Project Feasibility Report

Feasibility Study for Dry Creek Bypass Pipeline Project

Sonoma County Water Agency

March 15, 2011

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PRELIMINARY
FOR REVIEW ONLY

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Prepared under the responsible charge of

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Executive Summary

Sonoma County Water Agency (Water Agency) provides water to nine cities and water districts, serving approximately 600,000 residents in Sonoma and Marin counties. Warm Springs Dam (WSD), owned by the US Army Corps of Engineers (Corps), is part of the Russian River Flood control system and provides water for habitat, recreational, and municipal uses. The WSD is a major water supply reservoir for the Water Agency.

A Dry Creek Bypass Pipeline Feasibility Study is required by the *Biological Opinion (BO) for Water Supply, Flood Control Operations, and Channel Maintenance conducted by the U.S. Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservation Improvement District in the Russian River watershed*. The BO was released by National Marine Fisheries Service (NMFS) in September 2008.

Background

The BO found that some aspects of flood control and water supply operations threaten to jeopardize steelhead and coho salmon. The BO also concluded that existing critical habitat for steelhead and coho salmon is not sufficient to serve the intended conservation role for these species. Current and expected flow releases from WSD during the low-flow season create high velocities in the channel, which would degrade the 14 miles of coho and steelhead rearing habitat in Dry Creek.

The BO states that there are three basic approaches to minimizing adverse effects of high summer flow releases in Dry Creek, which include: 1) reduction of water releases from WSD, 2) modifications to Dry Creek to accommodate higher flows as well as provide good quality habitat, and 3) bypass summertime high flow releases for water supply around Dry Creek with a pipeline. Approach 2 is currently being evaluated by the Water Agency under a separate study. This study evaluates the feasibility of approach 3, and includes a feasibility analysis of the inlet works at WSD, pipeline routes to bypass Dry Creek, and outlet sites and facilities to discharge the bypassed water back to the Russian River.

The BO states that:

> "SCWA will investigate the feasibility of constructing a pipeline to deliver water from Lake Sonoma to the mainstem of the Russian River in order to reduce the adverse effects of relatively high flow releases from WSD on rearing habitat for coho salmon and steelhead. An assessment of bypass pipeline alternatives will enable SCWA to identify the best method to ensure water deliveries while meeting salmonid habitat needs in Dry Creek in the unlikely event that habitat enhancement efforts in Dry Creek are unsuccessful in supporting successful growth and survival of juvenile steelhead and coho salmon."

The BO also states that the Corps will install a new emergency water supply pipeline to the Don Clausen Fish Hatchery (DCFH) at the base of WSD and complete construction of additional rearing facilities for the coho salmon broodstock program. The Water Agency sent a letter of intent expressing an interest in partnering with the Corps to evaluate design alternatives for the emergency water supply that would incorporate the needs of a bypass pipeline project.

The Corps is proceeding with 60-percent designs for the emergency water supply system alternatives. One alternative proposes the installation of pumps in the control structure to send water to the hatchery in a 36-inch pipeline. A second consists of an integrated pipeline project, in which a 72-inch diameter pipeline is installed in a tunnel from the control structure. The integrated alternative allows flow to be split between the hatchery and the potential future bypass pipeline.

This report is prepared with the understanding that a bypass pipeline may be constructed only in the event that habitat enhancement efforts in Dry Creek are unsuccessful. This report may need to be updated in the future as new information becomes available. The next step is an Engineering Report that continues the development and analysis of the preferred alternative from the Feasibility Report.

Purpose

The Water Agency is evaluating the feasibility of a raw water bypass pipeline for Dry Creek that accomplishes the following goals:

- Serve as a conduit to convey raw water flows that cannot be sustainably managed in Dry Creek alone, and
- Ensure that inlet and outlet structures route flows in a manner that is protective of the environment and which does not modify existing in-stream flow patterns in a negative way.

Therefore, the purpose of this Feasibility Study Report is to:

- Identify uncertainties and potentially significant issues associated with the raw water bypass pipeline,
- Identify alternatives or suggestions to facilitate design and/or construction, and
- Identify the preferred project alternatives.

Stakeholder Involvement

The development of this Feasibility Report involved communication with key stakeholders throughout the process. Meetings and presentations were held with the Regional Water Quality Control Board, National Marine Fisheries Service, the Department of Fish and Game, the Dry Creek Advisory Group, the Santa Rosa Board of Public Utilities, and the general public.

