RESOLUTION NO. 8-22

A RESOLUTION OF THE COUNCIL OF THE CITY OF RICHMOND, CALIFORNIA, ACCEPTING THE KELLER BEACH SANITARY SEWER CCTV REVIEW AND ASSESSMENT REPORT FOR THE CITY OF RICHMOND PREPARED BY NCE-COASTLAND, DATED JANUARY 3, 2022

WHEREAS, the City of Richmond ("City") entered into a second settlement agreement with San Francisco Baykeeper (Baykeeper) in 2018 due to the fact that the City was not able to meet the terms of the 2016 Settlement Agreement regarding significant sanitary sewer overflows during wet rainy weather due to the condition of the City's sanitary sewer collection system; and

WHEREAS, the City agreed within the settlement agreement with Baykeeper to make improvements to the City's sewer collection system; and

WHEREAS, in addition to specific Capital Improvement Projects listed in the Settlement Agreement, Baykeeper requested that a feasibility study should be performed to determine the condition of the Keller Beach Sewer Trunk line due to the sensitive location; and

WHEREAS, the City established funding in the FY 2021-2022 budget in the amount of $500,000 to cover the cost of this study.

NOW, THEREFORE, BE IT RESOLVED that the Council of the City of Richmond hereby accepts the Keller Beach Sanitary Sewer CCTV Review and Assessment Report, dated January 3, 2022, (Exhibit A) as presented.

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I certify that the foregoing resolution was passed and adopted by the City Council of the City of Richmond at a regular meeting thereof held January 18, 2022, by the following vote:

AYES:	Councilmembers Bates, Jimenez, Martinez, McLaughlin, Willis, Vice Mayor Johnson III, and Mayor Butt.
NOES:	None.
ABSTENTIONS:	None.
ABSENT:	None.

PAMELA CHRISTIAN
CLERK OF THE CITY OF RICHMOND
(SEAL)

Approved:

THOMAS K. BUTT
Mayor

Approved as to form:

DAVE ALESHIRE
Interim City Attorney

State of California }
County of Contra Costa : ss.
City of Richmond }

I certify that the foregoing is a true copy of **Resolution No. 8-22**, finally passed and adopted by the City Council of the City of Richmond at a regular meeting held on January 18, 2022.

Pamela Christian, Clerk of the City of Richmond

CLERK'S
CERTIFICATE

I, Pamela Christian, City Clerk of the City of Richmond, do hereby certify as follows:

The foregoing resolution is a full, true and correct copy of **Resolution No. 8-22** duly adopted at a regular meeting of the City Council of said City duly and regularly held at the regular meeting place thereof on the 18th day of January 2022, of which meeting all the members of said City Council had due notice and at which a majority thereof were present; and that at said meeting said resolution was adopted by the following vote:

AYES:	Councilmembers Bates, Jimenez, Martinez, McLaughlin, Willis, Vice Mayor Johnson III, and Mayor Butt.
NOES:	None.
ABSTENTIONS:	None.
ABSENT:	None.

An agenda of said meeting was posted before said meeting at City Hall, 450 Civic Center Plaza in the City of Richmond, California, a location freely accessible to members of the public, and a brief description of said resolution appeared on said agenda.

Such agenda was further posted, and such meeting was conducted in accordance with and pursuant to Assembly Bill 361, issued by the Governor of the State of California on September 15, 2021, that allowed cities to continue to hold public meetings via teleconferencing.

I have carefully compared the foregoing with the original on file and of record in my office, and the foregoing is a full, true and correct copy of the original resolution adopted at said meeting.

Said resolution has not been amended, modified, or rescinded since the date of its adoption and the same is now in full force and effect.

Dated: January 28, 2022.

Pamela Christian

City Clerk of the City of Richmond

[SEAL]

COASTLAND
CIVIL ENGINEERING - CONSTRUCTION MANAGEMENT - BUILDING DEPARTMENT SERVICES

EXHIBIT A

REGISTERED PROFESSIONAL ENGINEER
JENNIFER A. MELMAN
No. C62260
CIVIL
STATE OF CALIFORNIA

Date: January 3, 2022

To: Andre Jadkowski, P.E., NCE

From: Jenny Melman, P.E.,
NASSCO PACP Cert. U-0819-70306761

Subject: City of Richmond
Keller Beach Sanitary Sewer CCTV Review and Assessment Report

At the City's request, Coastland has reviewed CCTV video of the Keller Beach Sanitary Sewer and conducted an assessment of observed pipe conditions. The CCTV video, dated 3/22/2021 – 8/16/2021, was provided by the City of Richmond's Contractor, Bayhawk, Inc., and Subcontractor Express Sewer on August 17, 2021. This report presents our findings. Based on these findings and our understanding of site conditions, we also offer preliminary recommendations for a full pipe replacement in a new alignment outside of the bay.

BACKGROUND

Keller Beach Sanitary Sewer

The Keller Beach sanitary sewer, as shown in City of Richmond Line 'Q' Shoreline Interceptor as-builts, consists of 5,392 linear feet of 8- to 12-inch concrete-encased cast iron pipe. The pipeline, constructed in 1959, is located off Keller Beach in the San Francisco Bay and is submerged during average tides. The location of the sewer is indicated by a red line in the image below and extends from sanitary sewer manhole MH Q-1 (adjacent to the Keller Beach sanitary sewer pump station) to sanitary sewer manhole MH Q-25. See Appendix A for an exhibit of sewer main locations and manhole numbering.

Access to the sanitary sewer pipeline for maintenance or repair is extremely difficult because the manholes are submerged during high tides, and vehicles cannot get within fifty feet of the pipeline due to the cliffs and private property. Access for foot traffic is also limited to public beach access and through private properties.

Existing Facilities
According to the 1959 Shoreline Interceptor as-builts, the Keller Beach sanitary sewer pipe is shown to be cast iron pipe encased in concrete. The Class-B concrete encasement is shown with a typical outer dimension of D+12 inches, where D = pipe diameter.

