

APPENDIX A

PRELIMINARY SITE SPECIFIC ALTERNATIVES EVALUATION

Wheeler Gorge Campground – Lower North Fork Matilija Creek Crossing

Wheeler Gorge Campground – Bear Creek Crossings

Soule Park Golf Course Crossing – San Antonio Creek

In conjunction with the North Fork Matilija Creek, Bear Creek, and San Antonio Creek Habitat Assessment, a fish passage assessment was conducted in each creek surveyed to identify potential upstream migration barriers to steelhead. Numerous crossings were cataloged within the San Antonio Creek watershed. In addition, 2 crossings and 2 natural barriers were cataloged on North Fork Matilija Creek, and 2 crossings on Bear Creek. As described in Section 3.3.1 of the main report, a ranking was established for each barrier giving the highest ranking to barriers that, when modified, would provide access to substantial amounts of suitable habitat upstream.

Of the barriers encountered during the studies conducted for this report, three of the higher priority barriers are located one on each tributary studied:

- Low flow crossing within the Wheeler Gorge Campground on North Fork Matilija Creek;
- Two low flow crossings within the Wheeler Gorge Campground on Bear Creek; and
- Soule Park Golf Course crossing on San Antonio Creek.

A preliminary assessment of each barrier was conducted to further determine the feasibility of removing or modifying these barriers based on cost and the potential enhancement alternatives. This appendix presents the results of this preliminary assessment and makes recommendations regarding which potential alternatives warrant further consideration. The methods and relative costs discussed for modification of these crossings can be used as a guideline for other similar crossings within the watershed.

The access road within the Wheeler Gorge Campground (Figure A-1) crosses North Fork Matilija Creek at three locations (Figure A-2). The downstream-most crossing is a bridge and does not impede steelhead movement. The other two crossings are both low-flow crossings designed for water to pass over the surface of the road at higher flows and for the road to be passable only at lower flows. The downstream low-flow crossing represents a complete barrier to fish passage (Photos 23 and 24) and the upstream road crossing represents a partial barrier with passage likely at moderate and higher flows. The downstream crossing consists of an “Arizona” or “fairweather” type crossing which is constructed of concrete. The road crossing is approximately 45 feet long and a near vertical (approximately 0.5:1 slope) concrete apron is situated along the downstream edge of the road crossing. The road crossing presents a physical barrier to passage as the road surface is situated approximately 12 feet above the downstream streambed.

The objective of the analysis presented herein is to evaluate potential alternatives and identify the most appropriate alternative to enhance fish passage across the downstream road crossing in order provide access to high quality upstream habitat. The analysis consists of a brief description of the channel conditions in the immediate vicinity of the road crossing based on information collected during a site visit on February 27, 2003, a presentation of potential fish passage enhancement alternatives, and a discussion regarding the recommended project alternative.

2.1 EXISTING CONDITIONS

This section provides a brief description of the North Fork Matilija Creek channel conditions in the immediate vicinity of the project road crossing and of the Bear Creek channel conditions in the vicinity of the project area since one of the potential fish passage enhancement alternatives involves the construction of a bypass channel to Bear Creek. Bear Creek is a tributary to North Fork Matilija Creek and the confluence of the creeks is situated approximately 125 feet downstream of the project road crossing. The Wheeler Gorge Campground road also crosses Bear Creek at two locations with the downstream crossing situated approximately 110 feet to the east of the project road crossing (see Section 3).

2.1.1 NORTH FORK MATILIJA CREEK

The streambed upstream of the project road crossing is at grade with the road. The stream channel is dominated by boulder/cobble substrate and consists of a cascade/low gradient riffle morphology with a slope of approximately 3-5% slope. The channel has a limited floodplain with moderately sloping streambanks and was visually classified as a B2 channel based on the Rosgen Stream Classification System (Rosgen 1996). The bankfull width and depth of the upstream channel are approximately 25-30 feet and 3-4

feet, respectively. The streambanks are stable and consist of primarily boulder-sized substrate with a dense riparian corridor consisting of mature alder trees.

The streambed downstream of the road crossing has been scoured to bedrock and is situated approximately 12 feet below the road surface. The stream channel is dominated by bedrock/boulder substrate and is deeply entrenched with near vertical streambanks and no floodplain area. The channel has a step pool morphology and was visually classified as an A1/A2 channel based on the Rosgen Classification System (Rosgen 1996) with a slope of approximately 6-8%. Immediately downstream of the crossing the channel is approximately 50 feet wide and tapers to a bankfull width and depth of approximately 35-40 feet and 3-4 feet, respectively. The streambanks are unstable with evidence of slumping and undercutting and consist of boulder and cobble sized substrate with mature alder trees at the top of the banks.

2.1.2 BEAR CREEK

The downstream Wheeler Gorge Campground road crossing on Bear Creek is situated approximately 110 feet to the east of the project road crossing. The road crossing consists of an "Arizona" or "fairweather" type road crossing which is constructed of concrete. The road crossing is approximately 25-30 feet long and several large boulders are situated along the downstream edge of the road crossing. The boulders are situated at grade with the road crossing and the streambed is situated approximately 3-4 feet below the top of the boulders. The road crossing is a complete barrier to fish passage at low flows with passage likely at moderate to high flows.

