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MEMORANDUM

DATE:	August 1, 2024	SE Project #: 25956
TO:	Christopher Laude, PE, Acting Chief County of Hawai'i Department Environmental Management	
FROM:	Giannicola Tumino, PE	
PROJECT:	Hilo Wastewater Treatment Plan Outfall Inspection	

Introduction

Sea Engineering (SE) has been engaged by the County of Hawaii's Department of Environmental Management to conduct a visual inspection of the Hilo Wastewater Treatment Plant Ocean Outfall. The purpose of the inspection was to visually survey the current condition of the outfall and surrounding adjacent seafloor corridor.

The Hilo outfall is a 4,468-foot-long ocean outfall constructed of 48-inch diameter reinforced concrete pipe (RCP). It generally runs south to the north from the Hilo WWTP in Puhi Bay, Hilo, and terminates at a water depth of approximately 52 feet, as shown by the project site map provided in Figure 1. A general schematic of the outfall is provided in Figure 2, and is annotated with significant features, descriptions, and stationing along the corridor.

The outfall was built between 1964 and 1965. Since that time several repairs on the outfall have been completed. In 1972, a dislocation between pipe sections occurred and was subsequently repaired. In 1977, additional repairs were completed along 420 feet of the pipe in water depths of 40 feet. In 1988 and 1989, extensive repairs were conducted by pouring new concrete in areas of the pipe subjected to scour. SE also performed concrete repair work in 1988-1989; and in 2009 measured and documented the positions of the individual diffuser ports and manholes using survey-grade differential GPS. The latest repairs have been performed by others in 2016 to address structural deficiencies and leaks.

SE has performed inspections of the outfall in 1987, 1990, 2001, 2005, 2011, 2018, and most recently in 2024, the results of which are documented in this memorandum. The previous inspection, performed by SE in 2018, found no evidence of leakage throughout the length of the outfall.

