Fish Passage Monitoring

SRF 2025Fish Passage Design Workshop


Assume
Steady State

STREAMS CHANGE

Streams + Crossings = Channel
(dynamic) (static) Adjustment

1979

1998

Assessments Provide Baseline for Monitoring

- Assessment efforts are monitoring the performance of the existing infrastructure.
- Our baseline is drawn (almost).
- Passage Assessment Database (PAD). www.calfish.org

Five-Co. Assessments

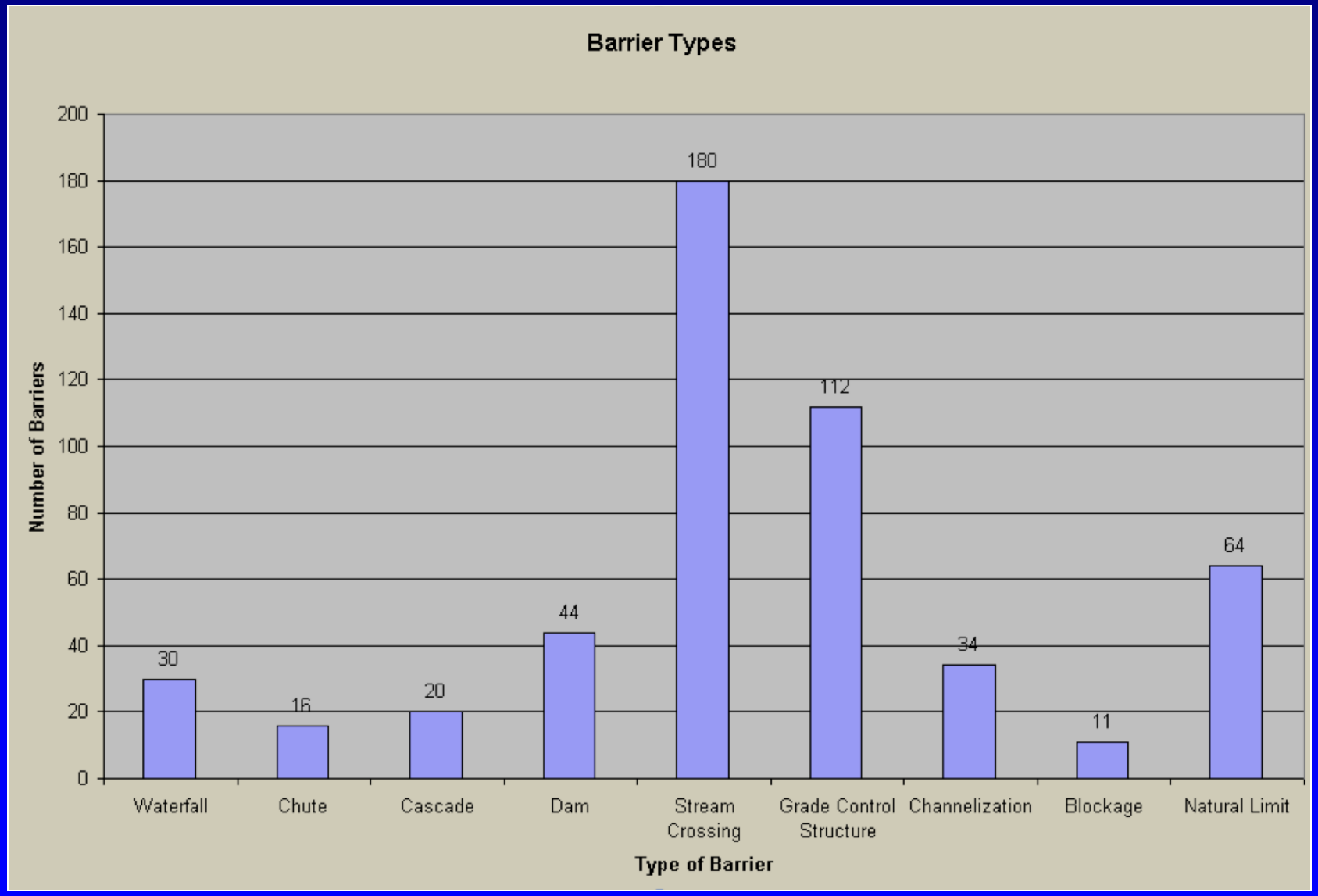
- Humboldt County – 160 crossings inventoried and 92 evaluated.
- Del Norte County – 67 crossings inventoried and 34 evaluated.
- Coastal Mendocino – 74 crossings inventoried and 34 evaluated.
- Siskiyou County – 118 crossings inventoried and 36 evaluated.
- Trinity County – 107 crossings inventoried and 51 evaluated.

COUNTY	Poor Condition	Undersized (<10 yr)	Passage Assessment	High-Priority Sites
Humboldt	28%	57%	Red = 14 Gray = 51 Green = 2	20 sites
Del Norte	21%	79%	Red = 9 Gray = 17 Green = 2	6 sites
Siskiyou	19%	53%	Red = 25 Gray = 10 Green = 1	10 sites
Coastal Mendocino	39%	36%	Red= 15 Gray = 10 Green = 3	5 sites
Trinity	14%	73%	Red = 41 Gray = 9 Green = 1	13 sites
Clean-up Assessment	42%	74%	Red = 30 Gray = 9 Green = 1	5 sites
AVERAGE or TOTAL	**23%**	**62%**	**RED = 134** **GRAY = 106** **GREEN = 10**	**59 sites**

Five-Co. Projects Completed: 1998-2012

County	Completed Projects	Miles Made Accessible	Percent High Priority Completed	Remaining High Priority Sites
Del Norte	6	11	75%	2
Humboldt	26	39	71%	6
Mendocino	11	20	100%	0
Trinity	12	25	67%	3
Siskiyou	10	51	40%	9
TOTAL	**65**	**146**	**71%**	**20**

Santa Barbara Co. Barriers Identified by Matt Stoecker



Three Monitoring Types

- Implementation — "Did we build it as intended?" ODF Survey
- Effectiveness — "Did it work?" Smith River PIT, Reba
- Validation — "Are the assumptions correct?" Lang, Love & Trush

General Types of Stream Crossing Monitoring

- **Qualitative**
  - All replaced or retrofit crossings, selected performance checks. Revisit should be scheduled (Implementation + Effectiveness).
- **Quantitative**
  - Fewer projects, but more comprehensive (Effectiveness + Validation).

