

Technical Memorandum

Phase 1 Part 2 CSO Control Plan Wellington Avenue CSO Facility

Thames Street Interceptor Television Inspection

Prepared for:

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August 30, 2006

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INTRODUCTION

This Thames Street Interceptor Television Inspection Technical Memorandum (TM) has been prepared to describe the investigation procedure used, results of the investigation, and recommendations for rehabilitation of observed defects. Figure 1 presents a schematic of the television inspection procedure.

DESCRIPTION OF THAMES STREET INTERCEPTOR

The Thames Street Interceptor is the major interceptor sewer serving Newport. It is a brick, egg shaped, 38-inch wide by 49-inch tall sewer (Photo 1) that flows approximately 6,200 linear feet from south to north parallel to the Newport Harbor shoreline between Morton Avenue and Washington Square. As Shown on Figure 2, at an upstream location, flow enters the Thames Street Interceptor from the eastern portion of the City at Narragansett Avenue. An 84-inch storage conduit is located on Narragansett Avenue to provide approximately 0.55 million gallons (mg) of storage of wastewater flows during wet weather. The interceptor also receives flow from the southern portion of the City at the intersection of Carroll Avenue and Morton Avenue and the southeastern portion of the City at Wellington Avenue as well as flow from Middletown's Wave Avenue Pump Station at Memorial Boulevard and Bellevue Avenue. The interceptor receives flow from many direct connections from collector streets between Morton Avenue and its downstream terminus near Touro Street.

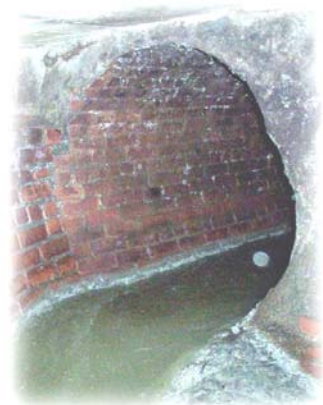


Photo 1 – Typical View of Thames Street Interceptor

CLOSED CIRCUIT TELEVISION (CCTV) INSPECTION PROCEDURES

Based on the age and importance of the Thames Street Interceptor, the Phase I Part I CSO Control Plan included a recommendation that preparatory sewer line cleaning and internal television inspection be performed on the sewer. Television inspection allows the location of individual flow sources within these segments to be pinpointed, viewed and assessed. Television inspection was performed by Severn Trent Pipeline Services (STPS) under subcontract to Earth Tech (ET), between March 14, 2006 and March 18, 2006.

During this procedure, the interceptor was first pressure cleaned to facilitate the movement of the television camera through the pipe. The camera used was a track-operated device with pan and tilt

capability (Figure 1). Infiltration sources in each segment were pinpointed by viewing television footage and observing leaking joints, cracked and broken pipes, leaking services, sagging pipes, etc. The television inspection determined the specific location, condition and observed the estimated flow rate of the sources of infiltration within the line sections. Television inspection also allowed the estimation of flow from running or leaking services. Appendix A presents a summary of the television inspection performed showing the length of sewer televised, the major defects encountered and the infiltration found and the individual CCTV inspection logs documented by STPS.

CCTV INSPECTION RESULTS

Earth Tech reviewed the television inspection logs, and the following general observations were noted. For service connection information, defects, and rehabilitation recommendations by length of pipe see Tables 1-12. For detailed information at individual locations, see the CCTV Inspection Report Logs in Appendix A:

- The Thames Street Interceptor is generally in good condition.
- Figure 2 presents a plan of the Thames Street Interceptor and also includes the manhole numbering that is referenced in the summary tables presented later in this TM. The dimensions of the interceptor as observed during the inspection are as follows:
 - The interceptor measured 38-inches in width by 49-inches in height between the downstream outfall near Touro Street and Dixon Street,
 - 38-inches in width by 39-inches in height between Dixon Street and Webster Street where the top of the brick sewer was removed to facilitate lowering Thames Street, and
 - 36-inches in width by 42-inches in height between Webster Street and Morton Avenue.
- 384 service connections were observed. The breakdown is as follows:
 - 200 service connections in good condition
 - 49 service connections capped
 - 75 service connections with constant clear water infiltration running
 - 6 leaking service connections
 - 9 service connections with a poor connection between the service and the main
 - 10 locations with broken pipes or longitudinal cracks visible in the service connection
 - 11 locations with mineral deposits in the service connection

- 2 service connections were flowing sewage at the time of the inspection
- 13 locations with dirt and debris in the service connection. Occasionally obscuring the camera's view of the service connection.
- 3 locations with light root growth in the service connection
- 3 locations with moderate root growth in the service connection
- 3 locations with heavy root growth in the service connection
- 5 locations where water was observed leaking through the brick sewer
- 29 locations where pipes cross through the crown of the interceptor restricting the flow area of the Thames Street Interceptor and collecting debris.
- Based on the CCTV inspection, Approximately 185,000 gallons per day (gpd) of infiltration was observed in the sewer main and service connection piping with a majority of the clear water flow entering the interceptor through service connections. Much of the clear water infiltration flow, about 85 percent, was observed entering the interceptor at tributary mains from side streets. Additional flow isolation and/or CCTV inspection is required to further identify the source of infiltration in the service connections and tributary lines from side streets.