The sanitary sewer is shallowly buried on the beach in sand (per as-builts, most segments have 2-4 feet of cover). Some segments of the concrete-encased sewer are exposed on the beach. Some manholes were buried at the time of inspection, indicating sand elevations and depth of cover have shifted and varied over time.

Based on the as-builts of the twenty-five (25) sewer structures located within this Shoreline Interceptor pipeline, seventeen (17) are manholes and eight (8) are cleanouts, which the as-builts show to be tees with a plug. There are fifteen (15) bends (fittings) in the sewer main between manhole structures, eight (8) of which are greater than 30 degrees. Four (4) of these bends are greater than 45 degrees.

According to the as-builts, at the time of construction there were the following connections to the Keller Beach Sanitary Sewer: twenty-two (22) sewer laterals, twenty-nine (29) capped tees (future lateral connection points), a 12-inch branch sewer entering at MH Q-9, and two 8-inch branch sewers entering at Hartnett Street (MH Q-15) and at Marine Street (MH Q-19).

OBSERVATIONS OF SEWER MAIN PRIOR TO CLEANING

Express Sewer provided the following general observations of pipe conditions prior to cleaning.

- **Severe internal pipe corrosion** was observed throughout the pipeline length. Water jetting was insufficient to remove the corrosion and clean the pipe. Express Sewer used a chain flail to descale the pipes, which was effective to descale the upper sections of pipeline (MH Q-17 to MH Q-25), but was less effective for the downstream sections (MH Q-1 to MH Q-17).
- **Pipes Full of Water:** The pipeline wouldn't drain when plugged upstream and was holding full of water through most of its length. Standing water appeared to be caused by pipeline sags, the presence of heavy corrosion and deposits that obstructed flows, and possibly infiltration. Standing water was removed during pipe inspections by operating a hydronozzle in the downstream direction in advance of the camera.
- **Sand Deposits:** Much of the pipeline was observed to have substantial sand deposits. Several pipe segments, particularly between MH Q-14 and MH Q-16, were essentially choked full of sand. Considerable effort was required to remove sand and clean the pipe prior to performing a video inspection. Some segments of pipe refilled with sand within the two-week period between the time of cleaning and the next suitable tide condition when crews returned to complete the video inspection, and needed to be cleaned again. The presence of sand in the sewer main is evidence of the presence of holes or defects in the upstream collection system (either the sewer main, laterals, manholes or cleanouts). Another contributing source of sand and I&I was MH Q-14 which was discovered to have no manhole cover (the manhole cover has since been replaced).

- **Defective Laterals:** Several laterals were observable from the beach, either encased in concrete or as exposed cast iron pipe. Some of these laterals have visible breaks or other defects. Broken and defective laterals are considered to be major sources of sand and infiltration in the sewer main s well as possible spills on the bluff and beach. Express Sewer observed pieces of small diameter pipe (broken lateral pipe) in the sewer main, which is further evidence of the presence of defective laterals upstream. We understand that the City is in the process of inspecting and making repairs of these laterals.
- **Limited Maintenance Access:** The cleanout structures (capped tee fittings described as lampholes in Appendix A, Sewer Express Notes) were too small to allow for use of the preferred cleaning and CCTV inspection equipment. The tighter bends in the pipe also limited camera access.
- **Buried Manholes:** At the time of inspection, MH Q-4 and MH Q-5 were buried. They were uncovered and extended to the surface with ABS pipe for the purpose of the inspection efforts.
- **Work Hours Limited due to Tide Constraints:** Cleaning and CCTV inspection work periods were limited to 3-4 hours during negative/low tide conditions. This necessarily resulted in video inspections being rushed.

SEWER CLEANING

Express Sewer conducted pipe cleaning prior to CCTV inspection of the Keller Beach Sanitary Sewer. Prior to cleaning, most segments were impassable to camera equipment due to high levels of sand and deposits and tuberculated pipe corrosion.

Extensive pipe cleaning was conducted, including high-pressure water jetting with a hydronozzle, chain flailing to break off (descale) corroded tubercules, and removal of sand and deposits. According to Express Sewer, pipe cleaning took many hours for most segments due to the high levels of accumulated sand and deposits (particularly near MHs Q-9, Q-14 and Q-15) and/or pipe corrosion that was resistant to descaling.

Figure 1. View of Keller Beach sewer pipe prior to cleaning. Hydro nozzle is in use. Chain flail is in view.

CCTV INSPECTION

At the time of Coastland's review of the CCTV videos, Express Sewer's CCTV inspections had been conducted between MH Q-1 and MH Q-9, and between MH Q-13 and MH Q-25. No inspections have yet been conducted of the 1,144 feet of sanitary sewer between MH Q-9 and MH Q-13.

Express Sewer prepared an exhibit of sewer video locations and a spreadsheet with inspection notes (attached as Appendix A). The exhibit and spreadsheet have color coding for each sewer segment indicating various inspection results. Green colored segments indicate segments where the video captured clear visual images of the pipe interior. Yellow colored sewer segments indicate partial or limited visual images of the pipe interior. CCTV inspection of the remaining sewer segments (red-colored in spreadsheet, not colored on exhibit) did not obtain a clear visual image of the pipe or video inspection was not completed.

The CCTV video inspections conducted to date consist of 4,221 feet of pipe (out of the 5,392 linear feet of sewer per the as-builts). According to Sewer Express, the videos had the following characteristics:

- 2,735 feet of clear visual inspection (green coded)
- 1,108 feet of limited clear visual inspection (yellow coded)
- 379 feet of incomplete or not completed video (red coded)

Eight of the videos were incomplete. Five of the incomplete videos recorded inspections for less than 50% of the pipe length. Three of the incomplete videos did not have distances measured so their lengths are unknown. Incomplete videos were generally caused by pipe obstructions, impassable bends, poor access which prevented the inspectors from using the equipment needed to drawdown the water level in the pipe, or for unknown reasons.

