split).
- Water Emphasis – Double the relative weight of the Water Quality and Water Supply objectives compared to the baseline weighting.
- Environment Emphasis – Double the relative weight of the System Sustainability and Ecosystem objectives compared to the baseline weighting.
- Land Use Emphasis – Double the relative weight of the Agricultural Lands and Undeveloped Lands objectives compared to the baseline weighting.
- Community Emphasis – Double the relative weight of the Community Benefits objective compared to the baseline weighting.

The additional simulations had similar prioritization orders for the concepts. Based on the results shown in **Table 5**, it is possible to conclude that the results of the analyses are not highly sensitive to changes in criteria weighting as described in this section considering:

- The top three concepts in the Baseline scenario are ranked in the top three places for all sensitivity scenarios except for one (Environment Emphasis), where one concept is ranked 4th.
- The top four concepts in the Baseline scenario are ranked in the top four places for all sensitivity scenarios except for Water Emphasis (where one concept is ranked 5th) and Land Use Emphasis (where one concept is ranked 7th.

Table 5: Weighting Scenario Prioritization Results

Concept	Baseline Weighting	Core Emphasis	Water Emphasis	Environment Emphasis	Land Use Emphasis	Community Emphasis
Floodplain Modification	1	1	1	2	1	1
Off-stream Detention Basin	1	1	2	1	3	2
Channel Modification	3	3	3	4	2	3
Bypass Channel	4	4	5	3	7	4
In-stream Detention Basin	5	5	3	7	6	5
Managed Floodplain	5	6	7	5	4	6
Low Impact Development	5	6	6	6	4	6
Policy Review & Development	8	8	8	8	8	8

See **Appendix A** for additional detail on objective weighting for the various scenarios as well as final scores.

3.2 Cost Considerations

Based on overall cost and funding opportunities for multiple benefit concepts, it appears that implementation cost should not be considered a fatal flaw for any of the concepts at this time. However, the cost for constructing a buried off-stream detention basin (one potential technique for the off-stream detention concept) is anticipated to be high and this additional cost does not seem to be off-set by a commensurate increase in benefits. A buried bypass channel would also have a high construction cost with limited additional benefits over a surface bypass. Unless additional funding becomes available for these particular project concepts, for example from a developer that wanted to use the land above the basin, burying a detention basin or bypass channel does not appear justified.

3.3 Implementation Feasibility

At this stage of project development, none of the concepts included in the prioritization process are deemed to be inherently flawed from an implementation perspective. In-stream detention basins, though,

would likely require significantly more mitigation and maintenance than the other concepts and could be difficult to permit except in some exceptional cases. Comparable benefits could likely be obtained through other concepts in the prioritization. For these reasons, in-stream detention basins are not recommended for inclusion in the Feasibility Study.

Similarly, channel modifications also have in-stream, channel bottom impacts along the length of the project. Since this concept does not impede sediment transport or biological passage though, the permitting and maintenance requirements are expected to be less than in-stream detention basins. With the above limitations in mind, channel modifications should be considered primarily as a location-specific solution and where possible not be a primary element in the solution to the flooding and groundwater recharge issues.

3.4 Recommended Concept Prioritization

Due to the location dependent nature of these concepts, the concepts have been assigned to prioritized tiers as differentiation within the tiers is difficult to justify at this time. The first tier includes the concepts that appear to fit the objectives of this Project and do not have overriding considerations described in the section above. Concepts in this tier should form the basis of the project concepts developed during the Feasibility Study. The second tier includes concepts that could be used to support project concepts based on the first tier concepts. The third tier includes concepts that would not normally be considered for implementation through this Project. The enhancement tier includes concepts that could be paired with concepts implemented as part of the Project to bring additional benefits. The recommended tiers for concept prioritization are:

- First Tier
  - Floodplain modification
  - Off-stream detention basin (surface)
- Second Tier
  - Channel modification
  - Bypass channel (surface)
- Third Tier
  - Off-stream detention basin (buried)
  - Bypass channel (buried)
  - In-stream detention basin
- Enhancement Tier
  - Managed floodplain
  - Low impact development
  - Policy review and development

Detention basin and floodplain modification concept locations will be dependent upon a willing land owner, zoning, and some geophysical considerations such as a low slopes and proximity to potential recharge zones. These first tier concepts are anticipated to be the primary methods through which to achieve flood hazard reduction and groundwater recharge. Channel modification and surface bypasses envisioned to be used as a solution to local flooding, as opposed to a regional solution. As such, they can be used to supplement the protection benefits of the overall project. Modeling will be required for any proposed project to evaluate hydraulic feasibility and to confirm that upstream hydromodification does not induce flooding in downstream reaches.

The three concepts included in the enhancement tier are fundamentally different from the construction projects in the first three tiers. These concepts are not recommended to be the basis of future feasibility

work. They do however provide benefits and could be used to supplement other projects. A short description of each enhancement concept and how it could be implemented is included below:

- Managed floodplain –This concept maintains the existing flood protection levels rather than reducing flood hazards. The U.S. Army Corps of Engineers has indicated that the attenuation provided by the upstream floodplains plays an important role in maintaining the effectiveness of the downstream flood control projects. It is therefore recommended that whenever possible, the Water Agency partner with the City of Petaluma and other agencies, including local open space and agricultural land preservation organizations to achieve maintenance of the existing attenuation benefits.
- Low Impact Development – Low impact development (LID) projects are typically not effective during large rain events as they are easily overwhelmed by large flows, thus reducing their flood protection benefit. They are, however, innovative ways to reduce stormwater runoff, promote infiltration, and improve water quality through development or redevelopment of areas. Additionally, the implementation costs for LID projects can oftentimes at least partially be offset by private developers. It is recommended that the Water Agency encourage implementation of LID projects by those agencies with oversight and control of land use activities.
- Policy Review and Development – Many decisions that impact stormwater runoff or recharge potential are made by entities that control land use and development. This is a concept that could help preserve existing resources and potentially improve conditions. It is therefore recommended that the Water Agency work with the City of Petaluma and Sonoma County to implement this or a similar concept.

4 Next Steps

Following review by the Water Agency, feedback from the public on this memorandum will be solicited. Based on that feedback and the input of regulatory agencies, the Water Agency will recommend any final edits to this memorandum prior to it being finalized.

The highest priority concepts described herein will form the basis of the Feasibility Study scope of work and implementation plan that will be developed as part of the Scoping Study. The Feasibility Study will identify candidate locations for the priority concepts; fill data gaps as necessary to further evaluate the feasibility of the concepts; confirm the flood hazard reduction and groundwater recharge benefits; and develop concept details to support project definition and funding applications. The Feasibility Study will also confirm that projects selected for potential implementation would, at a minimum, not have a negative impact on downstream flood protection projects. The Implementation Plan will help the Water Agency plan for future Project efforts and identify the steps and milestones as the Project moves forward.

Appendix A: Prioritization Sensitivity Scenarios

As described in the body of this memorandum, additional weighting scenarios were developed to test the sensitivity of the Baseline concept prioritization to objective weightings. The objective weights for the five sensitivity scenarios are summarized in **Table A1**.

By adjusting the weighting of the objectives in the five alternate scenarios, different strengths and weaknesses of the concepts are revealed. The concepts that are consistently at the top of each or most of the weighting scenarios are likely the strongest and the most likely to most completely fulfill the objectives of the Project.

Table A1: Objective Weighting Scenarios

Objective	Baseline Weighting	Core Emphasis[1]	Water Emphasis	Environment Emphasis	Land Use Emphasis	Community Emphasis
Flood Hazard Reduction	27.5%	35.8%	27.5%	27.5%	27.5%	27.5%
Groundwater Recharge	22.5%	29.3%	22.5%	22.5%	22.5%	22.5%
Water Quality	7.5%	5.3%	15.0%[2]	4.3%	4.2%	6.7%
Water Supply	6.5%	4.6%	13.0%[2]	3.8%	3.6%	5.8%
System Sustainability	8.5%	6.0%	5.3%	17.0%[2]	4.8%	7.6%
Ecosystem	6.5%	4.6%	4.0%	13.0%[2]	3.6%	5.8%
Agricultural Land	8.5%	6.0%	5.3%	4.9%	17.0%[2]	7.6%
Undeveloped Land	7.0%	4.9%	4.3%	4.1%	14.0%[2]	6.3%
Community Benefits	5.0%	3.5%	3.1%	2.9%	2.8%	10.0%[2]

Footnotes:

[1] Balance of the objective weighting in this scenario is 65% for core objectives and 35% for supporting objectives. In all other scenarios, the balance is 50% for core objectives and 50% for supporting objectives, as it is for the baseline scenario. Core objectives are always at least 50% of the evaluation weight as they directly support the Key Project Purpose.

[2] Objective weighting is double the baseline scenario weighting for the highlighted cells

Criterium Decision Plus (CDP) was used to evaluate the concepts using the above weighting scenarios. The same concept-objective evaluation scores as were used in the baseline scenario. **Table A2** summarizes the scores and ranks for each concept for the weighting scenarios.

Table A2: Weighting Scenario Prioritization Results

Concept	Baseline Weighting	Core Emphasis	Water Emphasis	Environment Emphasis	Land Use Emphasis	Community Emphasis
Floodplain Modification	1 (0.67)	1 (0.68)	1 (0.65)	2 (0.72)	1 (0.68)	1 (0.66)
Off-stream Detention Basin	1 (0.67)	1 (0.68)	2 (0.64)	1 (0.74)	3 (0.63)	2 (0.65)
Channel Modification	3 (0.6)	3 (0.63)	3 (0.57)	4 (0.6)	2 (0.64)	3 (0.59)
Bypass Channel	4 (0.59)	4 (0.62)	5 (0.56)	3 (0.66)	7 (0.56)	4 (0.58)
In-stream Detention Basin	5 (0.54)	5 (0.59)	3 (0.57)	7 (0.5)	6 (0.57)	5 (0.54)
Managed Floodplain	5 (0.54)	6 (0.48)	7 (0.46)	5 (0.59)	4 (0.6)	6 (0.52)
Low Impact Development	5 (0.54)	6 (0.48)	6 (0.53)	6 (0.53)	4 (0.6)	6 (0.52)
Policy Review & Development	8 (0.33)	8 (0.33)	8 (0.33)	8 (0.33)	8 (0.33)	8 (0.33)

Footnotes: Values shown are Rank and (Score).

Appendix G

Meeting Minutes from Stakeholder Meeting #3 (Zone 2A Advisory Committee Meeting)

Meeting Summary

Upper Petaluma River Watershed Flood Control Project Scoping Study

Subject: Stakeholder Meeting #3

Prepared For: Sonoma County Water Agency

Attendees: See Sign-in Sheet

Prepared By: RMC

Date/Time: December 8, 2011; 6:30 pm

Location: Lucchesi Community Center, Petaluma

Meeting Objectives:

- Review project concepts with stakeholders
- Discuss and obtain feedback prioritization process and study area priorities

Attachments

Attachment A: Meeting Agenda

Attachment B: Presentation Slides

Attachment C: Meeting Attendees (from sign-in sheet)

Discussion Items

This summary is of agenda items 8 and 9 as shown in Attachment A. A copy of the slides presented and made available to attendees is included as Attachment B. The names of meeting attendees that signed-in are included in Attachment C.

Zone 2A Committee Chair Ted Cabral opened this portion of the meeting.

8. Upper Petaluma River Flood Control Project

A. Overview and Review of Project/Scoping Study

Kent Gylfe introduced himself as Sonoma County Water Agency's project manager for the Scoping Study being conducted for the Upper Petaluma River Flood Control Project. This is the third outreach meeting for the Study and Mr. Gylfe provided a brief review of the past meetings noting that the project's success in moving forward hinges on developing partnerships and support for the project. He views the meeting as an opportunity to share information developed to date about the Project and receive comments and feedback on the Project. Mr. Gylfe made some additional points including:

- The first workshop held on April 28, 2011, focused on establishing project objectives.
- A bus tour was conducted by the Water Agency on October 1, 2011 to visit several multi-benefit flood-related facilities within the Laguna Mark West Watershed to help familiarize stakeholders with project concepts.
- The second workshop held on October 5, 2011 highlighted project concepts. A larger outreach and notification effort including mailers to all property addresses that were within potential project areas was completed for this meeting based on feedback in April.

- The purpose of this third workshop is to briefly review the concepts highlighted in the second workshop as well as describe and discuss the screening and prioritization process conducted for the Study.
- The Project area (Zone 2A) has a historical flooding problem which the Water Agency and City are working to address. There are several areas of severe urban and residential flooding as well as rural areas. Additionally, recent droughts, regulatory requirements, and a reliability study have shown vulnerability in the water supply reliability. The Water Agency Board adopted a Water Supply Strategies Action Plan which identified joint flood control and water supply projects as opportunities to address both flooding and water supply reliability. With that context, the Agency is addressing three watersheds within Sonoma County with similar studies. All of the watersheds have the same core objectives and nearly identical supporting objectives.
- It is not the expectation of this project to eliminate all flooding in Petaluma, but the intent is to implement a project that can provide significant flood reduction with a cost/benefit ratio that is appropriate. The project to be implemented will also ideally attract external funds.
- A project could be a combination of flood control concepts and could be implemented in phases.
- The Scoping Study is the first step in a multi-step process. Future phases will include modeling and determining how much flood protection could be provided. The Scoping Study's intent is to narrow the range of alternatives studied for feasibility and to establish a roadmap for project delivery.

  Summary of Draft Project Concepts from October Meeting

  Randy Raines, with RMC Water and Environment, introduced posters that had been prepared for the October workshop and described the Frequently Asked Questions handout that had been prepared in response to comments and questions received after the April 28 and October 5, 2011 workshops. Two new memoranda are available for review and describe the concepts as well as the screening and prioritization process and results. The memoranda can be found on-line. Mr. Raines then continued the presentation by summarizing the eleven concepts that had been identified for the Project and described in the October meeting.

  - Q: Where is habitat restoration included?
    - A: Mr. Raines noted that it is included as a supporting objective for the Project. The slides discussed are focused on the concepts that include varying degrees of habitat restoration.

B. Presentation of Screening and Prioritization of Project Concepts

Mr. Raines re-introduced the screening and prioritization processes. The screening process was described in the October meeting and eliminates concepts that do not achieve the Key Project Purpose, namely to provide both flood hazard reduction and groundwater recharge. Of the eleven concepts, the eliminated concepts were Levee/Floodwall, Bridge Improvement and Debris Removal, and Direct Recharge. Raines emphasized that these are not poor concepts, but that they do not fit this particular Project. The Water Agency or City may pursue these project concepts through other avenues.

Mr. Raines described the prioritization process that was applied to the remaining eight concepts. One aspect of the prioritization process is ranking objectives . The objectives were ranked by the public in the October meeting using the Objectives Prioritization Worksheet. Mr.

Raines estimated that approximately 30 surveys were completed (*post meeting note correction – 28 surveys were completed by stakeholders*). The results of the public input were that flood hazard reduction was weighted slightly higher than groundwater recharge, and of the supporting objectives – weighting was fairly evenly distributed, with system sustainability and agricultural land ranked slightly higher than other supporting objectives.

The second step of the prioritization was to evaluate how well each concept satisfied the established project objectives. Score between 0-3 were given to each concept and corresponding objective.

A tool called Criterion Decision Plus was used to combine the objective ranking and concept evaluation to develop a concept priority list. The baseline prioritization results showed that four concepts better fit the objectives of the project. These included 1) Floodplain Modification, 2) Off-stream Detention Storage, 3) Channel Modification, and 4) Bypass Channel. Sensitivity analysis supported this baseline prioritization. Other factors such as cost and implementation feasibility were considered as well when developing the three tiers and special enhancement categories of concepts.

C. Discussion of Screening and Prioritization Process and Recommendations

At this point in the presentation, several questions were asked about the prioritization process and are captured below:

The following are general questions and comments offered by attendees:

- Q: Why does a difference of 0.05 in the prioritization model mean that one concept is better than another?
    - A: Any concept is not necessarily better or worse than another. The scores at this point are based on limited information that broadly defines the concepts. We are attempting to identify concepts that will work, provide multiple benefits, and attract external funding. The higher scores are an indication that a concept has a better chance of doing these things.
- Q: Aren't LID and Policy Review and Development good ideas?
    - A: Yes, they are good ideas which is why they have been included in the enhancement category.
- Q: Does LID help with major flood reduction?
    - A: LID projects are not typically considered effective flood control projects during a 100-year event. They are more effective at smaller events, when the ground isn't saturated. Ground saturation causes additional runoff. LID does provide benefits during smaller flood events as well as other types of benefits, such as water quality benefits, and could be implemented parallel to the concepts more suited for large flood events.
- Q: Benefit to cost ratio should be examined and considered. Many of the lower ranked concepts are relatively cheap to implement.
    - A: Noted. Benefit to cost ratios will be developed in the Feasibility Study phase.
- Q: The relative scores for the managed floodplain, LID and Policy Review should be elevated. These are the low cost items and should be considered in the mix of projects.