OBSERVATIONS AND EVALUATIONS

Based on the observations made during the Thames Street Interceptor CCTV inspection, Earth Tech presents the following evaluations and recommendations:

Service Connections

Service Connections in good condition or capped service connections require no action at this time. These service connections are shown in Tables 1 and 2.

Table 1 - Service Connections in Good Condition

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number
1	118-13	118-12	Morton Avenue	Morton Ave	15	0
2	118-12	118-8	Morton Avenue	Webster Street	244	3
3	188-8	188-7	Webster Street	Carey Street	246	6
4	188-7	118-128	Carey Street	Narragansett Avenue	245	2
5	118-128	118-1	Narragansett Avenue	Narragansett Avenue	13	0
6	118-1	110-39	Narragansett Avenue	Hammond Street	245	10
7	110-39	110-40	Hammond Street	Dixon Street	196	9
8	110-40	110-44	Dixon Street	Wellington Avenue	276	11
9	110-44	110-44A	Wellington Avenue	Wellington Avenue	10	0
10	110-44A	110-45	Wellington Avenue	Wellington Avenue	7	0
11	110-45	110-46	Wellington Avenue	Wellington Avenue	42	1
12	110-46	110-47	Wellington Avenue	Lee Avenue	149	9
13	110-47	100-6	Lee Avenue	Dean Avenue	298	8
14	100-6	100-9	Dean Avenue	Holland Street	138	8
15	100-9	100-2	Holland Street	Dearborn Street	182	3
16	100-2	100-4	Dearborn Street	South Baptist Street	218	17
17	100-4	100-6	South Baptist Street	Pope Street	267	9
18	100-6	93-30.1	Pope Street	Howard Street	240	11
19	93-30.1	93-30	Howard Street	Young Street	198	9
20	93-30	93-36	Young Street	Dennison Street	165	3
21	93-36	93-37	Dennison Street	Easement from Spring Street	169	2
22	93-37	93-38	Easement from Spring Street	Brewer Street	164	3
23	93-38	87-5	Brewer Street	Ann Street	141	2
24	87-5	87-1	Ann Street	Gidley Street	124	3
25	87-1	87-3	Gidley Street	Fair Street	100	3
26	87-3	87-23.1	Fair Street	Memorial Blvd.	155	7
27	87-23.1	87-23.2	Memorial Blvd.	Memorial Blvd.	20	0
28	87-23.2	87-23	Memorial Blvd.	Franklin Street	250	7
29	87-23	79-46	Franklin Street	Green Street	221	5
30	79-46	79-45	Green Street	Pelham Street	178	8
31	79-45	79-44.1	Pelham Street	Mill Street	247	7
32	79-44.1	79-44	Mill Street	Church Street	249	13
33	79-44	71-15	Church Street	Mary Street	331	8
34	71-15	71-12	Mary Street	Mid Block between Mary St. and Touro St.	253	6
35	71-12	71-1	Mid Block between Mary St. and Touro St.	Near Touro Street	160	7
TOTAL						200

Table 2 - Service Connections Capped/Bricked

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number
1	118-13	118-12	Morton Avenue	Morton Ave	15	0
2	118-12	118-8	Morton Avenue	Webster Street	244	1
3	188-8	188-7	Webster Street	Carey Street	246	0
4	188-7	118-128	Carey Street	Narragansett Avenue	245	0
5	118-128	118-1	Narragansett Avenue	Narragansett Avenue	13	0
6	118-1	110-39	Narragansett Avenue	Hammond Street	245	0
7	110-39	110-40	Hammond Street	Dixon Street	196	0
8	110-40	110-44	Dixon Street	Wellington Avenue	276	0
9	110-44	110-44A	Wellington Avenue	Wellington Avenue	10	0
10	110-44A	110-45	Wellington Avenue	Wellington Avenue	7	0
11	110-45	110-46	Wellington Avenue	Wellington Avenue	42	0
12	110-46	110-47	Wellington Avenue	Lee Avenue	149	0
13	110-47	100-6	Lee Avenue	Dean Avenue	298	0
14	100-6	100-9	Dean Avenue	Holland Street	138	2
15	100-9	100-2	Holland Street	Dearborn Street	182	0
16	100-2	100-4	Dearborn Street	South Baptist Street	218	0
17	100-4	100-6	South Baptist Street	Pope Street	267	6
18	100-6	93-30.1	Pope Street	Howard Street	240	2
19	93-30.1	93-30	Howard Street	Young Street	198	2
20	93-30	93-36	Young Street	Dennison Street	165	3
21	93-36	93-37	Dennison Street	Easement from Spring Street	169	5
22	93-37	93-38	Easement from Spring Street	Brewer Street	164	3
23	93-38	87-5	Brewer Street	Ann Street	141	1
24	87-5	87-1	Ann Street	Gidley Street	124	0
25	87-1	87-3	Gidley Street	Fair Street	100	3
26	87-3	87-23.1	Fair Street	Memorial Blvd.	155	4
27	87-23.1	87-23.2	Memorial Blvd.	Memorial Blvd.	20	0
28	87-23.2	87-23	Memorial Blvd.	Franklin Street	250	7
29	87-23	79-46	Franklin Street	Green Street	221	1
30	79-46	79-45	Green Street	Pelham Street	178	1
31	79-45	79-44.1	Pelham Street	Mill Street	247	3
32	79-44.1	79-44	Mill Street	Church Street	249	1
33	79-44	71-15	Church Street	Mary Street	331	0
34	71-15	71-12	Mary Street	Mid Block between Mary St. and Touro St.	253	2
35	71-12	71-1	Mid Block between Mary St. and Touro St.	Near Touro Street	160	2
TOTAL						49