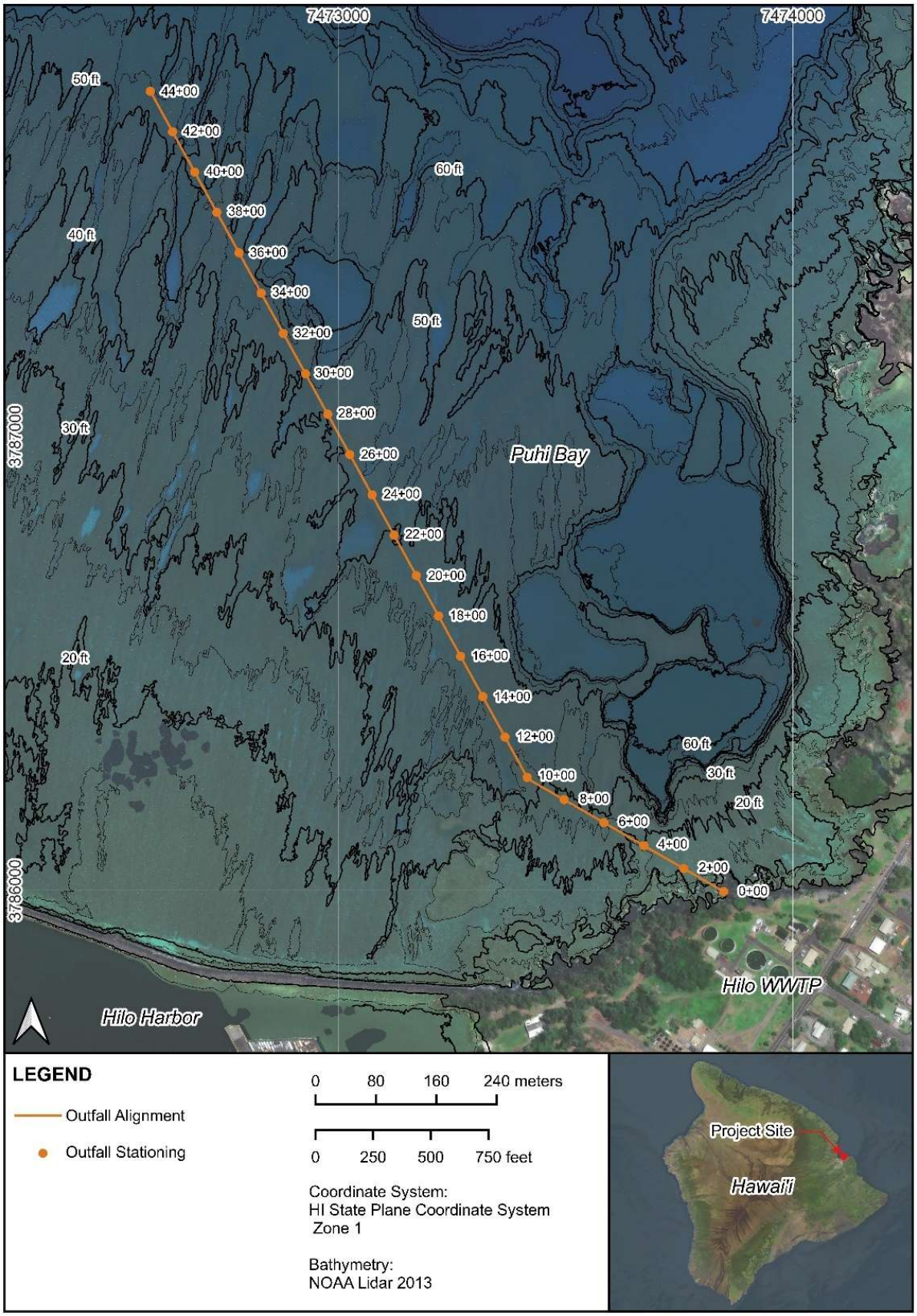

Figure 1. Hilo WWTP outfall project site and stationing

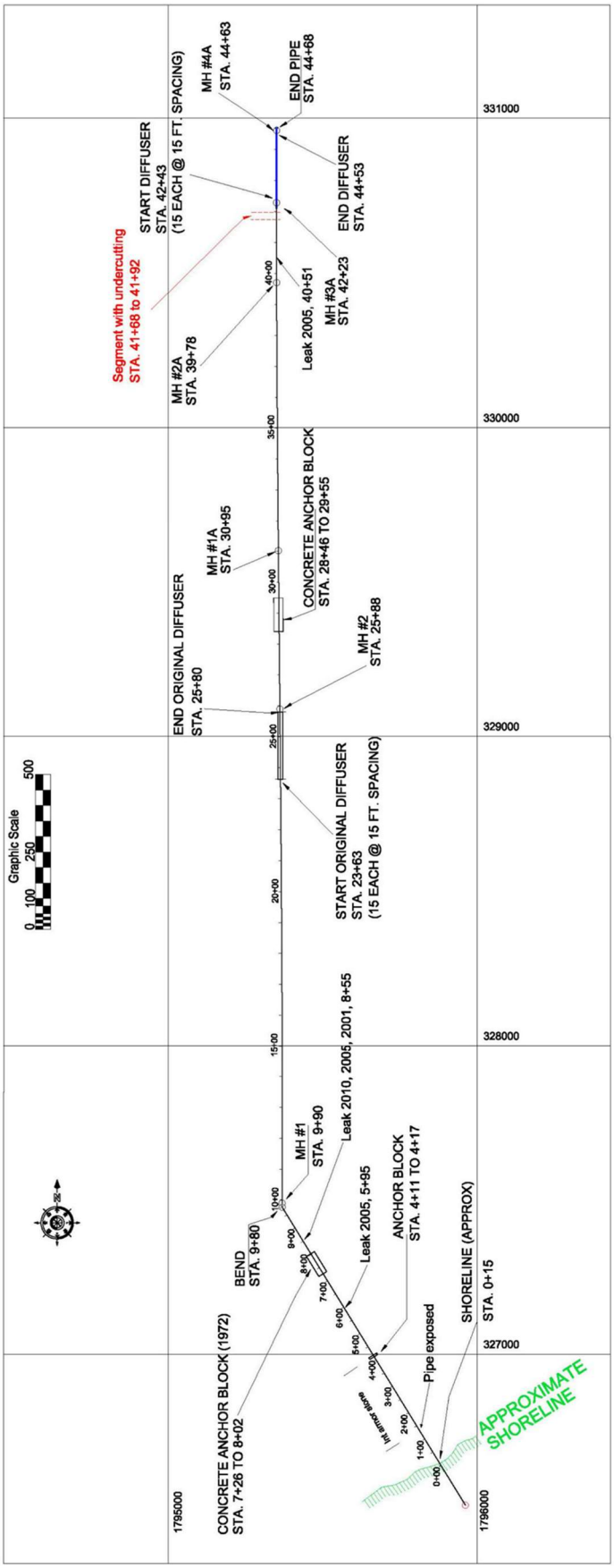

Figure 2. Hilo WWTP general schematic

Methodology

Engineering divers from SE performed the underwater inspection of the Hilo outfall on July 11, 2024. On the day of the dive operations, ocean conditions were favorable with 1-2 ft waves and 5 knot winds from southeast. Underwater visibility was excellent with minimal surge and slack currents. Dive operations consisted of a 4-person dive team using SCUBA methods, with one dive supervisor, two in water divers, and one standby diver. The team inspected the entire submerged length of the outfall. Accurate positioning was established by outfitting the support vessel with a survey-grade differential GPS System (Trimble) and weather resistant computer with industry standard data acquisition software (Hypack). Stationing of the outfall was established by dropping bright markers with station number labels prior to the dive inspection commencing (see Figure 3).

Figure 3. Station marker closeup (*top*) and as deployed on the outfall (*bottom*)

To assist divers in identifying potential areas of leakage from the outfall during the inspection (excluding the diffuser leg), Bright Dyes® fluorescent yellow/green tracer dye was introduced into the effluent stream through an onshore manhole located just upstream of the ocean outfall's origin at station 0+00, as depicted in Figure 4. This particular tracer dye was a non-toxic, biodegradable product commonly employed for pipeline inspections, with an example of the product shown in Figure 5. Preparing for injection, one pound of dye was mixed with five gallons of water; the solution was then drip-fed into the injection port over the course of the inspection, as shown in Figure 6. A total of four pounds of the powdered dye were used during the outfall inspection operations. The introduction of the dye into the manhole started at 0934, the dye was first observed at the diffuser end of the outfall at 1220 local standard time. Dive operations initiated at 1230 and were concluded at 1420.