Define performance expectations (objectives); monitor against these.

Bed Stability
Sediment Distribution
Bank-Lines
Bank Stability
Water Depths
Velocities

Fish Migration/Delay
Population Densities
Habitat Utilization
Juvenile Passage

NMFS – Tier 1 Monitoring

Applied to projects removing dams and removing or replacing culverts.

1) Site Passability: channel width, channel gradient, and jump height.
2) Target Fish Species: presence/absence of target fish species, life stage limited by barrier.
3) Operating/Maintenance/Liability Costs: annual for next five-year period.
4) Safety Hazard: describe hazard diminished or eliminated.
5) Civic or Community Enhancement: changes to infrastructure, utilities or recreational facilities.

NMFS – Tier 2 Monitoring

1. In-depth evaluation of habitat and population metrics, focused on ESA species recovery.
2. Metrics developed by National Fish Passage Team.
3. Enhanced Habitat and Abundance Metrics.
4. Provide context of how a specific project contributes to watershed-level or ESU-level population recovery targets.
5. Overarching question – what are the changes in abundance, and the spatial and temporal distribution associated with the project?

NMFS Tier 2 Enhanced Habitat Metrics

1. Potential length of habitat.
2. Amount of habitat re-occupied.
3. Quantity and quality of specific habitat types made accessible.
4. Production potential of newly accessible habitat.

NMFS Tier 2 Enhanced Abundance Metrics

1. Presence/absence.
2. Presence/absence with seasonality and/or life stage.
3. Distribution and/or progression of re-occupation of newly accessible habitat.
4. Relative Abundance.
5. Population Estimates.
6. Population Census.

Implementation Monitoring

- Crucial elements to get right
  - Lack of understanding of design details
  - Inadequate inspection
  - Inexperienced inspectors
- “As built” vs design
- Essential to evaluate and interpret effectiveness

Qualitative Monitoring: Develop a Checklist

Bed adjustment and stability

- ✓ Is a channel setting up in the crossing?
- ✓ Aggradation and degradation?
- ✓ Permeability problems?

Channel adjustment and stability

- ✓ Bank stability
- ✓ Head-cutting
- ✓ Pool formation

Crossing condition

- ✓ Catching debris
- ✓ Accumulating sediment at inlet
- ✓ Structural issues

Photo Monitoring

Upstream Channel

Culvert Outlet

Culvert Inlet

Downstream Channel

Effective Use of Photos

- ✓ Careful selection of vantages.
- ✓ Reference points and scale in shots.
- ✓ Wide angle or panoramas.
- ✓ Take lots, find the keepers.
- ✓ Metadata! (captioning). Never skip this.
- ✓ Effective archiving.
- ✓ Re-shoot the same frames on revisit.

Photo Monitoring – reference points

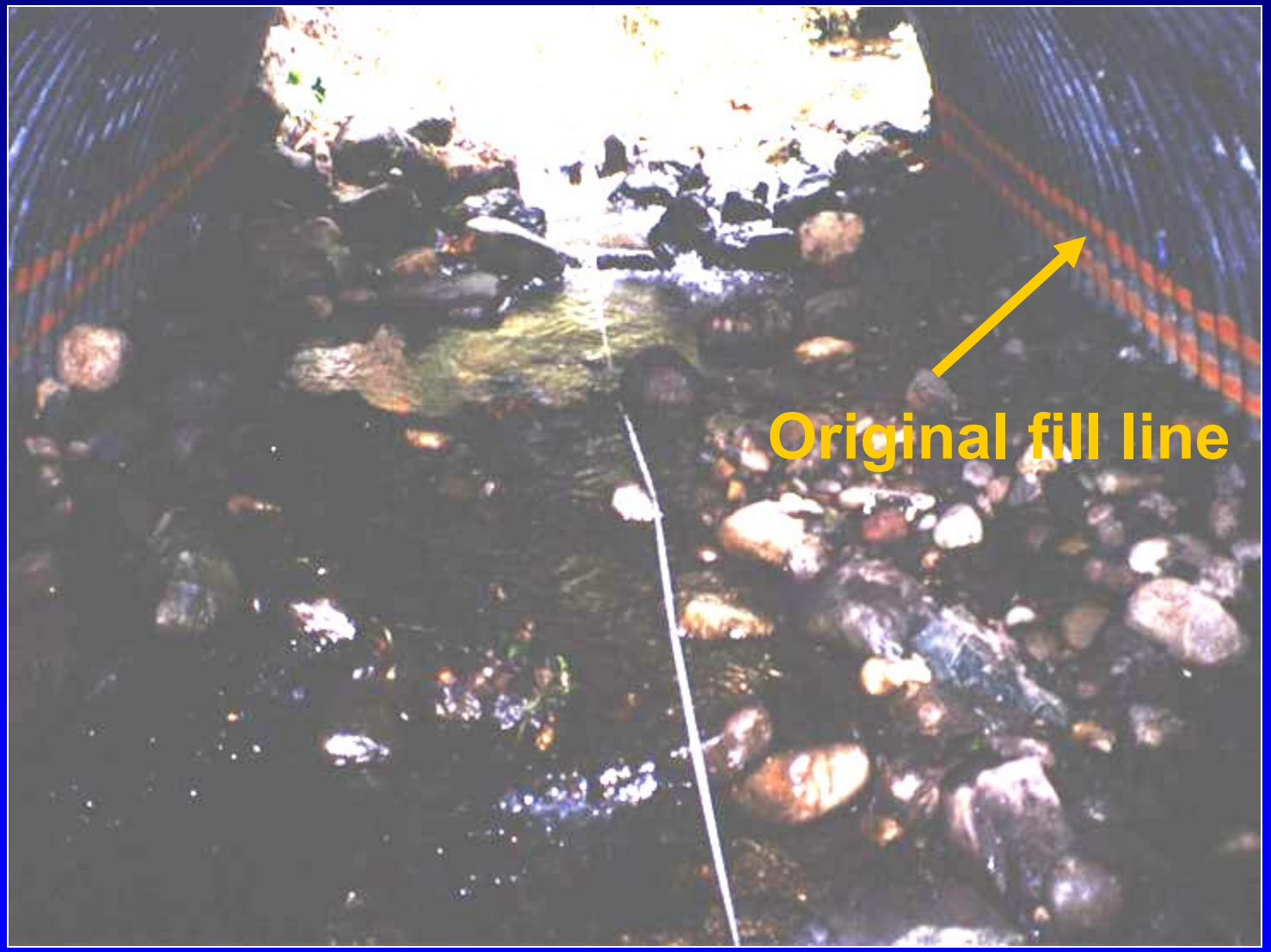


Photo Monitoring – McCready Gulch

Implementation

Photo Monitoring – McCready Gulch

Effectiveness

Quantitative Monitoring

Physical Monitoring

- Longitudinal profiles
- Velocity distributions
- Substrate composition
- Bedload movement

Detailed measurements needed over time

Quantitative Monitoring

Streambed Simulation Design Option:

- Slope w/in new crossing similar to natural channel?
- Velocities w/in new crossing similar to natural conditions?
- Minimum depths w/in new crossing similar to natural channel?