Service Connections Running Constant Clear Water Flow (Running Services)

75 running services (Table 3) were observed during the CCTV inspection of the Interceptor. The 75 running services included 26 main line tributaries servicing side streets from Thames Street and 49 services directly connected to the Interceptor. As shown in Table 3A, based on the high clear water service flows observed from the mainline sewers tributary to the interceptor, approximately 82 percent or 151,000 gpd of an approximate total of 185,000 gpd enters the interceptor at the tributary mainline connections. Earth Tech recommends flow isolation and CCTV inspection of the tributary mainline sewers where the infiltration is significant and rehabilitation of identified sources is cost-effective (i.e., greater than or equal to 4,000 gpd/inch diameter mile). The locations where flow isolation and CCTV inspection is recommended is presented in Table 3B. The estimated cost to perform flow isolation and CCTV in these segments of the system is presented in Table 3B.

Investigation and rehabilitation of the 49 services directly connected to the Interceptor can be performed using various methods as follows:

- CCTV of the service line may assist in locating damaged or leaking connections or cracked or damaged pipe in the service, but this method cannot be used where there is not access to a cleanout at the building and the service pipe connection to the mainline sewer.
- House to house surveys can determine if extraneous flow is originating in a service connection pipe or the building. Performing house to house surveys of the buildings along the Thames Street interceptor and along the tributary mainlines help to identify running flows from within the connected building (i.e. sump pumps, drains, leaks, etc.). House to house surveys will likely be recommended as part of a full field investigation to identify inflow and infiltration sources for Area 6, including manhole inspections and dye and smoke testing. Earth Tech's recommendations for a full field investigation in Area 6 will be presented in the Area 6 Flow Metering TM, after a review of the metering data obtained over the March to May 2006 metering period.
- If a running service is determined to be the result of leaking joints or minor damage to the service pipe, joint sealing with a mechanical packer or short liner (lining approximately 3 feet) installations can be performed. Both methods typically require that the service pipe be 6 inches in diameter or greater and require access to either end of the service. Short liners and joint sealing also typically require that the area of damage is visible to the eye or located by CCTV inspection of the service pipe.

- Lining the complete length of a sewer service pipe will eliminate leakage and provide structural strength to the service pipe. Full length lining of the service connection, requires CCTV of the service pipe and access to the service pipe at the building. Full lining is advantageous in areas where the service pipe is in congested utility corridors and excavation and bury installation methods would be difficult.
- Excavation and replacement of a service does not require CCTV or access at either end of a service pipe. Though, there is disturbance of the area in the vicinity of the excavation, the work typically lasts only a few days.