Upstream of this road crossing, Bear Creek consists of a boulder/cobble dominated plane bed channel (approximately 2-4% slope) with a limited floodplain that was visually classified as a B2/B3 channel based on the Rosgen Stream Classification System (Rosgen 1996). The bankfull width and depth of the upstream channel are approximately 16 feet and 1.5 feet, respectively. The streambanks are stable and consist of primarily boulder sized substrate with a dense riparian corridor consisting of mature alder and willow trees.

The stream channel downstream of the road crossing is incised and consists of an entrenched boulder dominated channel with near vertical streambanks and no floodplain area. The streambed has a step pool morphology and was visually classified as an A2 channel (approximately 5-7%) based on the Rosgen Stream Classification System (Rosgen 1996). The bankfull width and depth of the downstream channel are approximately 10 feet and 3-4 feet, respectively. The streambanks consist of primarily boulder-sized substrate with a dense riparian corridor composed of willow and alder.

2.2 POTENTIAL FISH PASSAGE ENHANCEMENT ALTERNATIVES

Based on information collected during a site visit on February 27, 2003, the following conceptual fish passage enhancement alternatives for the project road crossing have been developed:

- Removal of the road crossing, if campground traffic can be rerouted;

- Removal and replacement of the existing road crossing with a bridge or natural bottom culvert; and,
- Constructing a bypass channel to Bear Creek.

Several streambed/water-slope modification approaches such as a rock-riffle fishway or series of boulder weirs were considered; however, these approaches were discarded since they would only provide passage opportunities at moderate to high flows and would involve a large project footprint, significant volumes of rock to construct due to the significant elevation difference (12 feet) between the road surface and downstream streambed, and the associated high cost to purchase appropriate sized boulders. A preliminary estimate placed the cost of the rock-riffle fishway approach higher than a bridge and therefore this alternative was eliminated from further review.

A description of the proposed alternatives and a preliminary cost estimate (excluding permitting costs) for each alternative is provided below. The scope of these alternatives is conceptual and would require additional surveying to develop a topographic map of the project area and conducting hydrologic, sediment transport, and geomorphic studies prior to preparation of the final design.

2.2.1 REMOVAL OF THE EXISTING ROAD CROSSING

This option would provide for fish passage at a wide range of flows by removing the existing road crossing, if it is not needed, and modifying the streambed to an appropriate slope which is consistent with the geomorphic conditions and fish passage requirements. Discussions with the U.S. Forest Service would be required to determine if campground traffic could be re-routed to remove this crossing.

Assuming that the streambed would need to be modified to a slope between 4% and 6%, the extent of channel grading activities would involve modifying between 200 and 300 feet of streambed to accommodate for the vertical difference in streambed elevation of 12 feet. The grading activities would involve both filling a portion of the downstream channel and excavating a portion of the upstream channel. These activities would be designed to stabilize the streambed so that the upstream low flow crossing would remain passage at moderate to high flows. The construction activities would likely require approximately 3-4 weeks to complete, and the anticipated steps involved in implementing this option are as follows:

- Conducting a site survey to develop a topographic map with 1-foot contours of the project area;
- Conducting hydrologic, geomorphic, and geotechnical studies to determine the existing conditions and develop the project design;
- Removing the existing crossing including the concrete and baserock;
- Modifying the streambed grade upstream and downstream of the road crossing;

- Stabilizing the streambanks within the project area; and,
- Revegetating the impacted areas.

The estimated cost for implementation of this option is approximately \$150,000 to \$250,000.

2.2.2 REPLACEMENT OF THE EXISTING CROSSING WITH A NATURAL BOTTOM CULVERT OR BRIDGE

This option involves removing the existing road crossing and replacing the crossing with a natural bottom culvert or pre-fabricated bridge. In conjunction with this option, the streambed slope would need to be modified as described in the previous alternative to be consistent with the existing geomorphic conditions and provide for fish passage. The culvert/bridge length would be approximately 50-60 feet, and implementation would involve the placing of fill material for the bridge/culvert approaches, the construction of strip footings for the natural bottom culvert and abutments for the bridge, and the construction of wing-walls to protect the culvert/bridge. The construction activities would likely require approximately 4-6 weeks to complete, and the anticipated steps involved in implementing this option are as follows:

- Conducting a site survey to develop a topographic map with 1-foot contours of the project area;
- Conducting hydrologic, geomorphic, and geotechnical studies to determine the existing conditions and develop the project design;
- Removing the existing crossing including the concrete and baserock;
- Modifying the streambed grade upstream and downstream of the road crossing;
- Preparation for the installation of the bridge or culvert including construction of the strip footings or abutments and the approaches for the culvert or bridge;
- Installation of the culvert or bridge;
- Construction of wingwalls to protect the culvert/bridge;
- Stabilizing the streambanks within the project area; and,
- Revegetating the impacted areas.

The estimated cost for implementation of this option is approximately \$300,000 to \$400,000.

