# Beaver Dam Analogues on Moffett Creek, Siskiyou County, California

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**Abstract**

Efforts to continue research of elevated sediment supply transport from Moffett Creek, a tributary of the Scott River in Siskiyou County of northern California, led to a field study being conducted on a heavily degraded 1.3 mile reach of Moffett Creek to determine potential placements of Beaver Dam Analogues (BDAs). With the assistance of the Scott River Watershed Council (SRWC), a longitudinal and cross-sectional survey was completed to examine stream reach characteristics. To determine the best suited locations of proposed BDAs, an analysis of the cross-sectional profiles and calculated slope percentages at 100 foot intervals derived from the longitudinal profile were examined for the purpose of obtaining areas of reverse grade and severe incision. The analyzed sections of interest were then layered with LIDAR orthoimagery to produce a map of approximate flow accumulation and potential BDA placement at specific sites along the reach. Hydrologic monitoring and a vegetation survey was conducted to provide baseline data for future monitoring post BDA construction. Data collection will contribute to the design, planning, and monitoring of BDA implementation on Moffett Creek as well as restoration projects in the Scott River valley.

**1. Introduction**

The Scott River Watershed, located in Siskiyou County in northern California, covers 813 square miles. Due to regular periods of floods and droughts, the watershed experiences variability in water discharge (North Coast Regional Water Quality Control Board, 2005). The area is geographically diverse with mountains reaching up to 8,000 feet in elevation and an alluvial valley floor sitting at 2,000 feet in elevation. The variation in geography means the watershed is also geologically, hydrologically, and ecologically diverse. As a tributary of the Klamath River, an important coastal river for anadromous salmonid migration, the Scott River Watershed provides critical habitat for Coho Salmon (*Oncorhynchus kisutch)* and steelhead (*Oncorhynchus mykiss)* spawning and rearing (Scott River Watershed Council, 2018). The region has been impacted by beaver extirpation, road construction, agriculture, livestock management, water diversions, timber harvests, mining, and residential development. Both natural and anthropogenic impacts have altered and degraded the watershed, resulting in limited and impaired salmonid habitat.

Due to elevated sediment levels and elevated water temperature, the Scott River water quality is listed as "impaired" under Section 303(d) of the Clean Water Act from the U.S. Environmental Protection Agency (National Marine Fisheries Service, 2014). In response, the North Coast Regional Water Quality Control Board (NCRWQCB) implemented the Scott River Watershed Sediment and Temperature Total Maximum Daily Loads (TMDL). The plan seeks to achieve the TMDLs, thereby improving water quality for the migration, spawning, and reproduction of salmonids (NCRWQCB, 2005). Although multiple tributaries contribute to elevated sediment levels, the Moffett Creek sub-watershed has been identified as one of the main sediment contributors to the Scott River (SHN Consulting Engineers & Geologists, 2003). The Moffett Creek Watershed accounts for 28% of the Scott River watershed and drains 227.9 square miles. Many sections of Moffett Creek consist of heavily incised streambanks that have resulted in disconnection from the adjacent floodplain, resulting in a decline in groundwater recharge and decrease in nutrient deposition, impacting the riparian vegetation (Figure 1).


*Figure 1. An example of channel incision on Moffett Creek, evident throughout much of the study area.*

***1.1 Beaver Dam Analogue Function***

A significant impact on the watershed was the removal of beavers beginning in the 1830s during the peak of fur-trapping in California (Scott River Watershed Council, 2005). Beaver populations rapidly declined, consequently reducing beaver dams and altering the watershed hydrology (Charnley, 2018). The combined loss of beavers and changes in land and water use has further increased incision and degradation. Increasing beaver abundance in the Scott River Watershed has been identified as a high priority recovery action by the National Oceanic and Atmospheric Administration (NOAA) and Southern Oregon Northern California Coast Coho Salmon (SONCCC) Recovery Plan (National Marine Fisheries Service, 2014).

Beavers play a critical role in creating and maintaining stable, complex stream and wetland ecosystems as well as supporting an abundance of species diversity (Pollock, 2014). By imitating the effects of beaver dams, BDAs have the potential to trigger restoration that supports natural colonization by beavers and new beaver dam complexes (Charnley, 2018). The purpose of a BDA is to create habitat for beaver or increase the possibility of success for beaver reintroductions accelerating recovery of stream habitat (Castro, 2018). “BDAs should facilitate fluvial geomorphic changes that include sediment retention, streambed aggradation, increased stream sinuosity, pool formation, increased stream length, reduced stream slope, reduced bed shear stress, and a shift in the bed composition from coarser to finer sediment” (Castro, 2018). The deposition of suspended load is a function of flow velocity and turbulence, and initiating this process requires a significant decrease in flow velocity (Pollock, 2014). BDAs initiate a decrease in velocity allowing for the aggradation of sediment and organic matter behind dams which in turn raises the stream bed and reconnects incised channels with historic floodplains. The structural integrity of BDAs allows implementation in the earlier stages of stream succession where high velocity flows would normally breach dams built by beavers.

The slope is reduced by backwatering upstream from the BDA and through effective lengthening through distributary side channels (Pollock, 2014). “Beavers prefer to build dams on small- to medium-sized, low-gradient streams (<6% slope) that flow through unconfined valleys, and generally populate the lowest gradient (slope < 1-2%) sites first” (Castro, 2018).
The hydrologic effect of a BDA often results in an increased abundance of riparian vegetation (Scamardo, 2019). This vegetation provides flow resistance, storage and retention of sediments through root strength (Pollock, 2014). Furthermore, reintroduced beaver have transformed some intermittent streams back to perennial streams (Castro, 2015).