Quantitative Monitoring

Hydraulic Design Option:

- Resurvey crossing, longitudinal profile and tailwater cross-section.
- Re-run new crossing with FishXing.

Morrison Gulch – Case Study of Design versus As-built

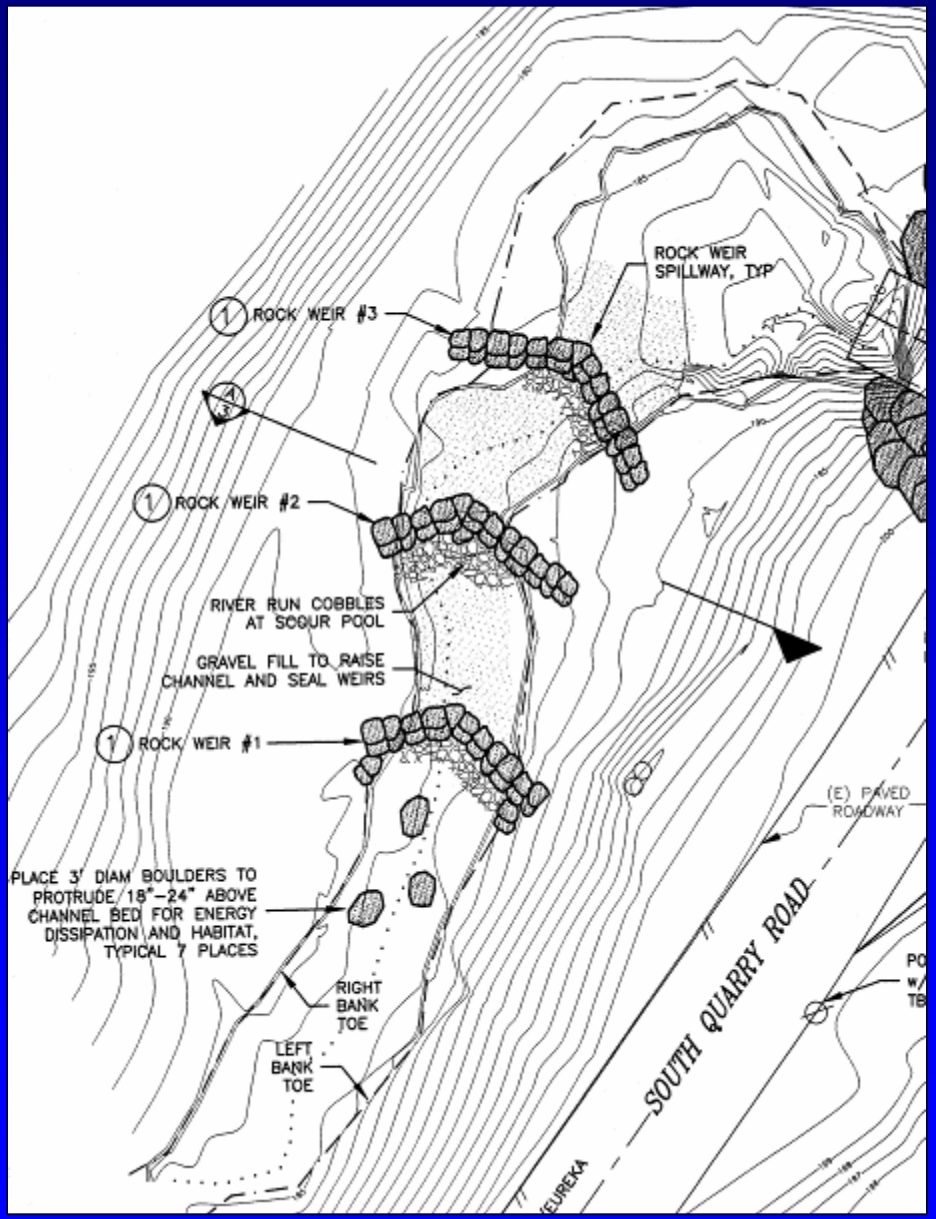
Morrison Gulch – Case Study

- High-priority – severity of barrier and fish presence.
- High likelihood of re-colonization raised site to #1 priority.
- Hydraulic design option selected.
- Grade-control structures utilized.

Morrison Gulch – Design Features

- Slope through culvert = 0.0%.
- Elevation of downstream weir relative to culvert outlet = 0.5 feet higher.
- Design concept – install culvert, then construct grade-control weirs.
- Elevation between grade-control weirs = 0.5 feet.