- A: These concepts are considered enhancement concepts and should be looked at for implementation in parallel with one or more tiered concepts.

- Q: What is the difference between the floodplain modification and managed floodplain concepts?
  - A: The difference between Managed Floodplain and Floodplain Modification was described. Concept 1 (Managed Floodplain) was described as maintaining existing floodplain (continue allowing the area to flood). This concept has been applied to an agricultural area near the Pajaro River that occasionally floods. The agricultural land has been designated as preserved floodplain area, allowing the current land uses to continue but limiting land use changes that could cause additional downstream flooding. Concept 4 (Floodplain Modification) was described using the example of the Denman Project – this is an area where terracing was completed to increase storage volume.

- Q: In-stream detention basins should not be thrown out because they can be cheaper than off-stream detention storage since there is no conveyance cost. They should be looked at for the extreme upstream areas where the impact is small and they provide ecological benefits.
  - A: In-stream detention basins are in a lower tier of implementation consideration because permitting is difficult and they have a high mitigation and maintenance cost. They could be considered for upstream areas if applicable.

- Q: Will the entire list of concepts be evaluated in the Environmental Impact Report?
  - A: No, after the feasibility study, the project concept(s) that is/are selected as feasible for implementation will be described in detail and evaluated in the EIR.

- Q: The 1% storm results in a flow of 9,000 cubic feet per second at the outlet mall. It is critical to maintain the flood storage capacity at Denman and upstream of the Army Corps weir to allow the downstream Petaluma project to continue to maintain its level of protection.
  - A: Agreed. It will be important to evaluate concepts adequately to make sure that no increased flow downstream results from implementation of a project.

- Q: Would a reduction in flows allow additional Petaluma development?
  - A: The potential for future development has not been a factor in this evaluation.

- Q: Regarding LID in rural areas – can more money be diverted to the Resource Conservation District for managing the rural floodplain through permaculture? This idea could be used to reduce the scale of reduction needed from engineered projects.
  - A: Comment noted.

Mr. Raines described the three tiers of recommended prioritization and reiterated that enhancement concepts such as Managed Floodplains, LID and Policy Review and Development could be considered for implementation in parallel with higher tiered concepts. David Keller mentioned that a parcel-specific mapping tool was utilized successfully in King County, Washington and Arcata. Mr. Gylfe noted that Petaluma's XP-SWMM model will be the modeling tool used for the Feasibility Study.

D. Next Steps

Mr. Raines noted that this was the last public meeting planned for the Scoping Study portion of the project, and the next steps would be to develop an implementation plan and proceed with the Feasibility Study for the area. Mr. Raines provided some details regarding elements of the Feasibility Study which include identifying alternative locations, hydraulic modeling, field testing, benefit and cost analysis, and alternatives definition and selection. Raines asked that any additional public comment (beyond the 3-minute public comment period following the presentation) be forwarded to his email address rraines@rmcwater.com or by mail to Ann DuBay with the Water Agency by December 16, 2011. Contact information is at the end of the presentation and in notification emails that have been distributed.

Questions and comments regarding next steps are shown below:

- Q: Will there be drawings/maps where floodplain management is taking place and where modification takes place?
    - A: Yes – these are part of the Feasibility Study
- Q: Terracing in Industrial Avenue area is poorly designed. The back-side does not drain and material must be removed from the floodplain.
    - A: Comment noted.
- Q: Are materials being developed for funding?
    - A: Yes, external funding will be pursued for implementation of this Project.
- Q: There are things that individual property owners can do to help support the goals of the Project. Complementary projects should be the focus of the Project but all of the ideas and concepts are interrelated. Will climate change impacts be incorporated into the project design?
    - A: The point on interrelated concepts is well taken. It is anticipated that climate change will be considered as part of the Feasibility Study. It will be important to review the assumptions that have been made in the models.
- Q: An integrated approach is critical.
    - A: Agreed.
- Q: A key recommendation of the Corps analysis in 1969 was that development stay out of the floodplain and this was ignored by the City and County. This approach is entirely based on modifying the watershed system. The example of Tulsa where the City removed development from the floodplain was described along with a notation about the Galloway Report for Mississippi in 1995/96. The Project should look at what can be removed from the floodplain and where development should be prevented.
    - A: (Raines) The managed floodplain concept would prevent future development. Removal of structures has not been considered as part of the Scoping Study. Preservation of open space will be evaluated.
    - A: (Cabral) Reduction of the tax base should not be considered.
    - A: (David Rabbitt) There will be another flood. Projects like this are about risk assessment and management.
- Q: Terracing is expensive and permitting is an issue
    - A: Comment noted.

- Q: The opportunity to provide written comments is appreciated. Will this project be developed into actions that property owners should take similar to "Slow It, Spread It, Sink It"?
    - A: The intent is to develop the project to a level where outside funding for implementation can be applied for.
- Q: The three enhancement concepts should be the primary concepts moving forward.
    - A: These concepts could be pursued in a parallel track.
- Q: City and County land use policies should be reviewed in the Feasibility Study.
    - A: Comment noted.

9. Public Comment

Mr. Cabral facilitated the public comment period. Commenters were give 3 minutes to provide comments. The following are comments received from meeting attendees and committee representatives:

- John Cheney
    - Cheney stated that he felt that the Corps' Payran flood project should be finished before this one starts. He questioned what effect this Project would have on the Corps' project. He noted that he saw vegetation removal in Willow Brook along Redwood Blvd, but that the plants were put there as part of mitigation for the Payran project.
- David Keller
    - Keller introduced himself as a representative of the Petaluma River Council, and noted he was not on the stakeholder list for the April meeting.
    - Keller noted that the Corps calculations for the downtown Petaluma Flood Project are contingent on maintaining the flood capacity upstream. Effects of this Project need to be turned into impacts to the Corps project. If there are changes to storage or flows it will cause deterioration of the Corps project. The Corps project used the 1987 General Plan for development conditions, not the current plan. These assumptions should be reviewed.
- JT Wick
    - Wick noted that the Friends of the Petaluma River, a group of 2,000 stakeholders was not notified of the meetings.
    - Wick also noted that he wants to see the ecosystem projects evaluated in the Feasibility Study.

[Committee Member Comments]

- John Fitzgerald
    - The Zone 2A Committee and the Water Agency have no control over the Corps project.
- Ted Cabral
    - Community has spoken loudly about the enhancement concepts, and this will be taken up at the next Zone 2A Committee meeting.

- Cabral reminded the room that the Zone Committee was made up of volunteers and that a polite atmosphere should be maintained.
- The Water Agency has been working hard and dealing with many issues, some of which have just recently come to the awareness of the Committee. Maintenance work is planned to double this coming year over previous years.
- Rural land owners have a valid concern about being shouldered with the responsibility for project implementation. This factor will be considered moving forward.
- This Project will not eliminate the risk of flooding but working together it can make a difference.

- Ned Orrett
  - Orrett stated that he enjoyed the quality of the spirit of the group tonight and feels confident that a creative solution will be identified.

Attachment A: Meeting Agenda

AGENDA

ZONE 2A ADVISORY COMMITTEE MEETING
December 8, 2011, 4:00 P.M.

1. **OPENING/INTRODUCTIONS**
   Opening comments and introductions by committee chairman

2. **PUBLIC COMMENT**
   Public comment on agenda and non-agenda items

3. **APPROVAL OF MINUTES**
   Committee approval of the July 21, 2011, October 1, 2011, and October 5, 2011 committee meeting minutes

4. **SONOMA COUNTY NO-NET-FILL POLICY**
   Report by Sonoma County Permits and Resource Management Department (PRMD) staff describing the County's current No-Net-Fill policy for unincorporated areas. Committee discussion item.

5. **CONSTRUCTED SEASONAL WETLAND PROJECT**
   Report by Sonoma County PRMD staff describing the scope and purpose of the existing seasonal wetland project constructed in the vicinity of the Willowbrook/Lichau Creek confluence. Committee discussion item.

6. **PROJECTS AND BUDGET FOR FY 2012/13**
   Committee discussion and approval of a recommended FY 2012/13 budget, including new proposed projects.

7. **REPORTS/COMMENTS**
   Reports and comments by committee members and Sonoma County Water Agency and City of Petaluma staff.

********** Break until 6:30 p.m. **********

8. **UPPER PETALUMA RIVER FLOOD CONTROL PROJECT**
   A. *Overview and review of Project/Scoping Study (SCWA staff)*
   B. *Presentation of Screening & Prioritization of Project Concepts (RMC)*
   C. *Discussion of Screening & Prioritization Process and Recommendations (RMC facilitated)*
   D. *Next Steps (RMC/SCWA)*

9. **PUBLIC COMMENT (3 minutes per person)**
   Public comment on agenda items

10. **NEXT MEETING**
    The next meeting date of the Zone 2A advisory committee to be announced

PUBLIC COMMENT: The committee invites public comment, as indicated above. Additional public comment is welcome during committee discussion of individual agenda items, at the discretion of the chair.

AGENDA DOCUMENTS: Any writings or documents provided to a majority of the Zone 2A Advisory Committee regarding any item on this agenda will be made available for public inspection at the office of the Sonoma County Water Agency located at 404 Aviation Boulevard, Santa Rosa, during normal business hours.

Attachment B: Presentation Slides

Upper Petaluma River Watershed Flood Control Project

Kent Gylfe, SCWA
Randy Raines, RMC

SONOMA COUNTY WATER AGENCY

www.sonomacountywater.org
www.scwa.ca.gov/stormwater-groundwater/

Presentation Agenda

A. Overview and Review of Project/Scoping Study
B. Presentation of Screening & Prioritization Concepts
C. Discussion of Screening & Prioritization Process and Recommendations
D. Next Steps

1

Presentation Purpose

- Review flood and groundwater project concepts
- Describe screening and prioritization process and results
- Solicit input on concepts, and screening and prioritization evaluation

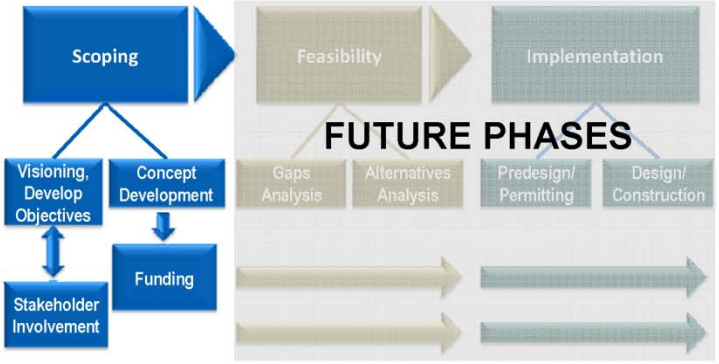
Project Overview

2

Project Basis

- Two core objectives
  - Provide up to 100-year flood protection
  - Increase groundwater recharge potential
- Seven supporting objectives
  - Water quality
  - Water supply
  - System Sustainability
  - Ecosystem
  - Agricultural land
  - Undeveloped land
  - Community benefits
- Projects are multi-benefit
  - Improve likelihood of outside funding
  - Provide additional implementation value
- Projects reflect input of partners, stakeholder groups, regulators and study area residents
  - Multiple workshops
  - Project tour
- Consistent with Water Agency mission and initiatives

Planned Process – Phases of Work



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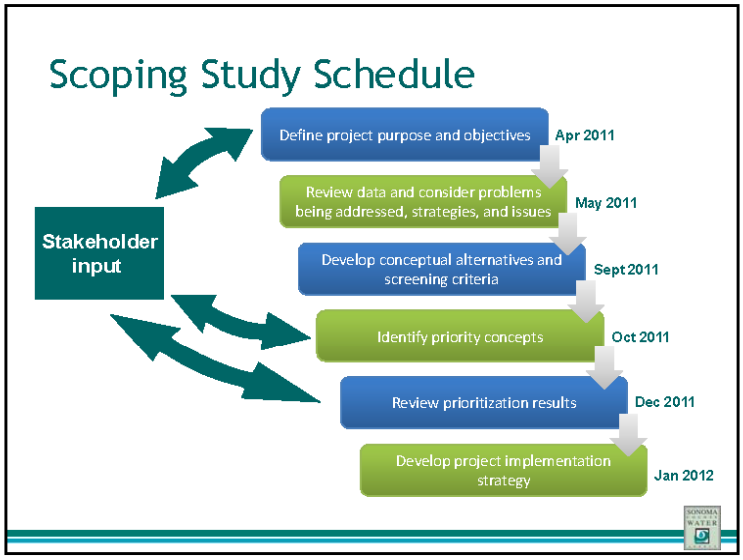
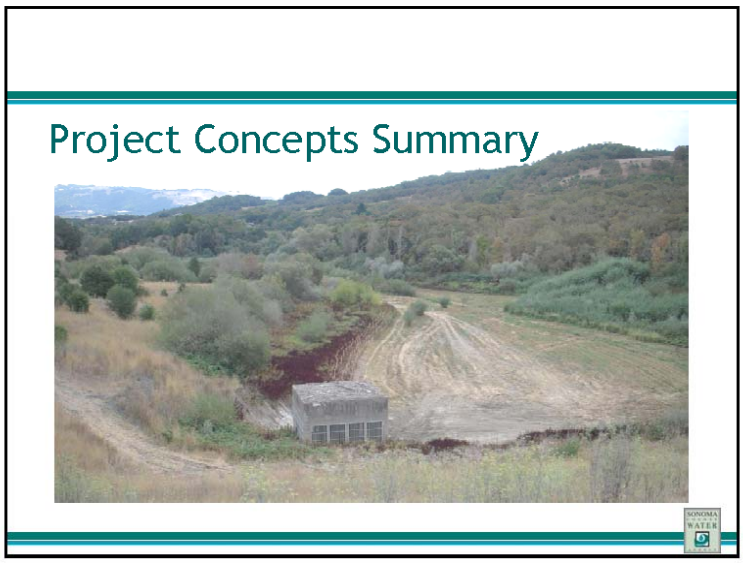
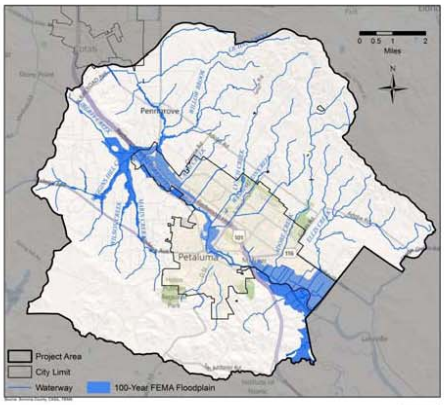

Scoping Study Schedule
Stakeholder input
Define project purpose and objectives
Apr 2011
Review data and consider problems being addressed, strategies, and issues
May 2011
Develop conceptual alternatives and screening criteria
Sept 2011
Identify priority concepts
Oct 2011
Review prioritization results
Dec 2011
Develop project implementation strategy
Jan 2012


Project Concepts Summary

4

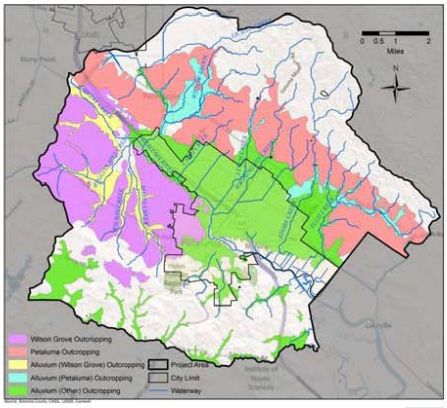
Flood Hazard Reduction Criteria

- Need to:
  - Reduce peak flows OR
  - Increase hydraulic capacity
- Impacts to downstream projects to be evaluated in feasibility phase
- Waterways upstream of and including Lynch Creek confluence
- Areas within 100-year floodplain are principal recipients of benefits



Recharge Criteria

- Wilson Grove Formation and Petaluma Formation are most effective for water supply recharge
- Alluvium above Wilson Grove and Petaluma also considered viable for water supply recharge
- Other alluvium could provide benefits other than water supply recharge