Table 3 - Service Connections Running Constant Clear Water

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number
7	110-39	110-40	Hammond Street	Dixon Street	196	1
8	110-40	110-44	Dixon Street	Wellington Avenue	276	4
12	110-46	110-47	Wellington Avenue	Lee Avenue	149	1
13	110-47	100-6	Lee Avenue	Dean Avenue	298	3
14	100-6	100-9	Dean Avenue	Holland Street	138	3
15	100-9	100-2	Holland Street	Dearborn Street	182	2
16	100-2	100-4	Dearborn Street	South Baptist Street	218	3
17	100-4	100-6	South Baptist Street	Pope Street	267	6
18	100-6	93-30.1	Pope Street	Howard Street	240	1
19	93-30.1	93-30	Howard Street	Young Street	198	3
20	93-30	93-36	Young Street	Dennison Street	165	2
21	93-36	93-37	Dennison Street	Easement from Spring Street	169	5
22	93-37	93-38	Easement from Spring Street	Brewer Street	164	1
23	93-38	87-5	Brewer Street	Ann Street	141	2
24	87-5	87-1	Ann Street	Gidley Street	124	2
25	87-1	87-3	Gidley Street	Fair Street	100	3
26	87-3	87-23.1	Fair Street	Memorial Blvd.	155	6
28	87-23.2	87-23	Memorial Blvd.	Franklin Street	250	3
29	87-23	79-46	Franklin Street	Green Street	221	4
30	79-46	79-45	Green Street	Pelham Street	178	1
31	79-45	79-44.1	Pelham Street	Mill Street	247	2
32	79-44.1	79-44	Mill Street	Church Street	249	4
33	79-44	71-15	Church Street	Mary Street	331	5
34	71-15	71-12	Mary Street	Mid Block between Mary St. and Touro St.	253	6
35	71-12	71-1	Mid Block between Mary St. and Touro St.	Near Touro Street	160	2

TOTAL

75

Table 3A – Tributary Sidelines Running Clear Water Flow

Tributary Main Line Location	Flow (gpd)	Upstream Pipe Length (LF)	Buildings Along Tributary Line	Infiltration Flow (gpd per Inch Diameter Mile)
Webster Street	4,320	810	33	3,520
Narragansett Avenue	14,400	2,100	33	3,017
Hammond Street	4,320	765	34	3,727
Dixon Street	14,400	2,220	39	4,281
McAllister Street	28,800	1,505	38	12,630
Lee Avenue	5,760	930	26	2,725
Underwood Court	144	375	17	253
Dean Avenue	1,440	650	24	1,170
Holland Street	4,320	600	23	3,168
Dearborn Street	2,880	1,750	17	724
South Baptist Street	1,440	705	21	1,348
Extension Street	1,440	540	22	1,760
Pope Street	11,520	1,750	75	4,345
Howard Street	1,440	900	34	704
Young Street	2,880	4,035	48	314
Dennison Street	1,440	435	16	1,457
Easement from Spring Street	7,200	525	6	4,023
Ann Street	144	2,265	51	28
Fair Street	10,080	450	10	14,784
Memorial Blvd.	1,440	390	5	1,625
Franklin Street	8,640	3,380	119	1,125
Green Street	5,760	390	11	7,798
Pelham Street	5,760	1,600	31	1,584
Mill Street	1,440	1,725	49	441
Church Street	5,760	2,000	32	1,901
Mary Street	4,320	1885	48	1,008
Total	151,488	34,680	862	

Table 3B - Estimated Cost to Investigate Running Services and Sidelines (Area 6)

Item	Assumption	Source	Unit Cost	Quantity	Estimated Cost
Flow Isolation	Side Lines with Infiltration exceeding 4,000 gpd per inch diameter mile (Dixon Street, McAllister Street, Pope Street, Spring Street Easement, Fair Street, and Green Street).	Infiltration	\$ 0.50	6,840	\$3,420
Cleaning and Television Inspection	50% of flow isolation footage	Infiltration	\$ 2.30	3,420	\$7,866
House to House Survey	Houses adjacent to tributary sewers with Infiltration in Excess of 4,000 Gals/Inch diameter Mile.	Infiltration/Inflow	\$ 45.00	179	\$8,055
Subtotal					\$19,341
Contingency	25%	Infiltration	\$ 4,835	1	\$4,835
Engineering	15%	Infiltration	\$ 2,901	1	\$2,901
Total					\$27,077
Estimated Cost For Flow Isolation and Inspection in Area 6					\$28,000

Infiltration at Service Connection/Poor Connection between Service Connection and Mainline Sewer and Broken and/or Cracked Pipe in Service Connections

Repair of infiltration at a service connection (Table 4) and/or at a poor connection (Table 5) and broken or cracked pipes between a service connection and the main line sewer can typically be repaired using a gel type sealant and a mechanical packer. However, based on the size of the brick sewer, the gel or grout sealant would need to be applied manually. Manned entry of the interceptor to perform the rehabilitation will require bypass pumping of sewage flows and additional personnel safety precautions.

Table 4 - Infiltration at Service Connection

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number
18	100-6	93-30.1	Pope Street	Howard Street	240	1
19	93-30.1	93-30	Howard Street	Young Street	198	1
21	93-36	93-37	Dennison Street	Easement from Spring Street	169	1
25	87-1	87-3	Gidley Street	Fair Street	100	1
35	71-12	71-1	Mid Block between Mary St. and Touro St.	Near Touro Street	160	2
TOTAL						6

Table 5 - Poor Connection between Service Connection and Mainline

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number
12	110-46	110-47	Wellington Avenue	Lee Avenue	149	2
13	110-47	100-6	Lee Avenue	Dean Avenue	298	1
15	100-9	100-2	Holland Street	Dearborn Street	182	3
22	93-37	93-38	Easement from Spring Street	Brewer Street	164	1
33	79-44	71-15	Church Street	Mary Street	331	2
TOTAL						9

