Photographic Monitoring of Salmonid Habitat Restoration Projects

Final Report

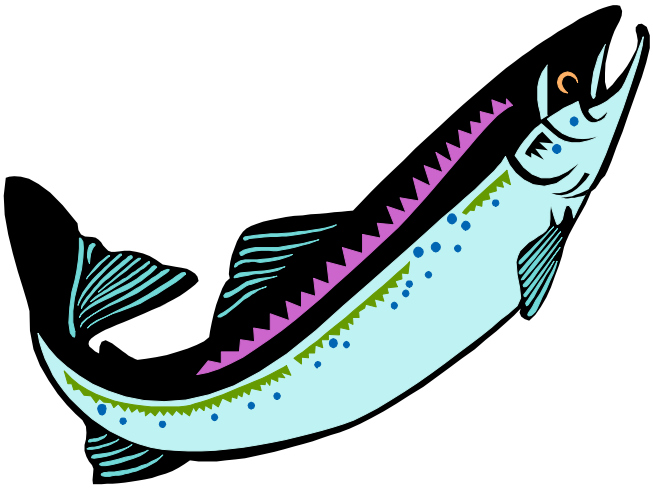

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TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

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INTRODUCTION

Photographs are a useful tool for monitoring pre-treatment conditions or changes that occur after implementation of a restoration project. With the advent of digital cameras, the capacity to do photographic monitoring has increased dramatically. The main purpose of this report is to provide a consistent way to document the locations and subjects of photographs so that they may be used in an effective manner. It is anticipated that it will be used by project contractors and DFG staff in the course of planning and evaluating restoration projects.

This report provides some guidance on the use of photographs for qualitatively monitoring restoration effectiveness. The goal is to enable users to compare sets of photographs taken at different points in time and determine if change has occurred. Photographs can then be used to support conclusions reached through other monitoring techniques[1].

Photographs may also be used as a stand-alone method to quantitatively assess change. There are many texts and papers on the use of both ground and aerial photographs for change detection. Specific examples applicable to restoration include use of photographs for evaluating forest canopy density (Chan et.al. 1986), channel form (Gilvear and Bryant 2004), substrate composition (Adams 1979, Ibbeken and Schleyer 1986, Bunte and Abt 2001), riparian conditions (Bauer and Burton 1993, Hall 2001) and erosion volume estimates (Reid and Dunne 1996). Quantitative analysis with photographs is not treated in this report. Interested readers should consult these references for further information.

Photographs are an integral part of *Qualitative Monitoring of Salmonid Habitat Restoration Projects* that will be used by DFG to monitor implementation of all restoration projects. The checklists included with *Qualitative Monitoring of Salmonid Habitat Restoration Projects* provide spaces for recording the frame numbers of photographs taken to illustrate current conditions relevant to each question. These may or may not be used as a basis for comparison after implementation so permanent photo-points may not be required. In cases where it is desired to monitor changes in conditions at a specific place or feature, permanent photo-points should be established. If permanent photo-points are used with *Qualitative Monitoring of Salmonid Habitat Restoration Projects,* the photo-point ID number(s) should be recorded in the spaces next to the appropriate question on each checklist. Although photographs are not required for every question or feature, in many cases they may be the only record of pre- and post-treatment conditions at a restoration site and will be essential for drawing conclusions regarding effectiveness.

PERMANENT PHOTO-POINTS

Photography at restoration projects may be done using permanent photo-points or "opportunistic" photographs. An opportunistic photograph is defined as one used to illustrate a specific condition but which will probably not be used to monitor changes over time and whose exact location is not documented. Good uses for opportunistic photographs include: documenting construction techniques during implementation, recording conditions at restoration sites during/after stressing events, capturing use of structures by fish, noting errors in implementation such as loose cables, inadequate epoxy, poor culvert alignment, etc.

[1] One semi-quantitative use of accurately reframed photographs suggested by DFG staff was to take repeated photographs of instream structures at sufficient scale to count individual pieces (rootwads, boulders, logs) and determine presence/absence over time. This could be used to support an assessment of long term durability.

Figure 1. Opportunistic Photograph of Seedling Vegetation Control Treatment.
Use of opportunistic photograph to document that scalping around planted seedlings met contract specifications. This photograph was not intended to be re-taken.