Figure 4. Manhole location used to introduce the tracer dye at Hilo WWTP

Figure 5. Sample container of Bright Dyes ® tracer dye used during outfall inspection

Figure 6. Manhole configuration (injection port) and dye setup for Hilo WWTP Outfall inspection

Observations and Results

Descriptions of recorded outfall conditions are provided below, as observed by the inspectors and recorded via underwater video. Divers commenced the survey from the seaward end of the diffuser leg and proceeded shoreward. Significant or notable findings recorded by inspectors are summarized in the following remarks:

- Manhole #4A located at Sta. 44+63, marked the end of the diffuser leg and the visible portion of the outfall, with no visual evidence of leakage. The manhole is situated at a water depth of approximately 52 feet. The termination of the outfall, including the end pipe at Sta. 44+68, was not visible due to extreme coral cover (Figure 7).
- Moving shoreward from Manhole #A4, is the diffuser field, where there are 15 individual ports staggered along the diffuser leg with Stationing from 44+53 to 42+43. Similar to previous visual inspection survey in 2018, the 6 most seaward ports appeared to be obstructed with no discharge of effluent (Figure 8), while the 9 most landward ports were observed discharging the dye infused effluent (Figure 9). Manhole #A3 located at the start of the diffuser leg (Figure 10) was found with no evidence of leakage.
- Between manholes #A3 and #A2, the main barrel of the outfall is visible with dense coral growth. The 2016 repairs of eroded or undermined seafloor on the outfall corridor with concrete fabric forms were observed by divers with no visible damage (Figure 11).