The purpose of these meetings and presentations was to provide opportunities for the stakeholders to understand the process and project status and provide input on key aspects.

Study Area

The study area includes the Dry Creek Valley and pipeline routes along Dutcher Creek Road, Canyon Road, Dry Creek Road to the Russian River, and Westside Road to the Water Agency's Mirabel facility.

Alternatives Development and Evaluation

The facilities required for the bypass pipeline include an inlet at WSD, a large diameter bypass pipeline, and an outlet structure to reintroduce the bypass water back into Dry Creek or the Russian River. Opportunities to include a hydropower facility with the bypass pipeline project were also included with each alternative.

A multi-step process was used to develop, screen, and evaluate a range of alternatives for the bypass pipeline project. The process involved establishing key planning criteria, development of and initial screening of facility concepts for the inlet, route, outlet and hydropower, and finally, evaluation of alternatives.

Key Planning Criteria

In order to develop and evaluate the feasibility of the project components (inlet, alignment, outlet, and hydropower), the following planning criteria were defined:

- Initial Hydraulic Head Conditions at WSD
  - Average Water Elevation at WSD: 439 ft AMSL
  - Low Water Elevation at WSD: 400 ft AMSL
  - Turbine Elevation for New Hydropower Facility at WSD: 250 ft AMSL
  - Maximum Elevation in Existing Stilling Basin: 220 ft AMSL
- Flow Requirements
  - Bypass Flow Range: 80 to 180 cfs
  - Flow to the Hatchery: 60 cfs
- Bypass Pipeline Diameter: 48-inch, 60-inch and 72-inch
- Operations Strategy: Continuous delivery of reservoir releases via the bypass pipeline under gravity-flow conditions.

Description and Screening of Facility Concepts

The facility options for each of the project components, as well as the results of screening analysis are briefly summarized below.

Inlet Options and Screening Results

Four inlet facility options were identified and are shown in Figure ES-1:

- **Option 1, Head Box Adjacent to the Stilling Basin.** For this option, the existing stilling basin would be modified with a gate to divert water into a head box on the bypass pipeline. The water surface elevation in the existing stilling basin would be raised to 220 feet. Hydropower would be generated using the existing generator in the control structure.

- **Option 2, Siphon Over the Existing Dam.** This option would include an inlet structure (e.g., concrete vertical intake pipe), piping running up and over the dam, and an outlet structure on the downstream side of the dam following hydropower generation or energy dissipation. A pump facility at the top of the dam is required to fill the pipes and create the siphon. Hydropower would be generated at new generators at the outlet of the siphon pipes.

- **Option 3, New Outlet Works through Left Abutment.** This option includes an intake temperature control structure, a conveyance system through the left abutment, and an outlet through a new power generation facility.

- **Option 4, Integrated Facility – New Corps Tunnel to Existing Control Structure.** This option includes partnering with the Corps on their alternative to construct a new tunnel with a 72-inch pipeline for the emergency water supply line to the DCFH. In constructing the tunnel and pipeline, the "emergency water supply" would be used as the main water supply and the existing facilities within the control structure is used as the "emergency water supply." There is an opportunity for the Water Agency to work with the Corps on the design and capacity of these facilities to meet the needs of the hatchery as well as the Dry Creek bypass flow requirements. New hydropower facilities is needed.

Inlet options were screened based on two criteria, design and construction, and facility operability. As a result of the screening process, the head box and integrated facility inlets were advanced to the alternatives development and evaluation step.

Route Options and Screening Results

Three general route corridors were identified for the bypass pipeline, including:

- **Northern Route**, WSD to the Russian River, near Geyserville or Cloverdale
- **Central Route**, WSD to the confluence of the Russian River and Dry Creek, and
- **Southern Route**, WSD to the Water Agency's facilities in the Mirabel/Wohler area.

For each of these general routes, alignment options were identified considering the possible alignment corridors in which a large-diameter water transmission pipeline could be located. Figure ES-2 illustrates each of the alignment options that were considered and identifies those that were screened out.