Table 6 – Broken/Cracked Pipes Observed in Service Connections

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number	Type
2	118-12	118-8	Morton Avenue	Webster Street	244	1	Broken Pipe
3	188-8	188-7	Webster Street	Carey Street	246	1	Broken Pipe
8	110-40	110-44	Dixon Street	Wellington Avenue	276	1	Broken Pipe
13	110-47	100-6	Lee Avenue	Dean Avenue	298	1	Long. Crack
15	100-9	100-2	Holland Street	Dearborn Street	182	2	Long. Crack
17	100-4	100-6	South Baptist Street	Pope Street	267	1	Broken Pipe
21	93-36	93-37	Dennison Street	Easement from Spring Street	169	2	Broken Pipe
31	79-45	79-44.1	Pelham Street	Mill Street	247	1	Broken Pipe
TOTAL						10	

Mineral Deposits/Grease in Service Connection

Mineral Deposits (Table 7) were observed in 11 service connections along the Thames Street Interceptor. Mineral deposits were also noted throughout the interceptor’s brick pipe walls. The mineral deposits observed typically ranged from minor to moderate. As they are generally not impacting flow within the interceptor or the service connection, Earth Tech recommends that remediation of mineral deposits in service connection and the Interceptor be completed as part of a future long term comprehensive rehabilitation of the Thames Street Interceptor. While the inspection did not observe leakage through the walls of the brick sewer, mineral deposits can be an indicator of past infiltration. This infiltration may be caused by seasonal high ground water levels or historic past high ground water levels.

Moderate grease was also observed at 2 locations along the interceptor. The first was 81 feet downstream of manhole 087-3 at Fair Street on the West side of Thames Street. The second connection with moderate

grease is located 129 feet down stream of manhole 079-45 located at Pelham Street on the east side of Thames Street. It is recommended that the City contact the building owners to discuss reducing the amount of grease entering the system before performance of the connection and interceptor is degraded.

Table 7 - Mineral Deposits Observed in Service Connection

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number
6	118-1	110-39	Narragansett Avenue	Hammond Street	245	1
18	100-6	93-30.1	Pope Street	Howard Street	240	1
20	93-30	93-36	Young Street	Dennison Street	165	3
21	93-36	93-37	Dennison Street	Easement from Spring Street	169	1
22	93-37	93-38	Easement from Spring Street	Brewer Street	164	1
23	93-38	87-5	Brewer Street	Ann Street	141	1
25	87-1	87-3	Gidley Street	Fair Street	100	1
31	79-45	79-44.1	Pelham Street	Mill Street	247	1
32	79-44.1	79-44	Mill Street	Church Street	249	1
TOTAL						11

Service Connections Observed In Use

Connections observed in use (Table 8) at the time of the inspection can mask infiltration flow however, due to the small number of service connections flowing sewage at the time of inspection, no action is required.

Table 8 - Service Connections in Use at Time of Inspection

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number
16	100-2	100-4	Dearborn Street	South Baptist Street	218	1
30	79-46	79-45	Green Street	Pelham Street	178	1
TOTAL						2

Service Connections with Debris

Connections that were submerged or likely capped and obscured by debris (Table 9) at the time of the inspection.

Table 9 - Service Connections Filled with Debris or Submerged

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number
3	188-8	188-7	Webster Street	Carey Street	246	1
20	93-30	93-36	Young Street	Dennison Street	165	1
33	79-44	71-15	Church Street	Mary Street	331	3
34	71-15	71-12	Mary Street	Mid Block between Mary St. and Touro St.	253	6
35	71-12	71-1	Mid Block between Mary St. and Touro St.	Near Touro Street	160	2
TOTAL						13

Roots

Roots were observed in some locations and are recommended to be removed to mitigate impacts to flow capacity and deposition of debris and possible clogging of services (Table 10). As there are a small number of locations, chemical methods of root removal can be considered to prevent or limit the ability of any roots to grow back into the service. Sealing the pipe in the vicinity of the root growth after removal may also assist in preventing re-growth. However, due to the size of the interceptor, mechanical methods of root removal may be necessary as the large quantities of root removing foam can cause problems in the biological treatment process employed at the wastewater treatment plant.

Table 10 - Root Growth

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number	Condition
14	100-6	100-9	Dean Avenue	Holland Street	138	1	Heavy
17	100-4	100-6	South Baptist Street	Pope Street	267	1	Moderate
29	87-23	79-46	Franklin Street	Green Street	221	5	Lt, Mod, & Heavy
30	79-46	79-45	Green Street	Pelham Street	178	1	Moderate
34	71-15	71-12	Mary Street	Mid Block between Mary St. and Touro St.	253	1	Light
TOTAL						9	

Leaking Brick

Leaking bricks were observed at 5 locations within the interceptor (Table 11). These locations require repair using manually applied hydraulic cement grout or a chemical sealant. Due to the low volume of infiltration flow at these locations and the high cost to enter the interceptor to perform the repairs, Earth Tech recommends repairs to leaking bricks be completed as part of a comprehensive future long term rehabilitation of the Thames Street Interceptor. Mainline pipe lining should be considered as a long term option to structurally reinforce the sewer and reduce infiltration through joints in the brick.