Manhole #A2 is observed with dense coral growth (Figure 12). No leakage was visible for either manhole.

- Between manhole #A2 and #A1 the outfall pipe is visible with dense coral growth. Some limited sections of scoured seafloor adjacent to the pipe were observed, (see Figure 13 and Figure 14), however no significant changes were seen when compared to the most recent 2018 inspection results at those same locations. It has also been noted in previous inspection reports that, because the outfall pipe is exposed at these locations and the seafloor appears to be erodible in places, this portion of the outfall corridor is thought to be potentially more vulnerable to future damage from wave action. Manhole #A1 is observed with sparse coral growth (see Figure 15) and no leakage.
- The concrete anchor block located inshore of manhole #A1 was observed with extensive coral growth on the top surface (Figure 16). Manhole #2 was seen further inshore of the anchor block at Station 25+88 (Figure 17). No evidence of leakage was found for either manhole.
- The non-operational diffuser field from the original outfall construction were observed shoreward of manhole #2, running from Station 23+63 to 25+88. All decommissioned diffuser ports were capped with blind flanges (Figure 18), with no visible leakage.
- Manhole #1 and the outfall bend are located between Station 9+90 and 9+80 (Figure 19), respectively. The manhole and riser were visible at this location, and appeared to be in good condition with no visible leakage.
- Landward of the bend, inspectors noted intermittent sections of limited scour located between Stations 6+00 and 2+00, typically less than 10 feet in length along the flank of the exposed pipe (see Figure 20). These areas appeared consistent with the latest inspection results, with minimal change.
- The outfall pipeline becomes embedded in the seafloor and no longer visible landward of approximately Station 1+30, where the visual inspection was subsequently terminated.
- As noted in previous inspection reports, and most recently in 2018, the majority of ballast stone originally installed over the outfall has since migrated off the pipe.

Summary

In general, the Hilo Outfall appeared to be in good operable condition, with no visible leakage observed along the outfall corridor. The outfall and adjacent seafloor corridor generally appeared stable. The outfall pipe has areas of very densely concentrated coral cover, while in some limited areas the reinforced concrete pipe was exposed. As mentioned in the 2018 report, the exposed portion of the outfall pipe is not an immediate concern; however, regular visual inspections should continue to check for progressive scour and/or undermining of the outfall pipe. Should undermining significantly advanced or further erosion be observed in future inspections, repairs may become necessary to prevent damage or dislocation of the outfall pipe.

Figure 7. Manhole #4A, located at Station 44+63, shown with high coral cover and outfall pipe covered