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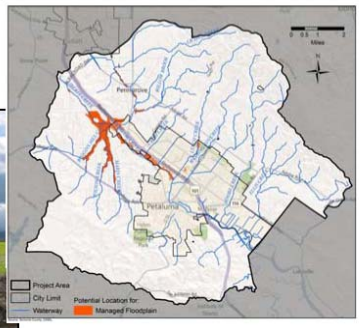
Concept 1: Managed Floodplain

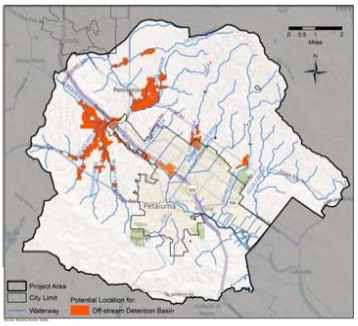
Goal: Maintain flood protection and recharge benefits provided by existing floodplain



Continued effectiveness of downstream flood projects depends on maintaining upstream storage benefits

Concept 2: Off-stream Detention

Goal: Divert high flows to temporary holding ponds for flood reduction and recharge

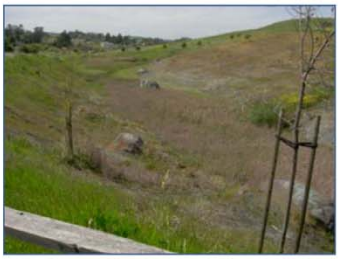


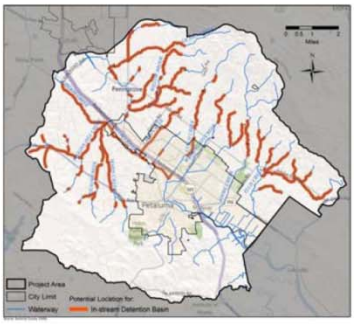
Concept keeps low flows in the channel to maintain environmental sediment-carrying conditions

6

Concept 3: In-stream Detention

Goal: Detain high flows for flood reduction and recharge using the existing stream as a basis

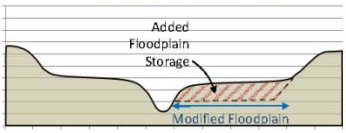


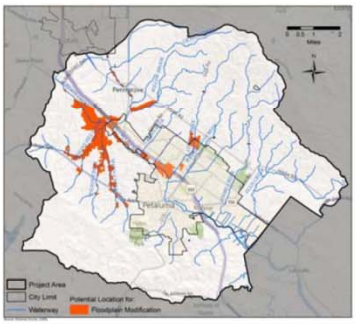


Concept can integrate local topography to reduce costs

Concept 4: Floodplain Modification

Goal: Create additional storage volume and potential recharge area using existing floodplains as a basis



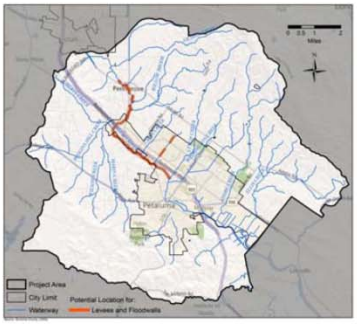


Same concept as Petaluma's Denman Terracing Project

7

Concept 5: Levee/Floodwall

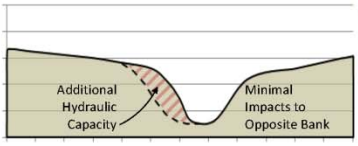
Goal: Constrain flows to a narrower pathway than the existing floodplain

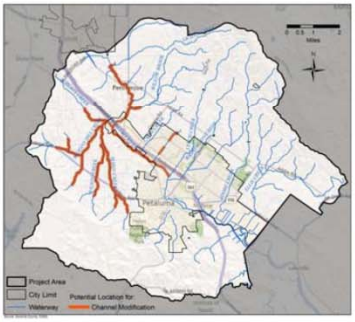


Project impact area directly correlated with benefit area

Concept 6: Channel Modification

Goal: Reshape channel section for increased capacity and recharge area



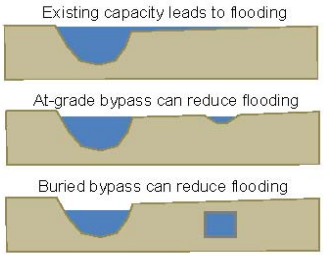


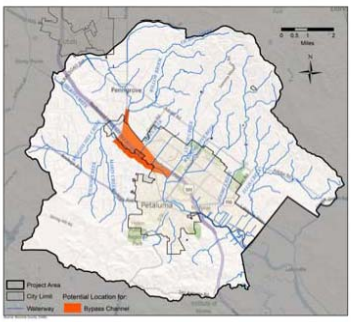
Project impact area directly correlated with benefit area

8

Concept 7: Bypass Channel

Goal: Divert high flows to parallel channel for flood reduction and potential recharge

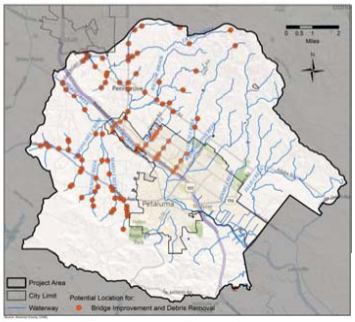




Concept keeps low flows in the channel to maintain environmental conditions and sediment transport characteristics

Concept 8: Bridge Improvement and Debris Removal

Goal: Improvement of bridge areas to reduce potential for flooding due to debris build-up

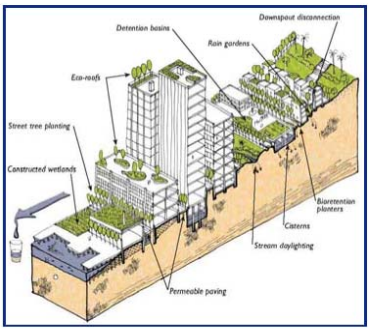


Concept could lead to less emergency operations and maintenance

9

Concept 9: Low Impact Development

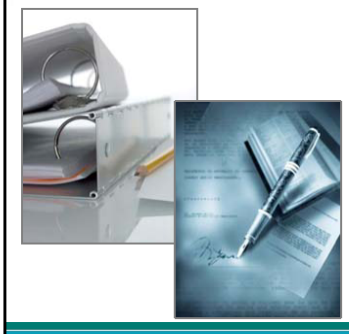
Goal: Reduce development-related runoff and provide opportunity for recharge



Many LID practices improve runoff water quality

Concept 10: Policy Review and Development

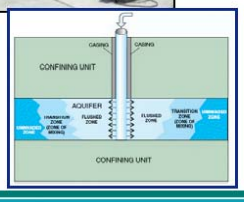
Goal: Identify policies that impact flood hazards and groundwater recharge and update as necessary

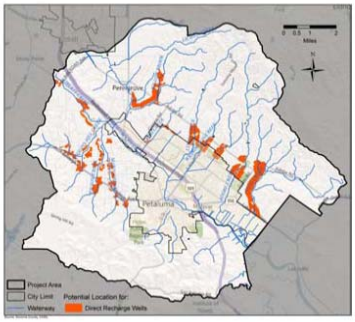


Collaborative concept could be applied at local or county-wide scales.

Concept 11: Direct Recharge

Goal: Recharge water directly into aquifers





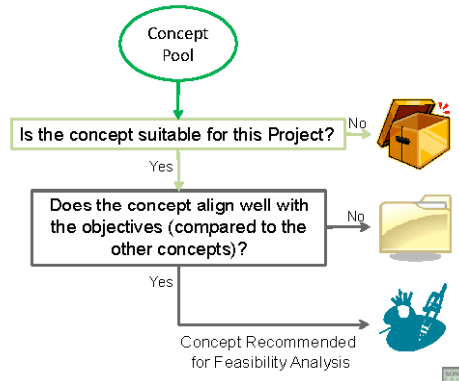
Better control of water quality entering aquifers than percolation methods

Concept Prioritization

11

Prioritization Process

- 2 Stages
  - Screening
  - Prioritization



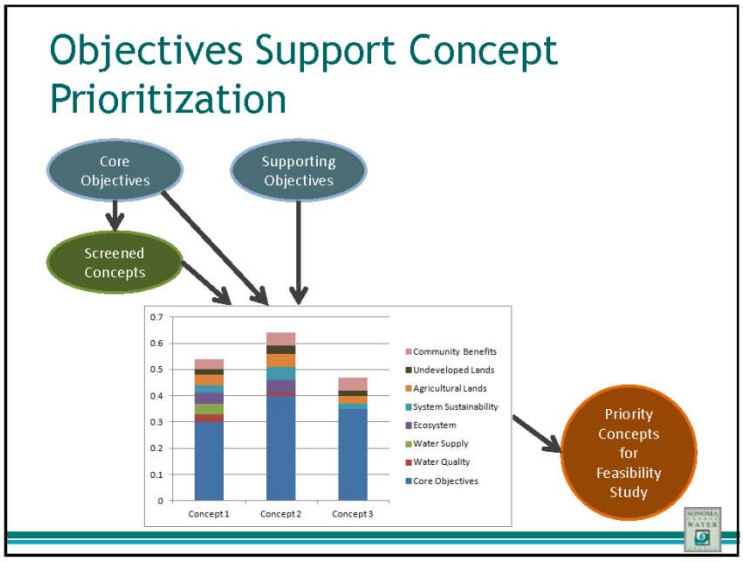
Screening Process

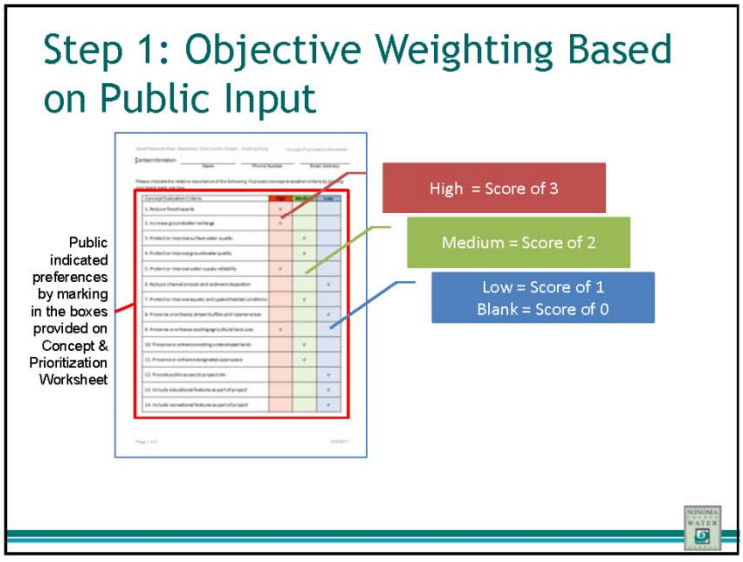
Does the Concept Provide Flood Hazard Reduction and Groundwater Recharge (Key Project Purpose)?

- Yes = Advanced to the prioritization process
- No = Not advanced to the prioritization process
  - Water Agency could consider participation through other venues

Concept	Response
1. Managed Floodplain	Yes
2. Off-stream Detention	Yes
3. In-stream Detention	Yes
4. Floodplain Modification	Yes
~~5. Levee/Floodwall~~	~~No~~
6. Channel Modification	Yes
7. Bypass Channel	Yes
~~8. Bridge Improvement & Debris Removal~~	~~No~~
9. Low Impact Development	Yes
10. Policy Review and Development	Yes
~~11. Direct Recharge~~	~~No~~

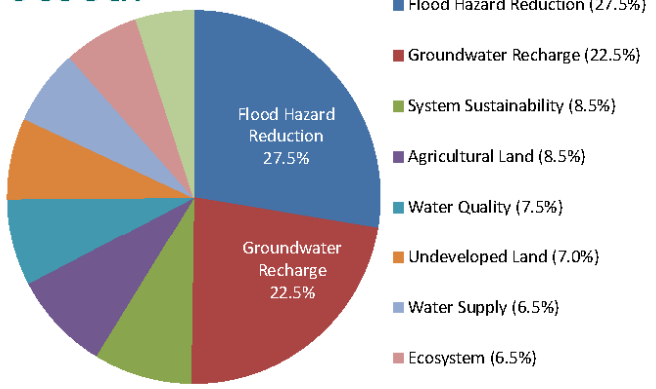
12


Objectives Support Concept Prioritization
Core Objectives
Supporting Objectives
Screened Concepts
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Concept 1
Concept 2
Concept 3
Community Benefits
Undeveloped Lands
Agricultural Lands
System Sustainability
Ecosystem
Water Supply
Water Quality
Core Objectives
Priority Concepts for Feasibility Study


Step 1: Objective Weighting Based on Public Input
Public indicated preferences by marking in the boxes provided on Concept & Prioritization Worksheet
High = Score of 3
Medium = Score of 2
Low = Score of 1
Blank = Score of 0

13

Results of Objective Weighting, Oct 5th



Core objectives received 50% of overall weighting

Step 2: Evaluate Each Concept and How it Satisfies Objectives

Objective	Managed Floodplain	Off-stream Detention Basin	In-stream Detention Basin	Floodplain Modification	Channel Modification	Bypass Channel	Low Impact Development	Policy Review and Development
Flood Hazard Reduction	1	3	3	3	3	3	1	1
Groundwater Recharge	1	1	1	1	1	1	1	1
Water Quality	1	2	2	2	1	1	2	1
Water Supply	1	1	1	1	1	1	2	1
System Sustainability	3	3	1	3	2	2	3	1
Ecosystem	3	3	0	2	1	3	1	1
Agricultural Land	3	1	1	2	2	1	2	1
Undeveloped Land	3	2	2	2	2	1	3	1
Community Benefits	1	1	1	1	1	1	1	1

3 = Provides a high level of benefit

2 = Partially meets objective

1 = Uncertain ability to fulfill intent of objective

0 = Does not fulfill objective

14

Baseline Prioritization Results

Rank	Concept	Score
1	Floodplain Modification	0.67
1	Off-stream Detention Basin	0.67
3	Channel Modification	0.60
4	Bypass Channel	0.59
5	In-stream Detention Basin	0.54
5	Managed Floodplain	0.54
5	Low Impact Development	0.54
8	Policy Review and Development	0.33

High scores better fit objectives of the Project

Sensitivity analysis supports baseline results

Additional Considerations

- Cost
  - Not considered a fatal flaw
  - Buried off-stream detention costs are high and may not be justified
  - Buried bypass channel costs high and may not be justified
- Implementation Feasibility
  - In-stream detention basins: high mitigation and maintenance, difficult to permit
  - Channel modification: permitting and maintenance less difficult than in-stream detention basins, but relatively challenging

15

Recommended Prioritization

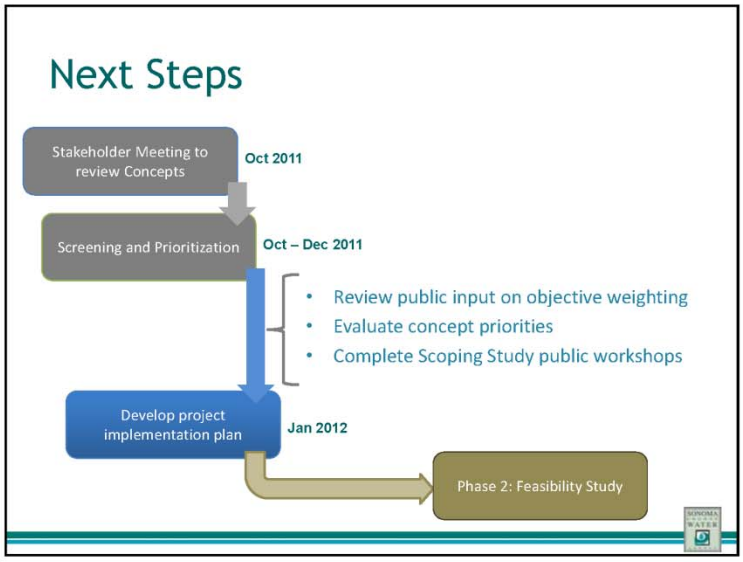
Tier 1	Floodplain modification	Off-stream detention basin		Recommended basis for feasibility phase
Tier 2	Channel modification	Surface bypass channel		Support project concepts in Tier 1
Tier 3	Buried off-stream detention basin	In-stream detention basin	Buried bypass channel	Not recommended for implementation at this time