REVIEW OF CCTV INSPECTION

Coastland reviewed CCTV videos and prepared inspection reports for each segment as discussed in the section above. All comments are based on NASSCO PACP standards and guidelines. The CCTV inspection reports are attached as Appendix B. A summary table of CCTV inspection observations is included as Table 1.

CONDITIONS ASSESSMENT

Our assessment of pipe conditions was limited to the portions of the pipe that were observable on the inspection video. Most of the CCTV inspection videos are of poor quality in terms of presenting a complete view of wall conditions throughout the entire length of pipe. The CCTV inspections were conducted under extremely difficult site limitations and time restraints (due to tide) so the resulting poor video quality is expected and understandable. Several inspections were incomplete due to obstructions or camera being underwater. Other inspections were blurry or shaky and taken at high speed. Often there were significant periods where the camera was underwater (with zero visibility) or the camera was pointed at the soffit and only portions of the pipe were visible.

A general assessment of pipe deficiencies are summarized below.

Interior Pipe Wall Conditions

According to Express Sewer, the entire reach of Keller Beach sanitary sewer was extremely corroded prior to cleaning. As shown in the post-cleaning images below, the upstream reach of pipe (MH Q-17 to MH Q-25) was generally descaled, while further downstream (MH Q-1 to MHQ-17) extensive turberculation and wall roughness remains.

MH Q-1 to MH Q-2

MH Q-2 to MH Q-3

MH Q-3 to MH Q-4

MH Q-4 to MH Q-5

MH Q-5 to CO Q-6

CO Q-6 to CO Q-8
(MH Q-7 was not constructed)

CO Q-8 to MH Q-9 	No CCTV provided between MH Q-9 and MH Q-13
MH Q-13 to MH Q-14 	MH Q-14 to MH Q-15 
MH Q-15 to CO Q-16 	CO Q-16 to MH Q-17 
MH Q-17 to CO Q-18 	CO Q-18 to MH Q-19 

MH Q-19 to CO Q-20 	CO Q-20 to CO Q-22 
CO Q-22 to CO Q-24 (blurry – poor visual) 	CO Q-24 to MH Q-25 

No holes or cracks were observed in any segment (that was visible) of the Keller Beach sanitary sewer main, though the pipe walls show extensive evidence of pipe corrosion. Corrosion of the pipe walls (with a decrease of the pipe's structural integrity) has resulted over time due to the presence of corrosive hydrogen sulfide gas, a natural sewer gas, in the unlined pipe. The presence of extensive sags and pipe obstructions further exacerbate the problem by causing organic solids to settle and increases localized hydrogen sulfide gas production in the pipe. Corrosion will continue to deteriorate the pipe's structural integrity as long as the pipe remains exposed to sewage gases.

Sags in Pipe Profile

In the Keller Beach sanitary sewer, most segments were observed to remain full of water after cleaning, even after the upstream flow has been plugged. Non-draining gravity pipes are generally caused by sags in the pipe profile or obstructions/pipe roughness. All of these conditions are present in the Keller Beach sanitary sewer to varying degrees.

When water levels are high enough for the camera to be submerged underwater, that is generally an indication of a severe sag in the pipe. Moderate to severe sags were present in twelve (12) of the seventeen (17) inspected pipe segments.

Sags in the pipe profile have likely resulted from inconsistent pipe support from the subgrade due to shifting sand under and around the pipe. Sags are expected to worsen as the pipe's structural integrity weakens.

Broken Laterals and Missing MH cover

Prior to cleaning, several segments of the pipe were choked with sand, which is evidence of breaks in the collection system, which allows inflow of seawater and sand into the sewer collection

system. Some segments reportably refilled with sand in two weeks, suggesting the defects are extensive. Recent inspection by Bayhawk of sewer laterals on the beach has shown evidence of cracks and breaks. The City is currently undergoing the assessment and repair of these laterals which should significantly reduce the inflow of seawater and sand into Keller Beach sanitary sewer.

CONCLUSIONS

Coastland draws the following conclusions based on our CCTV assessment and understanding of the site conditions.

Poor Pipe Conditions
The Keller Beach sanitary sewer has been in service for approximately 62 years and has reached the end of its useful design life. The pipe that is visible and CCTV inspected is highly corroded and the remaining wall thickness and structural strength is unknown, but clearly compromised. The sewer main has been partially descaled but remains weakened and increasingly prone to cracks and breaks. The pipe's profile has extensive sags, and will continue to sag and adjust due to its location in the surf zone under the force of shifting sand and wave action. Laterals are in poor condition with known and suspected defects which the City/Homeowners are obligated to correct.

Poor Access Conditions
Access is poor to the Keller Beach Sewer which makes repair and maintenance difficult and expensive. Access issues include:

- Lack of vehicle access to the sewer main on the beach.
- Limited foot traffic access due to private property and cliffs.
- Work periods that are restricted to negative/low tide conditions (often 3-4 hours). The sewer pipe is underwater and inaccessible during normal tide conditions.
- Lack of manholes at sharp bends in the sewer alignment. Bends greater than 30 degrees can block equipment access for maintenance and inspection.
- Cleanout structures are too small to allow equipment access for maintenance and inspection.
- Manhole lids are corroded shut and must be replaced whenever they are opened.
- Beach access is slippery and creates a hazardous work condition.

High Risk of Environmental Impacts in the Event of Pipe Failure
Due to the sewer main's location in the bay, a pipe failure would cause significant and unavoidable environmental impacts.

Environmental Permitting
Environmental permits will most likely be required for improvements to the sanitary sewer system and may be very difficult to obtain.

RECOMMENDATIONS

Coastland recommends that the City take immediate action to address the following deficiencies in the Keller Beach Sanitary Sewer:

- Poor conditions of the sewer main pipe, access points, and laterals;
- Poor access conditions for repair and maintenance; and
- High risks and costly environmental impacts in the event of a pipe failure.

For the City's consideration, Coastland offers two options for making the needed improvements: repair of the existing system in place, and replacing the sewer main in a new location.