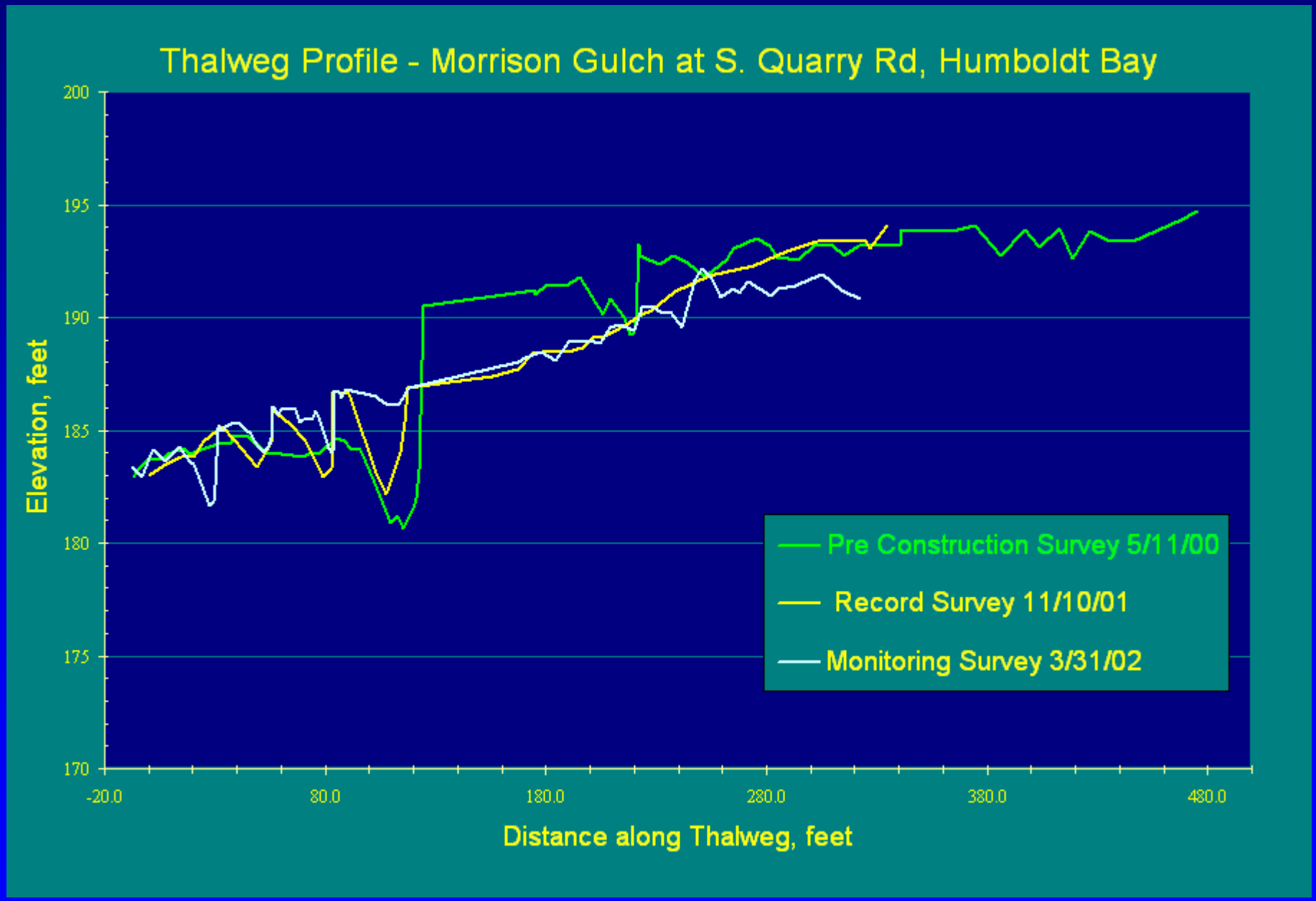
Morrison Gulch – Design Features



Morrison Gulch – As-Built Features

- Slope through culvert = 1.17%.
- Elevation of downstream weir relative to culvert outlet = set at same elevation.
- Grade-control weirs were constructed first - then culvert was installed.
- Elevation between grade-control weirs – 0.70 to 0.75 feet.

Channel Bed Adjustment



Quantitative Monitoring – Passage Evaluation

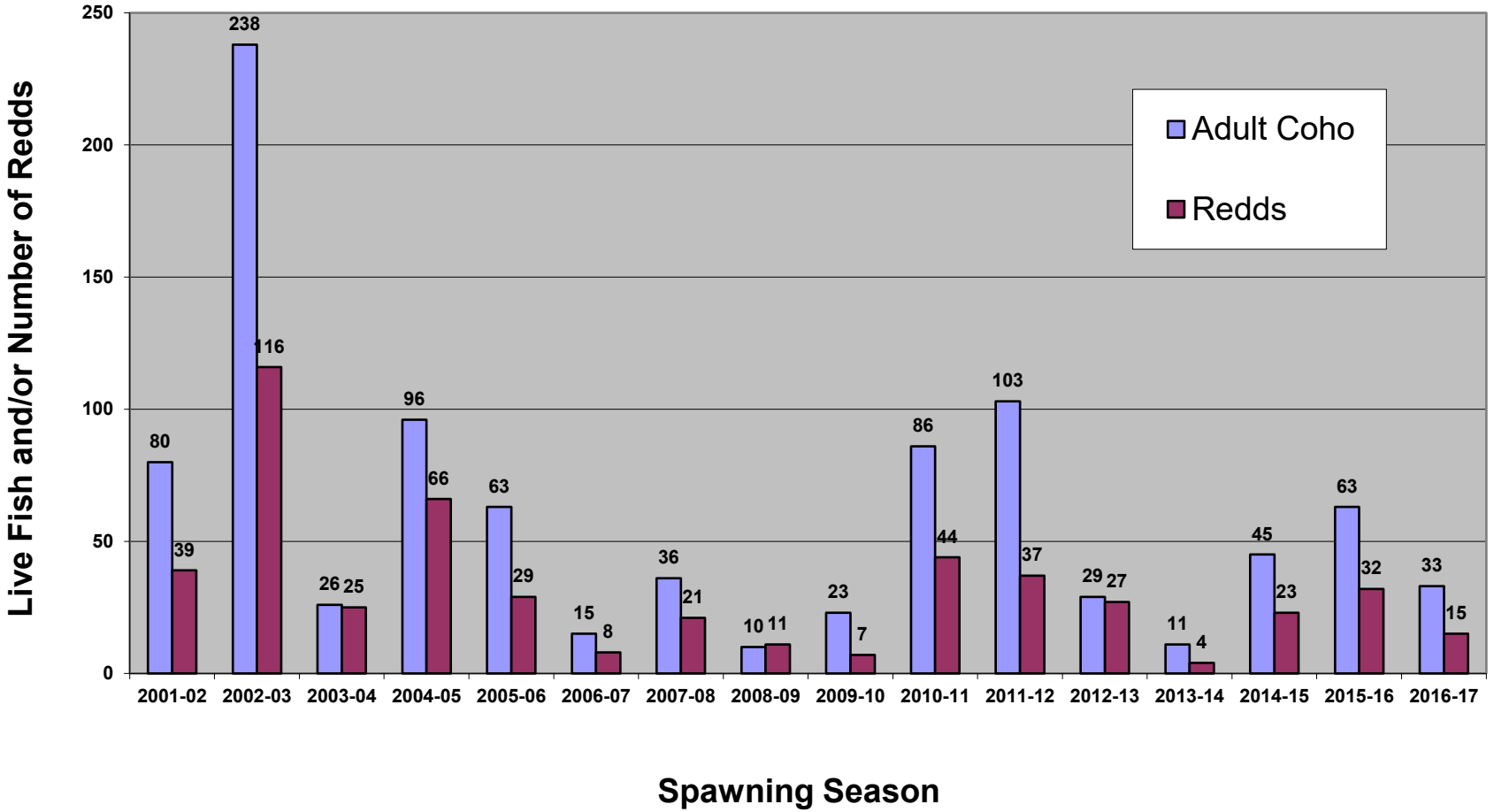
- Utilized 2001 record survey data and new culvert specification.
- Assessed with FishXing.
- Adult passage = 90% - insufficient depth.
- Resident passage = 30% - excessive velocity.
- Juvenile passage = 0% - excessive velocity.