Figure 2. Photograph of Instream Structure at High Flow.
Opportunistic photograph of boulder weir in Bull Creek during peak flow event (12/2002).
Area of low velocity on right bank is visible, while a standing wave below the structure is evidence of hydraulic forces acting on the bed to scour out a pool. *Photograph courtesy of Bill McDavitt.*

A permanent photo-point is a specific location that can be returned to exactly over time to repeat photographs taken previously. If a high level of accuracy is required, permanent photo-points are needed to ensure that the photographic setting can be replicated. There are many examples of

post-project photographs taken from slightly different angles, with slightly different cameras or otherwise different with limited interpretive value. The probability of detecting changes due to restoration treatments is higher using permanent photo-points because variability of the photographs/subject matter is reduced. It is possible to re-frame photographs where no permanent photo-points exist using the previous photograph as a guide in the field, but accuracy is likely to be lower.

Figure 3. Badly Reframed Photograph of Erosion Control Treatment. These photographs are nominally of the same location before (upper) and after treatment. Differences in contrast and photo-point locations reduce the value of the pair. There are no scale or reference elements in the photographs to help with interpreting the treatment results.

Use of Repeat Photography for Qualitative Monitoring

The suitability of each site for monitoring using repeat photography is determined by the availability of suitable photo-points. Photo-point suitability is determined, in turn, by a combination of inherent site characteristics and visibility or presence of elements necessary to evaluate effectiveness of the treatment (Hall 2001). Site characteristics such as dense or tall vegetation cover, low or uneven lighting, and narrow or partial perspectives can limit the ability to match up before and after treatment photographs and draw conclusions. Additionally, each type of restoration project (instream structure, road upgrade, etc.) has particular elements that need to be included in the photographs in order to evaluate effectiveness of the treatment (see Appendix A for guidance on photographing different project types). Based on these considerations and previous experience, the user must select sites that are suitable as permanent points for photographic monitoring.

Figure 4. Pre- and Post-Treatment Photographs of Instream Structure. Example of pre-treatment and post-treatment photographic pair for instream habitat project. No monument was established at the photo-point because it was in the stream channel. Distance from the bridge and position in channel were recorded initially and used along with the pre-treatment photograph in the field to reframe the scene. The bridge and twin tall trees are recognizable elements in each photograph. Both photographs were taken during low flow conditions. Change from shallow riffle to deep pool is obvious, scale is sufficient to count pieces of wood and even boulders in post treatment photograph.

Dramatic changes are most evident in photographic sequences such as, doubling of vegetation height or cover, change of habitat type from shallow riffle to deep pool, presence/absence of a structure, change from small undersized culvert to large culvert set at grade, etc. Subtle effects such as decreases in surface erosion, changes to road surface shape, changes in shrub species composition, shifting of materials in an in-stream structure, etc. will be more difficult to detect using photographic monitoring. Thus it is important to anticipate what types of effects are likely to occur at each site when deciding whether to include a site in a photographic monitoring study or how to best capture the expected change.

Figure 5. Pre- and Post-Treatment Photographs of Culvert Upgrade.
Example of pre-treatment and post treatment photographs at culvert upgrade site using opportunistic method. Both pictures taken during winter conditions, same scale element (person) in each photo, lighting is even, and dramatic change is evident. However, lack of reference elements in photographs makes it difficult to tell that they were taken in the same place. Post treatment photograph was taken using the pre-treatment photograph to reframe the subject, so view is slightly different.

Good judgment is required to determine which features are suitable for photographic monitoring and where to set up the photo-points at each feature. Photo-points should be established at sites likely to have observable results and where relevant aspects of the project feature will be visible for the duration of the proposed monitoring study. The best locations for photo-points allow a clear view of the project feature. These include points above the project looking down on it, or from mid-channel looking at channel banks. When elevated sites are obscured by vegetation, brushing and clearing may be necessary. The most useful photo-points include a view of permanent and recognizable landmarks that can be exactly reframed in the future.

Some monitoring studies are intended to capture short-term changes (1-3 years) while others may aim to evaluate long term effectiveness of projects (5-10 years). The rate of vegetation re-growth will be the prime determinant of long-term suitability of photo-points. In forested areas

on the coast, vegetation may obscure a site within two years while grassland settings in the interior may never be obscured. Knowledge of local plant species, growth rates and monitoring objectives should be considered when establishing photo-points.

Figure 6. Post-Treatment Photographs of Incision Below Culvert.
Top photograph was taken immediately after treatment; bottom photograph was taken after first winter. Note that channel incision downstream of the culvert is visible and can be monitored using photographs. Both photographs were taken from permanent photo-point.