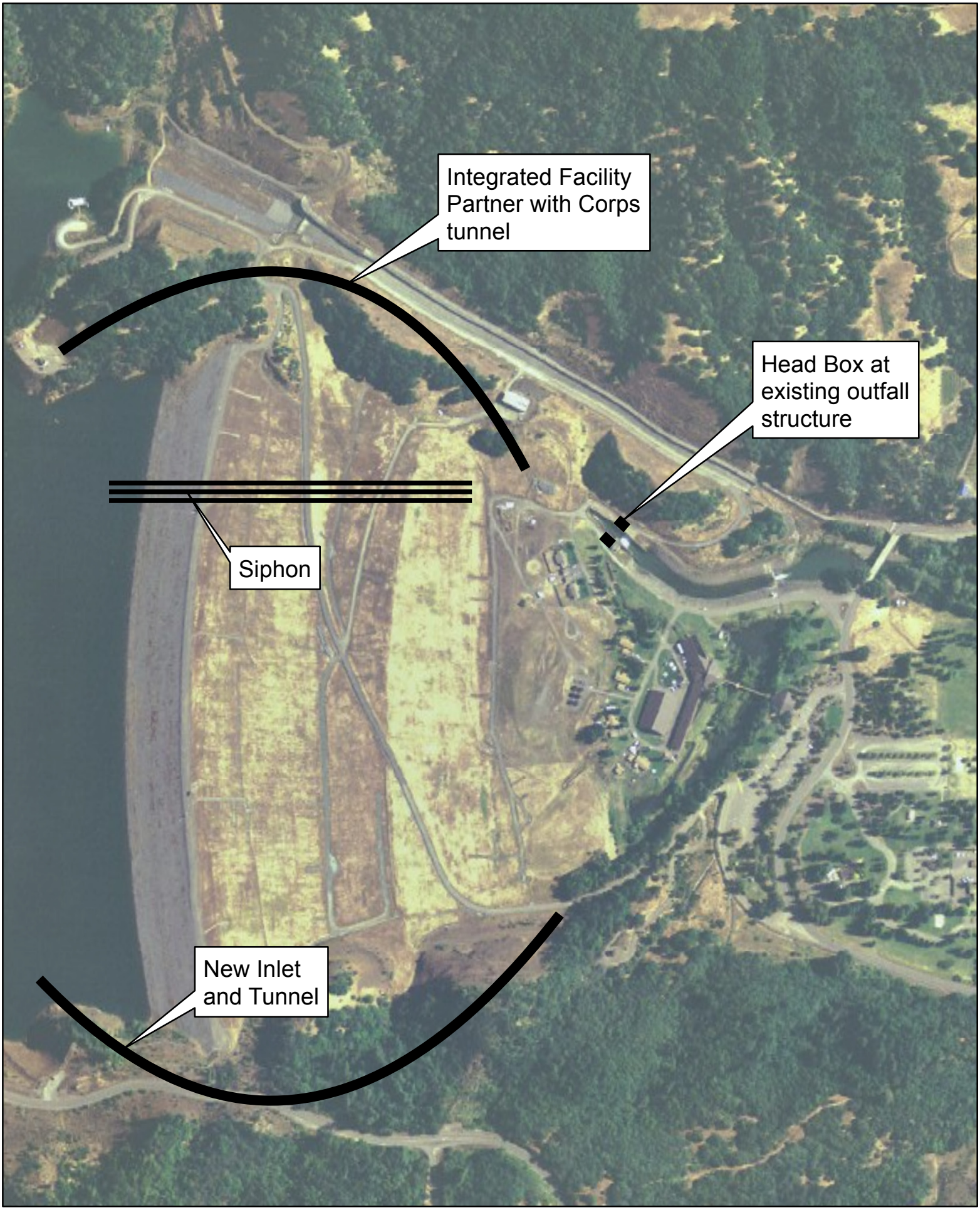

Figure ES-1
Inlet Works Options
Dry Creek Bypass Pipeline Feasibility Study

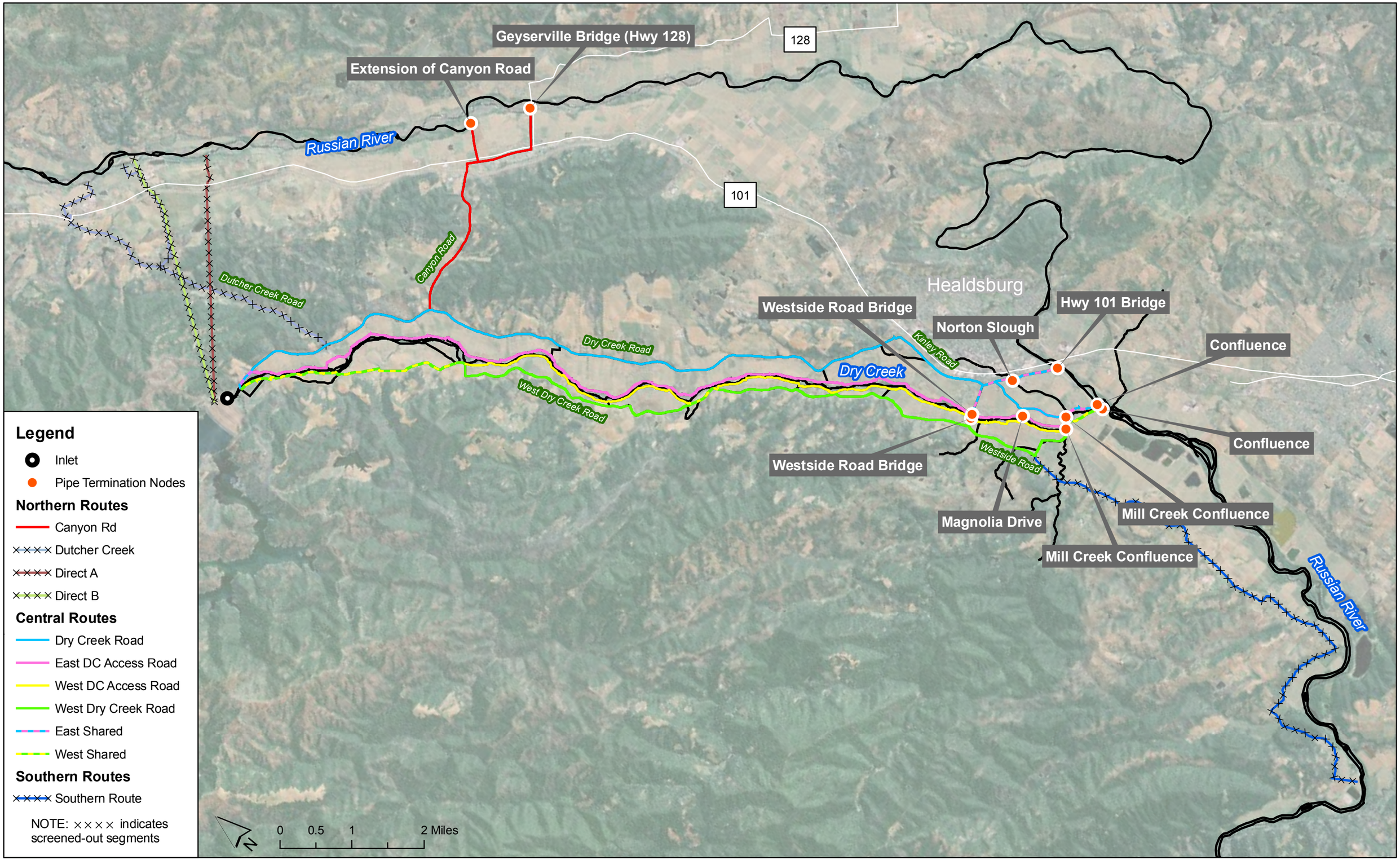

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Figure ES-2
Alignment Options and Screening Results
Dry Creek Bypass Pipeline Feasibility Study

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The head box inlet does not provide sufficient hydraulic head for the Northern Route alignments. Only the integrated facility inlet provides sufficient hydraulic head to limit the pipeline bury depth along the Northern Routes. Furthermore, some alignments in the Central and Southern Routes, if combined with the head box inlet, would require either trenchless construction or an alignment adjustment in order to avoid high points for which traditional open trench construction is not feasible.

As a result of the screening process, the direct alignment options and the Dutcher Creek Road alignment options were eliminated. The Northern Route Canyon Road alignment and all of the Central Route alignments were advanced to the alternative development and evaluation step. The Southern Route alignment was eliminated during the screening of outlet locations due to the technical infeasibility of this route.

Outlet Location Options and Screening Results

General outlet locations were identified for each pipeline route terminus (refer to Figure ES-2). Outlet locations associated with the Central Route are bounded by the Westside Road Bridge to the north, the Highway 101 Bridge on the east side, and the area around the confluence. For the Northern Route, discharge locations were evaluated where the extension of Canyon Road intersects the Russian River and near the Highway 128 Bridge.

Based on discussions with the Water Agency, it was determined that a discharge near the confluence of Dry Creek and the Russian River was preferred to downstream locations closer to or at the Water Agency's facilities at Mirabel and Wohler based on potential water quality issues and coordination between the outlet works and water supply facilities. Therefore, the Southern Route was not carried forward for this analysis and an outlet location was not identified.