2.2.3 CONSTRUCTION OF A BYPASS CHANNEL

This option involves constructing a bypass channel connecting North Fork Matilija Creek and Bear Creek. The upstream end of the bypass channel would connect to North Fork Matilija Creek upstream of the project road crossing and would necessitate replacing the downstream road crossing on Bear Creek with a natural bottom culvert or bridge. The confluence of Bear Creek and North Fork Matilija Creek is situated approximately 125 feet downstream of the existing road crossing and the objective of this option would be to provide for fish passage above the existing road crossing on North Fork Matilija Creek through Bear Creek and the bypass channel. The bypass channel would be constructed such that low to moderate flows would be diverted through the channel into Bear Creek and higher flows would be allowed to flow downstream within the existing North Fork Matilija Creek channel.

Based on the preliminary information collected during the site visit on February 27, 2003, the length of the bypass channel would likely be between 120 to 130 feet. The entrance would be situated approximately 110 to 120 feet upstream of the project road crossing on North Fork Matilija Creek and the confluence of the bypass channel with Bear Creek situated approximately 10 to 20 feet upstream of the downstream road crossing on Bear Creek. The bankfull width of the bypass channel would be approximately 20-30 feet. In conjunction with this option, the downstream road crossing on Bear Creek would need to be removed and replaced with a natural bottom culvert or pre-fabricated bridge and the width of the of Bear Creek channel situated downstream of the confluence with the bypass channel would need to be increased from a bankfull width of approximately 10 feet to approximately 30 feet to accommodate for the augmented flow regime. The construction activities would likely require 4-6 weeks to complete, and the anticipated steps involved in implementing this option are as follows:

- Conducting a site survey to develop a topographic map with 1-foot contours of the project area;
- Conducting hydrologic, geomorphic, and geotechnical studies to determine the existing conditions and develop the project design;
- Removing the downstream road crossing on Bear Creek including the concrete and baserock;
- Excavation of the bypass channel and widening of the Bear Creek channel downstream of the confluence with the bypass channel;
- Preparation for the installation of the bridge or culvert at the downstream Bear Creek crossing including construction of the strip footings or abutments and the approaches for the culvert or bridge;
- Installation of the culvert or bridge;
- Construction of wingwalls to protect the culvert/bridge;

- Stabilizing the streambanks within the project area; and,
- Revegetating the impacted areas.

The estimated cost for implementation of this option is approximately \$400,000 to \$500,000 including the replacement of the existing road crossing at Bear Creek with a natural bottom culvert or pre-fabricated bridge.

2.3 RECOMMENDATIONS

All of the alternatives considered in this evaluation would provide for passage at a wide range of flows. The most cost effective alternative would be to remove the existing crossing, if it is no longer needed. If access is required across the creek at this location, then the replacement of the crossing with a natural bottom culvert or pre-fabricated bridge would be the preferred alternative based on cost. The bypass channel is the most expensive option, but this option may also provide additional environmental benefits by creating habitat and enhancing passage opportunities on both North Fork Matilija and Bear Creeks.

The access road within the Wheeler Gorge Campground crosses Bear Creek at two locations (Figures A-1, A-2). Both of the road crossings represent partial barriers to fish passage (Photo 25). Enhancement of fish passage across the downstream crossing could be addressed during the construction of the bypass channel for enhanced passage in North Fork Matilija Creek and therefore a description of this barrier was provided in Section 2.1.2 above. Both barriers on Bear Creek are “Arizona” or “fairweather” type road crossings and therefore their alternatives for modification are similar. The text below focuses on describing the upper Bear Creek crossing although the alternatives are applicable to both crossings.

The upper Bear Creek road crossing is constructed of concrete, approximately 50 feet long and has a moderately sloped (approximately 2:1) concrete/rock apron situated along the downstream side of the road crossing. The concrete apron is approximately 8 feet long and the road is situated approximately 5 feet above the downstream streambed. The road crossing is a complete barrier at low flows due to insufficient depth of flow across the crossing, insufficient pool depth below the crossing, and the vertical difference in elevation of 5 feet between the downstream streambed and the road surface. Passage is likely at moderate and higher flows.

The objective of the analysis presented herein is to evaluate potential alternatives and identify the most appropriate alternative to enhance fish passage across the road crossings in order provide access to high quality upstream habitat. The analysis consists of a brief description of the channel conditions in the immediate vicinity of the road crossing based on information collected during a site visit on February 27, 2003, a presentation of potential fish passage enhancement alternatives, and a discussion regarding the recommended project alternative.

3.1 EXISTING CONDITIONS

At the upper Bear Creek crossing site, the streambed upstream of the crossing is at grade with the road and consists of a cobble/gravel dominated plane bed (approximately 1% slope) channel with a moderate floodplain that was visually classified as a B3/B4 channel based on the Rosgen Stream Classification System. The bankfull width and depth of the upstream channel are approximately 15 feet and 2 feet, respectively. Immediately upstream of the road crossing, the channel widens to approximately 45 feet in width. The streambanks are stable and consist of primarily gravel/cobble substrate with a dense riparian corridor consisting of willow and mature alder and oak trees.