See the instructions in Appendix A for guidance on the location of photography for specific restoration project types. *Documenting Salmonid Habitat Restoration Project Locations* should be consulted for advice on establishing permanent points.

Taking Photographs

All photographs should be taken standing up with the camera at eye height. If this position is not used, it should be noted on the Photograph Description Form (see form, below). Photographs should be framed to encompass the expected "area of influence" and not just the project component expected to cause changes. For example, projects involving large excavations of soil for a decommissioned stream crossing require a view of the entire excavation area. Photographs of in-stream structures designed to develop pools should include the area expected to scour and the resulting gravel bar immediately downstream. Fixed landscape features such as large or unique trees or stumps, boulders, fences, buildings, road intersections, and the horizon should be included. Each photograph should contain a scale element such as a vehicle, person, survey rod, meter board, or white board (Lewis et al. 2000).

The best time to take photographs is on overcast days, or early or late in the day. Subsequent photographs should be taken at about the same time of day and season as the previous photographs, if possible. For analog cameras, high-speed film and shutter speeds of 1/60 second or faster are recommended.

When re-photographing it is essential to have photographs from the previous sessions in order to line up the horizon, landmarks and the subject as closely as possible with the previous photographs. On digital cameras it is recommended to view the re-photographed site on the LCD viewer and compare it with the previous photographs for similarity; re-shoot the photograph if necessary. Photographs should be laminated or contained in plastic sleeves for transport to the field.

Before going in the field to take repeated photographs, a complete packet of information should be assembled including: all site location information and maps, associated pre-treatment or post treatment data, project proposal with objectives for each feature, and properly labeled photographs from previous sessions along with the Photograph Description Forms. Meta-data from the Photograph Description Forms should be attached to each photograph as a caption for easy reference in the field. Meta-data includes: date photograph was taken, camera used, lens setting, time of day, location of photo-point (if used), direction camera was facing and height of camera (if not eye height), feature number or subject of photograph, contract ID, and scene description.

PHOTOGRAPH DESCRIPTION FORM

All of the information necessary to document opportunistic photographs may be entered on the Photograph Description Form. Photographs taken at permanent photo-points require additional information on monument types and locations (see *Documenting Salmonid Habitat Restoration Project Locations*).

Photograph Monitoring Data Form Instructions

General Information- section 1

1) **Contract #-** Print in the project identification number (contract #) assigned to this contract by the Department of Fish and Game.
2) **Contract name:** Print in the project name assigned by the contractor.
3) **Page____ of _____ -** Enter the page number of the current page in the first blank and the total number of pages used for the project in the second blank.
4) **Stream/Road-** Enter the name of the tributary stream or main road closest to the project location as it appears on the 7.5 minute USGS quadrangle. For unnamed roads or streams, enter the name of the stream or road to which it is tributary.
5) **Date-** Enter the day's date: mm/dd/yy
6) **Photographer-** Enter the first initial and last name of the photographer.
7) **Drainage -** Enter the name of the main drainage basin that the stream is a tributary to.
8) **Camera ID-** Enter the serial number or other identifying number for the camera being used on this project.
9) **Lens (mm):** Enter the focal length of the lens used to take the photograph in mm. For cameras with a zoom lens it may only possible to determine the focal length at the extremes of the zoom range, i.e., fully wide angle or fully telephoto. Therefore on these zoom cameras you will have to use either the full wide or full telephoto settings and record the corresponding focal length, which is usually printed on the rim of the lens.
10) **DIGITAL- prefix:** enter the prefix assigned to each frame number by the camera, usually a three number or letter sequence (e.g. 'dcp' or 103). The prefix remains constant until a sufficient number of pictures have been taken to cause it to increase.
11) **FILM- roll #:** for analog cameras enter the film roll number corresponding to the photographs described on the form.
12) **Compass:** circle the appropriate term depending on the type of compass used Magnetic North or True North.

