

Cullinan Ranch Restoration Project

Monitoring Report 2019



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INTRODUCTION

The Cullinan Ranch Restoration Project is restoring approximately 1,500 acres of tidal wetlands on San Pablo Bay National Wildlife Refuge (Refuge) to ultimately create tidal marsh that will benefit at-risk species, especially salt marsh harvest mouse and Ridgway's rail (Figure 1). Ducks Unlimited (DU) is working in partnership with the Refuge to complete the restoration. In January 2015, approximately 1,200 acres of the project site were restored to tidal action. The eastern-most 300 acres of the property are still under construction and accepting beneficially re-used dredge material from SF Bay to raise the elevation of the site.

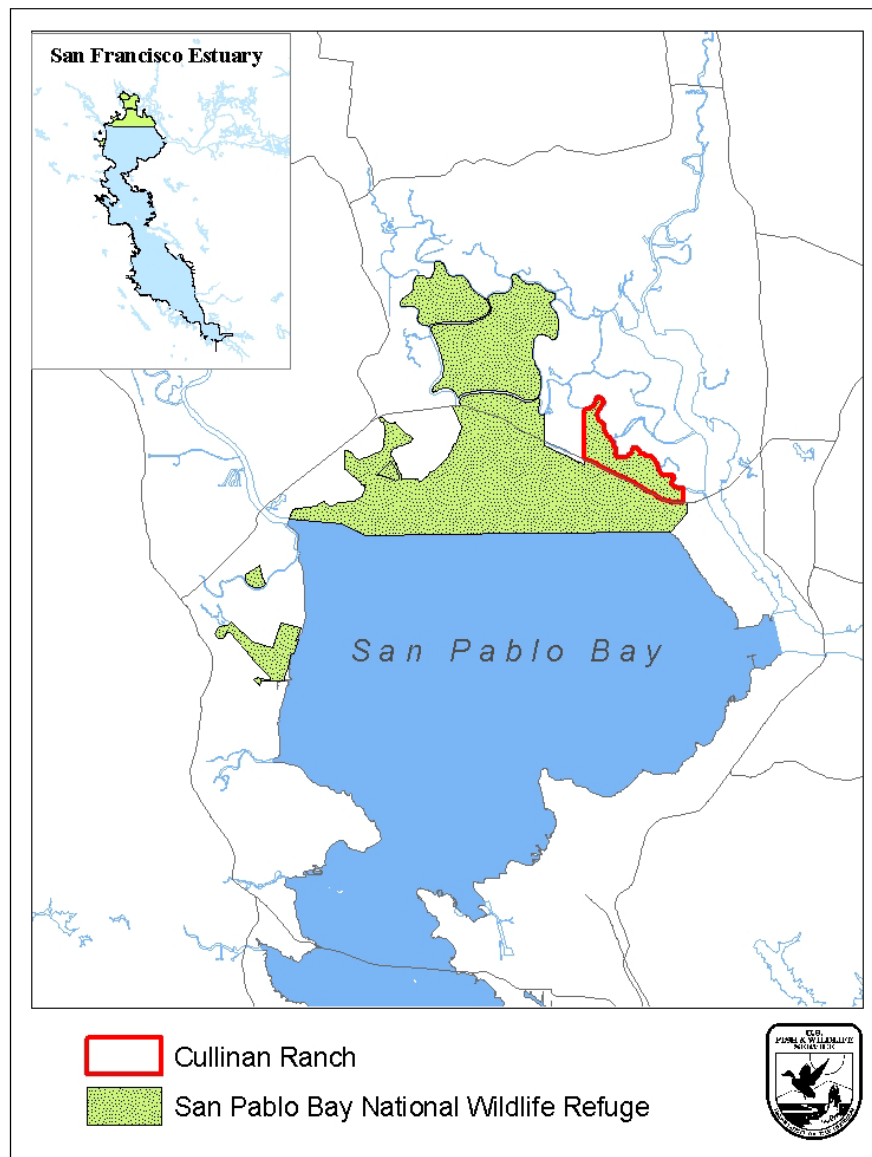


Figure 1. Regional map of restoration project location.

