Appendix H

Sampling Results

CROSSMAN ENGINEERING

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July 23, 2019

Eric Hindinger
Engineering Program Manager
Department of Public Works – Engineering Division
925 Sandy Lane
Warwick, RI 02886

Re: Consulting Services for Stormwater Management
Task 4
Dry-Weather Survey Information (January 1 – April 30)
CE Project No. 2336

Dear Mr. Hindinger:

Crossman Engineering (CE) is pleased to submit the results for the dry-weather surveys conducted on 100 outfalls as part of Task 4 (for the period of January 1- April 30). To organize the data, we decided to use a dry-weather survey/outfall location spreadsheet that we obtained from RIDEM's website. We modified this worksheet slightly, adding a few columns to include all field analysis and lab results.

For the GPS coordinates, we used the coordinates from the City of Warwick GIS database. Anything highlighted red in the Excel sheet was either not applicable (due to no dry-weather flow) or could not be filled out completely because a given outfall was not located. If a given outfall could not be located, the nearest structure upstream was always checked for dry-weather flow.

Should you have any questions or require additional information, please contact me at 401-738-5660.

Very truly yours,

CROSSMAN ENGINEERING

Daniel Jannetti, EIT
Civil Engineer

City of Warwick
Illicit Discharge Detection and Elimination (IDDE)
2018 Investigation Update

New High Priority Infrastructure

Dry Weather Survey Results (July 1 – October 31):

Outfall ID	Temp (°C)	pH	Conductivity (µs)	Salinity (ppm)	Surfactants (ppm)	Ammonia (ppm)	Total Chlorine (mg/L)	Fecal Coliform (MPN/100 ml)	Enterococci (CFU/100 ml)	Coliphage (PFU/100 ml
OF 45-3	13.7	9.84	193.4	89.6	0.05	0.05	0.33	<2	<10	<1
OF 79-1	16.9	6.97	185.2	88.4	0.10	0.10	0.11		1553.1	<1
OF 79-3	13.1	6.23	185.3	87.4	0.10	0.10	0.06	33	90	25
OF 79-6	18.8	7.54	186.4	89.3	0.75	0.15	0.03	174	<1	<1
OF 81-2	15.5	6.71	206	95.4	0.10	0.10	0.04	1600	10000	<1
OF 96-5	12.3	7.72	387	181	0.10	0.05	0.08	11	10	60
OF 108-1	15.3	6.90	205	96.5	0.10	0.05	0.08	<2	2300	100
OF 109-2	16.0	6.35	939	452	0.15	0.10	0.08	<2	80	105
OF 109-4	17.2	6.21	212	103	0.15	0.05	0.07	<2	20	75
OF 139-4	10.3	6.39	11.68	6290	1.00	0.05	0.08	>1600	130	95

Numbers highlighted in red include results that exceed the IDDE screening thresholds defined in the IDDE Plan

Additional Observations/Comments:

- CB 93-49: Observed yellow hose going directly into manhole. It appears that the hose was coming from 26 Drift Road.
- OF 45-3: Neighbor stated that she sees other neighbors pouring "stuff" into catch basins nearby.
- OF 109-2: Neighbor said that the outfall flows almost constantly, with a great amount of flow at some points. He said he believes there is a laundry mat nearby that connects into the drainage system.

High priority infrastructure retained due to ongoing investigations:

- OF 166-2
- OF 153-1
- OF 152-4
- OF 167-1
- OF 122-2
- Post Road (four known interconnections)
- West Shore Road/Warwick Ave (one known interconnection)

Previously Identified High Priority Infrastructure

The City of Warwick has previously identified the following locations as high priority infrastructure, based on available criteria.

The status of ongoing or recently closed-out investigations, including the next step, is summarized here. See Table 1 for an implementation schedule of work to be completed for select high priority infrastructures that require additional investigation. Investigations that require a definitive final task were taken off the list.