Option 1: Repair of the Existing Sewer Main
The preferred method of repairing the sewer main in place would be Cured-in-Place Pipe (CIPP) lining, which is a completely trenchless repair method which involves a heat or UV-cured resin-impregnated "sock" liner that can be installed through manholes. Express Sewer, a CIPP contractor, evaluated the possibility of CIPP-lining the sewer main and considered the project doable but expensive. The following tasks would likely be required:

- Repair the sewer laterals that are causing the sewer main to fill with sand (in progress). Sewer laterals that are broken or crushed will need to be replaced and reconnected to the sewer main.
- Descale the pipe walls of the lower portion of the sewer main and remaining pipe segments not yet cleaned or CCTV inspected using robotic equipment to remove tuberculation and roughness. It should be verified that descaling can be done to the degree that CIPP lining can be applied.
- Install manholes at tight bends and as needed for equipment access. This task would require open cut excavation and a system to dewater/dam the excavation area. Environmental permitting may not allow for open cut excavation in the bay.
- CIPP-line the sewer mains.
- CIPP-line the sewer laterals (if possible) and seal the lateral/main connection with a top-hat.

The benefits of CIPP-lining the sewer main would be to prevent further corrosion and extend the design life of the sewer main. The CIPP-liner would provide some minimal structural wall strength, but would not fully recover the lost pipe strength and ductility which is unknown. Additional assessment of the existing cast iron pipe thickness and strength would be needed to evaluate whether the CIPP-lined sanitary sewer main would provide sufficient strength to withstand site conditions. The extended design life of the CIPP-lined pipe is difficult to predict.

The drawbacks of the CIPP liner option are that the repair:

- Does not provide a full new construction design life to the sewer main facilities,
- Does not correct sags, and the pipe profile will continue to adjust and degrade,
- Does not address the poor maintenance access, and
- Does not address the high-risk and cost of sanitary sewer overflows into the bay in the event of a pipe break,

- Is an extremely costly repair.
- Environmental permits will most likely be required for improvements to the sanitary sewer system and may be very difficult to obtain.

Option 2: Replacement of the Keller Beach Sewer in a New Location
The replacement of the Keller Beach Sewer in a new location would involve the following tasks:

- Conceptual design of lift stations and alignment options,
- Alternative Analysis,
- Survey,
- Land or Easement Acquisition,
- Detailed Design,
- Permitting,
- Funding Acquisition,
- Construction of new sewer main and lift stations/Abandonment or removal of existing facilities, and
- Installation of residential lift stations in houses below the proposed sewer main.

The benefits of this option is that it is capable of addressing all the deficiencies of the existing Keller Beach Sanitary Sewer, and providing a full design life for the new facilities.

The major drawbacks of the sanitary sewer main replacement options are that it:
- Is an extremely costly project,
- Would take years to implement, and
- Would need numerous Homeowners' participation.

Coastland's preliminary assessment is that Option 1: CIPP-lining the Keller Beach sewer main may be constructable with additional study (additional CCTV, descaling and pipe material thickness study), but is an expensive repair that does not sufficiently address the deficiencies of the system to render it a cost-effective solution. In addition, environmental permits will most likely be required for improvements to the sanitary sewer system and may be very difficult to obtain. Option 2: Replacement of the Keller Beach Sewer is an expensive solution but it addresses all the system deficiencies. Coastland considers the high cost of replacement to be a necessary expense to avoid the high risk of pipe failure due to aged sanitary sewer system that is difficult to maintain.

Coastland advises the City to conduct its own assessment and take immediate action to address the Keller Beach sanitary sewer deficiencies.

In the short term, Coastland supports the City's in-progress efforts to CCTV inspect and repair or replace the sewer laterals connecting to the Keller Beach Sanitary Sewer.

Coastland/NCE/City of Richmond
Keller Beach Sewer CCTV Assessment
Table 1. Summary Table of CCTV Inspection Observations

Downstream MH	Upstream MH	Direction of Survey	Pipe Length	Inspection Length	% of Pipe Inspected	Pipe Size (in)	Pipe Material	Interior Pipe Wall Condition	Water Level Condition during Inspection	Pipe Features Observed	General Inspection Notes
MH Q-1	MH Q-2	DS	393	153	39%	12	CI	Severe roughness remains after descaling efforts, especially on top half of pipe.	Pipe holding full of water; Water surface pulled down by hydronozzle, even so pipe was typically 20-50% full; Moderate to severe sags	Start at MH Q-2; Did not reach MH Q-1; No laterals observed	Distance indicated on camera was not accurate; Forward progress in camera stopped due to obstruction
MH Q-2	MH Q-3	DS	139	139	100%	12	CI	Severe roughness remains after descaling efforts, especially on top half of pipe.	Pipe holding full of water; Water surface pulled down by hydronozzle, even so pipe was typically 20-50% full; Moderate to severe sags	Start at MH Q-3; Inspection ended at MH Q-2; No laterals	Complete inspection
MH Q-3	MH Q-4	DS	242	242	100%	12	CI	Severe roughness remains after descaling efforts, especially on top half of pipe.	Pipe holding full of water; Water surface pulled down by hydronozzle. Water level 5-10% during inspection	Start at MH Q-4; Inspection ended at MH Q-3; 2 laterals observed	Complete inspection
MH Q-4	MH Q-5	DS	219	Unknown	Unknown	12	CI	Severe roughness remains after descaling efforts. Infiltration runner observed (at 21:20 minutes)	Pipe holding full of water; Water surface pulled down by hydronozzle. Water level 5-10% during inspection	Start at MH Q-5; Did not reach MH Q-4; No laterals observed	Distance indicated on camera was not accurate; Camera stopped due to unknown impediment
MH Q-4	MH Q-5	US	219	96	44%	12	CI	Severe roughness remains after descaling efforts, especially top half of pipe.	Pipe holding full of water; Water surface pulled down by hydronozzle, even so pipe was typically 5-40% full; Moderate sags	Start at MH Q-4; Did not reach MH Q-5; 6" sewer connected at MH Q-4	Distance indicator working; Inspection abandoned by debris in pipe.
MH Q-5	CO Q-6	DS (reverse)	305	291	95%	12	CI	Significant/Severe roughness remains after descaling efforts.	Pipe holding almost full of water; Camera underwater; Severe sags	Start at CO Q-6; Did not reach MH Q-5; No laterals observed	Inspected in reverse. Distance indicator not working. Poor visual - view obscured by pull-rope. No survey from CO-6 for 14.3'. Inspection abandoned at sharp 30-degree bend.
CO Q-6	CO Q-8 (MH Q-7 was not constructed)	DS (reverse)	357	Unknown	Unknown	12	CI	Unknown: Pipe wall visible for only 11 seconds of video. Severe roughness remains after descaling efforts.	Pipe full of water during survey: Camera underwater; Severe sags	Start at CO Q-8; Did not reach CO Q-6; No laterals observed	Pull back with push camera; Unusable footage due to equipment limitations because of poor access; Only visual was 11 seconds on partial pipe wall (16:08 - 16:19)
CO Q-8	MH Q-9	DS	182	21.7	12%	12	CI	Significant/Severe roughness remains after descaling efforts. Only 22' of pipe was observed.	Inspectors unable to plug off flows for TV inspection due to large line coming in from neighborhood. Pipe at start flowing 40-50%. Camera underwater; Severe sags	Start at MH Q-9; Did not reach CO Q-8; No laterals observed	Camera blocked by tuburculated corrosion at 22'
MH Q-9	MH Q-10		257	0	0%	12	CI	No CCTV provided			
MH Q-10	CO Q-11		166	0	0%	12	CI	No CCTV provided			
CO Q-11	MH Q-12		393	0	0%	12	CI	No CCTV provided			
MH Q-12	MH Q-13		328	0	0%	12	CI	No CCTV provided			