MONITORING

To evaluate project success, the project partners developed the Monitoring and Adaptive Management Plan (MAMP) for the Cullinan Ranch Restoration Project in coordination with regulatory agencies. The monitoring plan includes both biotic and abiotic parameters, performance standards, habitat targets, protocols, and sampling frequencies for the project.

The 15-year monitoring period began in 2015. Monitoring data has been reported previously in a Breach Construction Completion Report (DU 2015a), Year 1 Monitoring Memorandum (DU 2015b), Years 1–3 Monitoring Report (DU 2018), and Year 4 Monitoring Report (DU 2019). This report summarizes monitoring data collected in 2019, or Year 5. For additional detail, please see past reports and references.

The format of this monitoring report follows the MAMP and includes summaries of water quality, biota, and geomorphic evolution monitoring. Specific monitoring protocols include water quality, avian, small mammal, vegetation, tidal channel evolution, and sedimentation (Figure 2). In addition, aerial imagery review (Attachment I), field photo monitoring (Attachment II), and methyl mercury monitoring were conducted at Cullinan Ranch and are reported below.

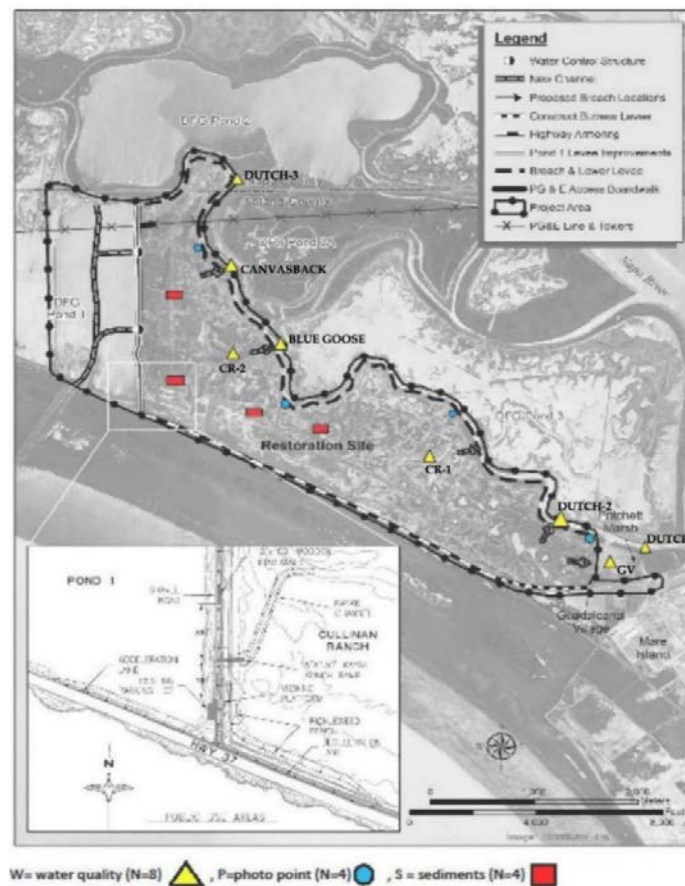


Figure 2. Monitoring locations at Cullinan. Photo points are depicted as blue circles and sedimentation plates are marked with red rectangles.

I. Water Quality

Water quality monitoring was specifically associated with project construction to assess the effects of breaching the perimeter levee on the receiving water quality. Measurements of salinity, temperature, pH, dissolved oxygen, and turbidity were taken at seven locations both prior to and for three months following breach construction. Water quality parameters equalized with the adjacent habitat and water system after breach construction (DU 2015a, DU 2015b). Additional water quality monitoring will occur in association with future breaching of the eastern Cullinan site.

II. Biota

This section discusses biological monitoring, including avian monitoring, fish, small mammals, and vegetation.