Quantitative Monitoring - Biological

Pre- and post-project:

- Visual observations
- Spawner or redd surveys
- Snorkel counts

Quantitative Monitoring



Photos: Thomas Dunklin

Project Stability and Longevity

- Resurveyed downstream weirs and culvert inlet and outlet on May 5, 2017.
- Slope through culvert = 1.31%.
- Elevation of 1st downstream weir relative to culvert outlet = 0.27 feet higher.
- Elevation between 1st and 2nd weirs = 0.78 feet.
- Elevation between 2nd and 3rd weirs = 0.79 feet.

Qualitative Monitoring – Crossing Retrofits

- Baffles and weirs within crossing.
- Grade-control structures.
- Re-visit photo points over time.
- Assess hydraulics during migration flows.
- Assess performance in passing storm debris.
- Assess longevity of structures.

Qualitative Monitoring - Retrofits

Additional Types of Biological Monitoring

- View Ports
- PIT Tag Antenna Array
- Time-Lapse Camera

Additional Types of Biological Monitoring

Frykman Gulch 2010 pre-project electrofishing

Downstream of barrier: juvenile steelhead, juvenile coho salmon, prickly sculpin and Pacific lamprey ammocetes.

Upstream of barrier: juvenile steelhead and prickly sculpin.

Additional Types of Biological Monitoring

Frykman Gulch 2012 post-project electrofishing

Downstream of Bridge: juvenile steelhead, juvenile coho salmon, prickly sculpin and Pacific lamprey ammocetes.

Upstream of Bridge: juvenile steelhead, juvenile coho salmon, and prickly sculpin.

Coho salmon – most likely non-natal. Juveniles often are initial colonizers of newly opened habitat (Pess et al. 2011).

Additional Types of Biological Monitoring

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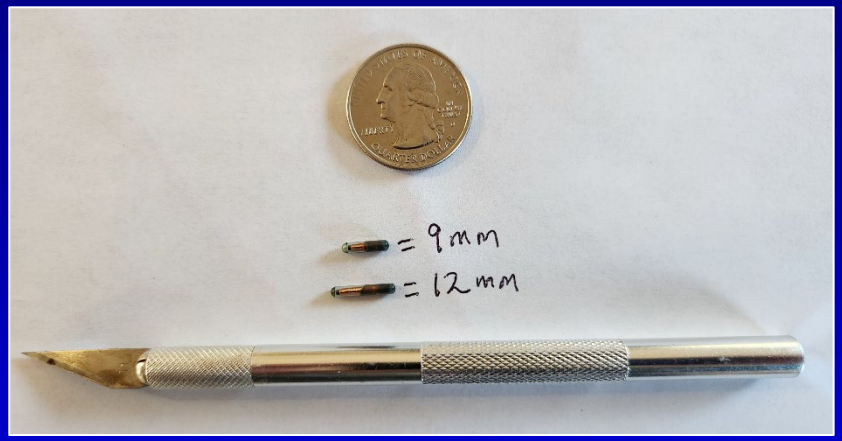