Coastland/NCE/City of Richmond
Keller Beach Sewer CCTV Assessment
Table 1. Summary Table of CCTV Inspection Observations

Downstream MH	Upstream MH	Direction of Survey	Pipe Length	Inspection Length	% of Pipe Inspected	Pipe Size (in)	Pipe Material	Interior Pipe Wall Condition	Water Level Condition during Inspection	Pipe Features Observed	General Inspection Notes
MH Q-13	MH Q-14	DS	261	261	100%	12	CI	Significant/severe roughness observed, expecially top half of pipe; Grease observed	Pipe was empty during inspection. Water surface pulled down by hydronozzle. Camera underwater	Start at MH Q-14; Intruding lateral at 161.1'; Inspection ended at MH Q-13	Complete inspection
MH Q-14	MH Q-15	DS	173	Unknown	Unknown	12	CI	Severe roughness observed, expecially top half of pipe; Deep sags present throughout pipe	Water level 25-100%; Camera underwater; Severe sags	Start at MH Q-15; Did not reach MH Q-14;	High-flowing lateral into MH Q-15; Visual poor due to high water level
MH Q-15	CO Q-16	DS	252	45	18%	10	CI	Severe roughness observed, especially top half of pipe.	Water level 15-50%; Moderate to severe sags	Start at CO Q-16; Did not reach MH Q-15	Camera blocked by tuburculated corrosion at 45'
MH Q-15	CO Q-16	US	252	15	6%	10	CI	Unknown: No pipe visual	Inspectors unable to drawdown water due to reverse setup; Camera underwater 0-15'+; Severe sag	Start at MH Q-15; Did not reach CO Q-16;	No visual due to high water; Inspection abandoned at 15'; Could not drawdown water due to poor access conditions from CO;
CO Q-16	MH Q-17	DS	207	208	100%	10	CI	Significant/Severe roughness observed	Water level 5-50%; Moderate to severe sags	Start at MH Q-17; Lateral at 188.1'; Bend at 206'; Ended at CO Q-16	Good pipe visual; Difficulty passing bend in pipe
MH Q-17	CO Q-18	DS (reverse)	246	246	100%	10	CI	Pipe visual is poor; Where pipe is clear, pipe appears to be fully descaled. Evidence of significant pipe corrosion, especially top half of pipe.	Water level 5-100% Severe sags (camera underwater) last third of pipe up to MH Q-17	Start at MH Q-17; Push cam to CO Q-18; Pull back with hydronozzle; Ended at CO Q-18	Poor pipe visual; rapid/shaky footage; only one side of pipe in view; no stills to inspect pipe condition; distance meter not working
CO Q-18	MH Q-19	US (reverse)	185	185	100%	10	CI	Pipe walls are fully descaled after cleaning. Rough wall surface.	Pipe holds water, may be due to sags. Water level 10-20% in reverse footage	Start at MH Q-19; Push cam to CO Q-18; Pull back with hydronozzle; 2 laterals observed; Ended at MH Q-19	Pipe inspected in reverse. MH Q-19 appears to be possible source of I/I and should be inspected.
MH Q-19	CO Q-20	DS	201	201	100%	8	CI	Pipe walls are fully descaled after cleaning. Rough wall surface.	Water level 5-100% Severe sags (camera underwater)	Start at CO Q-20; Push cam to MH Q-19; Pull back with hydronozzle; 1 lateral observed at 5'; Ended at CO Q-20	Push cam operated in reverse. Poor visual: rapid/shaky footage; no stills to inspect wall condition
CO Q-20	CO Q-22	US (reverse)	273	273	100%	8	CI	Rough wall surface. Pipe walls are fully descaled after cleaning. Poor visual (blurry and rapid return footage)	Low water level in most of reverse footage due to hydronozzle. Severe sags; Camera underwater 206'-226'	Start at CO Q-22; Ended at CO Q-20; Pull back with hydronozzle; Ended at CO Q-22	Push cam operated in reverse. Poor visual: rapid/shaky footage; no stills to inspect wall condition
CO Q-22	CO Q-24	DS (reverse)	344	344	100%	8	CI	Very poor visual (blurry and rapid). Rough wall surface. Pipe walls appear to be fully descaled after cleaning.	Low water level in footage due to hydronozzle.	Start at CO Q-24; End at CO Q-22	Push cam operated in reverse. Poor visual: rapid/shaky footage; no stills to inspect wall condition
CO Q-24	MH Q-25	DS	307	274	89%	8	CI	Rough wall surface. Pipe walls are fully descaled after cleaning. Poor visual (blurry and rapid return footage)	Water level 5-25%	Start at MH Q-25; 2 laterals observed; Did not reach CO Q-24	Push cam operated in reverse. Poor visual: rapid/shaky footage; no stills to inspect wall condition; complete inspection (including US footage)