Table 11 - Leaking Brick

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number
11	110-45	110-46	Wellington Avenue	Wellington Avenue	42	1
17	100-4	100-6	South Baptist Street	Pope Street	267	1
18	100-6	93-30.1	Pope Street	Howard Street	240	2
22	93-37	93-38	Easement from Spring Street	Brewer Street	164	1
TOTAL						5

Pipes Crossing through the Interceptor

Table 12 presents the locations where pipes were observed crossing through the Thames Street Interceptor. Evaluation of each line crossing through the interceptor is recommended (i.e. water, gas, electric, etc., live or abandoned). Debris was observed trapped on and around some of the pipe crossings.

Table 12 - Unidentified Pipe Crossing through Interceptor

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number
2	118-12	118-8	Morton Avenue	Webster Street	244	2
3	188-8	188-7	Webster Street	Carey Street	246	1
4	188-7	118-128	Carey Street	Narragansett Avenue	245	4
5	118-128	118-1	Narragansett Avenue	Narragansett Avenue	13	0
6	118-1	110-39	Narragansett Avenue	Hammond Street	245	2
7	110-39	110-40	Hammond Street	Dixon Street	196	1
8	110-40	110-44	Dixon Street	Wellington Avenue	276	1
9	110-44	110-44A	Wellington Avenue	Wellington Avenue	10	0
10	110-44A	110-45	Wellington Avenue	Wellington Avenue	7	0
11	110-45	110-46	Wellington Avenue	Wellington Avenue	42	0
12	110-46	110-47	Wellington Avenue	Lee Avenue	149	0
13	110-47	100-6	Lee Avenue	Dean Avenue	298	2

Table 12 – Unidentified Pipe Crossing Through Interceptor (continued)

Sewer Section	Upstream Manhole	Downstream Manhole	Upstream Street	Downstream Street	Length (ft)	Number
14	100-6	100-9	Dean Avenue	Holland Street	138	0
15	100-9	100-2	Holland Street	Dearborn Street	182	0
16	100-2	100-4	Dearborn Street	South Baptist Street	218	0
17	100-4	100-6	South Baptist Street	Pope Street	267	1
18	100-6	93-30.1	Pope Street	Howard Street	240	1
19	93-30.1	93-30	Howard Street	Young Street	198	2
20	93-30	93-36	Young Street	Dennison Street	165	1
21	93-36	93-37	Dennison Street	Easement from Spring Street	169	2
22	93-37	93-38	Easement from Spring Street	Brewer Street	164	0
23	93-38	87-5	Brewer Street	Ann Street	141	0
24	87-5	87-1	Ann Street	Gidley Street	124	0
25	87-1	87-3	Gidley Street	Fair Street	100	0
26	87-3	87-23.1	Fair Street	Memorial Blvd.	155	0
27	87-23.1	87-23.2	Memorial Blvd.	Memorial Blvd.	20	0
28	87-23.2	87-23	Memorial Blvd.	Franklin Street	250	0
29	87-23	79-46	Franklin Street	Green Street	221	1
30	79-46	79-45	Green Street	Pelham Street	178	0
31	79-45	79-44.1	Pelham Street	Mill Street	247	0
32	79-44.1	79-44	Mill Street	Church Street	249	1
33	79-44	71-15	Church Street	Mary Street	331	7

TOTAL

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Perforated Manhole Covers

During the Phase 1 Part 1 field investigations, 17 manhole inspections were performed on the Thames Street Interceptor. The inspections indicated that at nine locations, the manholes had perforated covers. The locations are presented in Table 13.

Table 13 – Locations of Manholes with Perforated Covers

Manhole	Location	Number of Perforations
071-15	Thames Street at Mary Street	37
079-44	Thames Street at Church Street	37
087-5	Thames Street at Ann Street	37
087-23	Thames Street at Franklin Street	32
100-2	Thames Street at Dearborn Street	37
100-6	Thames Street at Pope Street	37
110-44	Thames Street at Wellington Avenue	2
110-45	Thames Street at Wellington Avenue	5
118-2	Thames Street at Narragansett Avenue	32

REHABILITATION RECOMMENDATIONS

Based on the results of the CCTV inspection, the Thames Street Interceptor is generally in good condition and currently does not require major rehabilitation work. Therefore, Earth Tech has prepared the following short term and long term recommendations for rehabilitation of the Thames Street Interceptor.