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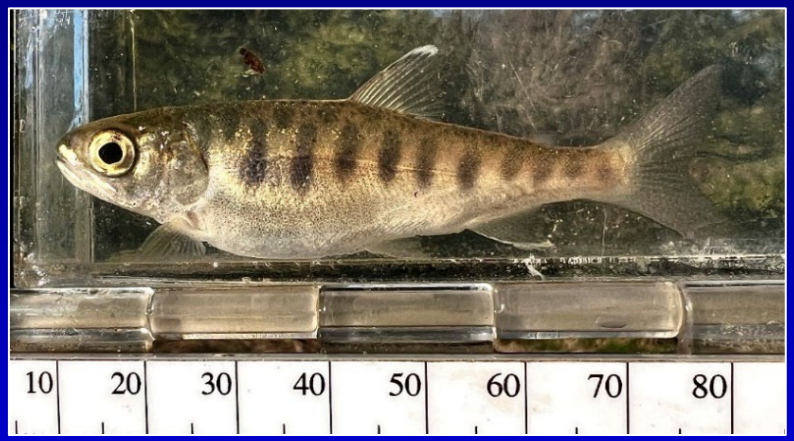
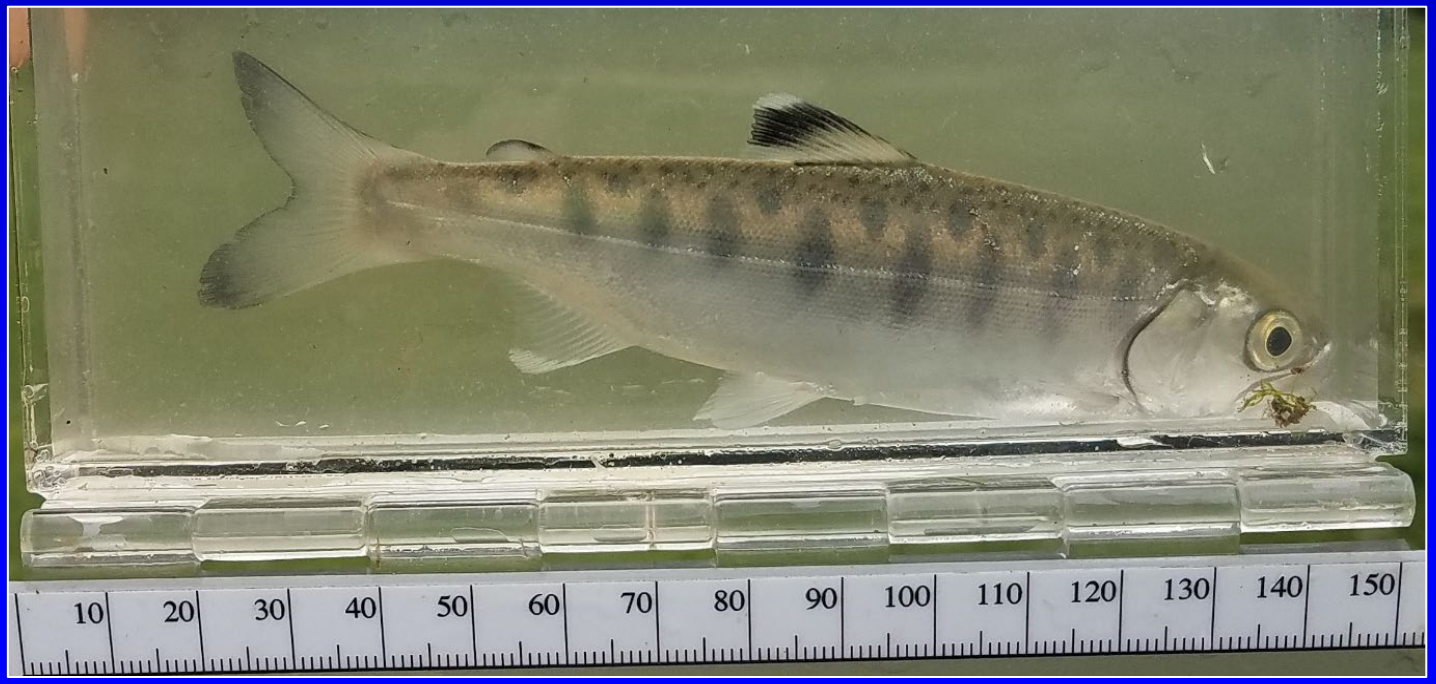
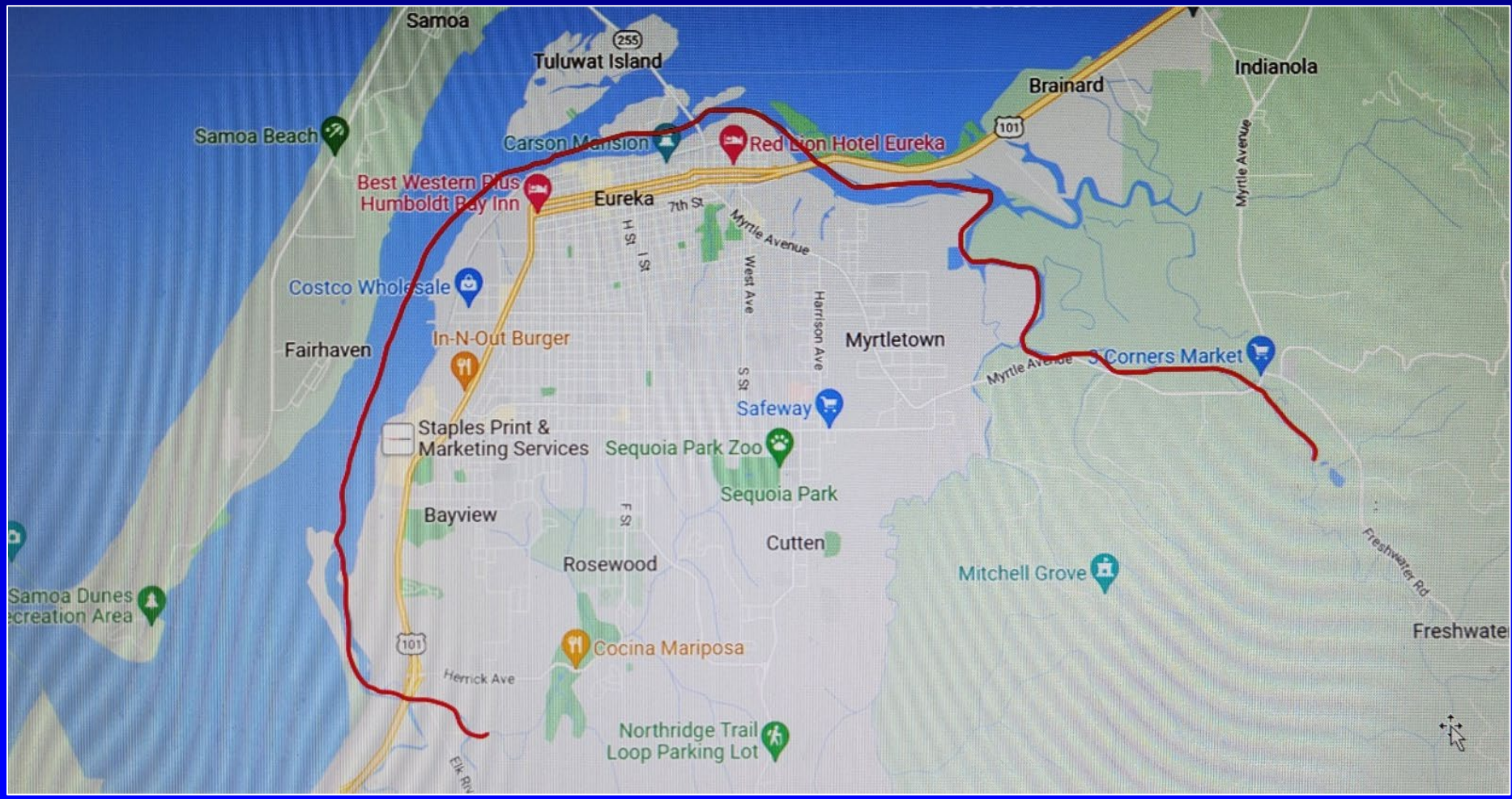