Coastland/NCE/City of Richmond
Keller Beach Sewer CCTV Assessment
Table 1. Summary Table of CCTV Inspection Observations

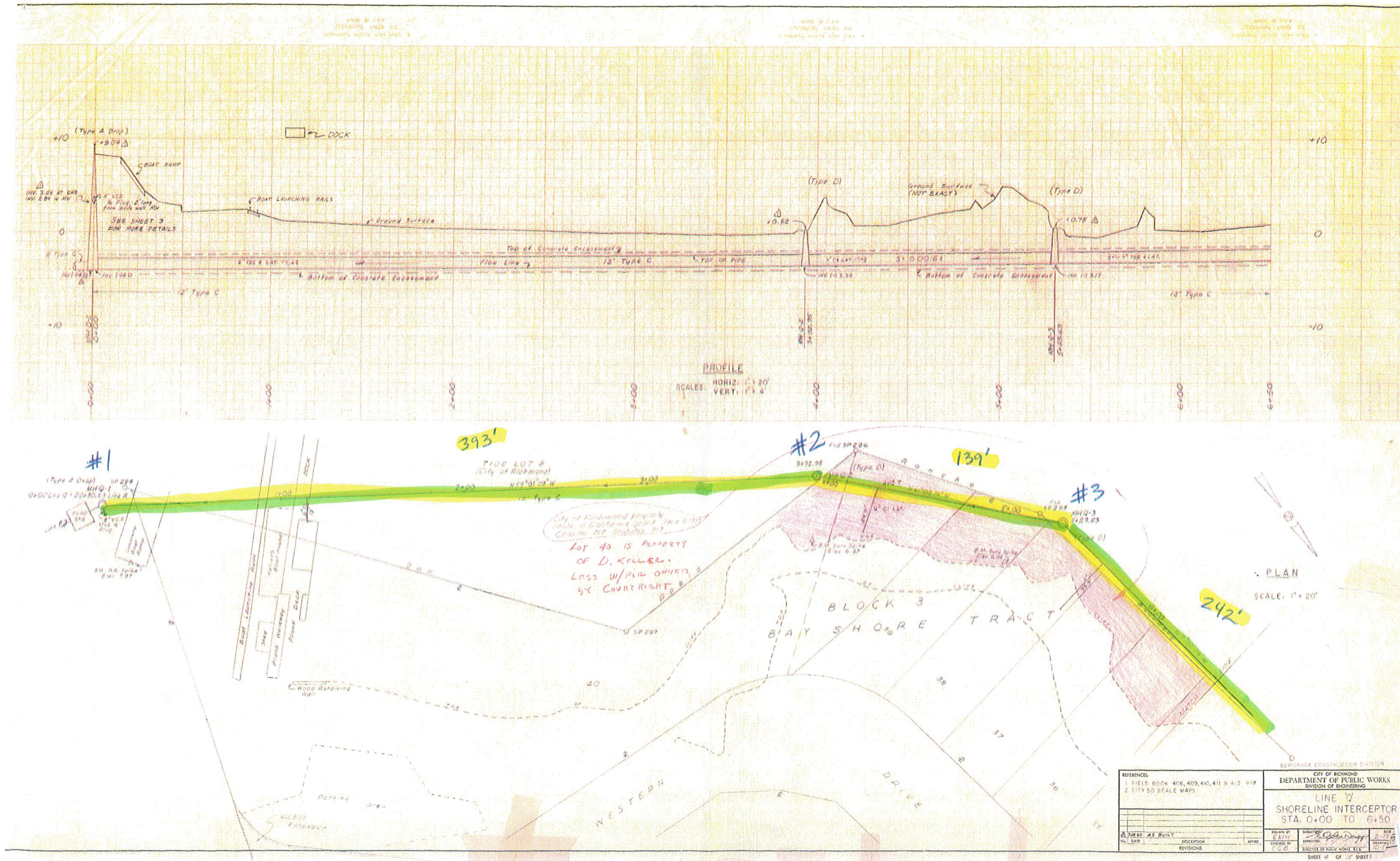
Downstream MH	Upstream MH	Direction of Survey	Pipe Length	Inspection Length	% of Pipe Inspected	Pipe Size (in)	Pipe Material	Interior Pipe Wall Condition	Water Level Condition during Inspection	Pipe Features Observed	General Inspection Notes
CO Q-24	MH Q-25	US	307	70	23%	8	CI	Rough wall surface. Pipe walls are fully descaled after cleaning. Poor visual (rapid footage)	Water level 5-10%	Start at CO Q-24; 1 lateral observed (overlapping DS inspection); Did not reach MH Q-25	Push cam operated in reverse. Poor visual: rapid/shaky footage; no stills to inspect wall condition; complete inspection (including DS footage)