The streambed downstream of the road crossing is situated approximately 5 feet below the road surface and is stabilized by the downstream road crossing on Bear Creek (situated approximately 120 feet downstream) which serves as a grade control structure.

The stream channel is dominated by cobble/boulder substrate with a moderate floodplain and plane bed morphology. The channel was visually classified as a B3 channel based on the Rosgen Classification System with a slope of approximately 1-3%. Immediately downstream of the crossing the channel is approximately 50 feet wide and tapers to a bankfull width and depth of approximately 16 feet and 1.5 feet, respectively. The streambanks are stable and consist of primarily boulder/cobble substrate with a dense riparian corridor consisting of willow and mature alder trees.

3.2 POTENTIAL FISH PASSAGE ENHANCEMENT ALTERNATIVES

Based on information collected during a site visit the following conceptual fish passage enhancement alternatives for the project road crossing have been developed:

- Removal of the road crossing, if it is not needed;
- Removal and replacement of the existing road crossing with a bridge or natural bottom culvert; and,
- Constructing a rock-riffle fishway downstream of the road crossing.

A description of the proposed alternatives and a preliminary cost estimate (excluding permitting costs) for each alternative is provided below. The scope of these alternatives is conceptual and would require additional surveying to develop a topographic map of the project area and hydrologic, sediment transport, and geomorphic studies prior to preparation of the final design.

3.2.1 REMOVAL OF THE EXISTING ROAD CROSSING

This option would provide for fish passage at a wide range of flows by removing the existing road crossing, if it is not needed, and modifying the streambed to an appropriate slope which is consistent with the geomorphic conditions and fish passage requirements. Discussions with the U.S. Forest Service would be necessary to determine if the traffic pattern within the campground can be re-designed to accommodate removal of the crossings. Given the current configuration of the campground, it is more likely that the lower Bear Creek crossing might potentially be eliminated, rather than the upstream crossing.

For the upper crossing, assuming that the streambed would need to be modified to a slope between 4% and 6%, the extent of channel grading activities would involve modifying between 80 and 125 feet of streambed to accommodate for the vertical difference in streambed elevation of 5 feet. The construction activities would likely require approximately 3-4 weeks to complete, and the anticipated steps involved in implementing this option are as follows:

- Conducting a site survey to develop a topographic map with 1-foot contours of the project area;

- Conducting hydrologic, geomorphic, and geotechnical studies to determine the existing conditions and develop the project design;
- Removing the existing crossing including the concrete and baserock;
- Modifying the streambed grade upstream and downstream of the road crossing;
- Stabilizing the streambanks within the project area; and,
- Revegetating the impacted areas.

The estimated cost for implementation of this option is approximately \$100,000 to \$150,000.

3.2.2 REPLACEMENT OF THE EXISTING CROSSING WITH A NATURAL BOTTOM CULVERT OR BRIDGE

This option involves removing the existing road crossing and replacing the crossing with a natural bottom culvert or pre-fabricated bridge. In conjunction with this option, the streambed slope would need to be modified as described in the previous alternative to be consistent with the geomorphic conditions and provide for fish passage. The culvert/bridge length would be approximately 30-40 feet, and implementation would involve the placing of fill material for the bridge/culvert approaches, the construction of strip footings for the natural bottom culvert and abutments for the bridge, and the construction of wing-walls to protect the culvert/bridge. The construction activities would likely require approximately 4-6 weeks to complete, and the anticipated steps involved in implementing this option are as follows:

- Conducting a site survey to develop a topographic map with 1-foot contours of the project area;
- Conducting hydrologic, geomorphic, and geotechnical studies to determine the existing conditions and develop the project design;
- Removing the existing crossing including the concrete and baserock;
- Modifying the streambed grade upstream and downstream of the road crossing;
- Preparation for the installation of the bridge or culvert at the downstream Bear Creek crossing including construction of the strip footings or abutments and the approaches for the culvert or bridge;
- Installation of the culvert or bridge;
- Construction of wingwalls to protect the culvert/bridge;
- Stabilizing the streambanks within the project area; and,

- Revegetating the impacted areas.

The estimated cost for implementation of this option is approximately \$200,000 to \$250,000.

3.2.3 ROCK RIFFLE FISHWAY

This option involves the construction of a rock-riffle fishway downstream of the existing road crossing to increase the range of flows during which fish passage would be provided, depending on the design flow for the rock-riffle fishway. The fishway would act as an artificial riffle and will dissipate flow energy and create pocket water/shallow pool areas to provide a migration pathway through the structure. The structure would be constructed such that flow is focused through the center of the fishway at low to moderate flows to provide greater water depth at these flows. At the lowest flows, depths would still be too shallow to provide passage.

The fishway would likely be constructed of 2-3 ton (24"-30" diameter rock) and the structure would be constructed at a slope between 5% and 7% and extend between 70 and 100 feet downstream. The anticipated steps involved in implementing this option are as follows:

- Conducting a site survey to develop a topographic map with 1-foot contours of the project area;
- Removing the existing concrete apron;
- Placement of the boulders; and,
- Revegetating the impacted areas.