December 2022 = 75 mm
May 2023 = 130+ mm

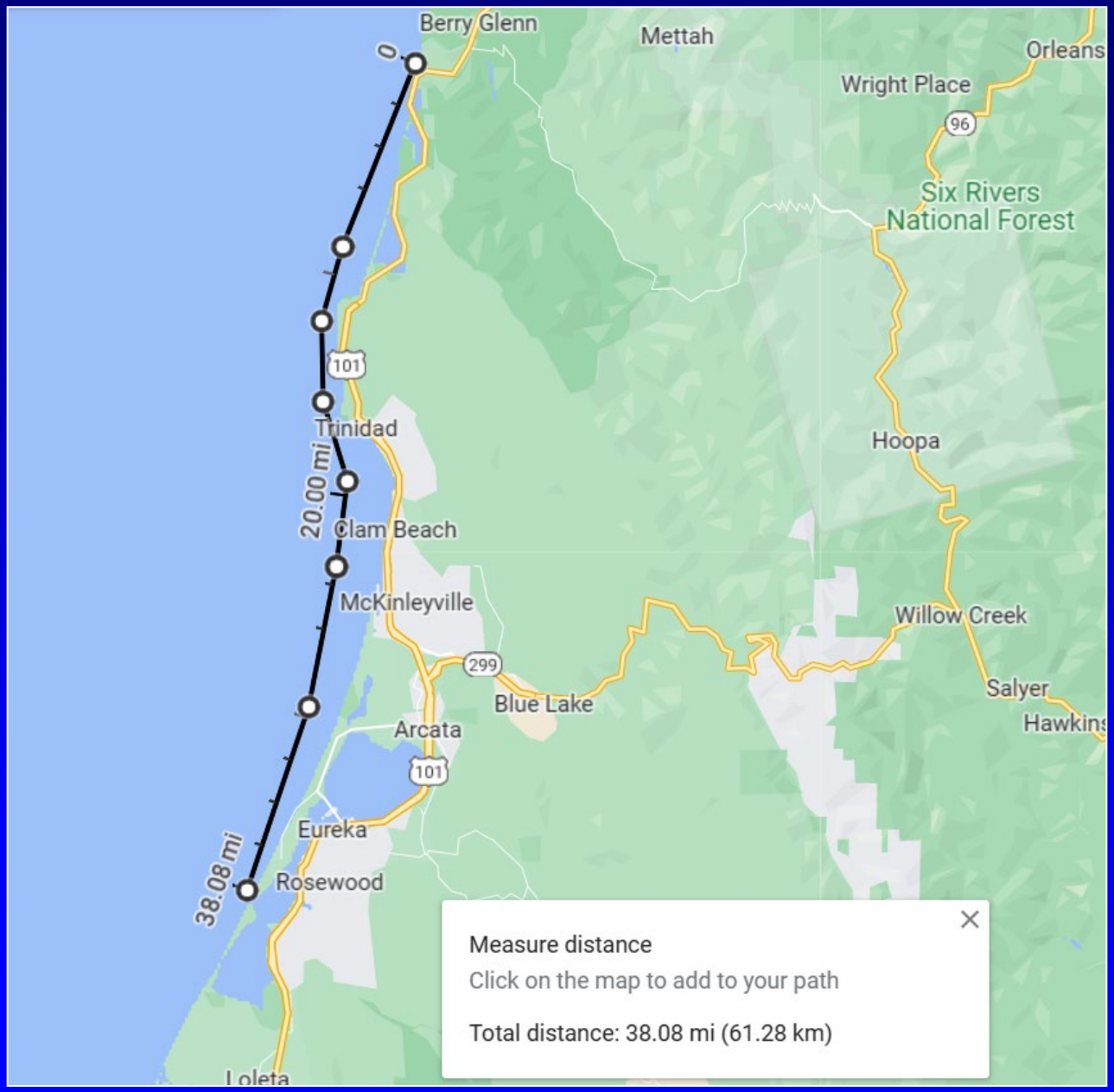


Additional Types of Biological Monitoring

Humboldt Bay – Movement Detections of Juvenile Coho



Ocean Entry Detection - Juvenile Coho



Additional Types of Biological Monitoring

Soctish Creek – Pre-project eDNA Sampling

Additional Types of Physical Monitoring

Glenbrook Gulch/Albion River – Dam Removal Project

Secondary project objective: restore spawning habitat .

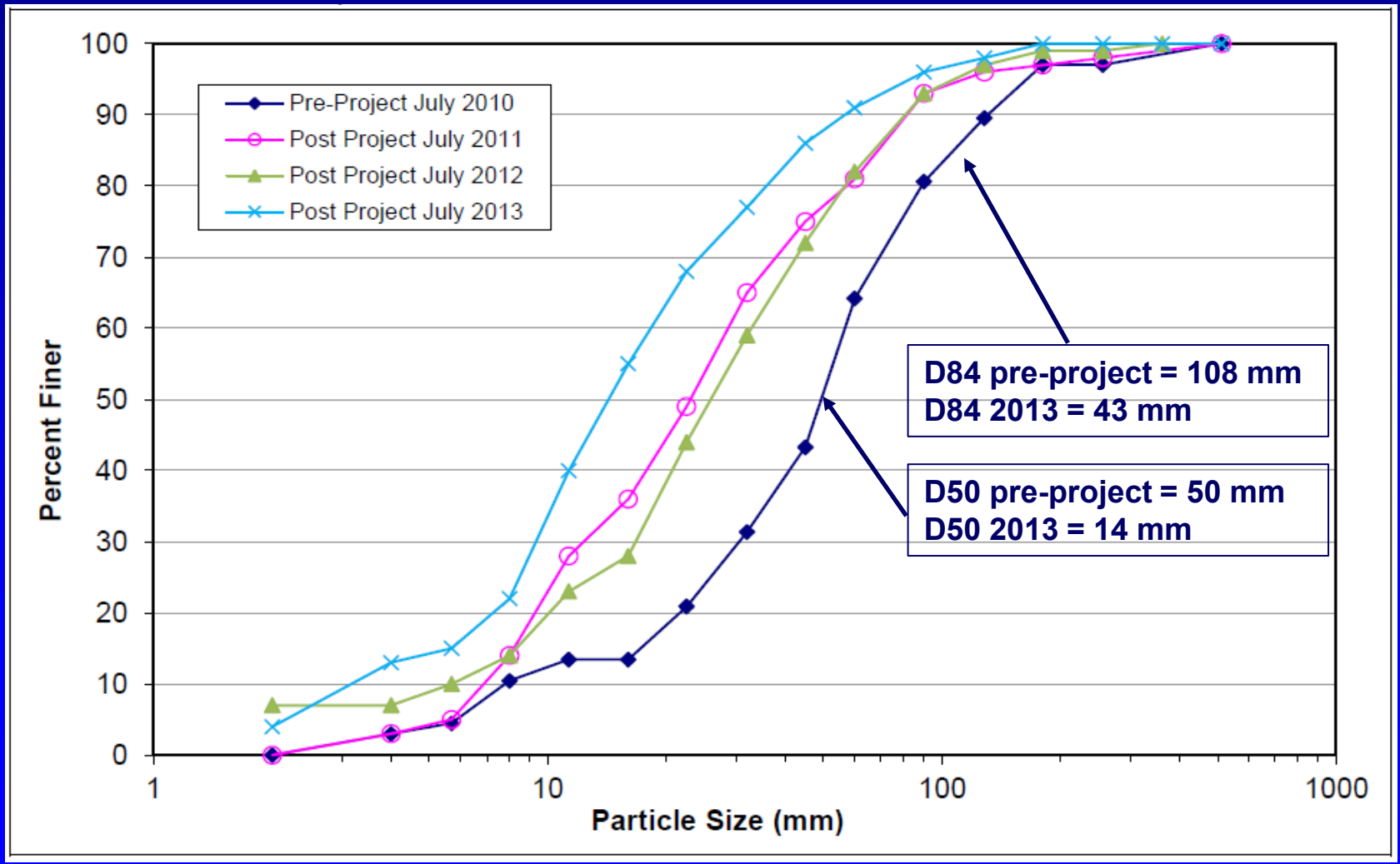
Downstream of Dam: channel scoured to bedrock with large angular substrate. No suitable spawning habitat.