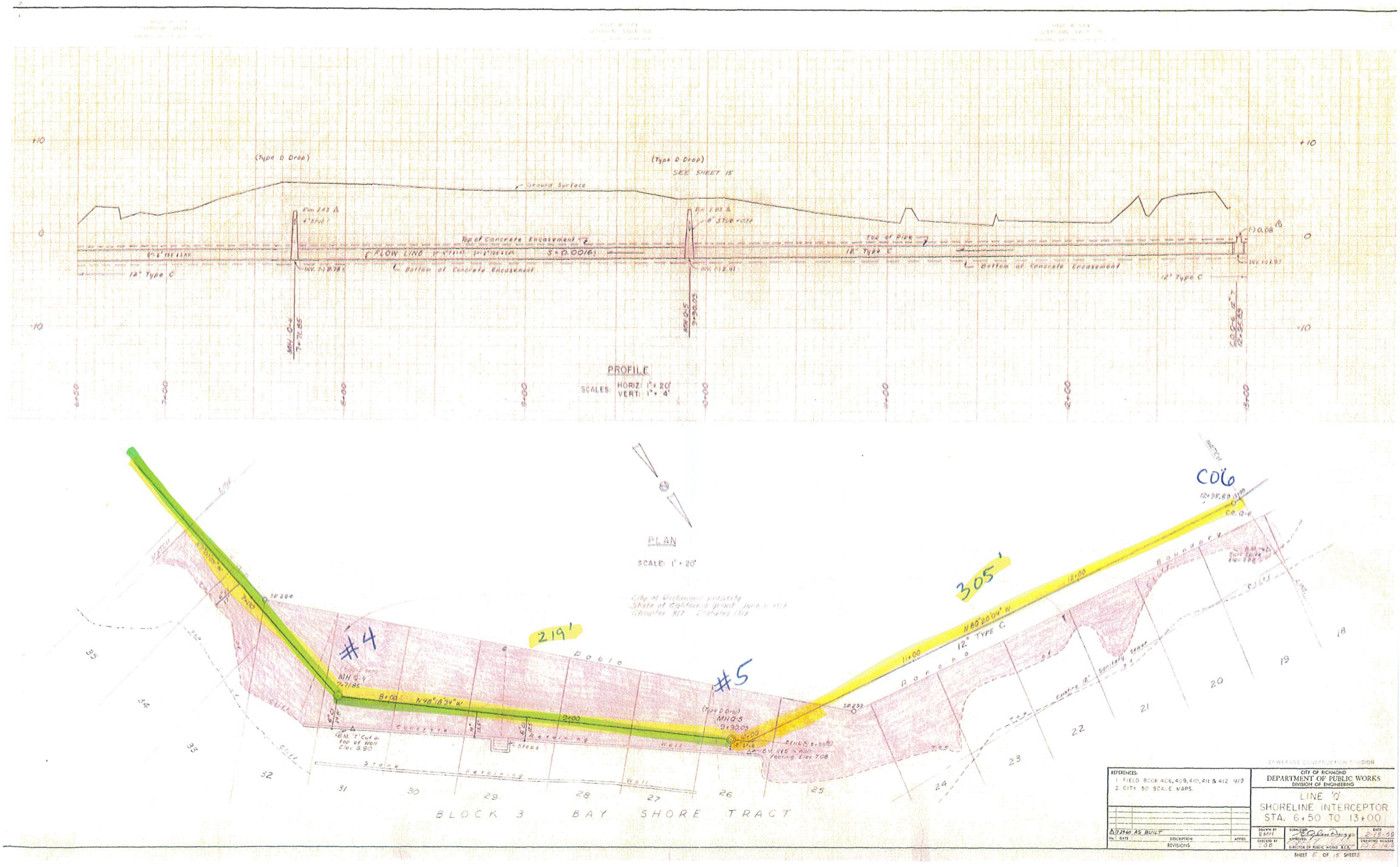
APPENDIX A:

EXPRESS SEWER NOTES AND EXHIBIT

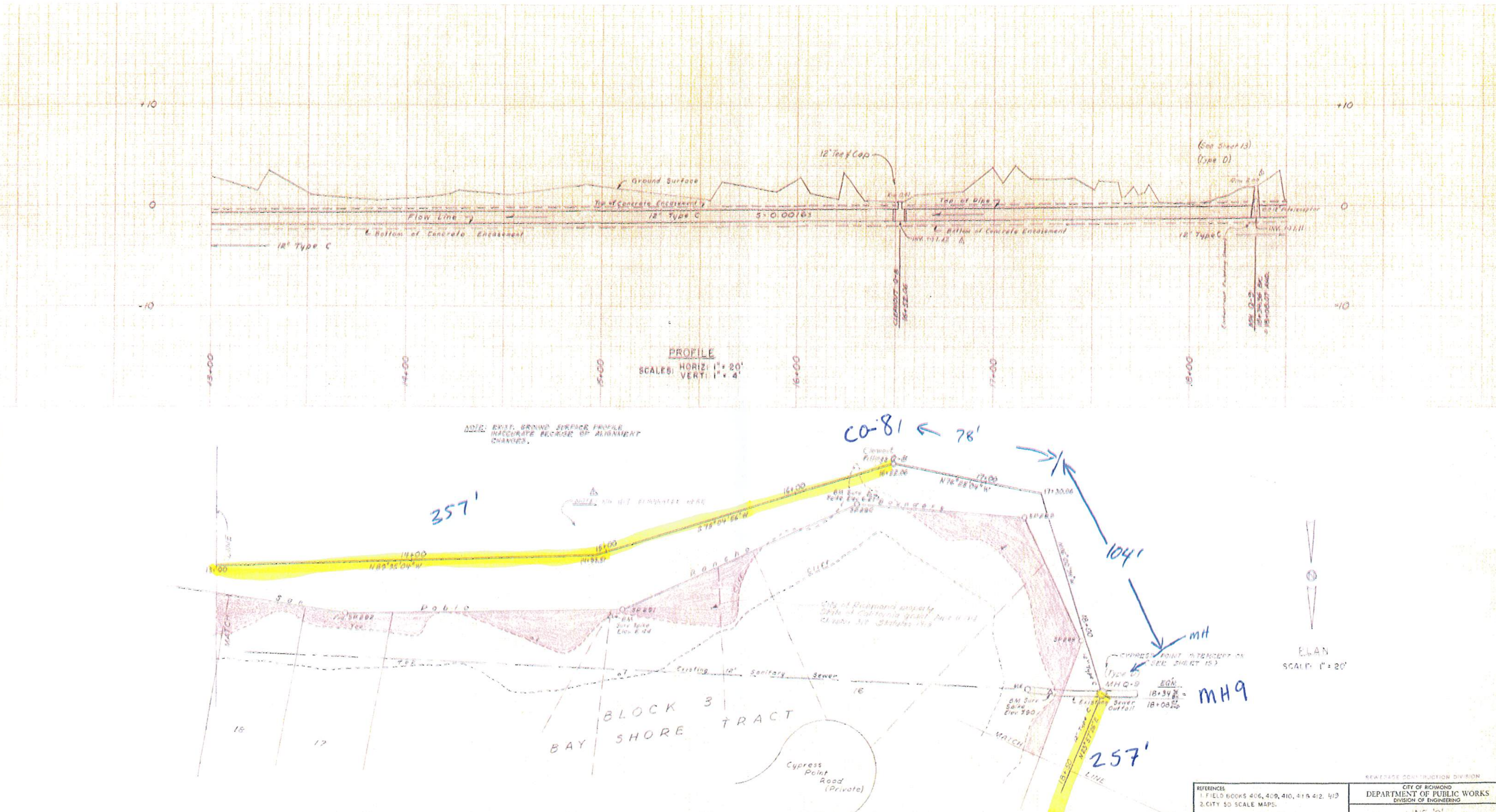
City of Richmond
Keller Beach Sewer Video Notes