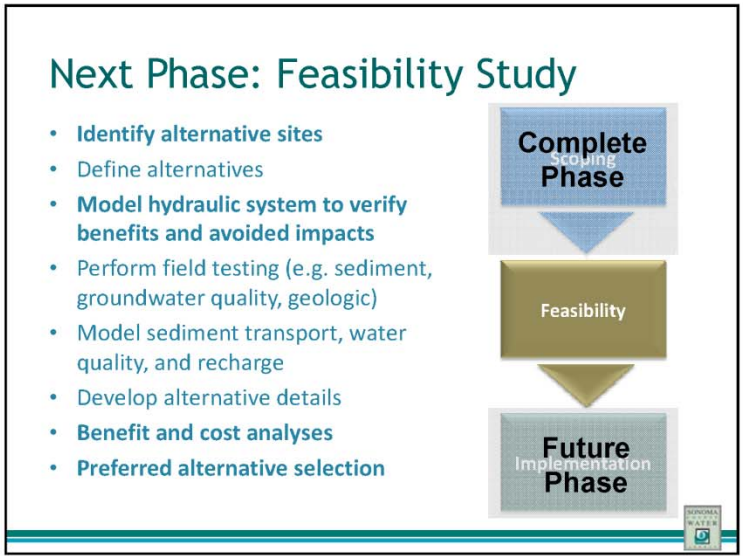
Enhancement Concepts

Managed Floodplain | Low Impact Development | Policy Review and Development

- Potential implementation in parallel with one or more tiered concepts to:
  - Increase security of existing benefits
  - Improve overall benefits
  - Increase funding chances

16


Next Steps
Stakeholder Meeting to review Concepts
Oct 2011
Screening and Prioritization
Oct – Dec 2011
Review public input on objective weighting
Evaluate concept priorities
Complete Scoping Study public workshops
Develop project implementation plan
Jan 2012
Phase 2: Feasibility Study


Next Phase: Feasibility Study
Identify alternative sites
Define alternatives
Model hydraulic system to verify benefits and avoided impacts
Perform field testing (e.g. sediment, groundwater quality, geologic)
Model sediment transport, water quality, and recharge
Develop alternative details
Benefit and cost analyses
Preferred alternative selection
Complete Scoping Phase
Feasibility
Future Implementation Phase

17

Upper Petaluma River Watershed Flood Control Project

Kent Gylfe, SCWA
Randy Raines, RMC
rraines@rmcwater.com

SONOMA COUNTY WATER AGENCY

www.sonomacountywater.org
www.scwa.ca.gov/stormwater-groundwater/

18

Attachment C: Meeting Attendees

Meeting attendees included:

Richard Tavernetti
Rich Tavernetti
Richard Borders
Tito Sasaki
Christ Albertson
Marcus Trotta
Unknown
Jason Sweeney
Mike Orton
Michael Bowers
Henry Hansel
John Cheney
J T Wick
Betty Dale
Vaughn Kelp
Louisa Craviotto
Brad Benson
Tom Hammond
Wayne Leach
Susan Kirks
Bob Krieger
Eugene Camozzi
Bill Kortum
Bob Martin
Chris Ward
Grant Davis
David Keller
Jenny Sterling
Chris Cheek
Mark Ferguson
Bill Bennett
John King
Christy Kennedy
Randy Raines
Tim Harrison

It appeared that not all attendees signed in when they arrived at the meeting.

Appendix H

Zone 2A Concept Evaluation

Technical Memorandum

Upper Petaluma River Watershed Flood Control Project Scoping Study

Subject:	**Zone 2A Concept Evaluation**
Prepared For:	Kent Gylfe, SCWA
Prepared by:	Tim Harrison, RMC
Reviewed by:	Steve Bui, Randy Raines RMC
Date:	August 24, 2012

1 Introduction

The Sonoma County Water Agency (Water Agency) is presently undertaking a Scoping Study for the Upper Petaluma River Watershed Flood Control Project (Project) to identify stormwater management/groundwater recharge projects that provide flood hazard reduction and groundwater recharge benefits (Key Project Purpose).

The Water Agency has requested that RMC review several project concepts that have been proposed in the past and provide recommendations for how to proceed with each concept. The Water Agency is particularly interested in determining whether the concepts should be included in the next steps of the Project, whether a concept should be pursued outside of the Project, or whether the concept should move forward at all.

2 Summary of Concepts

RMC has reviewed the information on the concepts provided by the Water Agency, included in this memorandum as Appendices A – F. The following are summaries of the six concepts:

- **Marin Creek / Denman Flats Drainage Study** - This study would evaluate flood reduction concepts in an agricultural area around Marin Creek between Skillman Lane and the confluence with the Petaluma River. This area has been identified as one that provides natural flood detention through its floodplains.
- **Marin, Wilson, and Wiggins Creek Channel Maintenance and Revegetation Project** – This project would re-establish creek channels through sediment removal and reduce flooding in nearly the same agricultural area as described above. The concept description also mentions including riparian planting to stabilize the banks and create a permanent channel.
- **Holm Road Ditch Extension – Feasibility Study** – This study would extend an existing drainage/ditch system in the Holm Road area to collect overland flow from north of Highway 101 and reintroduce the flow to the Petaluma River downstream of the current river tributaries. The study description suggests that the ultimate project could be broken into four phases that start at the existing Holm Rd. ditch upstream of Corona Road and end at 1) Lower Corona Creek; 2) Lynch Creek; 3) Washington Creek; and 4) McDowell Creek.
- **Lichau Creek Hydraulics & Vegetation Management** – This project consists of two primary tasks: 1) Create a new HEC-RAS model based on the City of Petaluma's XP-SWMM model, Water Agency and Federal Emergency Management Agency (FEMA) data, and new cross-section data to be obtained as part of the project; and 2) Continue revegetation maintenance and

irrigation installation. Community outreach, follow-on project descriptions, and estimates are also included in the project.

- **Willowbrook Flood Reduction Feasibility Analysis** – This analysis could lead to the design of an off-stream detention basin for Willowbrook Creek upstream of Old Redwood Highway. The first identified phase is to evaluate cost/benefit feasibility and identify willing landowners. Phase 2 of the project would be to provide design services.
- **Corona Reach Linear Overflow Channel Feasibility Analysis** – This analysis could lead to the design of a linear channel that provides detention and natural filtration for local run-off and flooding. The first identified phase is to evaluate cost/benefit feasibility and model the system. Phase 2 of the project would be to provide design services.

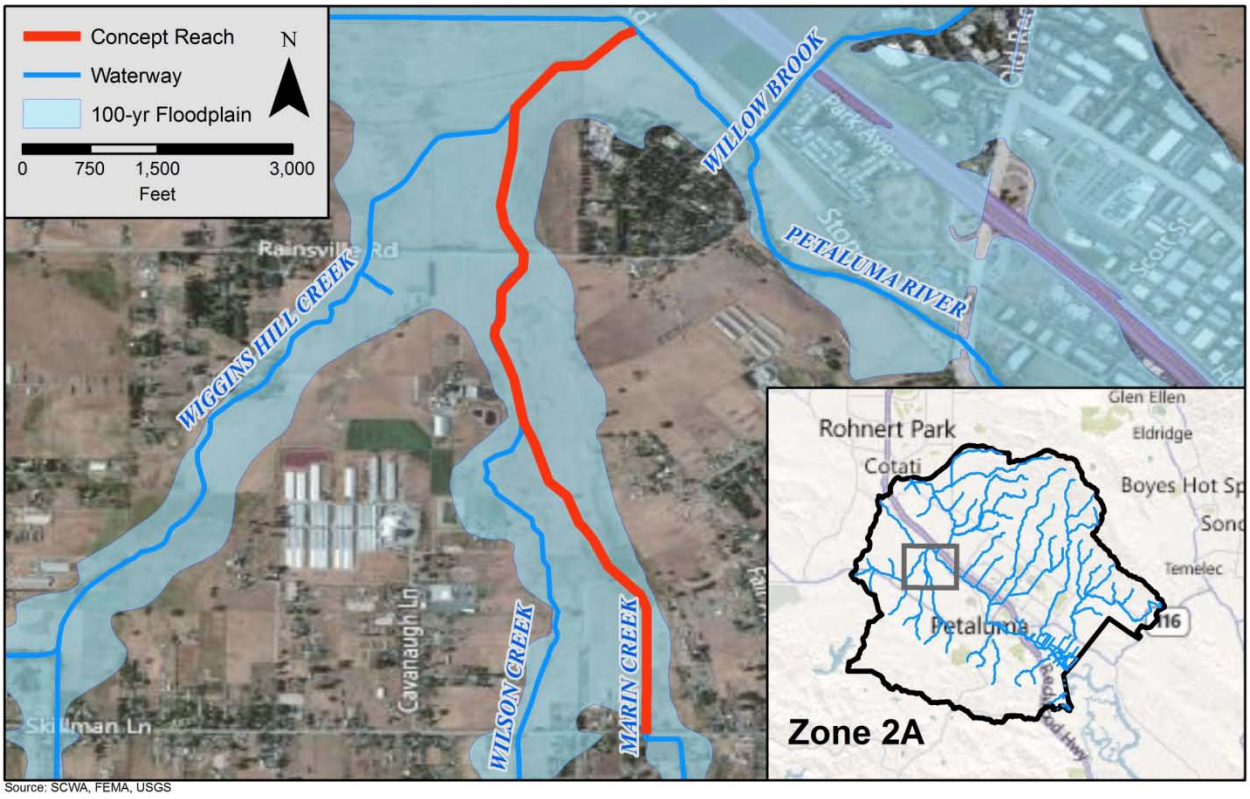
3 Concept Discussion

The concepts described in Section 2 encompass a wide range of implementation complexity and project types. Below is a short discussion about each concept.

Marin Creek / Denman Flats Drainage Study

This is one of two concepts that addresses flood hazards in the large floodplain west of Highway 101 upstream of the Petaluma River. This study focuses on one of the three main tributaries in the area. While no specific project is suggested, the description states that the overall goal as identification of a drainage improvement project. The implication of that description is that the implemented project would reduce the detention capability of the floodplain. As stated in the description, this area has been designated as a natural flood-detention depression. The detention characteristic of the floodplain is a natural flood reduction feature for the downstream areas. Hydraulic modeling would be needed to determine whether reduction in detention in the study area would lead to increased water surface elevations downstream, thereby inducing flooding downstream.

Figure 1: Marin Creek / Denman Flats Drainage Study



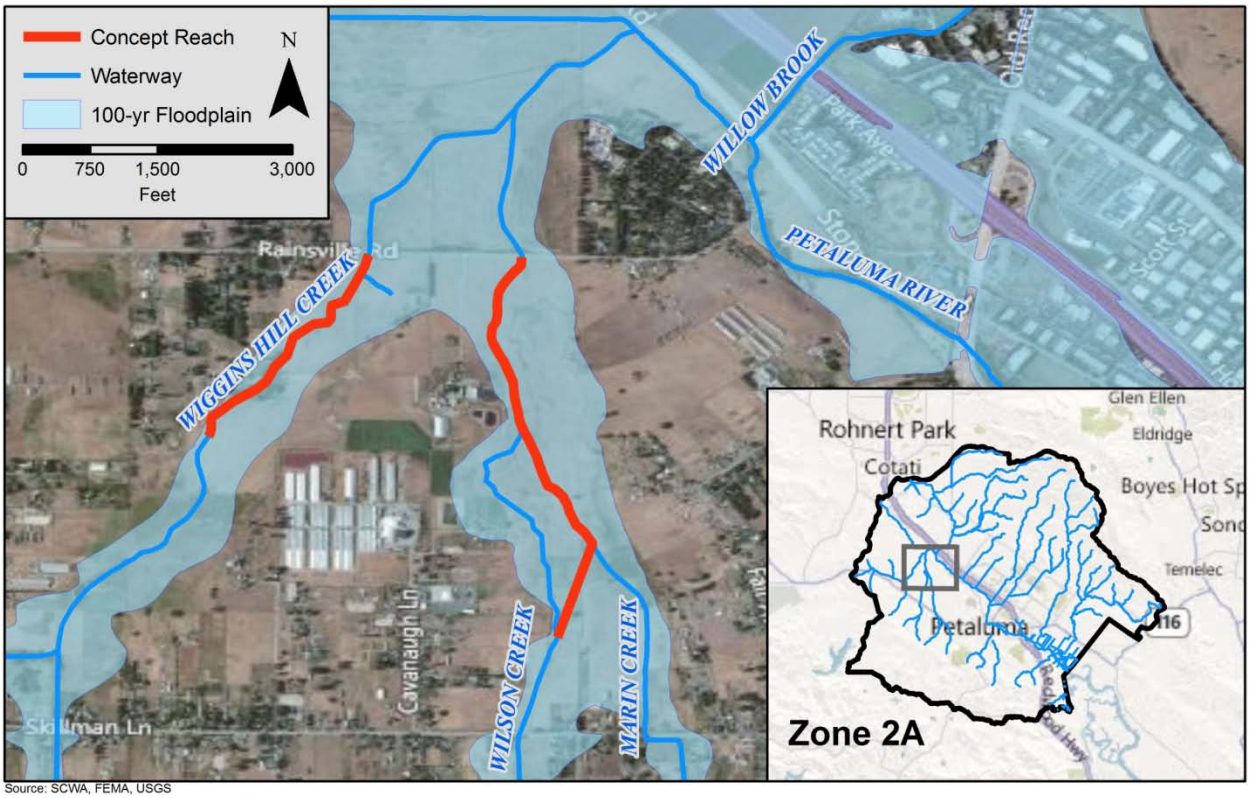
Source: SCWA, FEMA, USGS

Marin, Wilson, and Wiggins Creek Channel Maintenance and Revegetation Project

This is the second concept evaluated in this memorandum that addresses flood hazards in the large floodplain west of Highway 101 upstream of the Petaluma River. The concept description is more direct than the Marin Creek / Denman Flats Drainage Study as it clearly states the intent of the project is to remove sediment deposits from existing channels and establish riparian vegetation. In doing so, the project is intended to prevent flooding to local residents and establish a permanent channel. Similar to the Marin Creek / Denman Flats Drainage Study, hydraulic modeling would need to be performed to determine whether channelization of the floodplain would lead to increased water surface elevations downstream.

It would seem that planting riparian habitat along the newly established channels would increase the habitat diversity and potentially the habitat value of the area. Biologists would need to confirm what species and habitats are established already and whether the planned plantings would be of greater ecological value. Whether planting riparian habitat would help to create a permanent, well defined channel is not clear. Additional geomorphological work is necessary to confirm, but it would seem that sediments are depositing in this area because there is not sufficient grade in this area to generate the energy to transport the sediment downstream. Planting riparian vegetation might reduce the potential for erosion in the new channel but would not address the sedimentation issue. It is unclear whether the sediment is being generated in the floodplain area or is transported from the upstream hills. Removal of the sediment would be a long term maintenance task.