Suitable discharge locations were identified for each of the pipeline termination nodes, as listed in Table ES-1.

Table ES-1. Discharge Locations

Route	Pipeline Route Terminus	Suitable Discharge Locations
Northern Route	Upper Russian River	Extension of Canyon Road
		Near Geyserville Bridge (Hwy 128)
Central Route	Russian River	Hwy 101 Bridge
		Russian River near Dry Creek Confluence
	Dry Creek	Westside Road Bridge
		Magnolia Drive
		Mill Creek Confluence
		Norton Slough
		Dry Creek near confluence with Russian River

Outlet Facility Options and Screening Results

The options for direct discharge facilities vary considerably in appearance and function. Four outlet facility types, shown in Figure ES-3, were initially evaluated and defined as follows:

- **Riverbank outfalls**. A structure or facility located on the bank of a river, through which water is discharged directly into the surface flow.
- **Diffusers (in-river discharge)**. An in-river diffuser consists of a pipe fitted with well-defined openings through which water flows to discharge.
- **Diffusers (in-bed discharge)**. In-bed diffusers discharge water through either well screens or perforated pipes buried in river bottom (alluvium).
- **Diffusers (in-bank discharge)**. Discharge is accomplished through a perforated pipe constructed in the bank.

For the purposes of developing and evaluating the feasibility alternatives, a screened riverbank outfall was used. Once a specific site is identified as the most feasible, an Engineering Report will be developed to continue the evaluation of outfall types.

Hydropower Location

Opportunities for power generation vary based on the combination of inlet facility, pipeline alignment, and outlet location because power generation is the result of residual hydraulic head available after head losses. A coarse analysis of hydropower generation was performed to determine the preferred location, whether upstream at the inlet or downstream near the outlet, for a new hydropower facility. Based on the results of that analysis, the preferred location for a hydropower facility, based on inlet type and route, is shown in Table ES-2.

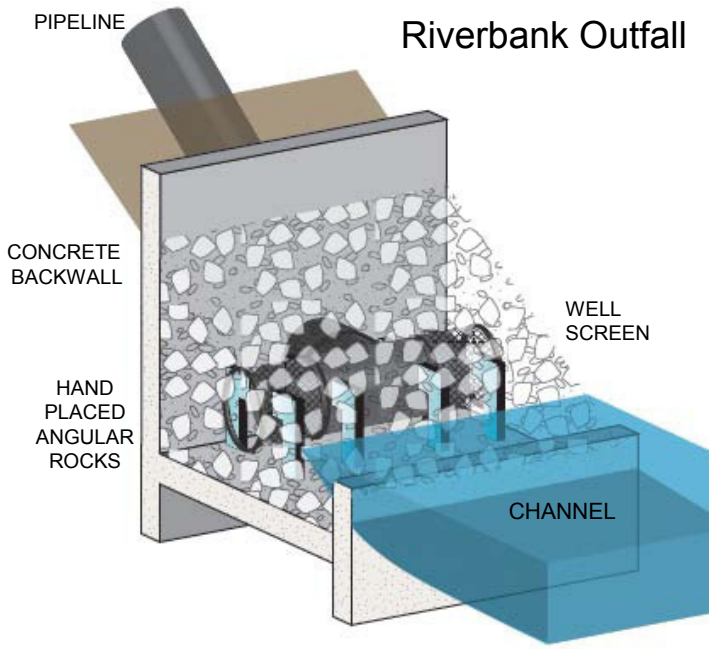
Table ES-2. Discharge Locations

Inlet Facility	Route	Location / Description
Integrated Facility	Northern Route	New generator near the outlet
	Central Route	New generator at the dam
Head Box	Central Route	Existing generator at the dam