Typical follow-up actions are as follows:

1. Contamination encountered
2. Conduct CCTV investigation of system
3. Clean and flush pipe
4. Identify potential contaminant
5. Remove contaminant from system
6. Resample and conduct additional investigations as needed

A. The EPA identified the following:

- **OF 166-2** (located at the western end of Strand Avenue)

Utilizing the City's GIS mapping and RIGIS Lidar 2-ft contours, the City has delineated the catchment area for this outfall. A dry-weather survey was conducted on 10/4/2018. At the time of this survey, there was no dry-weather flow present. The City will use "sandbagging" or other equivalent method to determine whether there is an illicit discharge. This technique involves placing sandbags or similar barriers within outlets to manholes to form a temporary dam that collects any intermittent flows that may occur. Sandbags are typically left in place for 48 hours, and should only be installed when dry weather is forecast. If flow has collected behind the sandbags/barriers after 48 hours, it can then be sampled. If no flow collects behind the sandbag, the presence of an illicit discharge can be discarded. If flow is present and exceeds testing parameters, the City will conduct CCTV investigation of the system to locate any potential illicit discharges and remove them from the system.

- **OF 153-1** (located at eastern end of Suburban Parkway)

Utilizing the City's GIS mapping and RIGIS Lidar 2-ft contours, the City has delineated the catchment area for this outfall. A dry-weather survey was conducted on 10/18/2018. Dry-weather flow was observed and a sample was taken. The parameters for enterococci and total chlorine were exceeded, which warrants further investigation. The next step the City will

take is conducting is a CCTV investigation of the system to locate any potential illicit discharges and remove them from the system.

Dry-weather survey results (10/18/2018):

Outfall ID	Temp (°C)	pH	Conductivity (µs)	Salinity (ppm)	Surfactants (ppm)	Ammonia (ppm)	Total Chlorine (mg/L)	Fecal Coliform (MPN/100 ml)	Enterococci (CFU/100 ml)	Coliphage (PFU/100 ml
OF 153-1	13.5	7.13	1675	818	0.15	0.05	0.07	240	230	<1

- **OF 167-5** (located at Oakland Beach parking lot)

Utilizing the City's GIS mapping and RIGIS Lidar 2-ft contours, the City has delineated the catchment area for this outfall. A dry-weather survey was conducted on 9/15/2016. Dry-weather flow was observed and a sample was taken. The parameters for fecal coliform, enterococci, and surfactants were exceeded, which warranted a further investigation. None of the thresholds for bacteria were exceeded indicating that sewerage is not the source of pollution. In 2017, city staff conducted camera investigations of the pipe, but did not detect any abnormalities in the pipe or associated structures. City staff then cleaned the pipes, by blocking the discharge and pressure washing the length of pipe. During this process, dead fish and fish remains were abundant at the terminal catch basin. The City is preparing a plan to screen the outfall pipe, which will minimize the amount of fish entering the system. A dry-weather survey was conducted on 10/18/2018. Dry-weather flow was observed and a sample was taken. The parameters for conductivity, surfactants, and total chlorine were exceeded. It appears as though the bacteria issue has been resolved. The City believes the remaining parameters exceeded originate from the ocean backwashing into the drainage system. The City recommends no further action.

Dry-weather survey results (10/18/2018):

Outfall ID	Temp (°C)	pH	Conductivity (µs)	Salinity (ppm)	Surfactants (ppm)	Ammonia (ppm)	Total Chlorine (mg/L)	Fecal Coliform (MPN/100 ml)	Enterococci (CFU/100 ml)	Coliphage (PFU/100 ml
OF 167-5	13.6	7.35	4.12 ms	2090	0.25	0.05	0.10	70	30	<1

- **OF 152-4** (located at Ottawa Avenue)

On May 10, 2016, the City visited the outfall and followed the pipe to CB 152-9, which is in front of 142 Ottawa Avenue. Two 1.5-inch PVC pipes were observed entering the upper portion of the catch basin. Based on the observations of dust and cobwebs inside these pipes, it seems that there has not been flow in them in quite some time. We assumed that these were likely once associated with sump pumps and the adjacent properties. These were capped to eliminate any potential discharge to the City's stormwater system. On May 19,

2016, the City revisited the outfall with a vacuum truck and operator. They setup at the upstream CB 152-9, and cleaned and flushed the pipes to the outfall.