Figure 2: Marin, Wilson, and Wiggins Creek Channel Maintenance and Revegetation Project



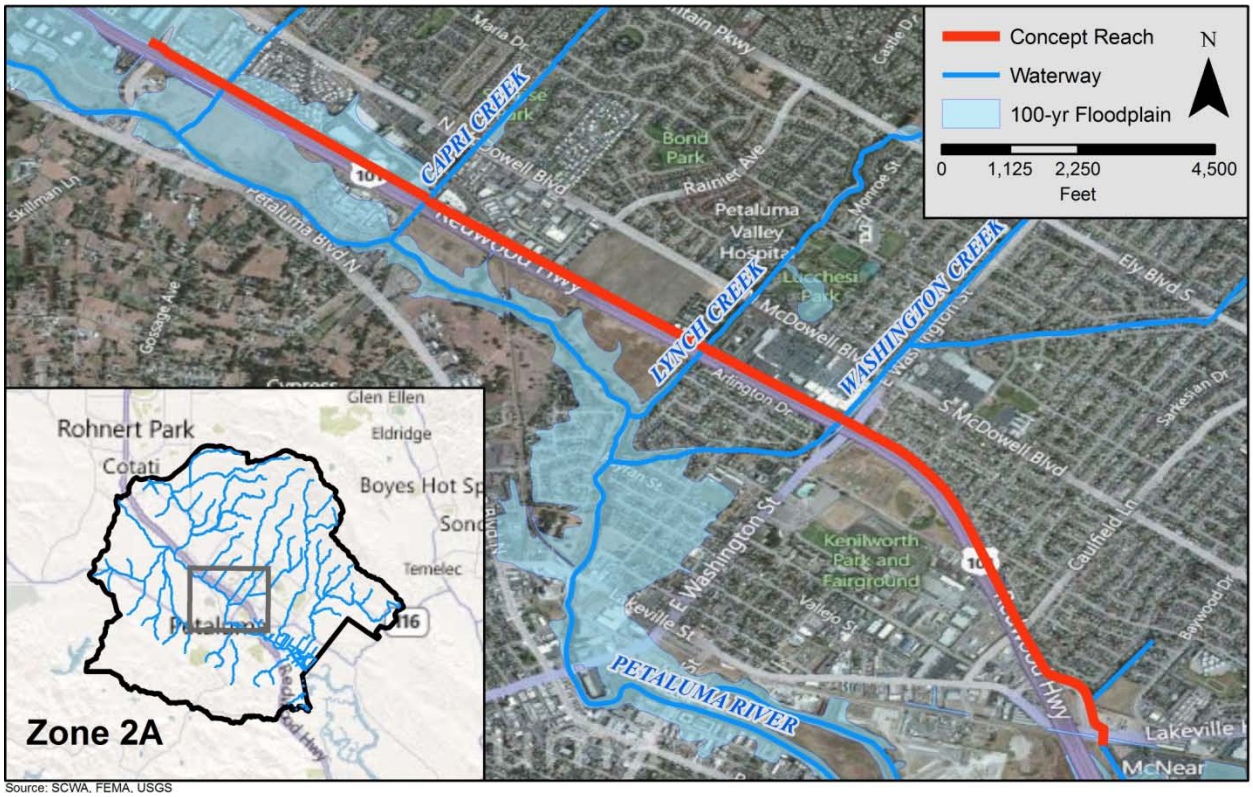
Holm Road Ditch Extension – Feasibility Study

As stated in the concept documentation, the intent of this concept would be to collect overland flows from north of Highway 101 and reintroduce the runoff to the Petaluma River downstream of the downtown Petaluma area via McDowell Creek. The documentation also notes that a peak water surface elevation of 31 feet at the Corona Road Bridge gaging station on the Petaluma River led to drains on the north side of Highway 101 being submerged by 10 feet.

It appears that there may be two goals to this project: reduce flooding in the N. McDowell area and reduce contributions of the tributaries to flooding in the Petaluma River. The latter goal would explain why the project extends to McDowell Creek, downstream of downtown Petaluma. Using the extended ditch as a high flow bypass could reduce the total flow in the Petaluma River upstream of McDowell Creek during storm events. Modeling would be necessary to determine whether this reduction in flow would be enough to reduce or eliminate the described backwater effects up the tributary creeks from the river. Modeling would also be necessary to determine if there were impacts to water surface elevations and induced flooding downstream of the confluence between the Petaluma River and McDowell Creek. Since a new pathway is being created for the water, there is potentially some groundwater recharge that may occur as a result of the project.

Right-of-way would be an obstacle for this project as there are numerous commercial and residential properties that encroach on the land that is anticipated to be needed for this project as well as Caltrans right-of-way and easements. Railroad and street crossings that would increase project complexity and cost include Corona Road, railroad tracks, Washington Street, Highway 101 on- and off-ramps, a footbridge, Caulfield Lane, and Lakeville Highway.

Figure 3: Holm Road Ditch Extension – Feasibility Study

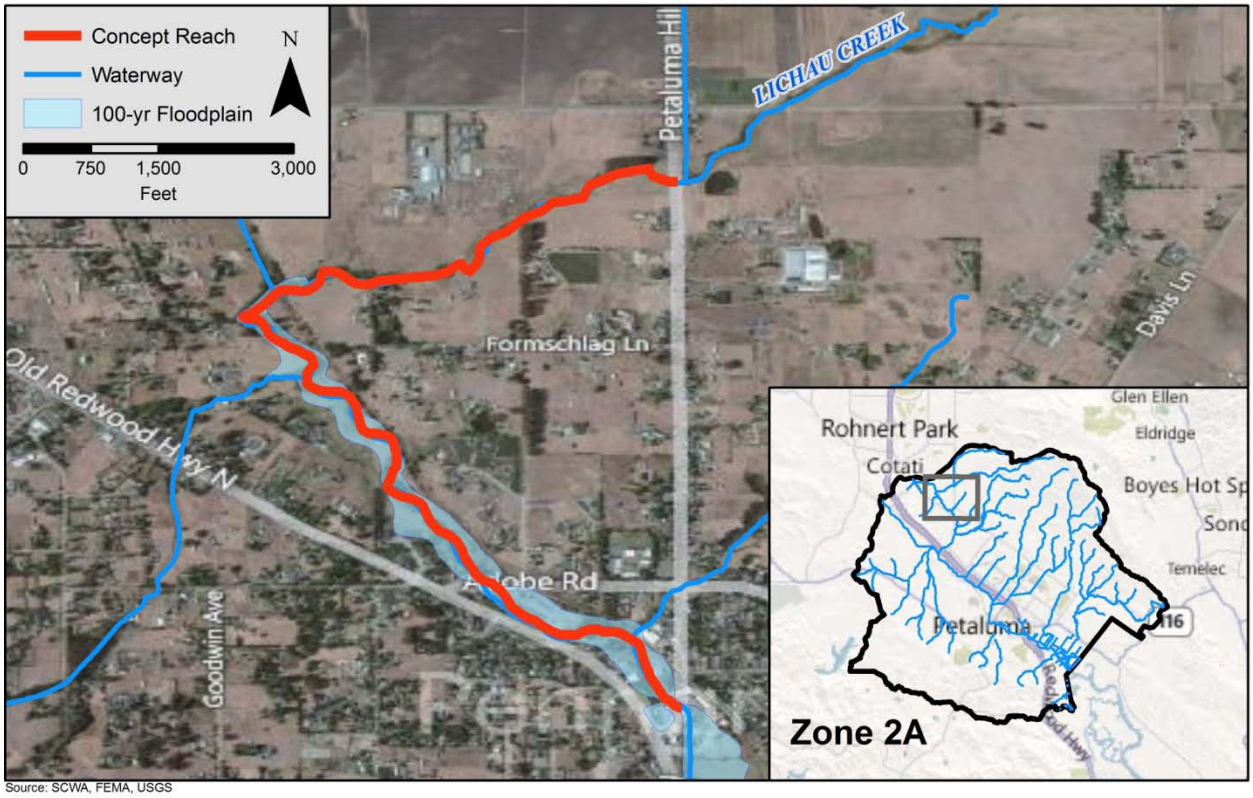


Lichau Creek Hydraulics & Vegetation Management

The City of Petaluma has been developing an XP-SWMM model which includes a portion of Lichau Creek. It is likely that the existing XP-SWMM model is not adequately refined at the concept site to represent the alternative conditions that the concept would implement. It is not clear however why the concept suggests creating a new HEC-RAS model rather than supplementing the XP-SWMM model with the proposed field cross-section survey and any other available updated information. Even if HEC-RAS is used, the XP-SWMM model should be updated to allow modelers to determine downstream impacts of proposed projects within the study area.

As part of the Revegetation Management for Habitat Enhancement & Erosion Reduction, the description states that irrigation will be installed. It was not clear from the description whether the irrigation would be short-term to help establish the vegetation or if the irrigation would be a permanent fixture. Southern Sonoma County Resource Conservation District staff have confirmed that the irrigation is anticipated to be temporary.

Figure 4: Lichau Creek Hydraulics & Vegetation Management

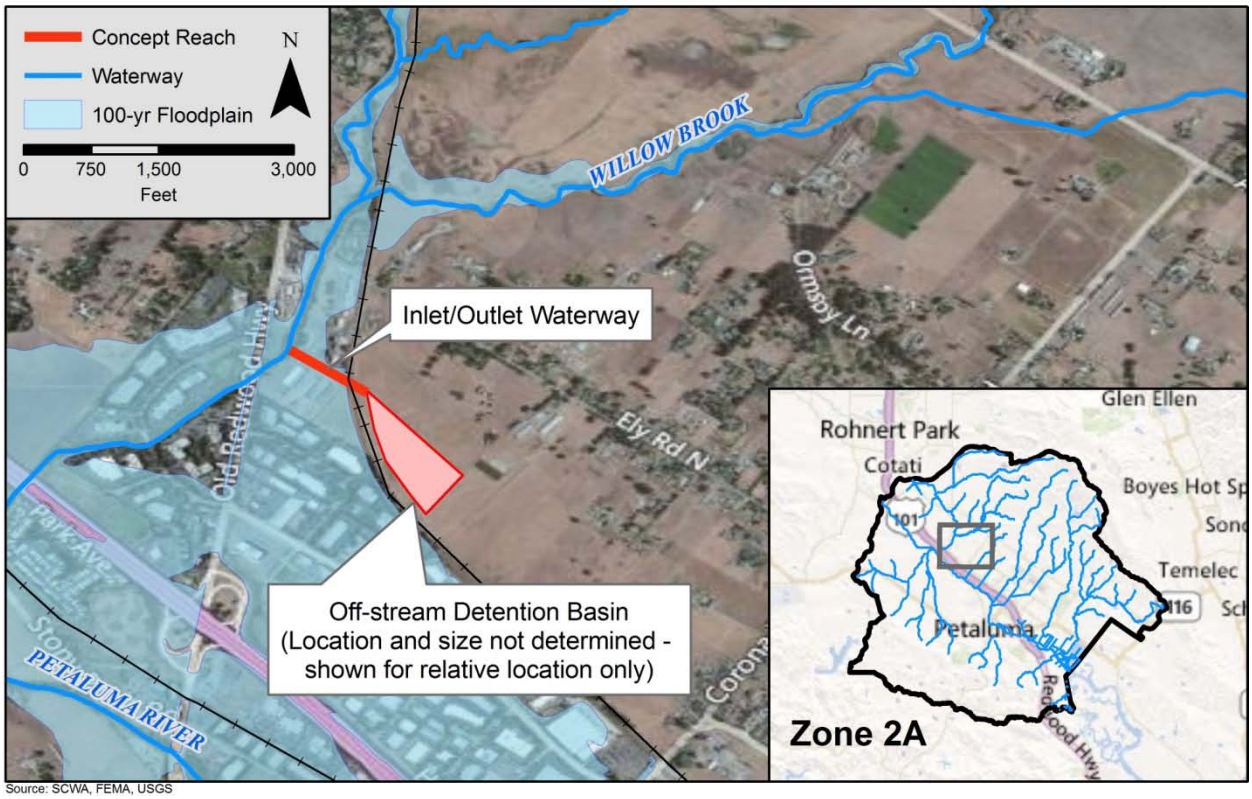


Willowbrook Flood Reduction Feasibility Analysis

The concept description describes the basin as "designed to step from property to property along the east edge of the railroad right-of-way from Old Redwood Highway to Corona Road." It is unclear what is meant by stepping from property to property. Figure 5 shows a potential inlet/outlet location and the relative location of the basin. The actual size and location of the inlet, outlet, and basin will need to be determined through modeling, discussions with property owners, and engineering analysis. It will be necessary, at a minimum, to cross the railroad once. Depending on design considerations and other factors such as willing land owners, it may also be necessary to cross either Corona Road or the railroad. Should the drainage channel that connects to the Holm Road drainage ditch need to be enlarged, the crossing at North McDowell Blvd and culvert from Highway 101 to the Petaluma River may also need to be modified. As part of the concept modeling, the impacts of the concept on downstream water surface elevations should be evaluated.

Recharge benefits would need to be verified through hydrogeologic investigations during the feasibility study.

Figure 5: Willowbrook Flood Reduction Feasibility Analysis

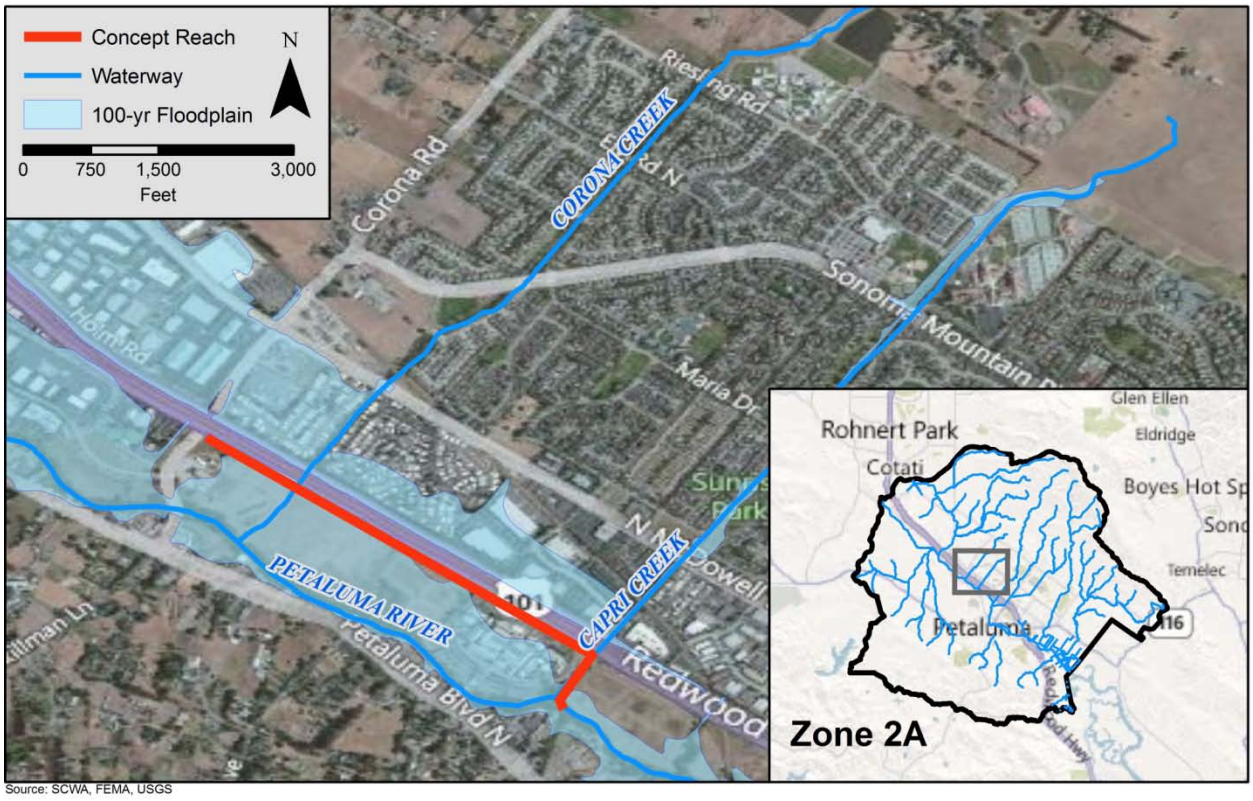


Corona Reach Linear Overflow Channel Feasibility Analysis

The intent of this project is to combine several disconnected depressions to facilitate drainage along the west side of Highway 101. By utilizing swales the concept may be able to provide some preliminary surface water treatment through filtration in grasses and settling. The description also mentions modification of the confluence of Capri Creek and the Petaluma River to reduce flow obstructions. It is not clear what obstructions are currently in place, but elimination of obstructions could be considered a separate project. Depending on the depth of the Capri Creek culvert, it may also be possible to route the flow into the Petaluma River downstream of the Capri Creek confluence, potentially utilizing the fields in a multi-benefit manner.

This project should be evaluated to determine whether completion of the project would cause an increase in downstream water surface elevations.

Figure 6: Corona Reach Linear Overflow Channel Feasibility Analysis



Source: SCWA, FEMA, USGS

4 Concept Alignment with Project Objectives

The concepts described in Sections 2 and 3 are evaluated in this section based on how well they relate to the Project's objectives, as detailed in this Study's *Project Objective Report*. The Project's two core objectives are:

- **Flood Hazard Reduction** – Improve management of stormwater that contributes, directly or indirectly, to reduced flood hazards.
- **Groundwater Recharge** – Increase beneficial recharge of groundwater, whether or not that recharged groundwater is directly accessible as water supply.

Other concepts evaluated for the Upper Petaluma River Watershed Flood Control Project Scoping Study have been screened from consideration for implementation in the Project based on their inability to fulfill both core objectives. The concepts evaluated in this TM were not developed with the Study's objectives in mind and so it should not be surprising that some of them don't achieve the Study's core objectives. These concepts were developed primarily to achieve flood reduction in accordance with the flood control objectives of Zone 2A. Table 1 summarizes whether the concepts reviewed in this memorandum are believed to fulfill the two core objectives. The Marin Creek / Denman Flats Drainage Study; the Marin, Wilson, and Wiggins Creek Channel Maintenance and Revegetation Project; and the Corona Reach Linear Overflow Channel Feasibility Analysis appear to not fulfill both core objectives.