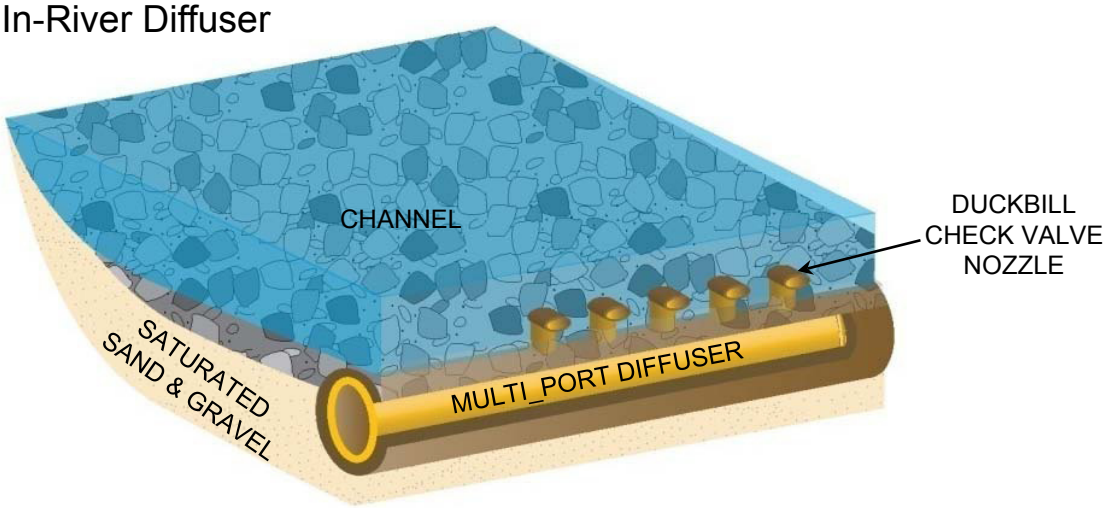
Alternatives Formulation

The screening process resulted in identifying two feasible inlet options, five general alignments and their respective outlet facilities on the Russian River and Dry Creek. The alignments are predominantly located in Canyon Road, Dry Creek Road, the access roads paralleling Dry Creek, and West Dry Creek Road. Feasible outlet sites were identified on the upper Russian River at the extension of Canyon Road and near the Geyserville Bridge, on the Russian River near the confluence with Dry Creek and at the Highway 101 Bridge, and finally on Dry Creek near the Westside Road Bridge.

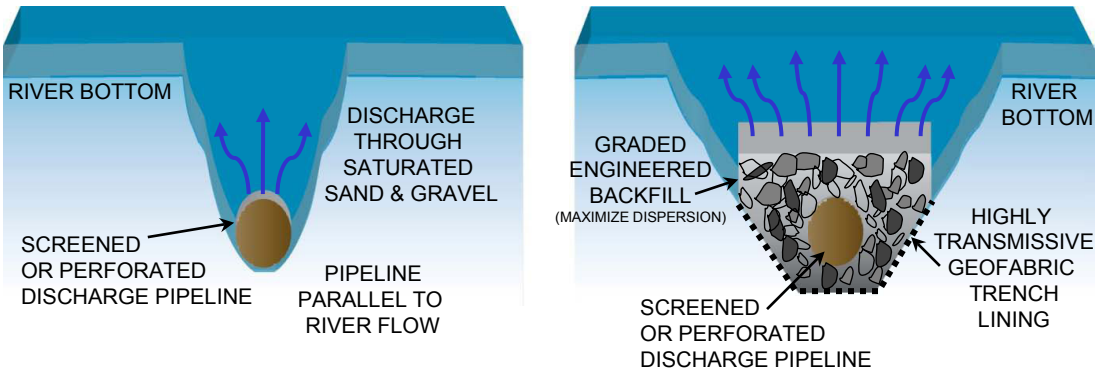
Riverbank Outfall



In-River Diffuser



In-Bank or In-River Diffusers



Adapted from Conceptual Outlet Facility Evaluation TM
(Kennedy/Jenks Consultants, Feb 2010)

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Figure ES-3
Outlet Facility Options
Dry Creek Bypass Pipeline Feasibility Study

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The feasible outlet sites between the Westside Road Bridge and the Russian River confluence were not specifically included in the alternatives analysis. Based on the facilities described above, there are 21 possible combinations of screened facilities. These combinations, which are shown in Table ES-3, make up the alternatives for the Dry Creek Bypass Pipeline.