Utilizing the City's GIS mapping and RIGIS Lidar 2-ft contours, the City has delineated the catchment area for this outfall. A dry-weather survey was conducted on 10/4/2018. At the time of this survey, there was no dry-weather flow present. The City will use "sandbagging" or other equivalent method to determine whether there is an illicit discharge. This technique involves placing sandbags or similar barriers within outlets to manholes to form a temporary dam that collects any intermittent flows that may occur. Sandbags are typically left in place for 48 hours, and should only be installed when dry weather is forecast. If flow has collected behind the sandbags/barriers after 48 hours, it can then be sampled. If no flow collects behind the sandbag, the presence of an illicit discharge can be discarded. If flow is present and exceeds testing parameters, the City will conduct CCTV investigation of the system to locate any potential illicit discharges and remove them from the system.

B. RIDEM MMAP Locations:

- **OF 167-1** (Bay Avenue)

There is no outfall located at this location. Instead, there is a flared end section that is part of a culvert. In the near vicinity of this area, there is a white 2-inch PVC pipe that appears to constantly flow. This 2-inch pipe discharges to an area subject to storm flowage (ASSF). This pipe does not directly tie into Warwick's MS4 system. Warwick will sample this pipe to determine the necessity for further investigation. If the sample exceeds parameters, the City will determine where this pipe originates from and remove it from the system.

- **OF 166-1** (Hewett Street)

The City's Engineering Division inspected this location based on RIDEM's inspection notes. RIDEM's issues of concern were the pipe being mostly blocked with sand and the pipe being partially crushed. A dry-weather survey was conducted on 10/4/2018. At the time of this survey, there was no dry-weather flow present. There was never any indications that an illicit discharge was present here, so no further sampling is no required. The area surrounding the pipe has since been cleaned. After cleaning, it was determined that the end of the HDPE pipe was box shaped and the pipe was not actually damaged. The City will clean and flush the pipe to remove the remaining sand within the pipe. After this cleaning, the City recommends no further action.

CB 153-29 (Uncas Street)

The City's Engineering Division inspected this location based on RIDEM's inspection notes. RIDEM's issues of concern were sediments in the basin bottom and suspected illicit connections. During the inspection, a PVC pipe associated with an adjacent residents sump pump was connected within the structure. The City removed this connection on date. Additionally, the hose observed going into the catch basin was removed as well. The City will/has cleaned the catch basin on date. The City recommends no further action.

- **CB 153-30** (Uncas Street)

The City's Engineering Division inspected this location based on RIDEM's inspection notes. When RIDEM went out to inspect this catch basin, there was asphalt paving that restricted opening of the structure. Asphalt was removed from the perimeter of the catch basin grate allowing for it be accessed. During the inspection, a PVC pipe was observed discharging to the resident's driveway approximately 20 feet from the catch basin. City staff questioned the homeowner about the pipe. They confirmed that it was associated with the residents sump pump. The resident confirmed that all plumbing was connected to the municipal sewer system and that this only discharged groundwater from the basement sump. The resident offered access to the City staff for inspection, but the City staff did not enter the residence. The City recommends no further action.

- **CB 153-32** (Pequot Avenue)

The City's Engineering Division inspected this location based on RIDEM's inspection notes. RIDEM's issues of concern were excessive sediments and tree roots that obstructed pipes as well as a foul sewage-like odor. The catch basin was cleaned on date and no tree roots, vegetation, or other obstructions were observed. Additionally, no odors were detected. The City recommends no further action. Need to confirm this.

- **CB 153-26** (Oakland Beach Avenue)

The City's Engineering Division inspected this location based on RIDEM's inspection notes. RIDEM's issues of concern were cleaning of the catch basin as well as a strong foul sewage-like odor. The basin was cleaned on date and no odors were detected. The pipes associated with this basin appear to be partially obstructed. Did the city follow through with the work order to clean and flush pipes associated with this basin?

- **CB 153-41** (Sagamore Street)

The City's Engineering Division inspected this location based on RIDEM's inspection notes. RIDEM's primary issues of concern were sediment and trash accumulation and a suspected

illicit connection. This basin is likely a leaching basin according to City records. The basin was cleaned on date and no odors were detected. While inspecting the catch basin, a small pipe was observed on the north side of the structure. The pipe was blocked by ???? and was not flowing at the time of inspection. Did the City seal the pipe (they said they would). The City recommends no more further action. Need to confirm this.