Table 1: Fulfillment of Project Core Objectives

Concept	Flood Hazard Reduction	Groundwater Recharge
Marin Creek / Denman Flats Drainage Study	Yes	No[1]
Marin, Wilson, and Wiggins Creek Channel Maintenance and Revegetation Project	Yes	No[1]
Holm Road Ditch Extension – Feasibility Study	Yes	Yes
Lichau Creek Hydraulics & Vegetation Management	Unknown[2]	Unknown[2]
Willowbrook Flood Reduction Feasibility Analysis	Yes	Yes
Corona Reach Linear Overflow Channel Feasibility Analysis	Yes	No[1]

Notes:

[1] These concepts are all related to channel development or modification. In *Conceptual Screening Alternatives Evaluation* (RMC, 2012), bypass channel and channel modification concepts were assumed to provide some potential for additional groundwater recharge as they were assumed to provide additional infiltration surface. The three concepts in Table 1 seem to eliminate either floodplain or standing water and replace these long-detention features with conveyance, leading to a net loss in infiltration potential.

[2] The description for this concept states that identification of projects will follow development of the updated model. Depending on the projects identified, flood hazard reduction and/or groundwater recharge could be improved.

The Project's supporting objectives are:

- **Water Quality** – Protect or improve water quality of surface water (Petaluma River, its tributaries and the San Francisco Bay) and groundwater.

- **Water Supply** – Increase or improve water supply availability, reliability and flexibility for domestic, municipal, industrial, agricultural, and environmental use.
- **System Sustainability** – Support energy and water efficiency and climate change resiliency of water management systems and developed supplies; provide for channel stability and sedimentation control; and consider the long-term viability of implemented project and impact on affected systems.
- **Ecosystem** – Improve ecosystem function and/or habitat enhancement, especially for listed species.
- **Agricultural Land** – Preserve agricultural land use.
- **Undeveloped Land** – Preserve and/or enhance open space and undeveloped land.
- **Community Benefits** – Create and/or enhance recreation, public access, education, etc.

Table 2 summarizes whether the concepts reviewed in this memorandum are believed to fulfill the seven supporting objectives.

Table 2: Fulfillment of Project Supporting Objectives

Concept	Water Quality	Water Supply	System Sustainability	Ecosystem	Agricultural Land[1]	Undeveloped Land[1]	Community Benefits
Marin Creek / Denman Flats Drainage Study	No	No	Partial	Unknown	Yes	Yes	Unknown
Marin, Wilson, and Wiggins Creek Channel Maintenance and Revegetation Project	No	No	Partial	Yes	Yes	Yes	Unknown
Holm Road Ditch Extension – Feasibility Study	No	Partial	Partial	Unknown	Yes	Yes	Unknown
Lichau Creek Hydraulics & Vegetation Management	Yes	No	Yes	Yes	Yes	Yes	Unknown
Willowbrook Flood Reduction Feasibility Analysis	Yes	Yes	Yes	Yes	No	Yes	Unknown
Corona Reach Linear Overflow Channel Feasibility Analysis	Yes	Yes	Yes	Yes	Yes	Yes	Unknown

Notes:

[1] These supporting objectives are highly impacted by the location of the project concept. For purposes of this evaluation, the concept is considered to have achieved the objective if it avoided negative impacts to the agricultural land use or open space qualities of the concept area.

5 Recommendations

Table 2 summarizes RMC's implementation recommendation for each of the six concepts discussed in this memorandum. Concepts are recommended for implementation either through the Upper Petaluma River Watershed Flood Control Project or through another implementation avenue. In some cases, additional analysis is necessary to determine whether the concept should proceed. In a few cases, portions of the concept could be implemented through one or more avenues. These recommendations assume that 100-year flood protection in the concept area is the flood protection goal for the concept.

Table 3: Recommended Vehicle for Concept Implementation

Concept	Recommended for Further Analysis	Candidate Concept for Upper Petaluma River Watershed Flood Control Project
Marin Creek / Denman Flats Drainage Study	Yes	No
Marin, Wilson, and Wiggins Creek Channel Maintenance and Revegetation Project	Yes	No
Holm Road Ditch Extension – Feasibility Study	Yes	Yes
Lichau Creek Hydraulics & Vegetation Management	Yes	Partial[1]
Willowbrook Flood Reduction Feasibility Analysis	Yes	Yes
Corona Reach Linear Overflow Channel Feasibility Analysis	Yes	No

Notes:

[1] A 'Partial' recommendation indicates either that limited aspects of the concept are recommended or that the concept is recommended only for certain areas. Additional description and clarification can be found in the discussion below.

The rationale for the recommendations in Table 2 is discussed below, as are some additional thoughts and recommendations:

- **Marin Creek / Denman Flats Drainage Study** – This concept is not recommended for implementation as part of the Project but should be studied further to better quantify the benefits of the floodplain. Should the modeling show that the floodplain in the study area does not provide downstream flood protection benefit, implementation of the concept could be revisited as part of an independent project. Analysis would need to account for considerations other than technical feasibility. Alternatively, flood easements could be considered in the concept area.
- **Marin, Wilson, and Wiggins Creek Channel Maintenance and Revegetation Project** – Implementation of the flood protection elements of this concept is not recommended but should be studied further to better quantify the benefits of the floodplain. Should the modeling show that the floodplain in the study area does not provide downstream flood protection benefit, implementation of the concept could be revisited as part of an independent project. Flood easements are an alternative to the flood protection elements of this concept. Riparian planting could be implemented, as its own project or as a component of a larger project, but it will be

important to understand the goals of such a project so as to appropriately scope the work required for implementation of the concept.

- **Holm Road Ditch Extension – Feasibility Study** – It is unclear how much flood reduction and recharge benefit could be achieved through this concept. There is enough merit however to do some additional analysis as a high flow bypass with potential recharge in the downstream reaches of the channel. Should the core objective benefits be comparable to other alternatives being evaluated in the feasibility study, other implementation factors such as land acquisition and maintenance would become considerations.
- **Lichau Creek Hydraulics & Vegetation Management** –Regardless of whether a separate HEC-RAS model is developed for this concept, the XP-SWMM model should be updated with surveyed sections as described in the concept description so as to evaluate downstream impacts of the concept. The potential for restoration of a healthy, native riparian buffer should be evaluated as a component of a flood hazard reduction and groundwater recharge project.
- **Willowbrook Flood Reduction Feasibility Analysis** – This concept, or one similar to it, is likely to be evaluated as part of the Project Feasibility Study as it is likely to lead to both flood hazard reduction and groundwater recharge.
- **Corona Reach Linear Overflow Channel Feasibility Analysis** – It is possible that this project would be able to alleviate flooding on both sides of Highway 101 between Corona Creek and Capri Creek. Additional study and modeling is necessary to confirm this flood hazard reduction and to confirm that the concept would not induce downstream flooding. This concept is not considered to be a candidate for inclusion in the Project as it likely reduces recharge as currently envisioned.

Appendix A: Information Sheets for Marin Creek/Denman Flats Drainage Study

PROJECT NEEDS REPORT

TITLE: **Marin Creek/Denman Flats Drainage Study**

FILE NO.: 2-_____-7

DATE: October 2003

JURISDICTION: Sonoma County Water Agency (Zone 2A)

DESCRIPTION:

The study area comprises the portion of Marin Creek located between Skillman Lane and the confluence with the Petaluma River, in an unincorporated area northwest of the City of Petaluma.

Currently, the study area experiences frequent flooding on the agricultural parcels located along the described portion of Marin Creek. The Petaluma River Watershed Master Drainage Plan identifies the area as a natural flood-detention depression commonly referred to as Denman Flats.

The study will investigate the hydrology, hydraulics, routing, right-of-way and environmental issues in the drainage area and propose a drainage improvement project.

PURPOSE:

The proposed study will identify a solution to alleviate existing flooding that occurs on the private agricultural parcels located along Marin Creek, in the Denman Flats area between Skillman Lane and the Petaluma River.

LAND OR R/W REQUIREMENTS:

No right-of-way or permits will be required for the study.

RELATIONSHIP TO OTHER PROJECTS:

PROJECT COST

Pre-design study	$50,000.00
CEQA	0
Right-of-way	0
Construction	0
Inspection	0
Revegetation (if applicable)	0
TOTAL:	$50,000.00

ANNUAL OPERATING COSTS

Labor	0
Materials	0
Equipment	0
Energy (fuel, electricity)	0
TOTAL:	$ 0.00

Engineer: Kent Gylfe

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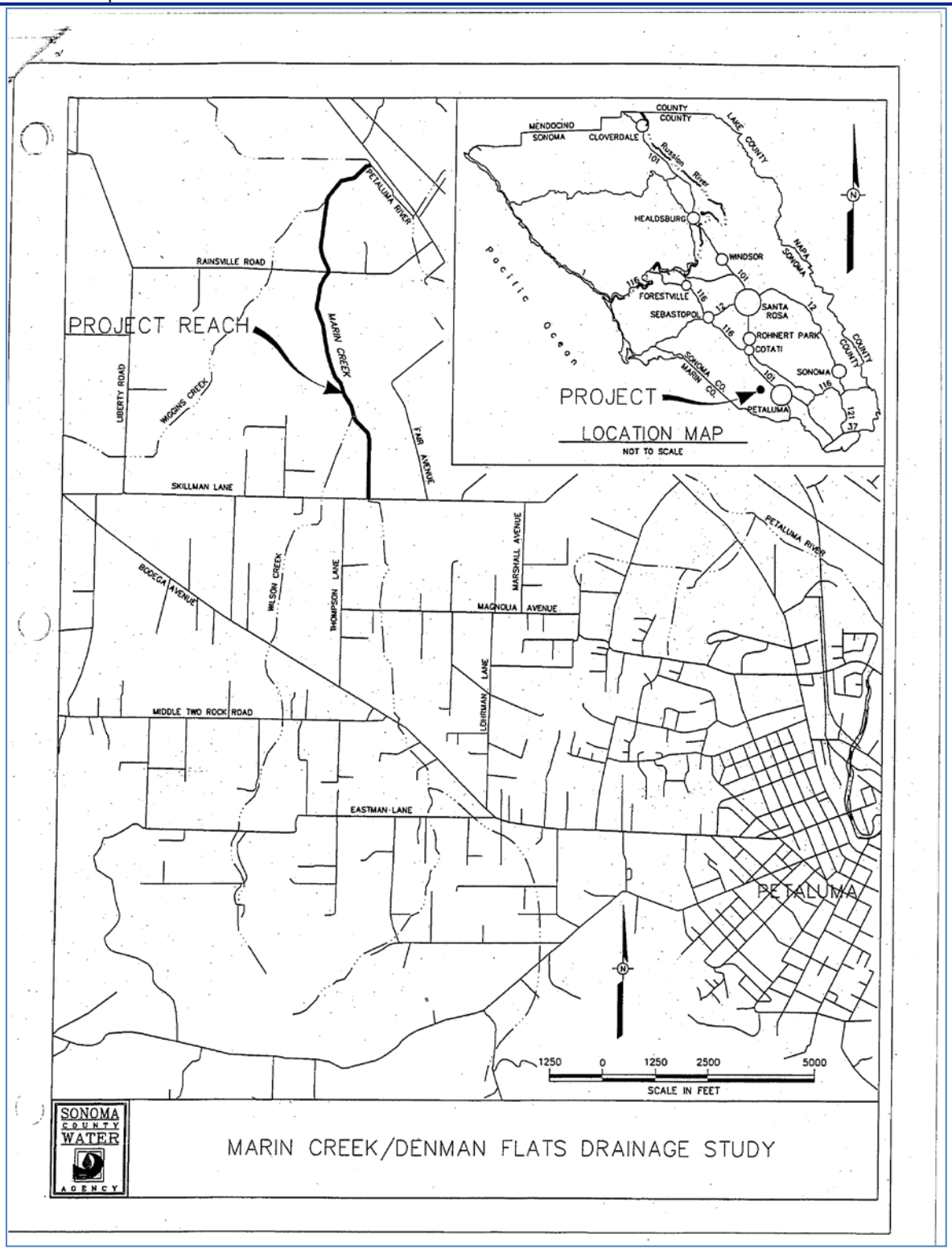

PROJECT REACH
RAINSVILLE ROAD
PETALUMA RIVER
MARIN CREEK
LIBERTY ROAD
WIGGINS CREEK
FAIR AVENUE
SKILLMAN LANE
BODEGA AVENUE
WILSON CREEK
THOMPSON LANE
MARSHALL AVENUE
MAGNOLIA AVENUE
LOHRMAN LANE
MIDDLE TWO ROCK ROAD
EASTMAN LANE
PETALUMA
PROJECT
LOCATION MAP
NOT TO SCALE
MENDOCINO COUNTY
SONOMA COUNTY
LAKE COUNTY
CLOVERDALE
HEALDSBURG
WINDSOR
FORESTVILLE
SEBASTOPOL
SANTA ROSA
ROHNERT PARK
COTATI
SONOMA
MARIN SONOMA
Pacific Ocean
Russian River
SONOMA CO.
MARIN CO.
1250 0 1250 2500 5000
SCALE IN FEET
SONOMA COUNTY WATER AGENCY
MARIN CREEK/DENMAN FLATS DRAINAGE STUDY

Appendix B: Information Sheets for Marin, Wilson, and Wiggins Creek Channel Maintenance and Revegetation Project

Project Objective Report

TITLE: Marin, Wilson, and Wiggins Creek Channel Maintenance and Revegetation Project

DATE: November 2004

JURISDICTION: Sonoma County Water Agency (Zone 2A)

DESCRIPTION:
This project is located in the Petaluma River Basin within the Marin Creek sub-basin. The project site is located along Marin, Wilson and Wiggins Creeks between Skillman Lane and Rainesville Road.

These creeks are subject to sediment deposit which causes flooding. The landowners would like the sediment cleared to mitigate channel flow and relieve flooding. In areas of extreme deposition on properties adjoining Rainesville Road, the channel needs to be re-established. Riparian planting is needed to stabilize the banks and create a permanent channel.

PURPOSE:
The purpose of this project is to prevent flooding to residents adjacent to the creeks and to reduce erosion that contributes sediment to the Petaluma River. The sediment removal and the creation of viable creek channels will maintain the creek flow and alleviate the flooding problem. Planting riparian habitat of trees and shrubs will stabilize and maintain the channel.

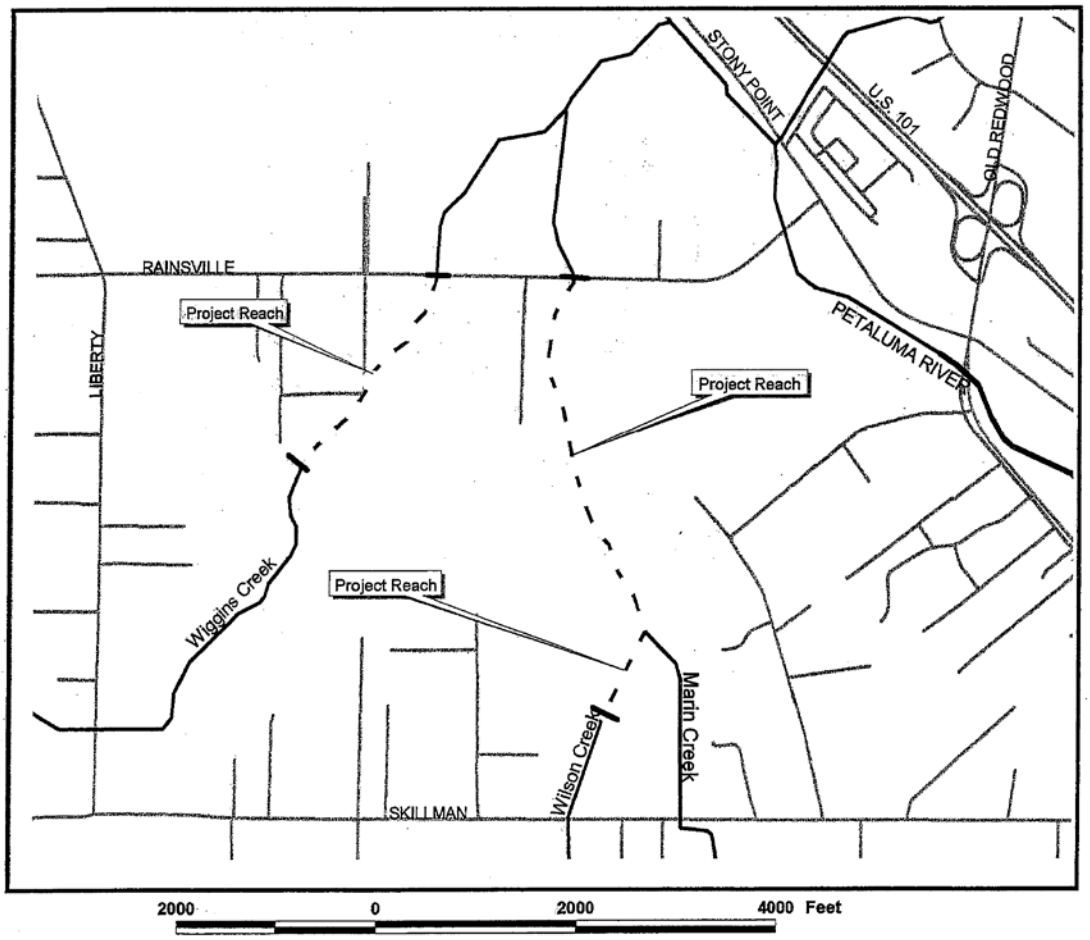
LAND OR R/W REQUIREMENTS:
Rights of entry to perform the work will be needed from all property owners adjacent to the creeks. The Southern Sonoma County Resource Conservation District will be responsible for attaining rights-of-way prior to study work.