Engineered flow obstructions have potential advantages over natural structures. They can be designed for specific outcomes and can withstand flow forces they are likely to encounter (Pollock, 2014). The placement can also be better controlled, allowing for adjustment when needed to expedite restoration objectives (Pollock, 2014). In addition, multiple BDAs will increase the system resilience and moderate it’s dependence on the structural integrity of any individual structure. The key to successful application of these techniques is to understand how they affect the transport of sediment and water, and how such effects vary depending on where they are placed within a watershed.

In December 2019, to contribute to meeting the objectives of the Action Plan for the Scott River Sediment and Temperature Total Maximum Daily Loads, the Scott River Watershed Council (SRWC) submitted the project "Addressing TMDL Water Quality Impairments in the Scott River's Largest Subwatershed, Moffett Creek, Phase I" to the State Water Board for funding. The project, the first phase of a long-term restoration initiative, will implement "BDAs, exclusionary fencing and riparian planting on a 1.3 mile reach" of Moffett Creek to increase aggradation in the channel, reduce sediment levels, and increase groundwater recharge (Scott River Watershed Council, 2019).

The Moffett Creek Beaver Dam Analogue Capstone project's initiative was to assist the SRWC in their project goals by collecting baseline hydrologic and vegetation data, completing a longitudinal profile to calculate an average slope and areas of reverse gradient, analyzing stream channel morphology, mapping high flow accumulation areas, and developing a comprehensive map of potential BDA placement on the study reach. This proposed restoration plan will address the question, 'can the implementation of BDAs on Moffett Creek improve the hydrological and ecological function?' The implementation of BDAs on Moffett Creek, will provide a cost effective and low-impact method to reduce incision, decrease flow velocity, increase groundwater recharge, and ultimately reduce sediment into the Scott River.

## 2. Methods

Baseline hydrologic and vegetation data was collected to determine current conditions of the study area and evaluate post-restoration response. Additionally, a geomorphic assessment was conducted to guide potential BDA placement. This included a topographic survey and a GIS analysis of flow accumulation sites.

### *2.1 Hydrologic Monitoring*

Hydrologic data was collected utilizing the monitoring network established by the Southern Oregon University 2018/19 Moffett Creek Capstone project. Data was collected at two discharge stations, eight groundwater wells, and four surface ponds (Figure 2).

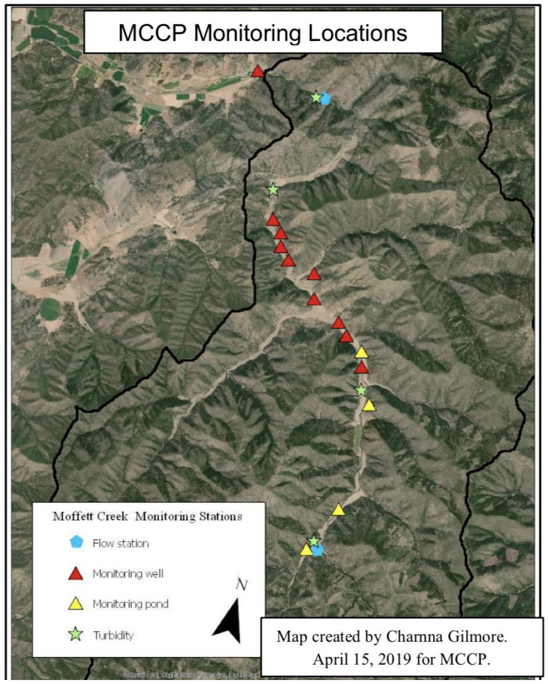


*Figure 2. Monitoring locations for hydrologic data collection established by 2018/19 Moffett Creek Capstone Project.*

Discharge was collected using a SonTek Flowtracker Handheld ADV Firmware Version 3.3 Software Version 2.20. Collection took place at previously established transects; one transect located at the top of the watershed and the other located downstream. Depth and flow velocity measurements were taken perpendicular to flow direction across the wetted width every half foot. Dissolved oxygen was measured with a YSI 6050020 Pro20 Dissolved Oxygen Meter. Data was recorded once a month and analyzed in Microsoft Excel.

Groundwater and surface water measurements were obtained from eight existing wells and four surface ponds monthly. At each well, the depth was recorded using a Solinst 101B Flat Tape Water Level Meter. In addition, at each well Onset U20L-04 HOBO Water Level Data Loggers recorded depth and temperature data every 15 minutes. Surface pond depth was obtained from AdirPro depth staff plates. Barometric pressure was also measured to calibrate surface water measurements.

Precipitation data was collected via an Onset Rainfall Smart Sensor, Model S-RGB-M002. This model of rainfall sensor works by allowing a small amount of water inside the unit, which percolates through a particulate filter screen and then percolates onto a tipping mechanism which collects precipitation data points up to 4000 times every 15 minutes. The sensor is deployed in an open area on private property for flat and level mounting as well as the safety of the unit, and records data every 15 minutes.