The estimated cost for this option is approximately \$75,000 to \$125,000.

3.3 RECOMMENDATIONS

Based on this preliminary evaluation of passage options, the most cost effective approach to enhancing fish passage over the broadest range of flows would be to remove the existing road crossing, if it is not needed. If removal of the road is not an option, then the options consist of providing fish passage at a wide range of flows by constructing a natural bottom culvert or bridge or providing passage at most flows by constructing a rock-riffle fishway. Of these options, the rock-riffle fishway is the most cost effective approach since passage at the Bear Creek road crossing likely currently occurs at moderate to high flows, and is not currently a complete barrier.

This project area consists of a concrete “Arizona” or “fairweather” type crossing used for equipment access along San Antonio Creek at the Soule Park Golf Course. A golf cart access bridge which also spans the stream channel is situated approximately 50 feet downstream of the fairweather crossing. The fairweather crossing likely presents a complete barrier to fish passage. The road crossing is approximately 110 feet long and a near vertical (approximately 0.5:1 slope) concrete apron is situated along the downstream edge of the road crossing. The concrete apron is undercut approximately 6 feet. The road crossing presents a physical barrier to passage as the road surface is situated approximately 11 feet above the downstream streambed. The road crossing is situated approximately 150 feet downstream of the confluence of Thatcher Creek. The location of the road crossing is provided in Figure A-3 and the crossing is shown in Photos 33 and 34.

The objective of the analysis presented herein is to evaluate potential alternatives and identify the most appropriate alternative to enhance fish passage across the downstream road crossing in order provide access to high quality upstream habitat. The analysis consists of a brief description of the channel conditions in the immediate vicinity of the road crossing based on information collected during a site visit on February 27, 2003, a presentation of potential fish passage enhancement alternatives, and a discussion regarding the recommended project alternative.

4.1 EXISTING CONDITIONS

The streambed upstream of the crossing is at grade with the road and consists of a cobble/gravel dominated plane bed channel (approximately 1% slope) with a moderate floodplain that was visually classified as a B3/B4 channel based on the Rosgen Stream Classification System. The bankfull width and depth of the upstream channel are approximately 25-30 feet and 1-2 feet, respectively. The streambanks are stable and consist of primarily cobble, gravel, and sand sized substrate with a dense riparian corridor consisting of willow trees.

The streambed downstream of the road crossing is incised and is situated approximately 11 feet below the road surface. The stream channel is dominated by boulder/cobble substrate and is deeply entrenched with a plane bed morphology and significant in-channel sediment deposition with vegetated mid-channel and lateral bars. The channel was visually classified as a G2/G3 channel based on the Rosgen Classification System with a slope of approximately 1%. Immediately downstream of the crossing the channel is approximately 70 feet wide and tapers to a bankfull width and depth of approximately 20-25 feet and 3-4 feet, respectively. The streambanks are unstable with evidence of slumping and undercutting and consist of cobble/boulder sized substrate with dense riparian willow vegetation along the channel margins and in-channel bars.

4.2 POTENTIAL FISH PASSAGE ENHANCEMENT ALTERNATIVES

Based on information collected during the site visit, the following conceptual fish passage enhancement alternatives for the project road crossing have been developed:

- Removal and abandonment of the road crossing and upgrading the existing bridge crossing situated approximately 50 feet downstream to accommodate equipment access; and,
- Removal and replacement of the existing road crossing with a bridge or natural bottom culvert.

Several streambed/water-slope modification approaches such as a rock-riffle fishway or series of boulder weirs were considered; however, these approaches were discarded since they would only provide passage opportunities at moderate to high flows and would require a large project footprint and significant volumes of rock to construct (and associated high cost) due to the significant elevation difference (11 feet) between the road surface and downstream streambed.

A description of the proposed alternatives and a preliminary cost estimate (excluding permitting costs) for each alternative is provided below. The scope of these alternatives is conceptual and would require additional surveying to develop a topographic map of the project area and hydrologic, sediment transport, and geomorphic studies prior to preparation of the final design.

4.2.1 REMOVAL OF EXISTING CROSSING AND UPGRADE OR REPLACEMENT OF DOWNSTREAM BRIDGE

This option would provide for fish passage at a wide range of flows by removing the existing road crossing and upgrading or replacing the existing golf cart bridge situated approximately 50 feet downstream to accommodate for equipment access. In conjunction with this option, the streambed would need to be graded both upstream and downstream of the crossing to restore the slope of the streambed to accommodate for passage. Assuming that the streambed would need to be modified to a slope between 4% and 6%, the extent of channel grading activities would involve modifying between 180 and 275 feet of streambed to accommodate for the vertical difference in streambed elevation of 11 feet.

In order to accommodate equipment access across the creek following removal of the crossing, the existing golf cart bridge would need to be upgraded or replaced depending on the bridge requirements and the structural specifications of the existing bridge abutments.