RELATIONSHIP TO OTHER PROJECTS
This project is a continuation of a previous project funded by Southern Sonoma County RCD through a federal grant, where channels were re-established on properties north of Rainesville Road.

PROJECT COST:

R/W	$ 15,000
Admin (RCD)	$ 40,000
Admin (SCWA)	$ 5,000
Design	$ 20,000
CEQA	$ 25,000
Permitting	$ 75,000
Construction	$ 80,000
Revegetation	$ 80,000
Monitoring	$ 10,000
TOTAL	**$ 350,000**

Marin, Wilson, and Wiggins Creek Channel Maintenance and Revegetation Project



Appendix C: Information Sheets for Holm Road Ditch Extension – Feasibility Study

DRAFT
DATE 11/16/06

PROJECT OBJECTIVES REPORT

FILE NO.:

TITLE: Holm Rd. Ditch Extension – Feasibility Study **DATE:** Nov '06

JURISICTION: Sonoma County Water Agency (Zone 2A)

DESCRIPTION:

This study will evaluate the feasibility of extending the Holm Rd. Ditch under Corona Rd. and continuing it south along Hwy 101 eventually entering the Petaluma River via McDowell Creek. Significant flood damage has recently occurred in the area of Corona Road and N. McDowell Blvd.
Improvements in the N. McDowell area have overwhelmed the existing capacities of both the North Corona Drainage system and the Holm Rd. Ditch. (Ref. Map # 31 MDP) Both of these drainage systems currently feed under Hwy. 101 and discharge into the Denman Reach (just upstream of the Corona Rd. Bridge) at an elevation of between 17 and 20 ft.
Streamgage readings at the CRD Station (Corona Rd. Bridge) recorded a peak elevation of 31ft during the 12/31/05 flood. This submerged the drainage outlets of both the Holm Road and North Corona Drainage Systems by about 10 Ft. The higher elevations of Hwy 101 and the railroad bed act as levees, trapping storm waters that would have previously flowed overland into the Petaluma River
This project could be broken into 4 phases:
Phase 1. Holm Road Ditch under Corona Road to Lower Corona Creek (map 31)
Phase 2. Lower Corona Creek, under railroad to Lynch Creek (maps 27 & 29)
Phase 3. Lynch Creek to Washington Creek (map 25)
Phase 4. Washington Creek, under Washington St. and Caufield Lane into McDowell Creek (map 22)

OBJECTIVES:

The proposed project is intended to relieve flooding in the Corona / N. McDowell area by channeling over flows from Holm Rd. ditch, North Corona drainage system, Lower Corona, Capri, Lynch and Washington Creeks into the Petaluma River via McDowell Creek. The concept is to provide a bypass channel, designed to convey storm waters that would have originally flowed overland into the Petaluma River prior to construction of the railroad and Hwy 101.

LAND OR R/W REQUIREMENTS:

Temporary access to private properties is anticipated for engineering study purposes. Much of the property is already public-owned or undeveloped.

RELATIONSHIP TO OTHER PROJECTS:

The concept of adding a bypass channel in parallel with the Petaluma River has the potential of reducing peak flows upstream of the weir. The proposed widening of Hwy 101 and overpass upgrades may provide opportunities to incorporate this drainage improvement. After all, Highway 101 has effectively created a dam right down the center of the watershed.

ESTIMATED PROJECT COST		ESTIMATED ANNUAL OPERATING COSTS	
Preliminary Engineering	50,000	Labor	0
Survey/ Mapping	25,000	Materials	0
Environmental/Permitting	15,000	Equipment	0
Right-of-way	10,000	Energy (fuel, electricity)	0
Construction	0		
TOTAL:	$100,000	**TOTAL:**	**$0.00**

Submitted by: Committee Member Bob Martin

Appendix D: Information Sheets for Lichau Creek Hydraulics & Vegetation Management

por.dot updated by rlk: 1/2/04

DRAFT PROJECT OBJECTIVES REPORT

FILE NO.: [redacted]

TITLE: Lichau Creek Hydraulics & Vegetation Management

DATE: Nov. 20, 2008

JURISDICTION: Sonoma County Water Agency (Zone 2A)

DESCRIPTION:
Southern Sonoma County Resource Conservation District (SSCRCD) is proposing a multi-benefit flood reduction and habitat enhancement project in the Lichau/Willowbrook Creek sub-basin. This project has 2 distinct tasks.

1) Modeling, Analysis & Project Identification: A hydrologic and hydraulic model will be developed to identify projects along approx. 13,000 linear feet of Lichau Creek from upstream of the Petaluma Hill Road culvert to a downstream terminus in Penngrove Park, below Main Street Bridge in Penngrove. The model will build upon existing hydrologic data from XP-SWMM (City), SCWA and FEMA sources. A HEC-RAS model will be built incorporating the hydrologic data with new cross sections along the entire reach. Detailed cross sections will be surveyed to provide an accurate model from which to recommend and ultimately design flood control and restoration projects. After the modeling, analysis and project identification phase, the RCD will share results with SCWA and City of Petaluma and conduct community outreach to discuss project opportunities and determine willingness for participation. 2) Revegetation Management For Habitat Enhancement & Erosion Reduction: Continued revegetation maintenance to meet the stream maintenance goals of changing the composition of the riparian canopy. A complex riparian canopy will reduce the need for maintenance over time, help to alleviate flooding and reduce sedimentation and erosion. Installation of irrigation and native plants is proposed, along with continued outreach to landowners along the affected reach.

Products/Results: a) highly accurate model for use by RCD, SCWA & City for design purposes, b) analysis, report, prelim. recommendations for restoration and cost estimates, c) stakeholder comments and participation determined, and d) additional native plantings installed and irrigation maintained to continue plant success.

OBJECTIVES:
1) to identify projects to accommodate winter storm flows, benefit groundwater recharge and enhance fish habitat, and 2) maintain revegetation with irrigation while installing additional native vegetation over successive years

LAND OR R/W REQUIREMENTS:
Rights of entry to perform the work have been obtained from all property owners adjacent to the project sites. The SSCRCD will be responsible for maintaining approved rights-of-way prior to conducting work.

RELATIONSHIP TO OTHER PROJECTS:
This project is directly related to the SCWA Zone 2A Lichau Creek Channel Maintenance & Revegetation project administered by the RCD and completed in 2007. The project also meets goals and objectives outlined in the Petaluma Watershed Enhancement Plan, Petaluma General Plan, and the future Petaluma River TMDL to reduce sediment and improve water quality. This project is related to SCWA, City of Petaluma, Friends of the Petaluma River, and other stakeholder groups' goals and objectives for flood alleviation and habitat enhancement.

ESTIMATED PROJECT COST	
Project Administration	20,000
Modeling & Analysis	132,000
Vegetation Management	13,000
Stakeholder Outreach	20,000
TOTAL:	$ 185,000

ESTIMATED ANNUAL OPERATING COSTS

TOTAL: *$ 0.00

Engineer: [redacted]

Appendix E: Information Sheets for Willowbrook Flood Reduction Feasibility Analysis

DRAFT PROJECT OBJECTIVES REPORT

FILE NO.: [redacted]

TITLE: WILLOWBROOK FLOOD REDUCTION FEASIBILITY ANALYSIS

DATE: October 2009

JURISDICTION: Sonoma County Water Agency (Zone 2A)

DESCRIPTION:
The City of Petaluma proposes to evaluate cost/benefit feasibility and conduct outreach to property owners for a retention/detention basin just beyond the northeast edge of the City where WillowBrook Creek presently overflows its banks. If appropriate, Phase 2 would provide design and construction of the improvements. The direction of overbank flow currently passes through and across numerous industrial and commercial properties causing extensive property damage. Storm flow is then directed into a piped system before being discharged to the Petaluma River, missing numerous opportunities to allow natural infiltration to recharge groundwater aquifers. The basin would retain peak storm flows, reducing downstream flood impacts and enhancing groundwater recharge potential for the agricultural land owners along the west side of Ely Road.

OBJECTIVES:
The project would meet goals and objectives of the Petaluma General Plan 2025 and the the Sonoma County General Plan pertaining to reduction of peak storm flow impact and preservation of groundwater resources within the Petaluma watershed.

LAND OR R/W REQUIREMENTS:
Construction and flood easements would be procured from land owners wishing to participate. The retention/basin would be designed to step from property to property along the east edge of the railroad right-of-way from Old Redwood Highway to Corona Road.

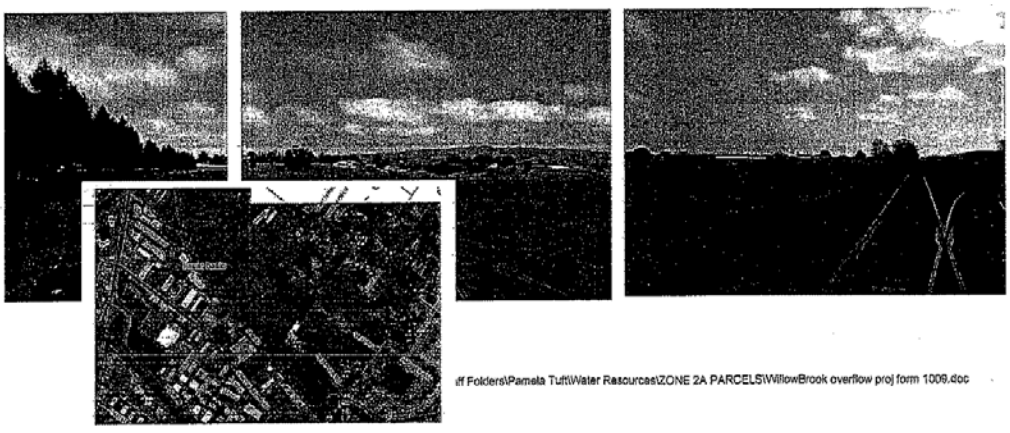
RELATIONSHIP TO OTHER PROJECTS:
This project relates to the concept of regional surface water planning to address flooding reduction and groundwater resource protection/enhancement goals and objectives.

ESTIMATED PROJECT COST	
Project Administration	$4,000.00
CEQA & Permitting	$43,500.00
Outreach	$1,000.00
Planning & Design	$43,400.00
Construction	$0.00
Maintenance & Monitoring	$0.00
TOTAL:	$91,900.00

ESTIMATED ANNUAL OPERATING COSTS

TOTAL: _____

Engineer: [redacted]



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Appendix F: Information Sheets for Corona Reach Linear Overflow Channel Feasibility Analysis

DRAFT PROJECT OBJECTIVES REPORT

FILE NO.: [redacted]

TITLE: CORONA REACH LINEAR OVERFLOW CHANNEL FEASIBILITY ANALYSIS

DATE: October 2009

JURISDICTION: Sonoma County Water Agency (Zone 2A)

DESCRIPTION:
The City of Petaluma proposes to conduct cost/benefit feasibility analysis and model run; and if appropriate design, and construction of a linear detention channel along the west side of Highway 101 from Corona Road overpass south along the old railroad right-of-way (held in private ownership); and modification of Capri Creek confluence with Petaluma River to reduce flow obstruction. The four photos show the disconnection and truncation of surface storm flows along the freeway and overland flows within the Corona Reach.

OBJECTIVES:
Allow continuation of existing linear channel to capture, contain, and direct storm flows within grass lined swales toward the Petaluma River. Provide a contaminant filtration and sediment/debris settling period prior to storm flows entering the Petaluma River.

LAND OR R/W REQUIREMENTS:
Coordination with CalTrans and Sonoma County Water Agency and easements from property owner, Chelsea Properties.

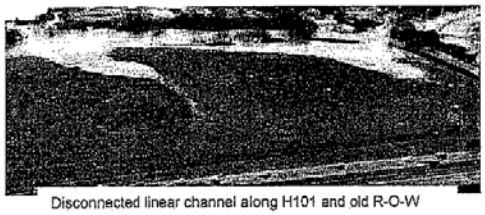
RELATIONSHIP TO OTHER PROJECTS:
This project relates to the concept of creating regional solutions to severe flooding that occurs within the Petaluma Watershed and to address water quality issues from urban runoff.

ESTIMATED PROJECT COST	
Project Administration	$4,000.00
CEQA & Permitting	$67,000.00
Outreach	$0.00
Planning & Design	$45,400.00
Construction	$0.00
Maintenance & Monitoring	$0.00
TOTAL:	$116,400.00

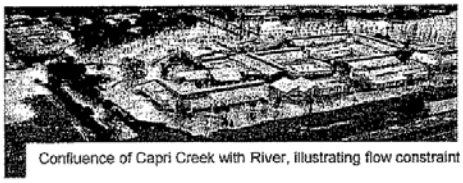
ESTIMATED ANNUAL OPERATING COSTS

TOTAL: _____

Engineer: [redacted]



Disconnected linear channel along H101 and old R-O-W



Confluence of Capri Creek with River, illustrating flow constraint

Corona Road overpass

Corona Reach linear channel proj form 1009

Appendix I

Feasibility Study Scope of Work

Technical Memorandum

Upper Petaluma River Watershed Flood Control Project Scoping Study

Subject:	**Feasibility Study Scope of Work**
Prepared For:	Kent Gylfe, SCWA
Prepared by:	Tim Harrison and Leslie Dumas, RMC
Reviewed by:	Steve Bui and Randy Raines, RMC
Date:	August 24, 2012

1 Purpose

The Sonoma County Water Agency (Water Agency) is presently undertaking a Scoping Study for the Upper Petaluma River Watershed Flood Control Project (Project). The goal of the Scoping Study is to identify storm water management/groundwater recharge concepts that provide flood hazard reduction and groundwater benefits (Key Project Purpose). In December of 2011, the Water Agency presented to stakeholders a prioritization of project concepts for further evaluation. This memorandum has been prepared based on that prioritized concept list and presents a proposed scope of work for a Feasibility Study (FS).

This scope is intended for planning purposes to better understand the range of scope elements that may be needed or desired for the FS. This planning scope may be modified in the future to best fit the needs of the Water Agency. At that later time, the schedule and budget will be established based on the identified scope.

2 Scope of Work

This scope describes work that is required for efficient advancement of the Upper Petaluma River Watershed Flood Control Project and completion of a Feasibility Study. A successful FS will help to establish a foundation for the other elements of Project implementation. These include design, construction, permitting, environmental documentation, and funding.

The scope contained herein consists of nine primary tasks, eight of which are recommended components of the Feasibility Study. The ninth task, Preliminary Design Report, has been included as an optional task. A Preliminary Design Report (PDR) is typically completed as part of the project design phase, but early completion of the PDR may position the Project for upcoming funding opportunities, potentially including Proposition 84 Round 3 Implementation Grant funding.

The following tasks are structured such that, after confirming available data and tools, several alternatives are broadly defined and evaluated so that those alternatives with the most value can be further refined and developed based on focused field investigations. Ideally, a single preferred alternative will be identified and advanced to the next implementation steps.

Task 1: Data Collection and Analysis

Subtask 1.1 – Collect Missing Data - In Subtask 1.1, data gaps identified in the RMC Technical Memorandum (TM) entitled *Feasibility Study Data Needs* will be addressed through coordination with Water Agency staff and other entities, as directed, to obtain needed information. These data will be obtained in electronic format whenever possible.