Birds

Ducks Unlimited contracted with the U.S. Geological Survey (USGS) to conduct the first 3 years of avian monitoring, beginning in the fall of 2015. Surveys were conducted four times a year, during fall and spring migration periods, and encompassing high and low tides. Reports conclude that the project created open water habitat used at high and low tide by many species of waterbirds, especially waterfowl (De La Cruz and Graham 2016). In year three, a total of 52,062 birds were counted on all surveys, and the site was most used by American Coot, Ruddy Duck, and Canvasback (Graham et al. 2018b). Similar bird use at both high and low tides indicated that there was little difference in the open water habitat available at both tidal cycles. Surveys will continue every 5 years (Year 8 and Year 13) or until vegetation cover reaches 75 percent and the predominant bird use shifts from shorebirds and waterfowl to resident marsh species.

Monitoring for Ridgway's Rail will be completed by the Refuge and will commence when appropriate quantity and quality of habitat has developed (e.g., 300 acres of contiguous vegetated marsh).

Fish

The Refuge coordinated with the North Bay Mercury Biosentinel regional program to include Cullinan Ranch in their fish (as well as methyl mercury) monitoring. Monitoring took place in 2016 and 2017. The North Bay Mercury Biosentinel program released a final report summarizing data from Cullinan Ranch (Robinson et al. 2018).

Fish sampling was led by Dr. Darrell Slotton at the University of California, Davis. Sampling methods for the region included midwater, benthic-tidal, and high marsh habitat sampling; with fish capture by active and passive seining, and minnow traps for high marsh habitat. Species collected at Cullinan Ranch included Mississippi silverside, topsmelt, Northern anchovy, yellowfin goby, and threespine stickleback. These species were also collected at nearby tidal marsh sites: Pond 2A and Napa Slough (Robinson et al. 2018).

Small Mammals

The Refuge is monitoring the presence or absence of federally listed small mammals at Cullinan Ranch in accordance with the established recovery programs. Refuge staff did not document any salt marsh harvest mice (SMHM) at Cullinan Ranch during pre-construction surveys. When suitable habitat is present and vegetation cover averages at least 75%, surveys will occur once every year until SMHM occupy available habitat for a period of at least 3 years.

Vegetation cover is currently far less than 75% and no suitable habitat is present. There is a source population at Guadalcanal Village and it is anticipated that once suitable habitat has developed this source population will migrate into, and colonize Cullinan Ranch.

Vegetation

Vegetation colonization in wetland areas is being monitored using aerial photography supported by ground-truthing. Vegetation assessment will begin when plant cover is approximately 20%, and will analyze species cover, richness, and composition. Prior to reaching the 20% level, the dominant pioneer species colonizing the marsh plain will be recorded.

Review of aerial imagery from Google Earth 2014–2018 (Attachment I) shows that tidal wetland plant cover is still only approximately 1% of the restored site. There is no readily available or free aerial imagery for 2019, however ground based observations of habitat evolution were consistent with 2018. Tidal wetland vegetation is colonizing the lowered levees along Dutchman Slough, several mounds and small islands, and the transition ramp along Highway 37, but not yet within most of the main acreage of the interior of the site. Since tidal wetland plant cover is less than the 20% threshold, vegetation assessment has not yet begun.

Field photo monitoring (Attachment II) shows that tidal wetland plant colonization has begun along the lowered levees of the restoration site and that the dominant pioneer species colonizing the lowered levees and transition slope edges are pickleweed and salt grass. Pickleweed is also colonizing the southwest corner of the site near the visitor's kiosk, expanding across the upper intertidal in scattered bands along the toe of Pond 1 levee, colonizing the northwest corner of the site (where the Pond 1 levee meets South Slough), and establishing in a band approximately 80 meters north of State Route 37 beginning approximately 685 meters east of Pond 1 levee (Figure 3). This vegetation band north of State Route 37 represents a relatively higher elevation portion of the site, though still subtidal, that supported a dense band of coyote brush prior to site restoration. Coyote brush was not removed prior to breaching and stems persisted in a density sufficient to support a heron rookery. Coyote brush stems continue to decompose and decrease in density.

Along portions of the Pond 1 and Pole Barn levees, vegetation establishment has been undermined by erosion. Pond 1 levee erosion has occurred mostly north of the water control structure and Pole Barn levee erosion has been more severe along the entire length, with sections of levee scalloping. This erosion is the subject of current levee repair work. Vegetation has not substantially colonized the toe of the Pole Barn levee.

As part of the Refuge's invasive plant management program, Refuge staff and volunteers conduct control efforts to remove invasive species colonizing the levees surrounding Cullinan.