### *2.2 Vegetation Survey*

A vegetation survey was conducted for future monitoring of riparian vegetation response post-BDA implementation. Stems counts of native woody vegetation categorized by height were measured to determine density of riparian vegetation. Sampling took place in early March, prior to spring foliage growth. Both woody and herbaceous vegetation are important for bank stabilization and sediment retention. However, research has shown that larger roots provide greater resistance against erosion compared to the smaller roots of herbaceous plants (Wynn, 2004). The study prioritized sampling woody vegetation which exhibit roots with larger diameters, and therefore greater stabilizing effects. Based on protocol for aspen sampling used by the SRWC, size class I was vegetation less than 18 inches, size class II was vegetation 18 inches to 5 feet, and size class III was vegetation over 5 feet. Size Class I characterizes recent recruitment, size class II characterizes more mature vegetation that is still susceptible to browsing, and size class III is vegetation no longer vulnerable to browsing (Jones et al, 2005).

The study reach was divided into four zones based on similar riparian vegetation cover. Five belt transects per zone (20 total) were established (Figure 3). The five belt transects in each zone were placed approximately every 100 feet, moving upstream; the distance measured running parallel to the road located on river right. Each transect was 26 meters total; 13 meters from the center of the channel to river right and 13 meters from the center of the channel to river left. When necessary transect length was modified due to road proximity. The belt transect extended 3 feet upstream and 3 feet downstream, for a total width of 6 feet. A stem count of live, native woody vegetation rooted in the transect was collected and classified by size class (Appendix A).

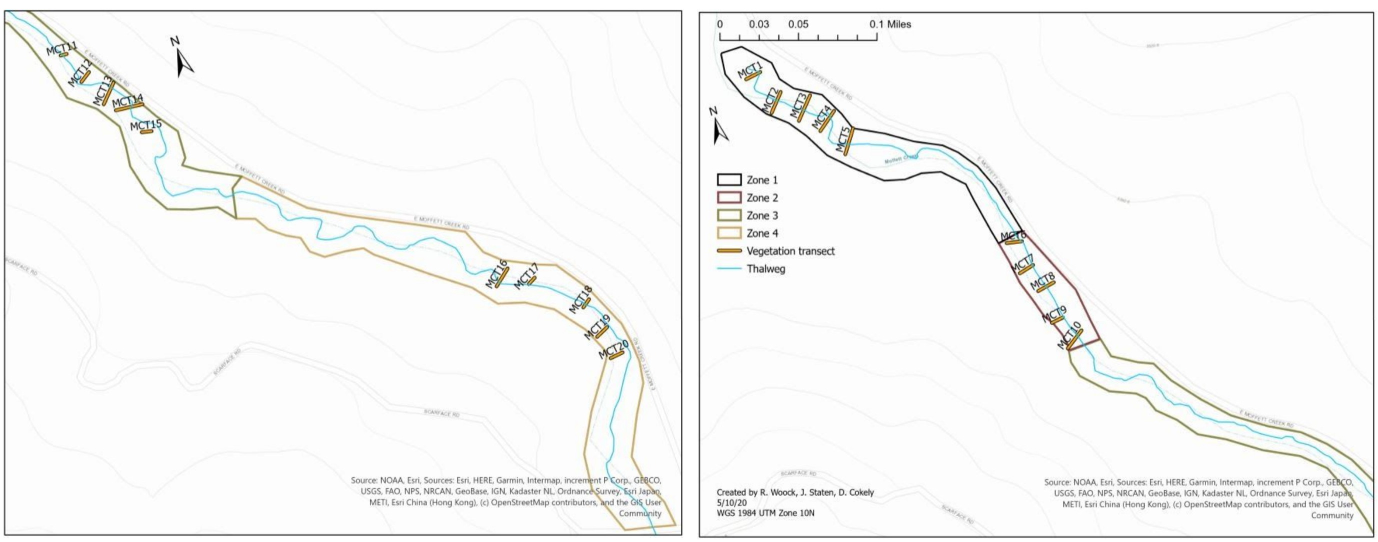


*Figure 3: Vegetation sampling transect locations.*

### *2.3 Geomorphic Assessment*

Using a RTK (Real Time Kinematic) Trimble GPS unit, a longitudinal and cross-sectional survey was conducted. Elevation points of the stream reach were labeled as different features such as base, top, toe, channel, thalweg and adjacent floodplain. Other anthropogenic structures were also noted in the survey. Survey data was analyzed in ArcGis Pro and Microsoft Excel to generate eighteen cross-sectional profiles in addition to a longitudinal profile. Stations at 100 foot intervals were assigned to the longitudinal profile to determine slope percentage within each 100 foot reach. Plateaued features were also distinguished from one another, to differentiate variations in elevation of eroded terraces.

To determine current stream conditions and assess historical conditions, 18 cross-sections were surveyed. In Microsoft Excel, each cross-section was graphed and analyzed to create a cross-sectional profile. For each cross-section, distance was calculated for: the historical (uppermost bank) top to top, toe to toe, river left top to toe, and river right top to toe. The same calculations were done for the first terrace, and, when present, the second terrace (Figure 4). Using the Excel engineering spreadsheet from the Wisconsin Natural Resources Conservation Service, the approximate area of each cross-sectional profile was calculated (NRCS Wisconsin Engineering, 2005).