- **CB 152-11** (Hazard Avenue)

The City's Engineering Division inspected this location based on RIDEM's inspection notes. RIDEM's issues of concern were sediment accumulation and damaged pipes. The City inspected this catch basin in March 2017 and did not observe excessive sediment accumulation. Shortly after RIDEM's inspection, the City cleaned this catch basin on date. The pipe ends of the CMP and PVC pipe are partially damaged but they are still functioning properly. The City recommends no further action.

- **CB 152-12** (Hazard Avenue)

The City's Engineering Division inspected this location based on RIDEM's inspection notes. RIDEM's issues of concern were accumulation of sediment within catch basin and inlet/outlet pipes as well as a safety concern for bikes regarding the catch basin grate orientation. Shortly after RIDEM's inspection, the City cleaned this catch basin on date. Are pipes clean? The catch basin grate was reoriented 90 degrees to eliminate the safety concern to bikes. The City recommends no further action.

- **CB 152-13** (Wilson Avenue)

The City's Engineering Division inspected this location based on RIDEM's inspection notes. RIDEM's issues of concern were accumulation of sediment, damaged pipes, and unknown connectivity of structures. This catch basin was cleaned on 5/15/2017. The pipes associated with this basin appear to be unobstructed. One CMP pipe end is partially damaged but is still functioning properly. BETA Group located all of the structures in between Wilson Street and Hazard Street that are located on residential properties. The City recommends no more further action.

- **CB 153-22** (Wilson Avenue)

The City's Engineering Division inspected this location based on RIDEM's inspection notes. RIDEM's issues of concern were sediment/trash accumulation within the catch basin and inlet/outlet pipes as well as two damaged pipes. This catch basin was cleaned on 5/15/2017. No odors, sediment, or vegetation was observed in or around the catch basin. The City has put in a work order in to clean and flush the pipes. Has this work order been completed?

C. RIDOT Interconnections:

- **OF 122-2** (West Shore Road – Discharges to Brushneck Cove)

Utilizing the City's GIS mapping and RIGIS Lidar 2-ft contours, the City has delineated the catchment area for this outfall. A dry-weather survey was conducted on 10/18/2018. Dry-weather flow was observed and a sample was taken. The parameters for fecal coliform, enterococci, and total chlorine were exceeded, which warranted a further investigation. This is not an interconnection with RIDOT. Based on the City of Warwick's GIS and plans of record titled *State Highway Resurfacing West Shore Road from Oakland Beach Avenue to Spring Grove Avenue Contract II (R.I. Contract 7920)*, it was determined that this outfall solely belongs to the City of Warwick and does not receive any flow from RIDOT's drainage system. The catchment area for this outfall is exceptionally large. The City will first try to narrow down the source of the illicit discharge by inspecting junction points. Then the City will conduct CCTV investigation of the system to locate any potential illicit discharges and remove them from the system.

Dry Weather Survey Results (10/18/18):

Outfall ID	Temp (°C)	pH	Conductivity (µs)	Salinity (ppm)	Surfactants (ppm)	Ammonia (ppm)	Total Chlorine (mg/L)	Fecal Coliform (MPN/100 ml)	Enterococci (CFU/100 ml)	Coliphage (PFU/100 ml
OF 122-2	15.2	7.06	228	108	0.10	0.25	0.06	900	1400	<1

- **Interstate 95 North** – Discharges to unknown (Outfall 87-6)

This outfall belongs to the Rhode Island Department of Transportation (RIDOT). Based on the City of Warwick's GIS, it appears as though there is no interconnection from Warwick's MS4 to RIDOT's system.