Solution: install channel-spanning boulder and log structures to capture mobilized sediment. Minimal removal of stored sediment during dam removal.

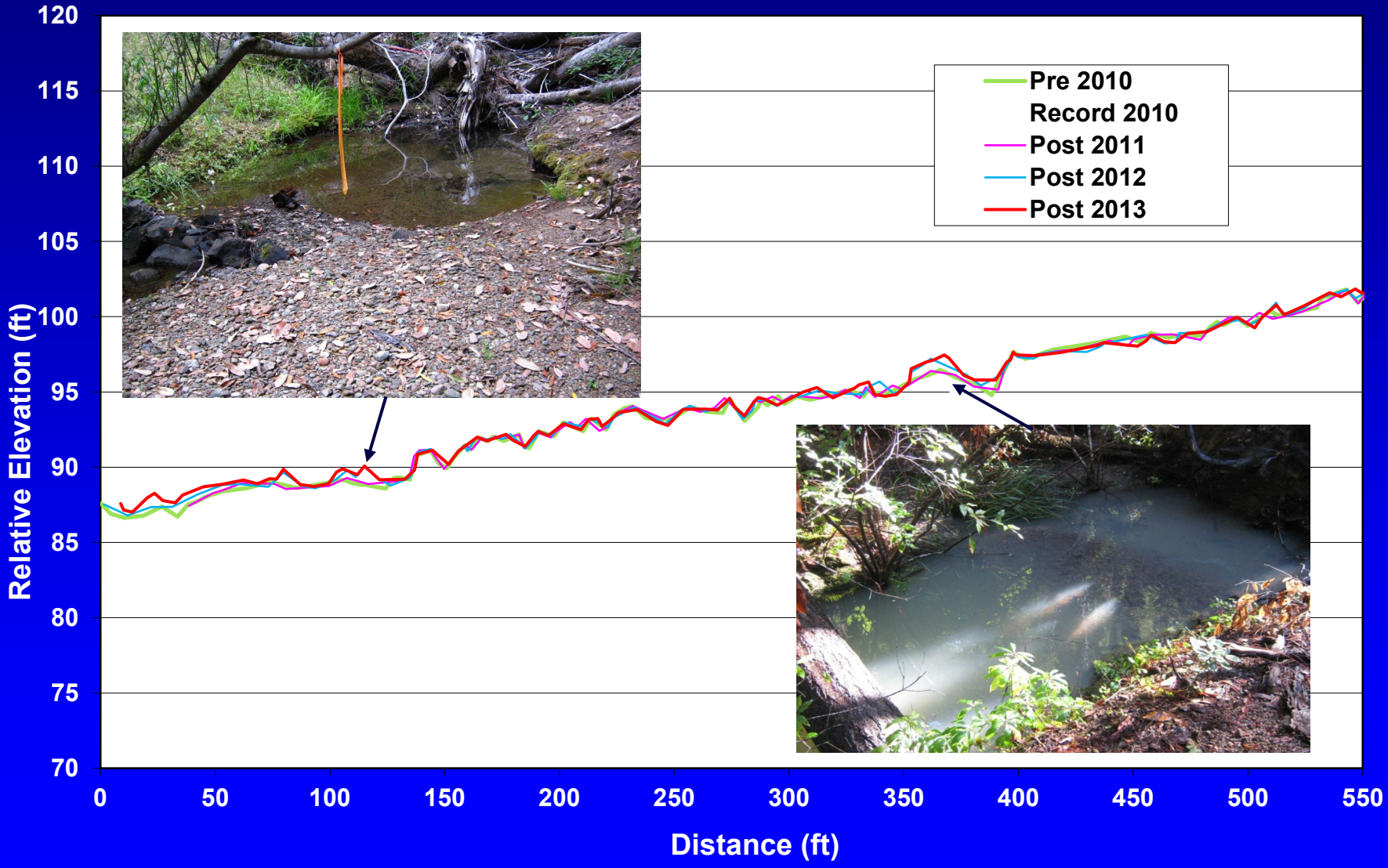
Monitoring: photo points, longitudinal thalweg surveys and pebble counts (pre and post).

Additional Types of Physical Monitoring

Below Dam – Pre and Post Particle Size Distribution



Sediment Retention Structures



Fish Passage Monitoring Resources

NOAA Fisheries: Monitoring and Evaluation for Restoration Projects. Overview with contact information and links to more sources.

NOAA Fisheries: Guidance for Proposing and Conducting Tier 1 Fish Passage Monitoring.

California Fish Passage Forum – Fish Passage Monitoring Methods (Taylor 2015).