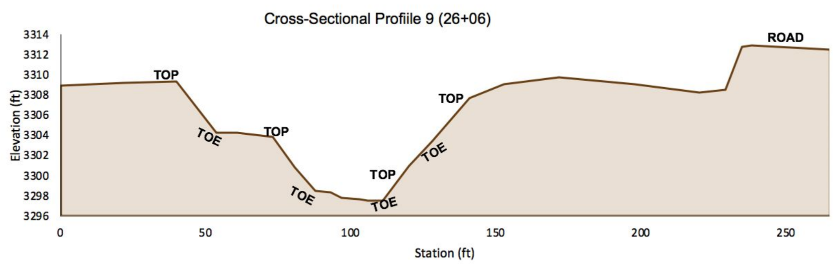


*Figure 4. Example of cross sectional profile displaying terracing. Tops and toes used for stream channel morphology calculations are labelled.*

Using LIDAR orthoimagery collected from the SRWC, a map of approximate flow accumulation sites was generated in ArcGIS Pro. Utilizing flow accumulation data combined with cross-sectional profile and slope data, a series of BDAs were projected and layered on top of the LIDAR orthoimage, to generate a map for locations to be evaluated in the field that will support SRWC project goals.

## 3. Results/Discussion

### *3.1 Baseline Data*

The completion of the pre-restoration vegetation survey revealed an overall low density of riparian vegetation, and a low occurrence of mature vegetation (Figure 5). Willow (*Salix spp.)* appeared to be the dominant riparian woody species. Other observed woody species included cottonwood (*Populus fremontii*), alder (*Alnus rhombifolia*), willow (*Salix spp.*), arroyo willow (*Salix lasiolepis),* California box elder (*Acer negundo californicum),* buckbrush (*Ceanothus cuneatus),* and creek dogwood (*Cornus sericea).* The highest mean stem count was in size class II with a mean of approximately 6 stems, and size class III had the lowest mean, approximately 2 stems (Appendix B). The overall low stem count is expected given the condition of the riparian zone; the high stream velocity decreases groundwater recharge, resulting in a greater distance between the water table and the riparian root zone.

The relative density for size class I was about 31%, for size class II about 55%, and for size class III about 14%. The higher density in size class II was most likely because of the absence of cattle for much of the year. Typically, cattle in this area have access to the riparian area resulting in excessive browsing of young, vulnerable vegetation. However, absence of cattle allowed size class I vegetation to mature into size class II vegetation.

In future monitoring, post-restoration, we would expect to see an increase in stem counts across all size classes. The addition of exclusionary fencing is expected to increase vegetation survival, thereby increasing bank stability and reducing erosion. Vegetation survival will further increase with the implementation of BDAs aimed at slowing the flow velocity to increase groundwater recharge. Future monitoring should reveal an overall increase in woody species, as restoration allows for improved recruitment and survival.

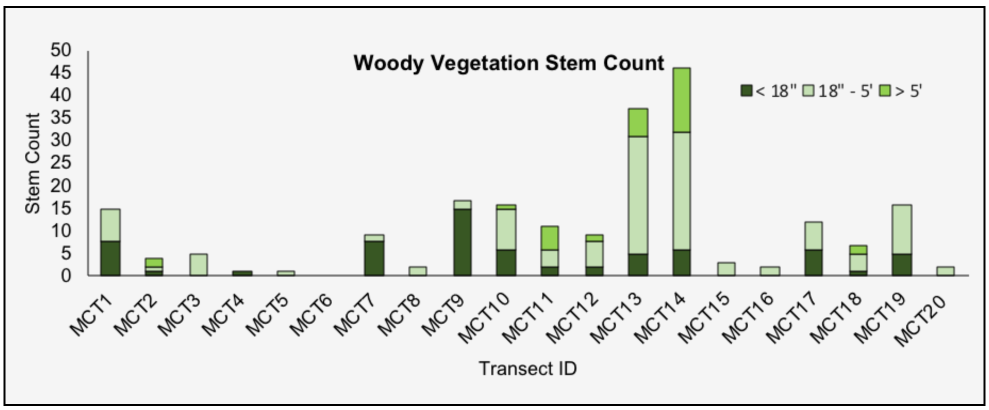


*Figure 5. Stacked bar chart showing the proportion of woody vegetation by size class per transect.*

### *3.2 Geomorphic Conditions*

The completion and analysis of the topographic survey assessed where the stream channel exhibited a positive slope, incision, terracing, and a narrow channel width; factors considered when determining where to construct BDAs.

The thalweg survey points were extracted from the survey data, and the distance between the points was calculated in Microsoft Excel. A longitudinal profile of the reach was then generated, showing elevation changes from the initial survey point to the lower reach of the study area. From the longitudinal profile, slope percentages were calculated at 100 foot intervals, allowing for areas of reverse grade to be determined. In total, 13 intervals exhibited positive slopes and were considered suitable for BDA placement. BDAs promote channel aggradation upstream of the structure. Construction of dams at the downstream end of the positive slope intervals supports continued aggradation. Intervals with a slope less than 2% also represent potential BDA placement (Figure 6).