Photograph Information- section 2

13) **Frame #:** record the frame number for each photo. For digital cameras use only the 3-4 digit number that follows the prefix that was entered above.
14) **Photograph Point Number-** Enter the number of the photograph point from which the photograph was taken. Photo-points are numbered sequentially as they are designated using the two letters followed by three numbers format. All photograph point numbers should start with "PP" (PP001, PP002, etc.).
15) **Feature Number-** The feature number that is the subject of the photograph should be recorded for each photo.
16) **Location -** Describe the physical setting where the photograph was taken. Use specific details when possible, such as tree species, size of rock, color and type of fencepost, slope angle, aspect, nearby landmarks, etc. If GPS data will be used at this site record the waypoint name assigned by the GPS unit to the point or the Latitude and Longitude coordinates. Position relative to the subject should also be described, i.e. '25 ft. downstream of weir'. If using a photo-point just refer to the ONSITE NAVIGATION FORM where the location was described, no need to restate.
17) **Facing and -** Record the direction the camera is facing in degrees (0-360°), or using stream directions (UPS, DNS, LB, RB)
18) **P or L-** record the orientation of the camera P for Portrait (vertical) and L for landscape (horizontal).

19) **Scene Description-** Describe the scene that was framed including: position of subject (center, top, bottom, side, etc.), notable landmark positions, horizon position, etc.

PHOTO DESCRIPTION FORM

Page ___ of ___

Contract #: **Contract name:**

Stream/Road: **Date:** **Photographer:**

Drainage:

Camera ID: **Lens (mm):** **DIGITAL - prefix:** **or FILM - roll #:**

Compass: Magnetic North or True North (* if photo is taken at the photopoint, include bearing in **Facing** column)

Frame #	Photo taken at a		Location:	Facing: *	P or L	Scene Description:
	Photo-point?	Project feature?				
enter # given by camera	enter PP###, if applicable	enter #, if applicable	Describe where the photographer was standing if photo is not taken from a photopoint OR provide additional relocation information.	N/W/S/E, AZ°, UPS, DNS, LB, RB, etc.	portrait or landscape	"Looking at" - describe feature or subject, position of subject (cntr, top, btm, side), notable landmarks, points of special interest, etc. as applicable.

For each photograph taken, record the frame number. For digital cameras the frame number and a prefix are automatically assigned to each photograph. The prefix (i.e., 103 or "DCP") usually remains constant, while the frame number changes with each photograph. Record the prefix once at the top of the data sheet and record the frame number along with other information each time a photograph is taken. If using an analog camera record the film roll number at the top of the data sheet.

Wide-angle lenses (up to 28 mm) are recommended for good overall views of restoration sites. Zoom lenses on point-and-shoot or digital cameras should be set at the maximum angle width to permit later re-shooting of a similar frame. Since the majority of photographs will be taken using digital cameras set at the wide angle lens setting, lens length is only recorded once at the top of the data sheet. If an analog camera is used with an adjustable lens length, the lens length data may be entered in the Scene Description column as needed.

The next step is to record where the photograph was taken. If the photograph was taken at a monumented photo-point, the photo-point ID number (derived from location forms, see *Documenting Salmonid Habitat Restoration Project Locations*) should be recorded on the Photograph Description Form. If the subject of the photograph is a restoration feature, its ID number should be recorded. If a permanent photo-point is *not* being used the location where the photograph was taken may be described in the "Location" column using a narrative description, GPS coordinates or waypoint ID, bearing and distance and/or reference to a map or site sketch.

The direction that the camera was facing should be recorded using the azimuth format (0-360°) or stream directions (upstream, downstream, left bank, right bank) depending on setting. Next record the orientation of the camera as 'portrait' (vertical) or 'landscape' (horizontal). Finally record a description of the contents of the photograph. Include notes on important elements of the subject to help with interpretation. For example, tension cracks observed on a road fill that may not be immediately apparent in the photograph should be noted so that area of the photograph can be enlarged for closer inspection.

Documenting Permanent Photo-Point Locations

Photo-point locations should be documented using the procedures and forms in *Documenting Salmonid Habitat Restoration Project Locations.* The locations of permanent photo-points need to be documented accurately enough so that a different person could relocate the point up to ten years in the future. A variety of navigation tools may be required for this task. Establishing monuments is encouraged where it is feasible to do so.

Monuments may be established at the point where the photograph was taken or at a nearby location if the photo-point itself is subject to disturbance. Stream channels, landslides and excavated areas are particularly prone to disturbance and require monuments to be established in the nearest stable location, with directions provided to the actual photo-point. Monuments established at known locations relative to the actual photo-points are known as "witness points" (Lewis et al. 2000). Alternately, the "two-pin" method may be used to relocate photo-points in unstable locations (see Appendix L of Flosi et al. 1998). The two-pin method uses triangulation from two witness points to relocate the actual photo-point.