The construction activities would likely require 4-6, and the anticipated steps involved in implementing this option are as follows:

- Conducting a site survey to develop a topographic map with 1-foot contours of the project area;

- Conducting hydrologic, geomorphic, and geotechnical studies to determine the existing conditions and develop the project design;
- Removing the existing crossing including the concrete and baserock;
- Modifying the streambed grade upstream and downstream of the road crossing;
- Stabilizing the streambanks within the project area;
- Retrofitting or replacing the existing golf cart bridge; and,
- Revegetating the impacted areas.

The estimated cost for implementation of this option is approximately \$200,000 to \$300,000.

4.2.2 REPLACEMENT OF THE EXISTING CROSSING WITH A NATURAL BOTTOM CULVERT OR BRIDGE

This option involves removing the existing road crossing and replacing the crossing with a natural bottom culvert or pre-fabricated bridge. In conjunction with this option, the streambed slope would need to be modified as described above to be consistent with the geomorphic conditions and fish passage requirements. The culvert/bridge length would be approximately 50-60 feet, and implementation would involve the placing of fill material for the bridge/culvert approaches, the construction of strip footings for the natural bottom culvert and abutments for the bridge, and the construction of wing-walls to protect the culvert/bridge. The construction activities would likely require approximately 4-6 weeks to complete, and the anticipated steps involved in implementing this option are as follows:

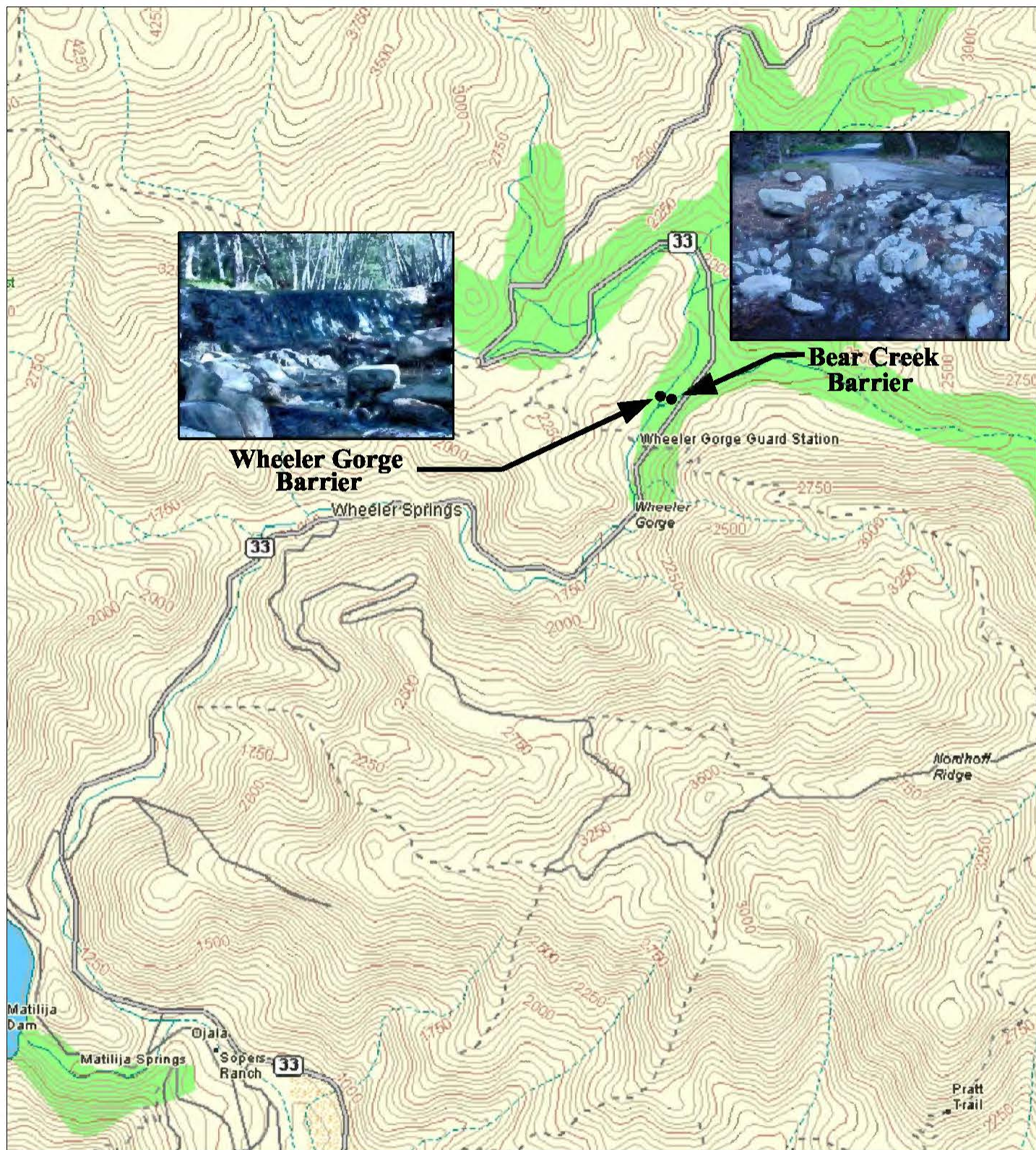
- Conducting a site survey to develop a topographic map with 1-foot contours of the project area;
- Conducting hydrologic, geomorphic, and geotechnical studies to determine the existing conditions and develop the project design;
- Removing the existing crossing including the concrete and baserock;
- Modifying the streambed grade upstream and downstream of the road crossing;
- Preparation for the installation of the bridge or culvert at the downstream Bear Creek crossing including construction of the strip footings or abutments and the approaches for the culvert or bridge;
- Installation of the culvert or bridge;
- Construction of wingwalls to protect the culvert/bridge;

- Stabilizing the streambanks within the project area; and,
- Revegetating the impacted areas.