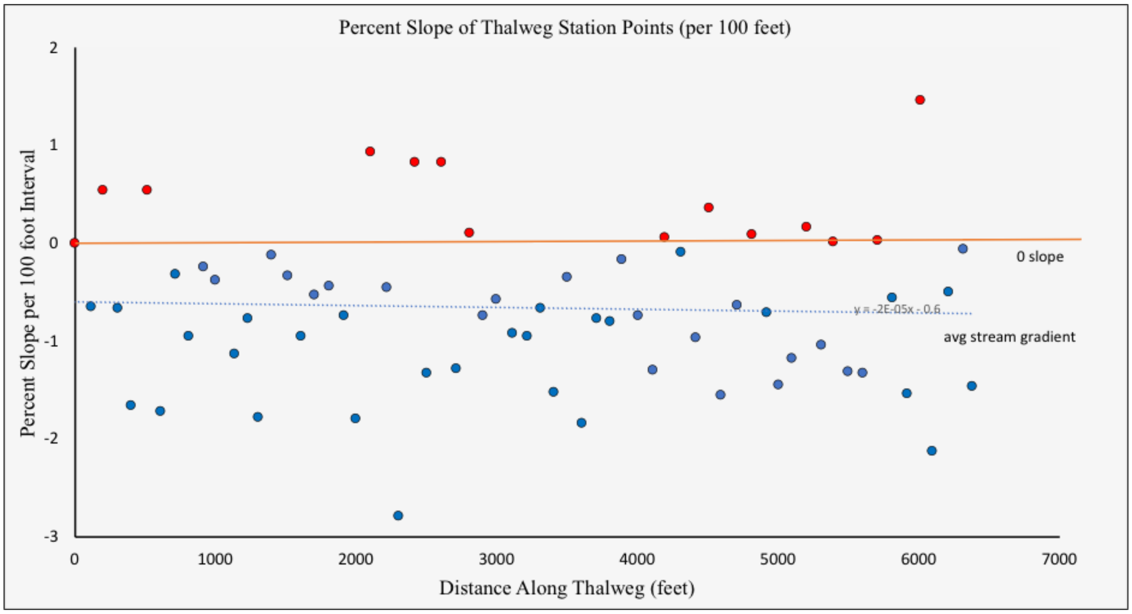


*Figure 6. Scatter-plot representing 100-foot interval slope percentages. Red markers indicate a positive slope percentage while blue indicates a negative slope percentage.*

The cross-section locations were mapped and assigned stationing. Stationing is used to indicate the horizontal distance along a survey line. The station number indicates the distance (feet) downstream from the initial survey point (0+00) along the thalweg (Figure 7).


*Figure 7. Topographical survey showing 18 representative cross-sections and assigned stations*

Further analysis of the cross-sectional profiles revealed a high level of degradation in the reach, consistent with in-field observations. Distance calculations for each cross-section helped assess the stream channel morphology (Appendix C). Cross-sections 0+13, 11+49, 26+06, 38+50, 5-+37, and 60+18 displayed multiple terracing, suggesting these sections of the stream are entrenched and disconnected from the historical floodplain. Cross-sections 22+52, 31+52, 38+50, 53+33, and 57+24 had a narrow channel width as demonstrated by a toe to toe distance under 15 feet. Additionally, the area of the lowest incised channel was calculated. By comparing the cross-sectional areas, the sections of highest channel confinement were determined. The middle of the study reach was found to be the most confined section (Figure 8).

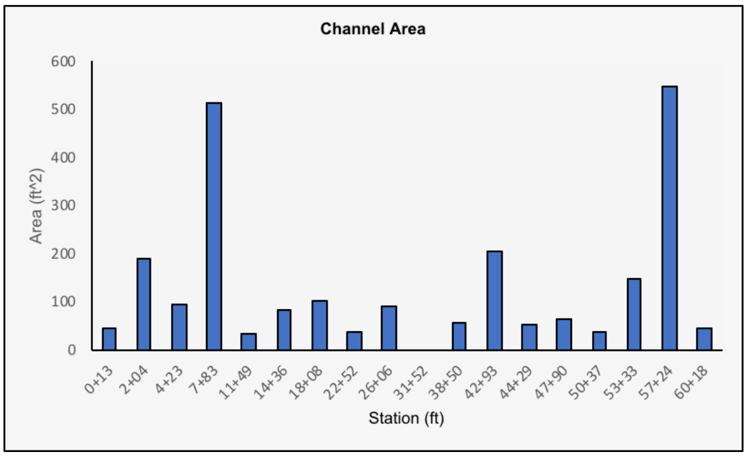


*Figure 8. Comparison of cross-section areas calculated from the lowest top to top elevation. Station number indicates the location of the surveyed cross-section, distance (feet) downstream from the initial survey point along the thalweg.*

The cross-sectional profile calculations guided BDA placement— narrow, confined areas were considered ideal for dam construction. When placed in narrow, incised reaches, BDAs are capable of reducing stream velocities and increasing sediment deposition. In areas with terraces, BDAs can raise the water to the former floodplain.

Using LIDAR data collected by the SRWC, an approximate flow accumulation map was created. The flow accumulation shows which areas accumulate the most water flows but also the most sediment from water transport, which can be used to verify areas in the field that are best suited for BDA implementation. A total of 40 BDAs can be placed at every creek accumulation point; according to the SRWC 20-30 BDAs would be ideal for the future implementation project. The 40 BDAs can be comfortably scaled down to meet the SRWC's goal if the proposed BDA locations are focused on medium and high accumulation areas (Figure 9). When aligned with longitudinal data taken from the RTK Trimble GPS unit, many of the cross-sections align with accumulation points within the creek (Appendix D). The alignment of the data will help facilitate review of proposed BDA locations when in the field. Key factors to assess in the field will be areas of acute incision, reverse gradient within any area of the stream channel, naturally occurring debris barricades, and notable woody vegetated areas.