Regardless of monument type, follow the documentation procedures for establishing permanent monuments and describing and mapping their location in *Documenting Salmonid Habitat Restoration Project Locations*. Briefly the procedure includes:

- Record driving directions to the project site using the Site Access Form.
- Record navigation directions to each photo-point within the project area using the Onsite Navigation Form.
- Assign each photo-point a unique ID number using the two letter, three number (PP###) format on the Onsite Navigation Form.
- Establish a photo-point location marker (monument) for each photograph point or two if using the two pin method (Appendix L, Flosi et al. 1998).
- Record the location coordinates and bearing and distance to a reference point on the Onsite Navigation Form. Provide a detailed description of each permanent marker. Plot locations of photo-points on maps and/or site sketches using an arrow pointing in the direction the camera was facing.

For studies of instream structures where establishing monuments at every permanent photo-point is not feasible, locations may be described using distance from the reference point used in the stream survey and position in the channel. Distance would be measured using a string-box and could be supplemented with GPS coordinates where available. Location within the channel may be described as mid-stream (MS), along the left bank (LB) or along the right bank (RB). The photo-points used in Figure 4 were relocated using this method. This method is not suitable for actively migrating stream channels where distance as measured along the thalweg could change dramatically over a ten year period.

Filing and Cataloging Location and Photograph Data

Completed forms should be entered into the appropriate DFG database and stored with project files. Photographs taken with film should also be developed digitally for storage in the database. Any photographs taken should be clearly marked and identified for storage in project files along with the photograph data sheet, sketch, and map of photo-point locations. Archival photograph storage sleeves should be used for all physical media. Access to these photographs in a useable form is essential to allow subsequent photographs to be taken from the correct locations.

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Appendix A

Guidance on Photographic Monitoring for Each Restoration Project Category

The tables provided below indicate how photographs should be taken for each of the major project types funded by the FRGP. The appropriate table should be consulted when planning and conducting photographic monitoring.

Table 1. Photograph Recommendations for Fish Passage Projects.

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Properly installed inlets and outlets	Photographs taken from directly downstream and directly upstream of future passage structure at elevation of structure	Photographs taken from directly downstream and directly upstream of passage structure looking through it
Proper culvert/bridge alignment	Photographs taken from above and from side looking at location where new structure will be installed	Photographs taken from above and from side of culvert/bridge slope. Culvert photographs should show culvert inlets and outlets relative to the vertical and horizontal distance from the channel bottom. Photograph of habitat unit at inlet and outlet of structure.
Area of habitat made accessible	Photograph of conditions causing fish barrier Photograph of habitat above barrier	Photograph of location of former barrier Photograph of habitat above former barrier
No unforeseen adverse effects on habitat such as incision, instability or sedimentation	Photographs of channel conditions taken from mid-channel upstream of barrier, downstream, and at barrier	Photographs taken from mid-channel of channel upstream and downstream of former, and at former barrier
Increased attraction flows during migration periods (for barrier modifications)	Photograph of attraction flow at barrier during migration	Photograph of attraction flow at former barrier during migration

Table 2. Photograph Recommendations for Instream Structure Installation Projects.

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Properly installed structures/Structures in good condition/ Structure integrity preserved/ No undesirable channel changes or bank erosion	Photographs taken from mid-channel looking upstream and downstream from each future structure location and photograph taken from either right or left bank looking down upon future structure location.	Photographs taken from mid-channel looking upstream and downstream from each structure location and photograph taken from either right or left bank looking down upon structure.
Increase in targeted habitat units	Habitat at future location of each structure	Habitat formed by each structure (pool, shelter, undercut banks, gravels, side channels, etc.)

Table 3. Photograph Recommendations for Instream Structure Removal Projects.

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Properly removed structures/ No undesirable changes or bank erosion / Increased riparian vegetation /Increased channel/floodplain connectivity	Photographs taken from mid-channel looking upstream and downstream from structure and photograph taken from either right or left bank looking down upon structure and the adjacent habitat.	Photographs taken from mid-channel looking upstream and downstream from former structure location and photograph taken from either right or left bank looking down upon former structure location.
Increase in targeted habitat units	Habitat at location of each structure	Habitat formed by structure removal (pool, shelter, undercut banks, gravels, side channels, etc.)