The Refuge partners with Point Blue's STRAW program to conduct revegetation efforts above the high-water mark. In addition, DU hydroseeded the upland slopes of several of the external levees with native grasses in the fall of 2016. These plantings were focused towards the southern end of Pond 1 levee and are now well established.



Figure 3. Aerial imagery shows a band of vegetation (blue polygon) beginning to establish approximately 80 meters north of State Route 37 and historic/evolving channel networks (white lines).

III. Geomorphic Evolution

Tidal Channel Evolution

Aerial imagery and erosion pins were used to monitor development of tidal channels at the site. Review of aerial imagery (Attachment I) indicates that channel networks are not yet detectable for most of the interior of the site because it is inundated at both high and low tides; however, the historic channel that was excavated to connect to the kayak launch is visible (Figure 4).

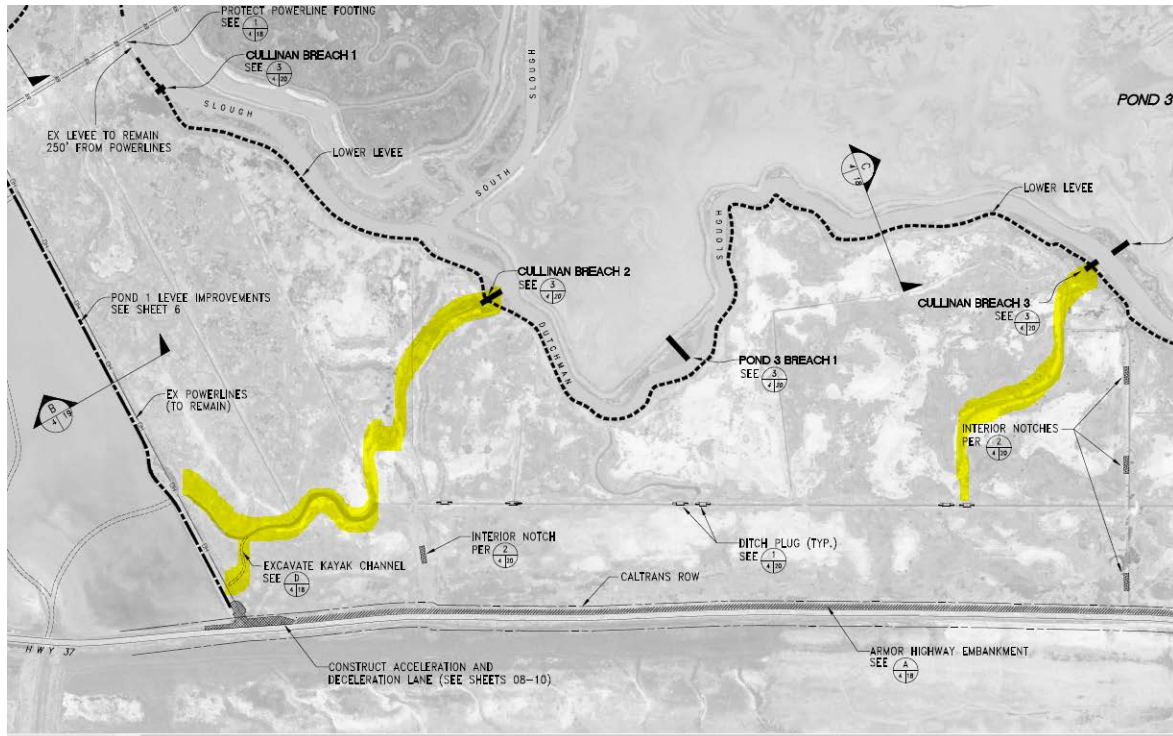


Figure 4. Project design showing remnant historic channels and excavated tie in for kayak launch, re-connected to Dutchman Slough.

Erosion pins were installed in both sides of the constructed breaches (Pole Barn, Blue Goose, and Canvasback). PVC rods were installed at each breach at 50' offset from the erosion pin locations. Between May 2015 and May 2017, breach widths expanded between 10 to 26 feet (DU 2018). All three breaches continued to expand between May 2017 and May 2019 (Table 1).