Table ES-3. Definition of Alternatives for Evaluation

Pipeline Alignment	Inlet Facility	Alignment Description	Discharge Location	Alt. ID
Canyon Road	Integrated Facility	Dry Creek Road to Canyon Road	Extension of Canyon Road	1a
			Near Geyserville Bridge	1b
Dry Creek Road	Integrated Facility	Dry Creek Road to Kinley Road and Westside Road	Westside Road Bridge	2a
		Dry Creek Road to Kinley and Magnolia	Confluence	2b
		Dry Creek Road to Kinley Road	HWY 101 Bridge	2c
	Head Box (with microtunnels)	Dry Creek Road to Kinley Road and Westside Road	Westside Road Bridge	3a
		Dry Creek Road to Kinley and Magnolia	Confluence	3b
		Dry Creek Road to Kinley Road	HWY 101 Bridge	3c
	Head Box (without microtunnels)	Dry Creek Road/Ag Land to Kinley Road and Westside Road	Westside Road Bridge	4a
		Dry Creek Road / Ag Land to Kinley and Magnolia	Confluence	4b
		Dry Creek Road / Ag Land to Kinley Road	HWY 101 Bridge	4c
East DC Access Road	Integrated Facility or Head Box	East DC Access Road To Westside Road Bridge	Westside Road Bridge	5a
		East DC Access Road to Confluence	Confluence	5b
West DC Access Road	Integrated Facility or Head Box	West DC Access Road to Westside Road Bridge	Westside Road Bridge	6a
		West DC Access Road to Confluence	Confluence	6b
West Dry Creek Road	Integrated Facility	West Dry Creek Road to Westside Road	Westside Road Bridge	7a
		West Dry Creek Road to Westside Road and private roads	Confluence	7b
	Head Box (with microtunnels)	West Dry Creek Road to Westside Road	Westside Road Bridge	8a
		West Dry Creek Road to Westside Road and private roads	Confluence	8b
	Head Box (without microtunnels)	West Dry Creek Road/Ag Land to Westside Road	Westside Road Bridge	9a
		West Dry Creek Road/Ag Land to Westside Road and private roads	Confluence	9b

Evaluation of Alternatives

Evaluation criteria, summarized in Table ES-4, were developed with the input of the Water Agency and the Dry Creek Advisory group, and include both engineering and environmental criteria. An economic evaluation was also conducted. Some criteria are common to all elements of the Bypass Pipeline, whereas others are specific to only one element (i.e., inlet facility, pipeline alignment, or outlet facility).

Table ES-4. Evaluation Criteria

Inlet Facility	Pipeline Alignment	Outlet Facility
	Engineering	
Reliability	Reliability	Reliability
Constructability	Constructability	Constructability
Operations	Operations	Operations
Right of Way Acquisition	Right of Way Acquisition	Right of Way Acquisition
Liquefaction and Hazard Potential	Liquefaction and Hazard Potential	Liquefaction and Hazard Potential
	Hydropower	River Channel Stability
	Special Crossings	
	Environmental	
Wetlands and Other Waters of the US	Wetlands and Other Waters of the US	Wetlands and Other Waters of the US
Sensitive Habitats and Species	Sensitive Habitats and Species	Sensitive Habitats and Species
Hazardous Materials	Hazardous Materials	Hazardous Materials
Cultural Resources	Cultural Resources	Cultural Resources
	Potential Loss of Trees	Water Quality and Fisheries

Preferred Alternative

Based upon the evaluation of the individual criteria, points were assigned and alternatives were ranked. The top nine alternatives and associated capital and present value costs are listed in order of lowest capital cost in Table ES-5.

Table ES-5. Top 9 Ranked Alternatives and Present Value Cost

Alternative	Evaluation Score	Evaluation Rank	Capital Cost	Present Value Cost	Key Difference from Alternative 4c
Alternative 4c (Preferred)	125.4	6	$141.5	$124.0	Head Box Inlet, Dry Creek Road and Private Road (Ag Land) to avoid microtunnel, HWY 101 Bridge Outlet
Alternative 4a	125.6	5	$146.3	$128.8	Westside Bridge Outlet
Alternative 4b	123.4	8	$146.7	$129.2	Confluence Outlet
Alternative 3c	126.8	2	$158.4	$140.9	Microtunnel to keep pipe in Dry Creek Road ROW
Alternative 3b	123.8	7	$163.4	$145.9	Microtunnel, Confluence Outlet
Alternative 2c	126.1	4	$166.8	$147.4	Integrated Inlet
Alternative 2a	126.2	3	$171.4	$152.0	Integrated Inlet to Westside Road
Alternative 2b	123.1	9	$171.8	$152.4	Integrated Inlet to Confluence Outlet
Alternative 3a	126.9	1	$176.8	$159.3	Microtunnel, Westside Bridge Outlet

