





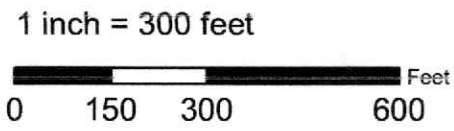



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Source: FDOT, 2010 (aerial); NRCS, 2010; AMEC, 2010

Legend

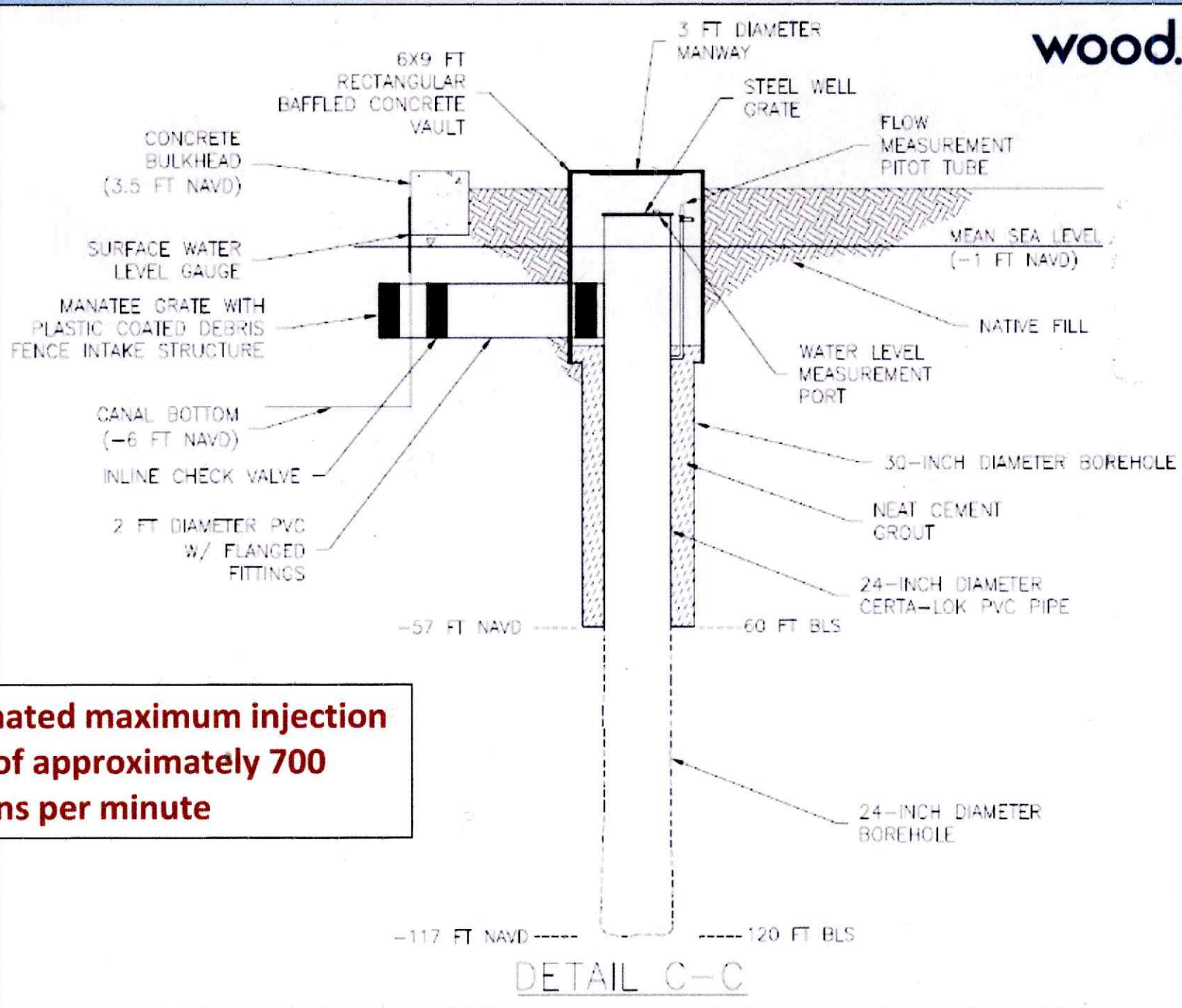
-  Monitoring Locations
-  Proposed Injection Well
-  C113
-  C114



Village of Islamorada			
114 Plantation Key - Injection Well			
Drawn	Date		MIAMI, FL Project # 600737
SJH	12/2/2022		
Checked	Date		
GWC	12/2/2022		

Injection Well – Canal 114 - Plantation Key

wood.