The estimated cost for implementation of this option is approximately \$300,000 to \$400,000.

4.3 RECOMMENDATIONS

Based on this preliminary evaluation of passage options, the recommended fish passage enhancement alternative is to remove the road crossing and upgrade or replace the existing golf cart bridge to accommodate for equipment access. This option is the most cost effective approach to provide for passage at a wide range of flows.



LEGEND



Fish Passage Barrier



0 1.0 2.0
APPROXIMATE SCALE IN MILES

E N T R I X

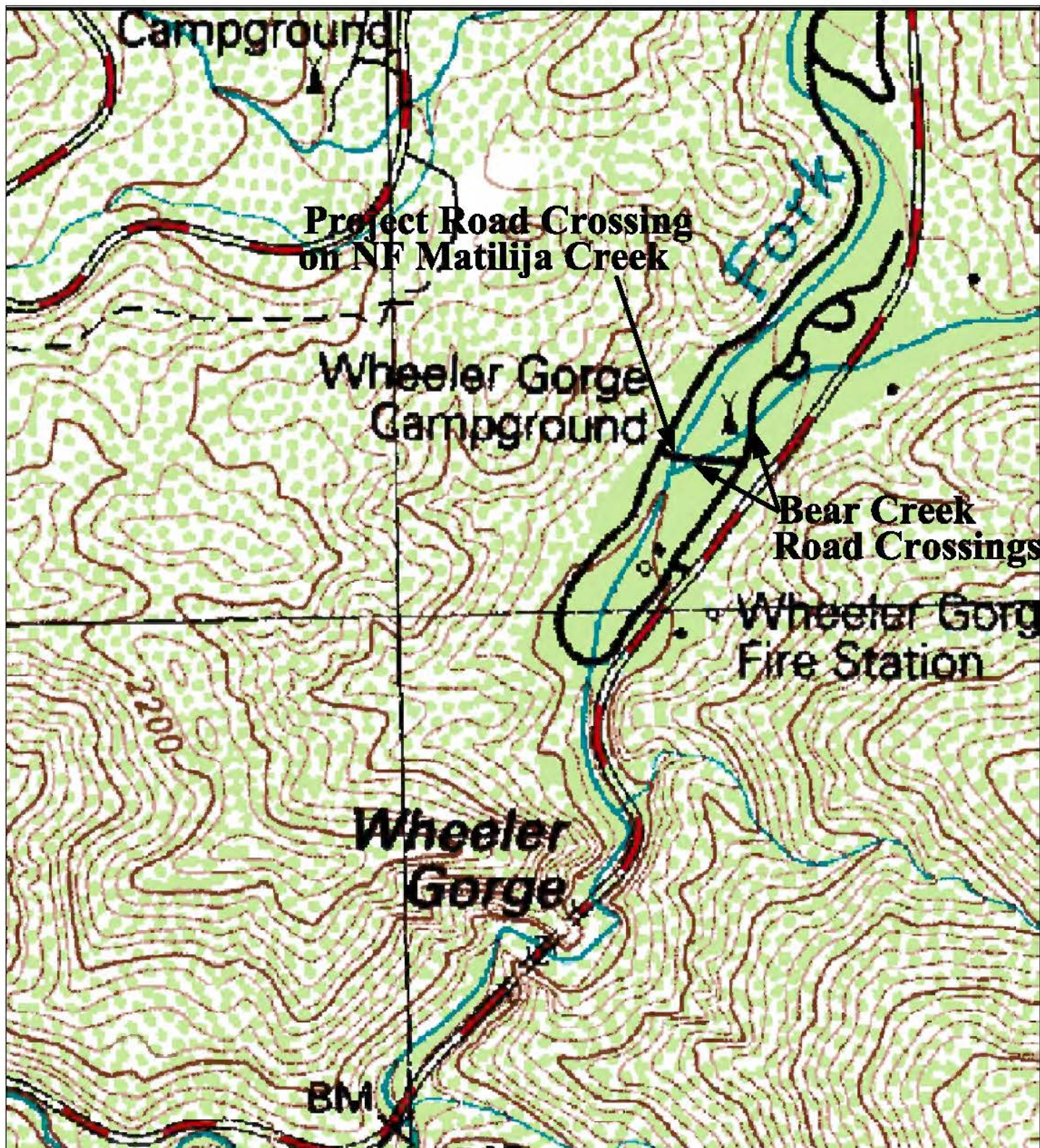
