



## Extreme Makeover Outfall Edition

Chelsea Waite, PE Erik Osborn, PE January 26, 2022





Inspection of the Town of Hull's Water Pollution Control Facility Effluent Outfall

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#### Getting to know the Outfall - General Location





#### Background – Outfall Structure





#### **Outfall Alignment**





#### **Outfall Profile**



End Diffuser/ Outfall Terminus



### **Diffuser** Details





#### **Review of Previous Inspection Data**



## -Project Goals & Investigation Strategy

**Inspection & Hydraulic Assessment** 





Locate Outfall & Diffusers

Inspect the Outfall

Hydraulic Assessment



## Side Scan Sonar

Locating the outfall in the field

#### Side Scan Sonar





## External Inspection

Looking for diffusers

# If I was a diffuser where would I be...







### **External Inspection Conclusions**

- 18 diffuser ports were located
- Diffusers were 3 to 8-inches from seafloor
- 17 of 18 diffusers had flow
- Inside of diffusers had little to no marine growth
- Three most inland diffusers were in two- to four-foot diameter crater-like depressions
- Diffuser spacing was every 10 feet except for two locations where it was about 20 feet.
- The diffusers were not damaged
- Diffuser openings were cut flush on a diagonal alternating east and west

Located Diffuser	Distance to	Average Height	Flow	Notes	
1 on	(Feet)	(Inches)			
1 (North/Farthest from Shore)	20	3.5	Stronger Flow		
2	10	5.5	Stronger Flow		
3	10	8	Stronger Flow		
4	10	5.5	Stronger Flow		
5	10	11	Stronger Flow		
6	10	7.5	Flowing		
7	20	7.5	Stronger Flow		
8	10	3.5	Flowing		
9	10	2	Stronger Flow		
10	10	9	None	Packed sand; Slushy when probed	
11	10	7	Flowing		
12	10	5.5	Flowing		
13	10	8	Flowing		
14	10	3	Flowing		
15	10	1	Flowing		
16	10	1	Flowing	2.5' x 4" Depression	
17	10	0	Flowing	3.5' x 12" Depression	
18 (South/Closest to Shore)	N/A	1	Flowing	3' x 6" Depression	



## Internal Inspection

Inspection from the inside

#### Internal Inspection Setup





#### The Remotely Operated Vehicle (ROV)



Standard BlueROV2





#### **Internal Inspection - Observations**

- Ten diffuser ports
- Rubber material/pipe gaskets
- Horizontal bend locations ROV headings
- Sediment in the outfall













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#### Some Inspection Drama...ROV Clogged with Seaweed





#### **Inspection Data**



Woodard & Curran

**—** 

#### Internal Inspection Summary

Survey abandoned at ~2,394'; Sediment depth ~10" • Diffuser J at 2,384'; Flow observed, Sediment depth ~7" O Diffuser I O Diffuser H; Flow observed O Diffuser G; Flow observed O Diffuser F O Diffuser E Diffuser D; Sand Sediment depth ~3" O Diffuser C; Sand O Diffuser B Q Diffuser A at 2,279'; Capped; ~6" Surface defect Gaskets at 14', 65', and 164' WPCF CCT



## **Inspection Findings**

- Not all 36 diffuser ports are currently in use.
  - Dive located 17 operating and 18 total
- Sea floor along the outfall appears to be dynamic.
  - Diffuser ports in record drawings were shown to extend approximately 3-feet above sea floor
- Falling sand and increasing sand deposits within outfall pipeline suggests that sand can enter the pipeline when:
  - Sediment builds up above the port opening
  - WPCF effluent flow is stopped.
- If sediments are not resuspended and ejected out of diffuser or removed through maintenance, sand could start to block diffusers and reduce outfall capacity.



## Hydraulic Analysis

What's the capacity?

#### The analysis considered the following conditions

- Wastewater treatment plant flow conditions
- Headloss through the pipe including the diffuser section
- Sea level elevation relative to the Chlorine Contact Tank







#### **Outfall Flow VS Required Head**





Required Head (feet)





Number of Diffusers Required to Achieve Capacity for Given Sea State									
Water Level Scenario, Sea Level Elevation	Average Annual 1.6 MGD	Maximum 30-Day Average 3.1 MGD	Maximum 7-Day Average 6.1 MGD	Maximum Day 9 MGD	Peak Hour 14 MGD				
100-year Return Period (2070), 13.82'	2	5	12	Not enough capacity	Not enough				
10-year Return Period (2070), 12.77'	2	4	10	Not enough capacity	hot enough capacity				
100-year Return Period (2030), 10.87'	2	4	9	29	Not enough capacity				
10-year Return Period (2030), 9.82'	2	4	8	20	Not enough capacity				
100-year Return Period (Present Day), 9.55'	2	4	8	19	Not enough capacity				
Mean High High Water (2070), 9.06'	2	4	2	17	Not enough capacity				
10-year Return Period (Present Day), 8.5'	2	3	7	16	Not enough capacity				
Mean High High Water (2030), 6.06'	2	3	7	12	Not enough capacity				
Mean High High Water (Present Day), 4.77'	2	3	6	11	Not enough capacity				
Mean Tide Level (2070), 3.87'	2	3	6	11	Not enough capacity				
Mean Tide Level (2030), 0.87'	2	3	5	9	Not enough capacity				
Mean Tide Level (Present Day), -0.42'	2	3	5	9	Not enough capacity				

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Note: Analysis assumes clean pipe and diffusers and no freeboard at the CCT or built into ocean levels.



#### **Recommended Next Steps**



- Regular Seafloor Mapping
- Diffuser Extension and Protection
- Sedimentation Removal



#### **Project Team**