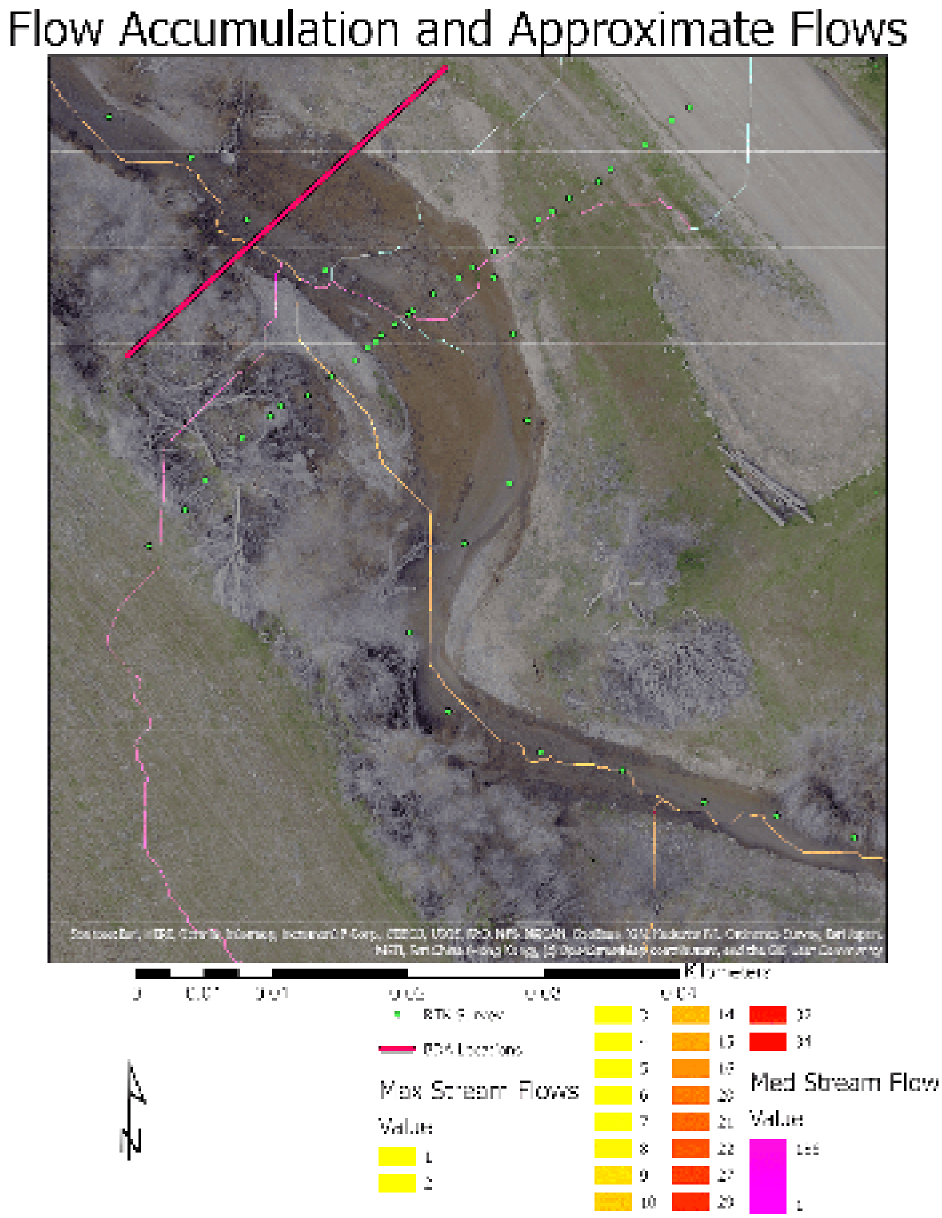


*Figure 9. Example of medium and high flows to the creek area and proposed BDA implementation location.*

### *3.3 BDA Placement*

The longitudinal profile, cross-sectional profile calculations, and flow accumulation map guided the proposed BDA placements. We have identified potential BDA locations considering areas of positive slope where aggradation is already occurring, narrow channels where flow velocity can be slowed, and multiple terracing where the stream can be raised to a mid-level terrace. Areas of high flow accumulation are indicated in the map below, and also represent potential dam locations (Figure 10). The zones highlighted in yellow are particularly suitable for BDA placement. These areas displayed all the factors considered: positive slope, narrow channels, terracing, and zones of high flow accumulation. After the initial BDA placement, additional BDAs would need to be placed upstream to provide redundancy. Constructing dams in a series reduces the risk of flooding downstream should a structure fail. Prior to construction, the SRWC will also need to consider road proximity and landowner approval.


*Figure 10. Proposed BDA locations for study reach. Yellow zones indicate ideal areas for BDAs, and dark blue represents high flow accumulation areas.*

## 4. Conclusion

In partnership with the Scott River Watershed Council, the Moffett Creek Beaver Dam Analogue Capstone assisted in pre-restoration surveying and analysis to inform the potential placement of BDA structures. The vegetation survey allows for future monitoring of vegetation response to geomorphic and hydrologic changes in the study area. The baseline hydrologic data collected utilizing the existing monitoring network allows for the continued development of a comprehensive understanding of the Moffett Creek Watershed. Implementation of the proposed BDAs will provide a cost-effective and low-impact method to increase groundwater recharge, reduce incision, increase riparian vegetation, and decrease sediment into the Scott River.

The SRWC will assist future capstone groups and volunteers in methodologies and processes involved in the implementation of BDAs. The SRWC has brought in experts in botany, stream biology, and a NOAA representative involved in the Northern California region of stream management to advise stream data collection techniques. The permitting process is handled strictly through the SRWC; they provide project information and evidence to the California Department of Fish and Wildlife for grants and permission for various actions that may alter water quality. Some previous permits have been written for small restoration projects to fast track them, however the SRWC plans to seek a permit for a larger restoration project that will allow for more grant money and avenues for further action.