Short Term Rehabilitation Recommendations

Earth Tech recommends that the City of Newport perform the following short term investigation and rehabilitation tasks for the Thames Street Interceptor and Sewer Catchment Area 6 with the following priority:

- Flow Isolation and CCTV investigation of the mainline sewers tributary to the interceptor in order to isolate infiltration upstream and complete house to house surveys along Dixon Street, McAllister Street, Pope Street, Fair Street, easement between Brewer Street and Dennison Street and Green Street (within Area 6) to locate sump pumps, leaks, or other connections that contribute to additional flows entering the interceptor and to determine which of the running services may require additional repair (i.e. lining or complete replacement).
- Replacement of perforated manhole covers. Manhole inspections were performed at 17 locations along the Thames Street Interceptor during Phase 1 Part 1. The inspections indicated that 9 of the 17 that were inspected had perforated covers. These covers are recommended to be replaced to eliminate inflow into the Interceptor. In addition, follow up field inspections will be performed by Earth Tech along the entire Thames Street Interceptor to identify any other perforated covers. If additional perforated manhole covers are observed, the cost to replace these will be included in the Phase 1 Part 2 CSO Control Plan Report. The estimated unit cost to replace these covers is \$200.
- Identification of the type and status (active or abandoned) of utility lines crossing through the interceptor in order to facilitate future planning to ascertain the feasibility of removing or relocating some or all of the lines outside of the interceptor.

Table 14 presents an order of magnitude cost estimate for the short term rehabilitation recommendations.

Table 14
Order of Magnitude Cost Estimate
Short Term Rehabilitation Recommendations

Item	Estimated Cost
Flow isolation, CCTV and House to House Inspections	\$28,000 (See Table 3B)
Replacement of Perforated Manhole Covers (Nine Covers, \$200/cover)	\$1,800
Estimated Cost	\$29,800

Long Term Rehabilitation Recommendations

As noted above, the Thames Street Interceptor is in good condition. Therefore, it is more cost effective to include the minor rehabilitation recommendations with the major rehabilitation recommendations as summarized below.

Based on Earth Tech’s discussions with several pipe rehabilitation and pipe lining companies, rehabilitation of the Thames Street Interceptor would include the following minor rehabilitation tasks:

- Repair of leaking service connections/poor connections between service connections and mainline sewers, including missing bricks and mortar, protruding services, and joint repair.
- Repair of broken and/or cracked pipes observed in service connections.
- Removal of mineral deposits in service connections and within the Interceptor.
- Removal of roots and joint sealing.
- Repair of leaking bricks within the interceptor.

In addition to the minor rehabilitation above, Earth Tech recommends that a structural pipe liner, such as a cured-in-place liner or an embedded sheet liner, be considered throughout the 6,200 LF of the Thames Street Interceptor as a future long term plan to prevent additional degradation to the brick pipeline by constant contact with the flow and abrasives, to reinforce the brick sewer structurally, and to extend the Interceptor’s service life.

The rehabilitation would require the installation of a sewage bypass pumping system to redirect flows around areas of work. Based on the costs of recent similarly sized projects with comparable flows to

the Thames Street Interceptor, the estimated bypass pumping costs are \$1,800 to \$2,500 per day. The rehabilitation work would include: manned entry of the interceptor to repair poor connections between the service connections and the mainline sewer; replace or seal minor damage to service connection pipe; clean mineral deposits and grease from service connections; clean debris not cleared by standard cleaning methods such as water jet cleaning or use of a clamshell bucket; remove and seal root intrusions; repoint and seal leaking bricks and replace missing bricks; and seal, repoint, and repair any visible damage not viewed in the CCTV inspection footage due to flow in the sewer at the time of the inspections. These include: leaking caps or bricks in abandoned service connections; missing or damaged bricks; repoint or repair missing mortar; and sealing any leaks in the sewer encountered below the flow level. The interceptor will then be prepared to accept the liner.

Long term rehabilitation of the Thames Street Interceptor is based on the following assumptions:

- The rehabilitation procedures are based on the physical condition of the interceptor and service connections as encountered in the CCTV inspection,
- Earth Tech's discussions with pipeline rehabilitation contractors,
- Removal or relocation of as many utility lines as possible that currently cross through the interceptor above or below the interceptor has been completed prior to commencement of rehabilitation of the interceptor (the feasibility of this work will need to be ascertained by more detailed evaluation of the status of such utility crossings and the ability for them to be relocated),
- That a suitable sewage bypass pumping system can be installed, and
- That there are no plans to replace the Thames Street Interceptor in part or in whole.

The preliminary costs to repair and line the interceptor and for bypass pumping are shown in Table 15 below. It is noted that these costs are based on the assumption that most of the pipes currently crossing the Interceptor can be removed and/or relocated at a future time. Further investigations are required to determine what must be accomplished to eliminate or relocate the crossing pipes. Removal of the crossing pipes will be a major effort and is estimated to cost approximately \$4,000,000 to \$5,000,000 (order of magnitude) and cannot be feasibly completed until more is known about these pipes, their status and ownership.