- **Post Road** – Discharges to wetland (Outfall 13-1)

A dry-weather survey was conducted on 10/4/2018. At the time of this survey, there was no dry-weather flow present. This outfall belongs to the Rhode Island Department of Transportation (RIDOT). Based on mapping from the City of Warwick, there are four interconnections from Warwick's MS4 to RIDOT's drainage system. These interconnections are located at Wendall Road @ Post Road (MH 13-2), Spofford Ave @ Post Rd (CB 13-31), Chambly Ave @ Post Road (MH 13-3), and Palm Blvd @ Post Road (MH 13-4). The City will conduct a dry-weather survey for each junction just before where the City's MS4 ties into RIDOT's. If dry-weather flow is not observed, The City will use "sandbagging" or other equivalent method to determine whether there is an illicit discharge. This technique involves placing sandbags or similar barriers within outlets to manholes to form a temporary dam that collects any intermittent flows that may occur. Sandbags are typically left in place for 48

hours, and should only be installed when dry weather is forecast. If flow has collected behind the sandbags/barriers after 48 hours, it can then be sampled. If no flow collects behind the sandbag, the presence of an illicit discharge can be discarded. If flow is present and exceeds testing parameters, the City will conduct CCTV investigation of the system to locate any potential illicit discharges and remove them from the system.

- **West Shore Road/Warwick Avenue –** Discharges to Knowles Brook

All of the outfalls in this area belong to the RIDOT. Based on available plans of record including the City of Warwick's GIS, RIDOT plans, and City of Warwick DPW maps, there is one interconnection into RIDOT's system that discharge to Knowles Brook. This interconnection is located at MH 124-11, from Warwick's MS4 on Wildflower Circle into RIDOT's system on West Shore Road.

System Vulnerability Factors:

The outfalls described below may be added to the high priority infrastructure list depending on the results of the additional screenings.

The following system vulnerability factors were identified throughout Warwick:

On August 26, 2018, the Warwick Sewer Authority discovered that sewage was overflowing into Buckeye Brook from a manhole near 910 Cedar Swamp Road due to a collapsed sewer line leading to the Cedar Swamp pump station. The Sewer Authority estimated that around 300,000 gallons of sewage overflowed, according to RIDEM. The area that the break occurred in was included in the catchment area of XX outfalls: City owned Outfalls....

On November 26, 2018, there was a sewer main break on Sandy Lane sewer break from Fletcher Street to Trent Avenue. The area that the break occurred in was included in the catchment area of two outfalls: City owned Outfall 93-7 and RIDOT owned Outfall 107-2.

The City is looking at outfalls in the area of Tidewater Drive. This area is not serviced by the municipal sewer system. There has been one known occurrence of a failed OWTS in this area. The area that the failed OWTS occurred in was included in the catchment area of XX outfalls: City owned Outfalls....

The City is monitoring Outfall 112-4 at the end of Longmeadow Avenue. There is an upstream catch basin that may be receiving flow from a failed cesspool or septic system. The City is working with RIDEM on enforcement of the discharge, but no issues have been detected at the outfall.

Table 1. Implementation Schedule – Ongoing High Priority Investigations

Structure ID	Task	Estimated Completion Date	Status
OF 166-2	Sandbagging to check for illicit discharge	XX/XX/2019	Update as progress is made....
	CCTV investigation (if necessary)	XX/XX/2019	
OF 153-1	CCTV investigation	XX/XX/2019	
OF 167-5	Install screen at end of outfall	XX/XX/2019	
OF 152-4	Sandbagging to check for illicit discharge	XX/XX/2019	
	CCTV investigation (if necessary)	XX/XX/2019	
OF 167-1	Sampling 2-inch PVC pipe	XX/XX/2019	
OF 166-1	Clean and flush pipe	XX/XX/2019	
OF 122-2	Narrow down source of flow and CCTV investigation	XX/XX/2019	

Table 2
Implementation Schedule - Dry-weather Surveys & Additional Screening

Task	*Year*							
	2016	2017	2018	2019	2020	2021	2022	2023
Mapping of all outfalls, catch basins, manholes, pipes, culverts, and swales								
2016 Inspection Area								
2017 Inspection Area								
2018 Inspection Area								
Dry-weather surveys								
2016 Inspection Area (Part 1)								
2016 Inspection Area (Part 2)								
2017 Inspection Area								
2018 Inspection Area								
System Vulnerability Factors - Additional Screening								
2016 Inspection Area (Part 1)								
2016 Inspection Area (Part 2)								
2017 Inspection Area								
2018 Inspection Area								