FIGURE A-1

**Location of North Fork Matilija and
Bear Creek Fish Passage Barriers**

PROJ. NO: 325405

CK: JLC

DATE: 03/03/2003



E N T R I X

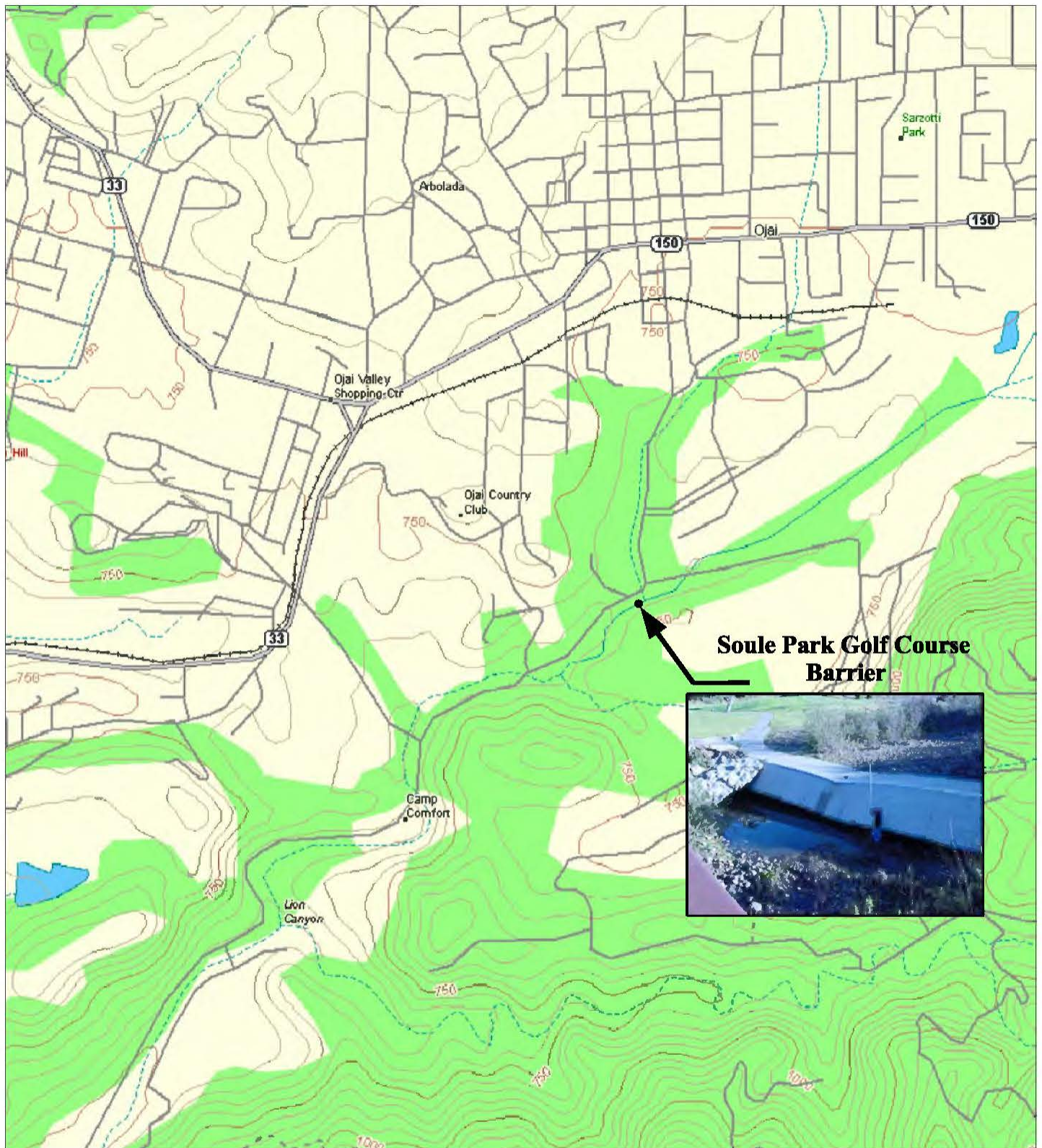
FIGURE A-2

**Site Map of North Fork Matilija and
Bear Creek Passage Barriers**

PROJ. NO: 325485

CK: JLC

DATE: 03/03/2003

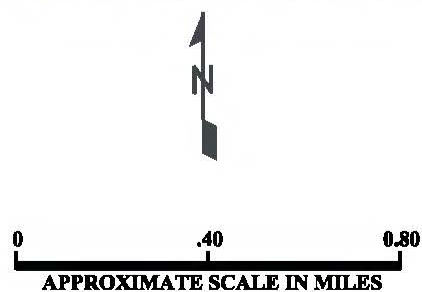


**Soule Park Golf Course
Barrier**



LEGEND

● Fish Passage Barrier



E N T R I X

FIGURE A-3

**Location of Soule Park Golf Course
Fish Passage Barrier**

PROJ. NO: 325405

CK: JLC

DATE: 03/03/2003