**Table 15 - Order Of Magnitude Cost Estimate
Long Term Rehabilitation Recommendations**

Item	Assumption	Unit Cost	Quantity	Estimated Cost
Minor repairs and lining of Thames Street Interceptor	Pipe crossings in interceptor have been removed	\$500/LF	6,200	\$3,100,000
Bypass Pumping of Flows around Work Area	Suitable location for equipment, suction and discharge can be located.	\$2,500/day	45	\$112,500
Subtotal				\$3,212,500
Contingency	25%	\$803,125	1	\$803,125
Engineering	15%	\$481,875	1	\$481,875
Total				\$4,497,500
Estimated Cost				\$4,500,000

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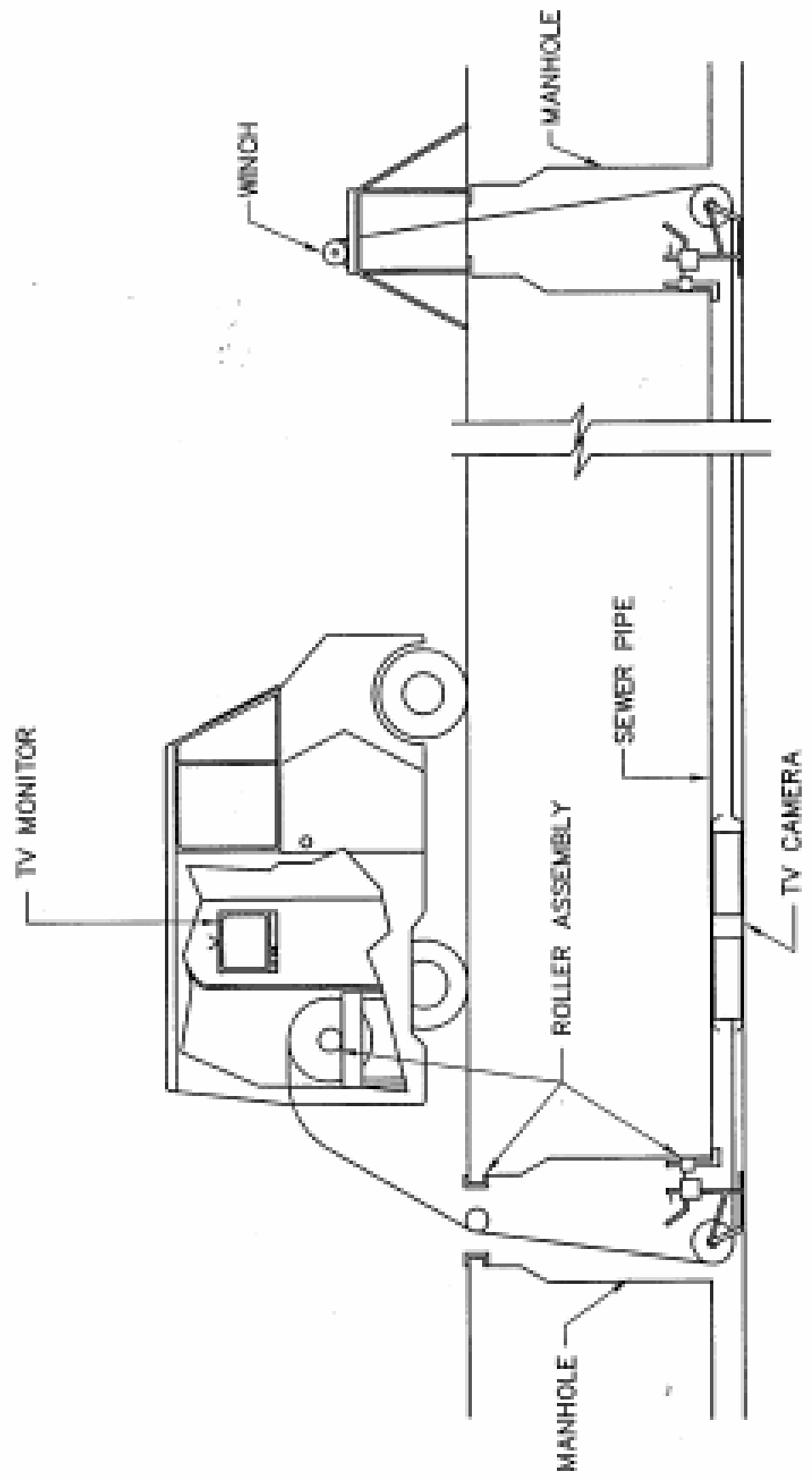


FIGURE 1
T.V. INSPECTION PROCEDURE
NOT TO SCALE