The evaluation scores for the top nine alternatives range between 126.9 and 123.1 or about 3%. This is within the accuracy of the scoring evaluation and therefore, all alternatives are essentially equal and are equally viable as route alternatives. Within the top 9 route alternatives, the least cost alternative is Alternative 4c and is preferred

because of its favorable evaluation score and cost. Alternative 4c uses a head box inlet, with a route along Dry Creek Road and Kinley Road to an outlet near the Highway 101 Bridge. To reduce pipeline construction cost, the alignment uses private roads within agricultural property to avoid microtunnel construction in Dry Creek Road, while maintaining gravity flow conditions. The next two alternatives, Alternatives 4b and 4a, consist of the same head box inlet and alignment, but have a different outlet location. Alternatives 3a through 3c all use microtunnel pipe installation to keep the pipeline in Dry Creek Road at the high points; therefore these alternatives have a higher cost. Alternative 2a through 2c use the integrated inlet, and if the Corps share of the construction cost were to increase, these is higher ranked and cost competitive with Alternative 4c and the other least cost alternatives.

The preferred alternative is 4c; however, the Water Agency should monitor the Corps progress and cost. If the Corps moves ahead with the emergency water supply line to the fish hatchery and if the economics of partnering with the Corps is favorable to the Water Agency, the additional hydraulic head provided by the integrated inlet facility would facilitate a gravity pipeline constructed entirely within Dry Creek Road using open cut trench technology. Under these conditions, Alternative 2c should be considered, which is ranked slightly higher because the entire route remains in Dry Creek Road. The Water Agency could also consider Alternative 3c as an alternate to Alternative 4c. Alternative 3c uses microtunnel technology to keep the pipeline in the Dry Creek Road right of way and therefore, ranked higher, but is more costly than Alternative 4c.

Preferred Alternative

Based upon the results of both the evaluation results and the cost estimates, the preferred Alternative 4c includes the head box inlet, the existing hydropower facility, an alignment in Dry Creek and Kinley Roads, and an outlet at the Highway 101 Bridge.

Inlet Structure

The head box consists of a concrete box inlet to the bypass pipeline and a gate installed in the existing stilling basin which would increase the water elevation in the stilling basin such that it can be diverted into the bypass pipeline. The maximum water surface elevation of the head box is estimated to be approximately 220 ft. This elevation should be revisited during design to determine the extent of backwater effects and to determine if a higher elevation is feasible, since it could reduce or eliminate hydraulic constraints for the pipeline alignment.

Alignment

The preferred alignment follows Dry Creek Road except where the hydraulic head would require a bury depth greater than 25 ft. To avoid deep bury depths, the alignment was rerouted into adjacent private roads within agricultural property.

In addition to the hydraulic constraints, the alignment in Kinley Road must be carefully designed due to the presence of the City of Santa Rosa’s 42-inch diameter reclaimed

water pipeline, as well as a high pressure natural gas line and sewer pipelines. It is expected that some utilities would need to be relocated to accommodate a 72-inch diameter bypass pipeline.

Outlet Facility

The outlet for the Central Route would be located at or near to the Highway 101 Bridge, on the Russian River (refer to Figure ES-2).

Hydroelectric Facilities

With the head box inlet, the preferred project would continue to use the existing hydropower facility at WSD. The existing facility has a capacity of 2.6 MW and is projected to have an annual energy production of approximately 12.9 million kWh/year.

Preferred Alternatives Cost Summary

The estimated cost for the preferred alternative, Alternative 4c, is presented for a 72-inch diameter pipeline in Table ES-6.

Table ES-6. Estimated Cost of Preferred Alternatives

Item	Basis	Preferred Alternative
		72-inch Pipe
Route		$ 61,450,000
Outlet		$ 4,090,000
Construction Subtotal		$ 65,540,000
Contractor's Field Overhead and Mob/Demob	9%	$ 5,900,000
Sales Tax on Materials and Rentals	2%	$ 1,310,000
Contractor's Fee (Office Ovhd and Profit)	15%	$ 9,830,000
Contractor's Bonds and Insurance	1%	$ 830,000
Undefined Scope of Work Estimated Cost	25%	$ 20,850,000
Route+Outlet Subtotal		$ 104,260,000
Inlet		$ 2,584,000
Construction Value Total		$ 106,844,000
Environmental Mitigation and Permitting		$ 1,050,000
EIR and Legal		$ 2,500,000
Subtotal		$ 110,394,000
Right-of-Way and Easements		$ 976,000
Right-of-Way Acqusition and Legal		$ 244,000
Subtotal		$ 111,610,000
Engineering	10%	$ 10,680,000
Construction Legal	5%	$ 5,340,000
Construction Administration	8%	$ 8,550,000
Owner Administration	5%	$ 5,340,000
Total Project Costs		$ 141,520,000