Table 4. Photograph Recommendations for Streambank Stabilization Projects

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Properly installed treatments / Treatment in good condition/ Treatment integrity preserved	Photographs taken from opposite bank and mid-channel looking across channel to where treatment is to be placed.	Photograph taken from opposite bank and mid-channel looking across channel at the treatment. Photograph taken from the bank with the treatment looking down upon the treatment.
Reduced bank erosion/ Improved channel geometry/ Increased riparian vegetation	Photographs of channel upstream and downstream of future treatment location. Photograph of channel at future treatment location from opposite bank.	Photographs of channel upstream and downstream of treatment. Photograph of channel at treatment location from opposite bank.

Table 5. Photograph Recommendations for Land Use Control Projects.

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Properly installed structures *(fences, troughs) /* Structures in good condition/ integrity preserved.	Photographs taken of future structure locations	Photographs taken of structures.
Livestock/wildlife effectively excluded	Photograph of animal impacts on riparian zone/channel	Photographs at same locations Photograph of fence line showing degree of vegetation use/trampling on each side.
Increased riparian vegetation/ riparian connectivity/ Increased bank stability/ Improved channel geometry	Photographs taken from mid-channel of riparian vegetation on left bank, right bank, channel upstream, channel downstream, and overhead [upstream of project reach, throughout project reach, and downstream of project reach]	Photographs taken from mid-channel of riparian vegetation on left bank, right bank, channel upstream, channel downstream, and overhead [upstream of project reach, throughout project reach, and downstream of project reach]
Improved water quality	Photograph of water clarity (including algal blooms and other indications of nutrient loading) within future project reach (from above channel at low flow)	Photograph of water clarity within project reach (from above channel at low flow)

Table 6. Photograph Recommendations for Vegetation Control Projects.

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Project properly installed/Planting survival/Reduced exotic plants/ Increased native plants/ species richness	Photographs where plantings/removals will occur	Photographs at same location after treatment
Reduced barren ground	Photograph of areas of bare ground	Photograph at same location after treatment
Increased riparian canopy cover/ Reduced vegetation within bankfull / Increased availability of spawning gravels (if clearing encroachment involved)	Photographs taken from mid-channel of riparian vegetation on left bank, right bank, channel upstream, channel downstream, and overhead [upstream of project reach, throughout project reach, and downstream of project reach]	Photographs at same location after treatment
Riparian tree composition meets planting or management objectives	Photographs taken in areas of future treatment site	Photographs at same location after treatment

Table 7. Photograph Recommendations for Riparian Planting Projects.

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Project properly installed/ Planting survival/ Advancement in riparian successional stage from grass-shrub to forest	Photographs where plantings/removals will occur (from opposite bank)	Photographs at same location after treatment
Increased riparian canopy cover / Increased riparian corridor continuity and patch size	Photographs taken from mid-channel of riparian vegetation on left bank, right bank, channel upstream, channel downstream, and overhead [upstream of project reach, throughout project reach, and downstream of project reach]	Photographs at same location after treatment

Table 8. Photograph Recommendations for Flow Augmentation/Restoration Projects.

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Project properly installed	Photograph of location where structure/practice to restore water will be implemented	Photograph of structure/practice where water flow restoration is occurring
Increased low flows, flows achieve natural peak flow regime	Photograph of streamflow/channel throughout future project reach (from mid-channel) during low flows and high flows targeted for change	Photograph of streamflow/channel throughout project reach (from mid-channel) during low flows and high flows
Increased sediment transport	Photograph of channel bed where increased sediment transport is expected to change substrate and habitat characteristics	Photograph of channel bed in same location after flushing flow occurs
No adverse changes in downstream flows	Photograph of streamflow/channel downstream from future project reach (from mid-channel) during high and low flows	Photograph of streamflow/channel downstream from project reach (from mid-channel) during high and low flows

Table 9. Photograph Recommendations for Slope Stability and Erosion Control Projects.

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Project structures or treatments are properly installed, implemented or applied.	Photographs of locations of future project structures or treatments, if any	Photographs of project structures or treatments, if any
Reduced likelihood of slope failure	Photographs of areas of slope failure	Photographs of same areas after treatment
Decreased soil erosion and sediment delivery from site	Photographs of areas with soil erosion and sediment delivery occurring	Photographs of same areas after treatment
Decreased sediment load near site during peak flow events/ No significant increase in mass wasting and sediment delivery from treated area	Photographs of areas where sediment from project area delivers to channel (ditch, culverts, channel)/ Photographs of channel immediately downstream from potential sites of sediment delivery	Photographs of same areas after treatment
If planting involved, reduced bare ground and increase in deep rooted vegetation.	Photographs of bare ground/Photographs of future planting locations	Photographs of plantings/ground cover

Table 10. Photograph Recommendation for Crossing Upgrading Projects.