Subtask 1.2 – Data Analysis - In this subtask, a detailed review of the documents/data obtained under Subtask 1.1 will be conducted. These data will be synthesized with existing information for use in subsequent tasks.

Task 2: Hydraulic Model Update

As part of its *Surface Water Management Master Plan*, the City of Petaluma recently developed a 1D/2D surface water hydraulic model using XP-SWMM. Per this Master Plan, this model was and is being used by the City of Petaluma to evaluate flood mitigation and sustainability alternatives. Under this task, a copy of this XP-SWMM model (along with all available support documentation) obtained under Subtask 1.1 will be updated to evaluate alternatives established in Task 4. This task assumes some hydrologic updates to reflect additional specificity in the upper watershed where necessary to model the proposed alternatives. Calibration will occur to re-establish the accepted FEMA flows within the City of Petaluma.

Task 3: Establish Standards and Criteria

Project-specific standards and criteria need to be established to provide the basis for alternative evaluation. Standards and criteria will be developed for:

- Design and Performance – These standards and criteria will specify provisions, practices, requirements or limits to be met (e.g. degree of protection for a structure) and/or goals to be achieved (e.g. maintain present water quality in underlying shallow aquifer). For example, the requirements of local and State ordinances and regulations pertaining to flood control and protection will be considered in the development of these standards and criteria.
- Regulatory Compliance – These standards and criteria have been established by State and Federal regulatory agencies such as the California Regional Water Quality Control Board or the Federal Emergency Management Agency. Examples of documents to be considered in establishing these criteria include General Permits for discharges of storm water and the Basin Plan.
- Alternatives Evaluation – The goals and objectives established for the Project, such as compliance with the Key Project Purpose, will be revisited to update language as necessary for application to the FS.

Subtask 3.1 – Establish Draft FS Evaluation Standards and Criteria – A draft FS Evaluation Standards and Criteria TM will be prepared that identifies the standards and criteria to be used to evaluate alternatives developed in Task 4. These standards and criteria will follow the three general categories provided above and will be measurable, where possible, to allow for direct application to alternative evaluation.

Subtask 3.2 – Standards and Criteria Workshop – A workshop will be held with Water Agency staff and other stakeholders to discuss the draft TM prepared in Subtask 3.1. During this workshop, the proposed standards and criteria will be presented along with the method of their application. A discussion will be facilitated to solicit and address comments and questions.

Subtask 3.3 – Finalize FS Standards and Criteria – The draft FS Evaluation Standards and Criteria TM will be revised to incorporate comments received, as appropriate. Comments not addressed through incorporation into the TM will be addressed in a separate comment and response log. The revised FS Evaluation Standards and Criteria TM will be submitted to the Water Agency.

Task 4: Preliminary Alternative Identification and Evaluation

Based on the information compiled and analyzed in Task 1, a limited number of preliminary project alternatives will be developed. Preliminary alternatives will be formulated considering identification of a willing site owner or availability of publicly-owned parcel(s), site suitability, and other similar criteria. Hydraulic modeling and recharge (hydrologic) modeling will be conducted to further refine the project

alternatives to the degree that compliance with the key Project Purpose is ensured and anticipated performance data are available for evaluation.

Subtask 4.1 – Preliminary Alternative Development - The preliminary alternatives identified will be site-specific and will be developed to the extent necessary to apply the standards and criteria developed in Task 3. This alternative development will be at a general level (i.e. general sizing of ponds using existing industry standards and templates) and will not constitute conceptual or preliminary design.

Subtask 4.2 – Preliminary Alternatives Evaluation - The standards and criteria established in Task 3 will be applied to the alternatives developed in Subtask 4.1, along with a simplified qualitative triple-bottom line analyses to capture the benefits each alternative provides. Results of the evaluation will be summarized in a matrix, ranking the alternatives based on the scoring results. The matrix will also include a qualitative summary of impact and/or benefits resulting from the alternatives. Based on the evaluation process results and input from Water Agency staff, several alternatives will selected for a more-detailed evaluation, conducted as documented in Tasks 5 and 6.

A public workshop will be held with Water Agency staff and other stakeholders to discuss the Preliminary Alternatives Development and Evaluation. During this workshop, the preliminary alternatives developed will be presented and the evaluation process summarized. A discussion will be facilitated to solicit and address comments and questions.

Task 5: Feasibility-Level Field Work

Field work will be conducted in Task 5 to collect data necessary to conduct detailed analyses on the preliminary alternatives carried forward. Due to the uncertainty of the field work to be required, the subtasks described below present a range of work that may be performed; these subtasks may be modified on a site-specific basis based on the specific field work requirements to be identified in Subtask 5.1. Individual work plans will be prepared for each alternative site under Subtask 5.2, however, if reasonable, a single work plan may be prepared instead to address field work at all sites.

Subtask 5.1 – Field Work Scoping – In this subtask, a list of anticipated field surveys, testing and work tasks will be developed for each of the alternatives recommended in Task 4.

Subtask 5.2 – Field Work Plan(s) - Individual field work plans will be prepared for each of the alternatives recommended in the Alternatives Development and Evaluation TM. The work plans will document the field tasks to be completed (as identified in Subtask 5.1), and will outline the sampling and testing protocols to be followed for each field task. If deemed reasonable, these work plans may be combined into a single work plan for implementation at all three sites.

Subtask 5.3 – Geologic, Hydrogeologic, Geotechnical and Permeability Testing – A site-specific testing program will be developed for each alternative site location. Testing that may be conducted at the site includes the drilling of boreholes and trenching to a maximum depth of 20 feet and geologic logging. One to two days of field work are anticipated for each site, during which up to ten boreholes and three trenches will be installed. Locations for the boreholes and trenches and testing to be conducted will be determined based on visual inspections of soils encountered at the site and on data collected in Task 1. Site-specific testing, sampling and analysis protocols will be developed for each alternative and documented in the Field Work Plans prepared in Subtask 5.2.

Falling head tests will be conducted in a subset of boreholes and trenches to determine near-surface permeability rates, and double-ring infiltrometer testing will be conducted to measure surface infiltration rates in the proposed recharge areas. Selected soil cores will be sent to a certified laboratory for soil grain size analyses, soil composition analyses, and determination of vertical permeability. These data will be used to estimate the hydraulic conductivity of underlying soils estimated using the Kozeny-Carmen

equation (Bear, 1972), site-specific percolation rates, and to calculate the flow rate and volume of water that could be infiltrated.

Subtask 5.4 – Groundwater Elevation and Quality Data Collection – Baseline groundwater elevation monitoring and water quality data will be collected on select wells adjacent to the alternative locations. Groundwater level monitoring will be collected using data loggers with regular measurements over a pre-determined length of time. The groundwater elevation monitoring protocols will be determined separately for each alternative, as appropriate, using site-specific information.

Groundwater samples will be collected from available wells adjacent to the alternative locations. Samples will be collected and analyzed for TDS, nitrate, major anions and major cations and analyzed at a State-certified laboratory. Parameters to be collected in the field will include turbidity, temperature, pH, conductivity, dissolved oxygen and reduced oxygen potential (redox). These data will be used to establish baseline water quality and to evaluate the recharge and groundwater quality with respects to potential geochemical interactions. Site-specific groundwater sampling and analysis protocols will be developed for each alternative and documented in the Field Work Plans prepared under Subtask 5.2.

Subtask 5.5 – Surface Water Quality Data Collection – Source water (storm water) samples will be collected and analyzed for major anions, major cations, TDS, TOC, nitrate, Suspended Sediments, Total Extractable Hydrocarbons (TEH), and Total Extractable Petroleum Hydrocarbons (TEPH). Turbidity, conductivity, dissolved oxygen pH, and temperature will be measured in the field. Sampling will be conducted using equipment programmed to collect full storm-hydrograph composite samples for calculating event mean concentrations of the constituents of concern. Full laboratory analyses will be completed for both the samples as collected and for samples decanted after settling to determine the benefit of incorporating settling basins into the design. Source water samples will be analyzed at a certified laboratory. Site-specific surface water sampling and analysis protocols will be developed for each alternative and documented in the Field Work Plans prepared in Subtask 5.2.

Subtask 5.6 – Flow Monitoring – Surface water flow monitoring may be required to confirm hydraulic model calibration at the alternative site locations and the hydrologic response of the respective contributing watersheds over a full rainy season. Full stream gauging stations will be installed at each alternative site. Gauging equipment will include staff plates, continuous sampling dataloggers, pressure transducers, specific conductance-temperature probes, and optical back scatter sensors for turbidity monitoring. All stations will be telemetered to allow the project team to remotely monitor the gauging equipment. A minimum of three site visits will be carried out during storm events at each site to produce field-verified rating curve for each location.

Subtask 5.7 – Habitat and Environmental Species Surveys – Reconnaissance-level biological and habitat surveys will be conducted to identify potentially sensitive species and/or habitats at the identified alternative sites. These field surveys will include a review of existing databases to identify potential species and/or habitats that may exist at the site and a site visit for a cursory evaluation of areas with potential sensitive species or habitats.

Subtask 5.8 – Preliminary Cultural Evaluations – A Northwest Information Center records search will be conducted to identify possible cultural resources and features at the identified alternative sites. This evaluation will be limited to a review of existing databases to identify areas of potential archaeological sensitivity at the sites.

Task 6: Alternatives Update

Using the results of the field investigations completed under Task 5, along with the preliminary alternatives descriptions prepared in Task 4, the preliminary project alternatives carried forward will be

updated to reflect site-specific conditions and evaluated using the standards and criteria established in Task 3.

Subtask 6.1 – Alternatives Description Update - The descriptions of the alternatives recommended in Task 4 for additional analysis will be updated using data obtained from field work conducted in Task 5. The descriptions of the selected alternatives will modified with respects to various site factors, such as site suitability and surrounding environment. Hydraulic and recharge modeling will also be updated, as appropriate, to reflect new information gained through Task 5 or to refine alternative concepts.

Each of the alternatives updated in this task will also be evaluated with respect to associated potential environmental impacts using the CEQA Initial Study Checklist and likely permitting requirements.

Subtask 6.2 – Detailed Alternatives Evaluation - The priority alternatives, updated in Subtask 6.1, will be re-evaluated using the standards and criteria established in Task 3. The triple-bottom line analyses performed previously for these alternatives will be revised to quantitatively evaluate the financial, social, and environmental benefits they will provide in addition to the flood protection and groundwater recharge benefits for which they were designed. Alternatives will also be evaluated with respect to potential environmental impacts, permitting requirements and other similar project implementation considerations. A recommended alternative to advance to the design phase will result from the evaluation process.

A public workshop will be held with Water Agency staff and other stakeholders (including the public) to present the updated alternatives and summarize the evaluation process. A discussion will be facilitated to solicit and address comments and questions.

Task 7: Outreach

All public meetings, and associated preparation for and follow-up after the meetings, are included in other tasks. This task provides for the attendance and presentation by the project team at additional meetings with individuals or groups (including preparation of presentations, handouts and meeting minutes) and other outreach support activities such as:

- Preparing communication materials, letters, notifications, and maps ;
- Assisting Water Agency staff with communicating with local media regarding the Project.

Task 8: Project Management

Task 8 provides project management support, including scheduling and managing project activities, budget tracking, project staffing and oversight, managing subcontractor activities and general project communications. This task also provides for coordination with the Water Agency's Project Manager and as-needed conference calls with Water Agency staff to discuss technical issues, deliverables, progress status updates, staffing, budget and schedule issues.

Periodic email project updates will be provided, as necessary, to keep communications with the Water Agency's Project Manager clear and to keep the project advancing. Meetings will be held with Water Agency staff to address key items of concern on an as-needed basis. For these meetings, meeting coordination and agenda support will be provided with draft and final meeting minutes prepared following the meeting.

Semi-annual DBE utilization reports will be prepared in a form acceptable to the Water Agency. These reports will be submitted for periods ending June 30th and December 31st of each year and at agreement closeout.

At the end of project, a brief cover memo will be prepared, providing an executive summary of the process described herein and the TMs produced. All deliverables produced in Tasks 1 through 6 will be appended to this memo/executive summary. The assemblage of these TM will act as a functionally-equivalent Feasibility Study report.

Task 9: Preliminary Design Report (optional)

The goal of Task 9 is to develop the basis for design of the preferred alternative identified in Task 6. Work conducted in Tasks 5 and 6 will be used to prepare a preliminary design report (PDR) detailing the conceptual layout of facilities for the preferred alternative and preliminary methods by which these facilities will be constructed.

Subtask 9.1 – Draft Preliminary Design Report – A draft PDR will be prepared presenting a conceptual-level design for the recommended alternative, describing construction methods for the design, and summarize construction permits and coordination required for project implementation. The report will also include design implementation information (schedule, preliminary list of drawings and specifications) along with a preliminary cost estimate for the preferred alternative based on the conceptual design.

Subtask 9.2 – Preliminary Design Report Meeting – A meeting will be held with Water Agency staff to discuss the draft PDR prepared under Subtask 9.1. A discussion will be facilitated to solicit Water Agency comments. All questions and comments will be addressed at the meeting.

Subtask 9.3 – Finalize Preliminary Design Report – The draft Preliminary Design Report will be revised to incorporate Water Agency comments, as appropriate. Any Water Agency comment not addressed through incorporation into the PDR will be addressed in a separate comment and response log. The revised Preliminary Design Report will be submitted to the Water Agency.

Appendix J

Feasibility Study Data Needs

Technical Memorandum

Upper Petaluma River Watershed Flood Control Project Scoping Study

Subject:	**Feasibility Study Data Needs**
Prepared For:	Kent Gylfe, SCWA
Prepared by:	Tim Harrison and Leslie Dumas, RMC
Reviewed by:	Steve Bui and Randy Raines, RMC
Date:	August 24, 2012

1 Purpose

The Sonoma County Water Agency (Water Agency) is presently undertaking a Scoping Study for the Upper Petaluma River Watershed Flood Control Project (Project). The goal of the Scoping Study is to identify storm water management/groundwater recharge concepts that provide flood hazard reduction and groundwater benefits (Key Project Purpose). In December of 2011, the Water Agency presented to stakeholders a prioritization of project concepts for further evaluation. A Feasibility Study memorandum has been prepared based on that prioritized concept list and presents a proposed scope of work for a Feasibility Study (FS) and corresponding estimated budget and schedule for completing the proposed scope. This Feasibility Study Data Needs memorandum has been prepared to compile a list of needed information (data gaps) that would need to be addressed prior to or as part of the Feasibility Study.

2 Data Needs

The following list summarizes data needs required to support a future Feasibility Study for the Project. It is anticipated that some of this information would be collected or developed prior to the start of the Feasibility Study. In other cases, FS tasks described in the Scope of Work will be used to develop this information or supplement prior studies.

2.1 Siting Information

- Location of City-, County-, and Water Agency-owned parcels, including rights of ways
- Current and future land uses
- Current land cover
- Site access and restrictions
- Zoning maps

2.2 Design Inputs and Tools

- Petaluma XP-SWMM model and documentation and confirmation that model is appropriate for Project use
- Topography information including LiDAR or site specific surveys
- Local and state design standards/criteria for selected concepts
- Stream hydrographs (2-year, 10-year, 50-year, and 100-year)
- Hyetographs and time of concentration
- Groundwater elevation and quality data
- Studies relating to geochemical interactions between surface and groundwater

- Location of known contamination sites or groundwater plumes
- Location of wells, septic systems, leach fields
- Site-specific geology, hydrogeology, and geotechnical reports
  - Permeability (site-specific; at least 5 feet below the ground surface)
  - Grain size distribution
  - Slope stability and other geotechnical parameters
- Runoff quality
  - Sediment load
  - Anticipated constituents of concern and concentrations
- Typical planting palettes and associated requirements

2.3 Environmental Information

- Biological database search and reconnaissance-level survey (in support of CEQA and to identify any potentially impacted species)
- In-stream flow requirements as established by State, County or any other regulatory agency
- Cultural database search (to support CEQA)

2.4 Other Information

- Location of trails and other recreational facilities

3 Future Data Needs

Even beyond updates to the data identified in Section 2, additional data will likely be necessary to complete the design phase of the Project. Likely new datasets that will be necessary include detailed survey and topography of the Project site(s), Phase 1 and Phase 2 Environmental Site Assessments for the Project properties, and digitized utility information. There may be some overall cost savings for this data if there are opportunities to bundle the data collection with other Water Agency or City of Petaluma projects.