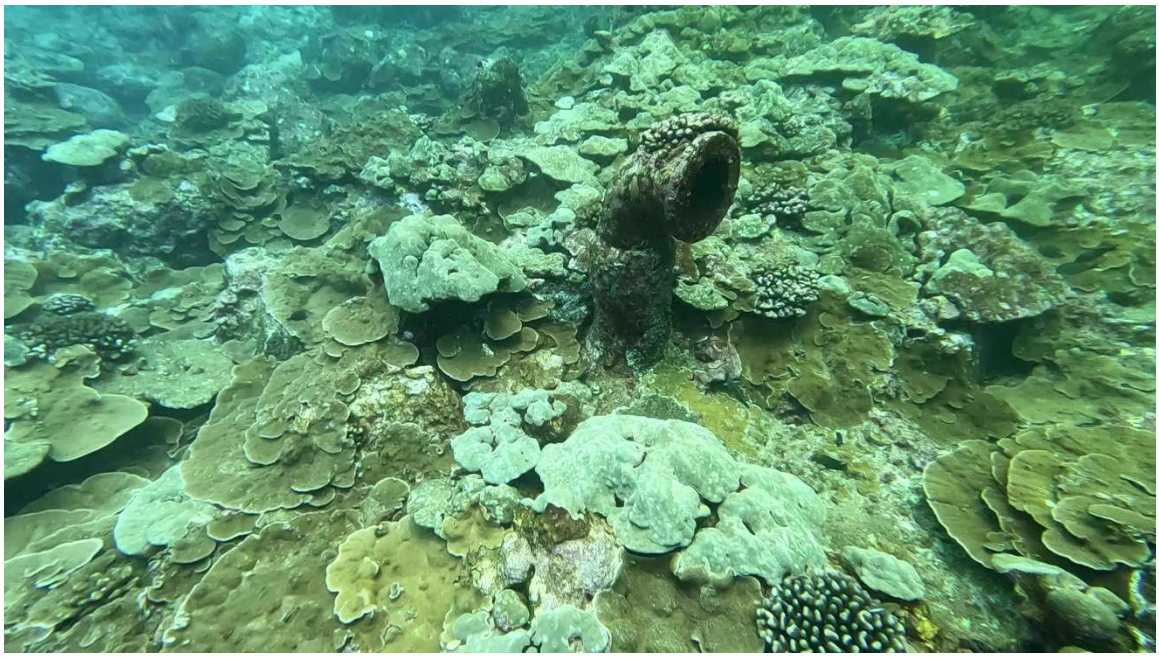

Figure 8. Typical diffuser port with no discharge of dye

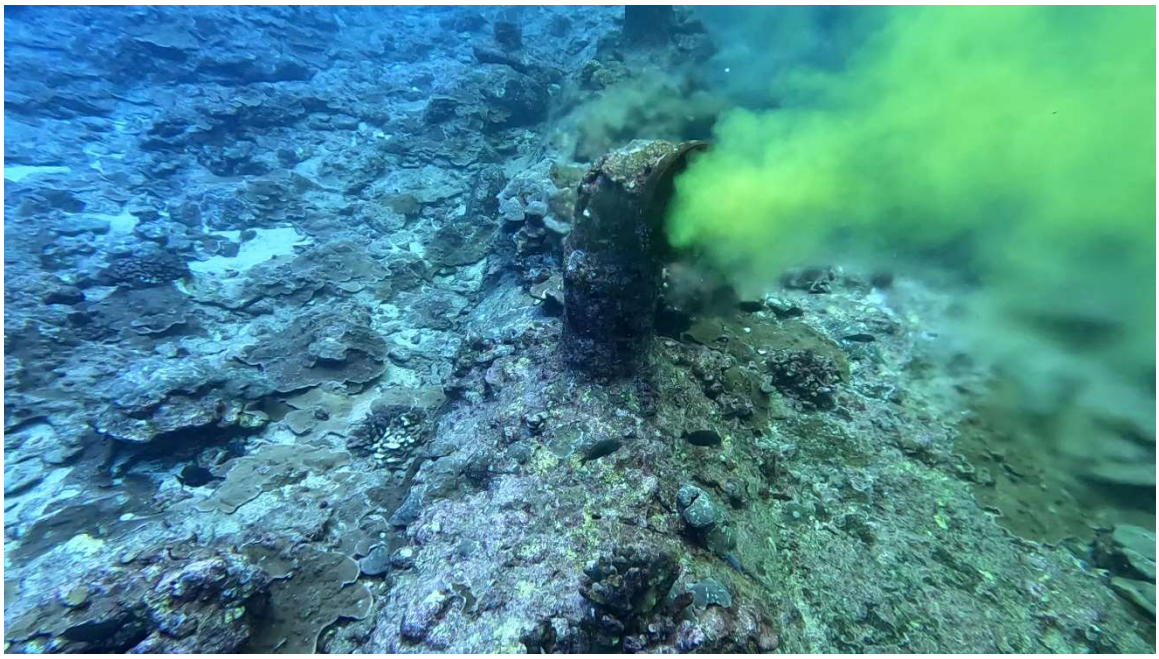

Figure 9. Typical diffuser port with discharge of dye

Figure 10. Manhole #A3 located at Station 42+23, with extensive coral cover but visible outfall pipe