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Project crossings properly installed	Photographs of crossing to be modified from downstream, upstream, and above	Photographs of modified crossing from downstream, upstream, and above
Reduced sediment delivery from road-related slope failure	Photographs of probable slope and road failure locations	Photographs of same areas after treatment
Improved channel geometry / No offsite adverse effects on erosion or sedimentation / Reduced erosion and sediment yield	Photographs taken of channel (from mid channel) upstream of project reach, throughout project reach, and downstream of project reach	Photographs taken of channel (from mid channel) upstream of project reach, throughout project reach, and downstream of project reach
Reduced sediment yield	Photographs of areas where sediment /water delivers to channel (road surface, ditch, culverts, gullies, channel, etc.)	Photographs of same areas after treatment

Table 11. Photograph Recommendations for Crossing Decommissioning Projects

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Crossing properly removed	Photographs of crossing to be removed from downstream, upstream, and above	Photographs of previous crossing location from downstream, upstream, and above
Reduced sediment delivery from crossing failures during stressing events	Photographs of crossing to be removed from downstream, upstream, and above	Photographs of previous crossing location from downstream, upstream, and above
Improved channel geometry / No offsite adverse effects on erosion or sedimentation / Reduced erosion and sediment delivery	Photographs taken of channel (from mid channel) upstream of project reach, throughout project reach, and downstream of project reach	Photographs taken of channel (from mid channel) upstream of project reach, throughout project reach, and downstream of project reach)
Reduced sediment yield/ Improved stream discharge regime in immediately adjacent watercourses	Photographs of areas where sediment /water delivers to channel (road surface, ditch, culverts, gullies, channel, etc.)	Photographs of same areas after treatment
Planting survival	Photographs where plantings will occur	Photographs of plantings
Reduced erosion rate from road surface/ Reduced runoff and/or increased infiltration rate on road surface	Photographs of road surface to be treated	Photographs of same areas after treatment
Cause or source of gullying is removed	Photographs of conditions causing gully formation, or of flows in gully.	Photographs of same areas after treatment

Table 12. Photograph Recommendations for Road Segment Upgrading Projects.

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Project structures properly installed	Photographs of locations where structures are to be installed	Photographs of project structures
Reduced sediment yield/ Improved stream discharge regime in immediately adjacent watercourses	Photographs of areas where sediment /water delivers to channel (road surface, ditch, culverts, gullies, channel, etc.)	Photographs of same areas after treatment
Reduced sediment delivery from road-related slope failure	Photographs of probable road and slope failure locations	Photographs of same areas after treatment
No offsite adverse effects on erosion or sedimentation	Photographs taken of channel (from mid channel) in vicinity of road segment	Photographs taken of channel (from mid channel) in vicinity of road segment
Reduced erosion rate from road surface	Photographs of road surface to be treated	Photographs of same areas after treatment
Cause or source of gullying is removed	Photographs of conditions causing gully formation, or of flows in gully.	Photographs of same areas after treatment

Table 13. Photograph Recommendations for Road Decommissioning Projects.

Implementation/ Effectiveness Criteria	***Pre-project photographs***	***Post project photographs***
Road and associated drainage facilities properly removed or otherwise treated	Photographs of road and drainage facilities to be decommissioned	Photographs of decommissioned road and locations of former drainage facilities
Reduced erosion rate from road surface/ Reduced runoff and/or increased infiltration rate on road surface	Photographs of road surface to be treated	Photographs of same areas after treatment
Reduced sediment delivery/ Improved stream discharge regime in immediately adjacent watercourses	Photographs of areas where sediment /water delivers to channel (road surface, ditch, culverts, gullies, channel, etc.)	Photographs of same areas after treatment
Reduced sediment delivery from road-related slope failure	Photographs of probable slope and road failure locations	Photographs of same areas after treatment
No offsite adverse effects on erosion or sedimentation	Photographs taken of channel (from mid channel) in vicinity of decommissioned road segment	Photographs taken of channel (from mid channel) in vicinity of decommissioned road segment
Cause or source of gullying is removed	Photographs of conditions causing gully formation, or of flows in gully.	Photographs of same areas after treatment
Planting survival	Photographs where plantings will occur	Photographs of plantings