Table 1. Breach width (in feet) measured at three constructed breaches at Cullinan

Breach	Width May 2015	Width May 2017	Width May 2019
Pole Barn Breach	121 ft.	147 ft.	151 ft.
Blue Goose Breach	120 ft.	140 ft.	160 ft.
Canvasback Breach	74 ft.	84 ft.	85 ft.

Sedimentation

To measure deposited sediment within the site, plates were installed to serve as a fixed elevation at the onset of restoration to measure sedimentation amounts as the site restores. The 12"x12"

stainless steel plate was welded to 4–12” legs and embedded into the ground so that the top plate was flush with the ground surface (Figure 5). Each plate was surveyed in using Trimble RTK GPS to establish horizontal and vertical locations. To facilitate locating the plates in the future, they were marked with 2 T-posts on either side of the plate and can be found by locating the “hard surface” in between the posts.

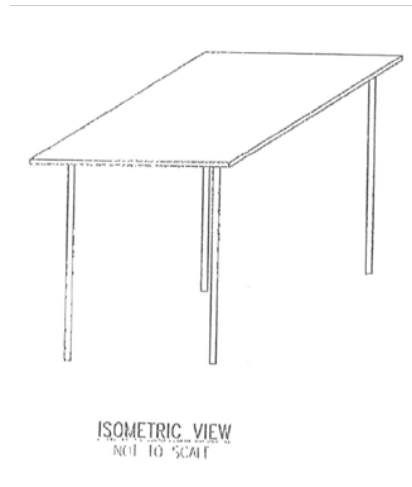


Figure 5. Sedimentation plate design.

Four plates were installed in May 2015 and surveyed again in May 2017 and May 2019. The actual surface of sediment was difficult to detect because it is several feet below the water’s surface and consists of fine, soft sediments. Since sediment was too difficult to measure with GPS, we used a field survey stick method. This method involved lowering a wooden survey stick straight down to reach the surface of the sediment plate, then measuring the length of the sediment residue (Figure 6). Figure 7 depicts a fully installed sedimentation plate on-site.

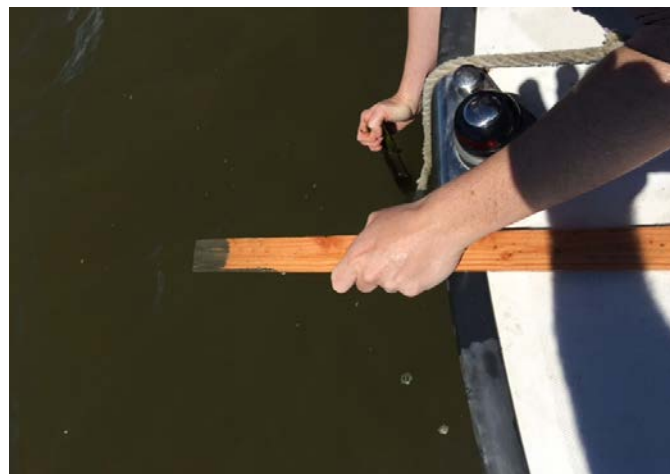


Figure 6. Field method for measuring sediment accumulation on plates



Figure 7. Sedimentation plate marked by T-posts, shown in the right-hand side of the photograph.

Three to four samples were measured in the field at each plate and the average for each plate is reported here (Table 2). Sediment accumulation varied across the site and monitoring data show that 2 years after breaching, some areas within Cullinan have as much as 13 centimeters of sediment accumulation (DU 2018). Four years after breaching, areas have as much as 30.2 centimeters of sediment accumulation. This pattern is also highly variable across the site. Note that Plate 4, which was installed in a deeper portion of the ranch on what was low-lying playa area prior to breaching the site (38° 8'0.97"N, 122°19'28.51"W), is missing data for 2019. The t-posts were no longer visible on the May 2019 field visit and the plate could not be found.

Table 2. Sediment depth (in centimeters) measured at four plates installed at Cullinan.

Plate #	Sediment depth (cm) May 2017	Sediment depth (cm) May 2019
1	13	20.3
2	3	1.3
3	6.5	30.2
4	6	-

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