Moving forward in the initiative of restoration and BDA placement on Moffett Creek we propose the implementation of bioengineering practices to restore the ecological function and mitigate the sedimentary load into the Scott River. By easing some of the more angled bank slopes and using bioengineering techniques such as brush mattresses, fascines, and willow stakes, the erosive characteristics in some of the more impacted areas have the potential to be mitigated. Cohesion of woody vegetation root characteristics helps in the developing guidelines for the implementation and use of vegetation for bank-stabilization and links the effect of riparian vegetation to the geomorphic structure that benefits ecosystem function.

Restoration of the stream should take into consideration impact on landowners' property such as lateral migration of the stream channel. Furthermore, communication with landowners regarding the potential increase in beaver populations is necessary as the result may lead to an increase in felled trees, expanded ponds, and tributaries of the creek (Goldfarb, 2018). Looking at the reported hydrogeomorphic, ecological, and socioeconomic benefits from people interviewed in the Scott Valley regarding the implementation of BDAs, an overwhelming amount of support suggests a positive response following beaver activity. Hydrogeomorphic responses include increased pooling and groundwater level near dams, decreased stream temperatures, and a longer seasonal duration of streamflows. Ecological impacts of BDAs include an increase in riparian vegetation and increased wildlife biodiversity. BDAs as a restoration method also result in increased community involvement in restoration stewardship (Charnley, 2018). The potential outcome of BDAs implemented throughout the Scott Valley include improved habitat conditions for beaver, enabling them to move in and take over BDA maintenance, building new beaver dam complexes. This reintroduction has the potential to be a self-maintaining resource management tool for promoting heterogeneity and connectivity of streams and rivers.

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## 6. Appendices

*Appendix A: Vegetation sampling data sheet.*

| Woody Vegetation Stem Count Data Form | | | | |
|---|---|---|---|---|
| **Site Name:** Moffett Creek | | | **SITE ID:** MC | |
| **Town, State/Province:** Fort Jones, CA | | | **Date:** 3/6/20 | |
| **Recorder(s):** RW, CG, JS, DC | | | | |
| **Veg Transect ID** | **Vegetation Height** | | | |
| | **Size Class I (< 18")** | **Size Class II (18" – 5')** | **Size Class III (> 5')** | **Notes** |
| MCT1 | 8 | 7 | 0 | |
| MCT2 | 1 | 1 | 2 | |
| MCT3 | 0 | 5 | 0 | |
| MCT4 | 1 | 0 | 0 | |
| MCT5 | 0 | 1 | 0 | |
| MCT6 | 0 | 0 | 0 | large cottonwood, ~12ft from transect,shortened due to road |
| MCT7 | 8 | 1 | 0 | |
| MCT8 | 0 | 2 | 0 | |
| MCT9 | 15 | 2 | 0 | buckbrush present, arroyo saplings |
| MCT10 | 6 | 9 | 1 | shortened due to road |
| MCT11 | 2 | 4 | 5 | |
| MCT12 | 2 | 6 | 1 | |
| MCT13 | 5 | 26 | 6 | |
| MCT14 | 6 | 26 | 14 | average of clusters |
| MCT15 | 0 | 3 | 0 | |
| MCT16 | 0 | 2 | 0 | |
| MCT17 | 6 | 6 | 0 | |
| MCT18 | 1 | 4 | 2 | located 200 ft from MCT17 due to dense gooseberry |
| MCT19 | 5 | 11 | 0 | |
| MCT20 | 0 | 2 | 0 | |
| **Notes:** Woody species found at MC: Cottonwood (*Populus fremontii*), alder (*Alnus rhombifolia*), willow (*Salix lasiandra*), arroyo willow (*Salix lasiolepis),* California box elder (*Acer negundo californicum),* Buck brush (*Ceanothus cuneatus),* Creek dogwood (*Cornus sericea)*<br>* Transects shortened on river right when in contact with road<br>* Zone 1 (MCT1-5), Zone 2 (MCT6-10), Zone 3 (MCT11-15), Zone 4 (MCT16-20) | | | | |