Estimated maximum injection rate of approximately 700 gallons per minute

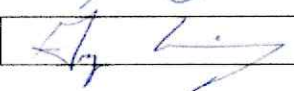
Technical Memorandum

	<p>A comparison between Canal 113 and Canal 114 are provided in Figures 5 and 6. Pre-construction, the average water quality within each canal is very similar, and Canal 114 looks coupled to Canal 113. Canal 114 is more variable than Canal 113, with more extreme changes in dissolved oxygen, but both showed similar trends over time. Post-construction, the water quality between the canals diverged. Canal 114's water quality has increased relative to Canal 113. The difference in average dissolved oxygen between canals 114 and 113, post-construction, is provided in Table 1. When comparing the dissolved oxygen in Canal 114 immediately post-construction (June 2023 to August 2023) to more recent observations (December 2023 to February 2024), the average dissolved oxygen in Canal 114 has risen by 25 percent relative to Canal 113.</p>
Conclusions	<p>The observed dissolved oxygen saturations within Canal 114 demonstrate that the infiltration well is providing an improvement to the water quality. The water quality in Canal 114 exhibits improved circulation, with higher dissolved oxygen observed in the back of the canal as the result of the infiltration well. Additionally, the average dissolved oxygen within Canal 114 exhibits an increase of approximately 25 percent relative to the control canal (Canal 113) due to the infiltration well.</p>

Completed By:

Name:	Stephen Hanks	Title:	Senior Engineer	Signature:		Date: 04/18/24
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Checked By:

Name:	Greg Corning	Title:	Project Manager	Signature:		Date: 04/18/24
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Technical Memorandum

WSP Project No:	600737	Project Name:	Canal 114 Gravity Flow Infiltration Well Water Quality Restoration Project
Site Owner	Village of Islamorada	Site Location	Plantation Key, Florida
Project Description	A gravity flow infiltration well was installed at Canal 114 in May 2023 to improve the circulation and dissolved oxygen concentration within the canal. WSP collected water quality data from Canal 114 between October 2022 and February 2024 to quantify the beneficial effects of the gravity flow injection well. Water quality data was concurrently obtained from Canal 113 to establish control conditions.		
Background	The gravity flow infiltration well was completed as a pilot project to evaluate the feasibility of using gravity flow infiltration wells to improve circulation. The October 2013 Canal Management Master Plan (CMMP) identified culverts, backfilling, dredging, air curtains, and pumping as viable alternatives to improve water quality. However, during implementation it was determined that pumping to improve circulation was too costly and therefore infeasible. Therefore, the need arose to find a passive/ low energy technology that could improve circulation. A technology feasibility ranking matrix developed in 2017 identified gravity flow infiltration wells as the preferred technology to improve circulation. The installation of a gravity flow infiltration well at Canal 114 is the first project to evaluate the effectiveness of the gravity flow infiltration well technology.		
Data Summary	<p>Water quality samples were collected at various locations within the canals. For Canal 114, points A, B, C, and D were respectively collected from 1,625 ft, 1,550 ft, 1,150 ft, and 130 ft from the canal entrance. For Canal 113, point A was 1,150 feet from the canal entrance, and point B was 660 feet from the canal entrance. The sampling locations are depicted in Figure 1. The dissolved oxygen in the water column at each sample location was measured at two feet above the bottom, at mid-depth, and one foot below the surface.</p> <p>The standard FDEP protocol for characterizing the dissolved oxygen within a canal is to collect a sample at the mid-point of the canal at two feet above the bottom and one foot below the surface. However, additional resolution was desired for this evaluation. Therefore, four points within Canal 114 were sampled at three depth intervals to provide more discrete characterization. In this study, relative change was primarily used to quantify the beneficial effect. However, the FDEP criteria for dissolved oxygen is that no more than three samples of a fifteen sample dataset exhibits a daily average dissolved oxygen concentration below 42 percent. It is the intent of the rule that the fifteen sample dataset is collected over a year to account for seasonal variation.</p> <p>The measurements were collected starting October 4, 2022, and were routinely collected until February 16, 2024. The results are depicted in Figures 2-5 and the average readings of each canal after construction are provided in Table 1.</p>		
Summary of Findings	<p>The average dissolved oxygen saturation at each observation point in Canal 114, prior to the well's completion (October 4, 2022, to March 27, 2023), is presented in Figure 2. The water quality was highly variable over time, with the dissolved oxygen saturation ranging from 13.8 percent to 116.2 percent. The water quality is also varied with distance from the mouth of the canal; on average, the water at point D had 57 percent more dissolved oxygen than at point A. Following completion of the infiltration well, the water quality in the canal became more uniform both temporally and spatially. The average dissolved oxygen saturation at each observation point after the well construction (June 9, 2023 to February 16, 2024) is presented in Figure 3.</p> <p>The differential between the front and back of Canal 114 between October 2022 and February 2024 is presented in Figure 4. The differential was determined by subtracting the average of the forward section locations (C and D) with the average of the back section locations (A and B). Prior to construction, there was a weak upward trend in the differential between the front and back of the canal. Following construction there was a significant downward trend in the differential between the front section and back section of the canal, with an observed reduction from a 20 percent differential immediately following construction to a 5 percent differential approximately 8 months following construction. This demonstrates that the water quality throughout the canal is becoming more uniform, and that the infiltration well is improving mixing along the centerline of the canal.</p>		