Figure 11. Outfall pipe with concrete mattress repairs performed in 2016, Stationing 41+92 to 41+54

Figure 12. Manhole #A2 located at Station 39+78 with coral cover but visible outfall pipe

Figure 13. Section of outfall with scour on one side near Station 39+15

Figure 14. Section of outfall found with scour on both sides, vicinity of Station 33+15

Figure 15. Manhole #A1 located at Station 30+95 with coral cover but visible outfall pipe

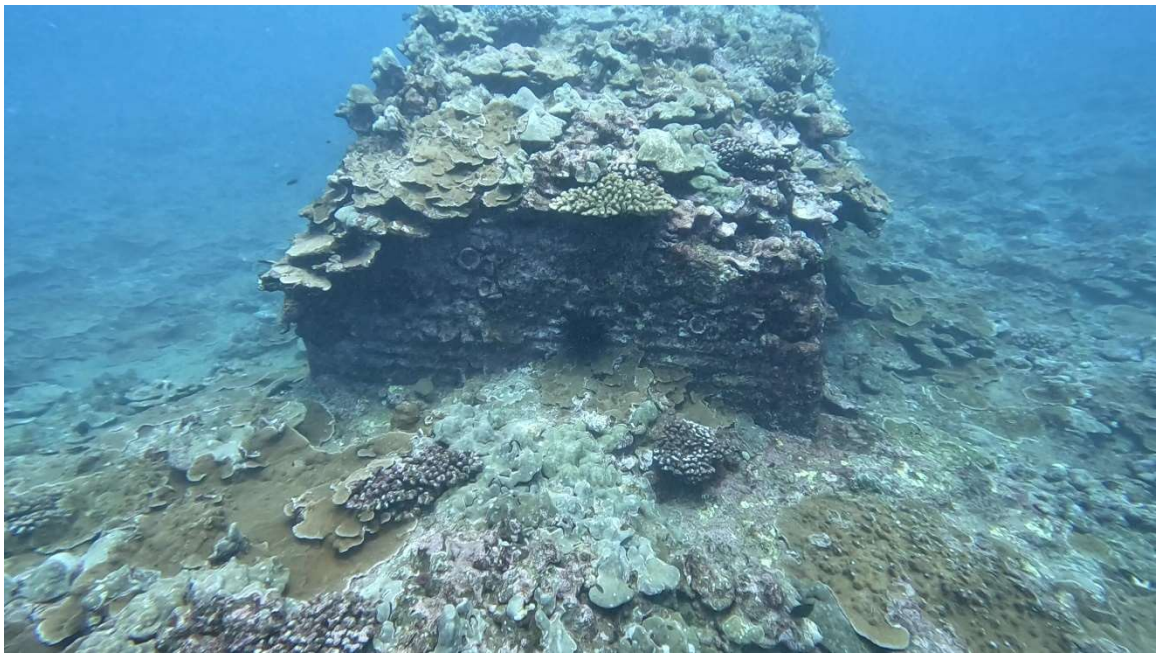

Figure 16. Concrete armor block located at Station 29+55 to 28+46

Figure 17. Manhole #2 located at Station 25+88 with no coral cover

Figure 18. Typical view of original diffuser ports and riser landward of manhole #2 with blanked port flanges visible

Figure 19. Manhole #1 located at Station 9+90 and outfall pipe bend located at Station 9+80

Figure 20. Typical outfall pipe scour observed between the bend and shoreline