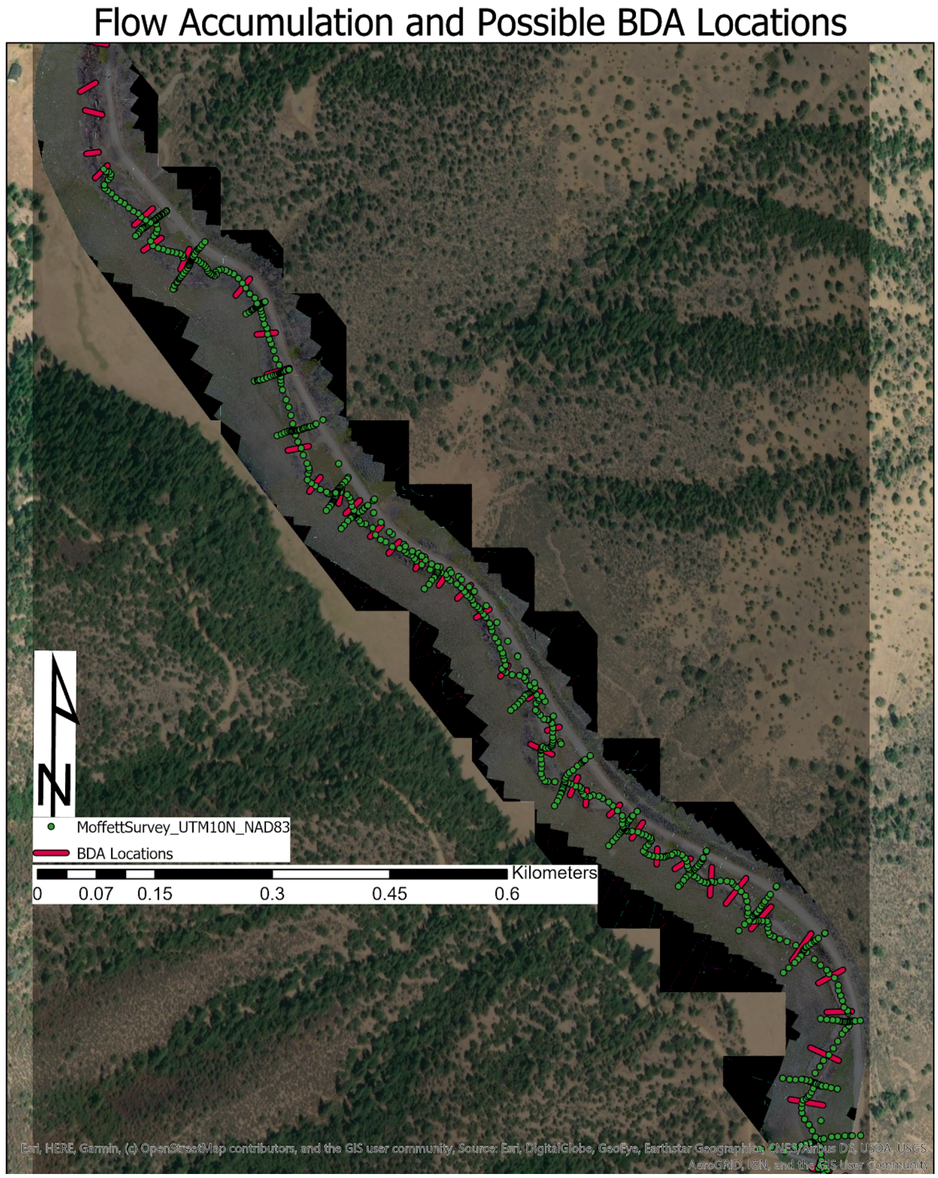
*Appendix B: Vegetation sampling descriptive statistics.*

| Woody Vegetation Stem Count Descriptive Statistics | | | | |
|---|---|---|---|---|
| **Height Class** | **Mean** | **Median** | **Mode** | **Standard Deviation** |
| Size Class I (< 18) | 3.3 | 1.5 | 0 | 4.00 |
| Size Class II (18"-5') | 5.9 | 3.5 | 2 | 7.48 |
| Size Class III ( > 5') | 1.55 | 0 | 0 | 11.52 |

*Appendix C: Cross-Sectional profile distance calculations for historical river tops, and terracing.*

| Cross-Sectional Profile Calculations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Historical | | | | First terrace | | | |
| station | Top-top (ft) | toe-toe (ft) | RL top-toe (ft) | RR top-toe (ft) | top-top (ft) | RL top-toe (ft) | RR top-toe (top) | Notes |
| 0+13 | 45.57 | 19.65 | 9.57 | 17.96 | 25.13 | 4.96 | 1.42 | |
| 2+04 | 50.49 | 29.24 | 11.18 | 12.21 | | | | |
| 4+23 | 57.53 | 43.63 | 6.98 | 7.33 | | | | |
| 7+83 | 74.91 | 48.11 | 10.59 | 22.15 | | | | |
| 11+49 | 107.28 | 17.84 | 24.69 | 67.32 | 25.13 | 3.24 | 4.37 | |
| 14+36 | 125.72 | 35.54 | 11.51 | 84.32 | 42.66 | 4.59 | 24.79 | |
| 18+08 | 121.15 | 19.53 | 41.07 | 39.55 | 32.37 | 10.01 | 4.90 | |
| 22+52 | 112.26 | 8.18 | 54.80 | 54.29 | 18.49 | 5.42 | 7.06 | |
| 26+06 | 194.66 | 22.27 | 49.33 | 125.17 | 68.56 | 16.53 | 32.23 | 2nd terrace |
| 31+52 | | 12.61 | | | | | | *river right not surveyed |
| 38+50 | 54.35 | 12.79 | 24.91 | 27.00 | 24.59 | 10.09 | 3.44 | |
| 42+93 | 78.50 | 26.45 | 9.28 | 45.96 | 62.69 | 7.91 | 30.45 | |
| 44+29 | 79.97 | 22.56 | 44.94 | 15.28 | 27.85 | 2.44 | 4.01 | |
| 47+90 | 99.12 | 23.77 | 31.45 | 45.95 | 34.32 | 7.96 | 3.30 | |
| 50+37 | 132.08 | 17.28 | 92.65 | 25.83 | 20.08 | 2.71 | 2.06 | |
| 53+33 | 37.69 | 4.92 | 3.91 | 31.35 | | | | |
| 57+24 | 165.18 | 12.75 | 103.81 | 49.60 | 32.73 | 17.25 | 6.33 | |
| 60+18 | 103.27 | 35.99 | 40.13 | 5.62 | 40.83 | 2.70 | 2.56 | |

*Appendix D: BDA locations at high flow accumulation areas of the creek overlayed with longitudinal survey GPS data.*



*Appendix E: Project Partners*

- Scott River Watershed Council
    - ➢ Erich Yokel- Monitoring Supervisor
      erichyokel@gmail.com
    - ➢ Charnna Gilmore- Executive Director
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- California Department of Fish and Wildlife
- Scarface Enterprises- landowner
    - ➢ Kenneth S. Mahan