Start Node	End Node	Distance	Notes	
MH 4	MH 3	237.0	Left Tap @ 78.8' Left Tap @ 210.3' Clear visual	
MH 3	MH 2	137.0	Pipe holding full pipe water, used Vaccon to pull water down for TV inspection	
MH 2	MH 1	393.0	Pipe holding full pipe water, used Vaccon to pull water down for TV inspection	
MH 5	MH 4	233.0	Pipe holding full pipe water, used Vaccon to pull water down for TV inspection	Part 1
MH 4	MH 5	96.0	Pipe holding full pipe water, used Vaccon to pull water down for TV inspection	Part 2
CO 6	MH 5	320.0	Pipe holding almost full pipe water, no acces with mainline TV camera from US CO. Inspected from downstream to upstream CO-06. Pulled back camera while recording to capture visual of pipe. Operator wheel rolled distance and made it to MH 5 Clear visual from 319.8' - 203.8' Belly from 203.8' (Approximately 3 - 5 ft no clear visual) hard to determine due to distance staying at 203.8' on pull back. Clear visual approximately from 198.8' - 58.1' Belly approximately from 58.1' - 14.3', TV truck got a visual up to the bend There is still an unclear visual from CO 6 up to 14.3'	
CO 8	CO 6	357.0	Pipe holding full pipe water, no accress thru lamphole for mainline TV camera, camerad with push camera and pulled back live.Clear visual @ 16:08 - 16:19 from video (Distance stayed at 0.0 Ft throughout video, couldn't determine distance). Operator wheeled rolled distance from CO 8 to CO 6. 357'	
MH 9	CO 8	21.7	Unable to plug off flows for TV inspection due to large line coming in from neighborhood. Pipe at start flowing 40-50%. Clear visual up to 21.7' Unable to pass corrosion in pipe at 21.7'. Pipe has severe scaling that camera could not pass and cleaning crew could not remove with chain flail. Line is incomplete	
MH 17	CO 16	208.0	Pipe is in fair condition, some areas of moderate to severe scaling. Left Tap @ 188.1' 45 bend in pipe 3' from CO 16	
CO 16	MH 15	45.0	Attempted to Tv inspect pipe from MH15 reverse but too much water to get visual. Set up from MH 17, ran camera down to CO16. Started TV inspection, Clear visual to 45 ft. Severe corrosion @ 45.3', unable to pass Did not meet up, line is incomplete	Part 1
MH 15	CO 16	153.0	Belly from 0.0' - 15.3' Unable to Camera due to line holding water and reverse setup Did not meet up, line is incomplete	Part 2
MH 19	CO 18	189.0	Mainline holds water, Tv insopected while Jetting to pull water out of pipe. Captured clear video of pipe during pull back with footage. Left Tap @ 42.5' Left Tap @ 94.4' Clear visual from pull back	
CO 18	MH 17	246.0	Unable to access with main line camera, unable to push with push camera, operator had to pull push camera in with hydro nozzle and then video while pulling camera back. There are sections in the video that have clear and not clear visual. Operator made it to MH 17. Footage distance shows 0.0 throughtout due to process. Operator verifies footage with wheel roller.	
CO 20	MH 19	201.0	Clear visual	
CO 22	CO 20	275.0	Unable to access with main line camera, unable to push with push camera, operator had to pull push camera in with hydro nozzle and then video while pulling camera back, 7:08 mark	
CO 24	CO 22	344.0	Unable to access with main line camera, unable to push with push camera, operator had to pull push camera in with hydro nozzle and then video while pulling camera back with hydro running to capture video. Footage distance shows 0.0 throughtout due to process. operator verifies footage with wheel roller.	
MH 25	CO 24	274.0	Left Tap @ 232'10" Left Tap @ 177'4" No clear visual from 0'0" - 13'0" Line is incomplete Overlapped with inspection #2, confirmed by locating	Part 1
CO 24	MH 25	70.0	Right Tap @ 58'7" Right Tap @ 67'5" Overlapped with inspection #1, confirmed by locating	Part 2
MH 15	MH 14	162.0	Pipe Has poor grade , crew fighting water and areas of corrosion in pipe. Crew had to follow hydro nozzle close for visual. Close to nozzle video 0 - 162' then debris, unable to pass end of video	
MH 14	MH 13	260.0	Left Tap @ 161.2' Clear Visual Segment of belly @ 232.0' - 242.4'	


(Type A Drop)
+9.04
BOAT RAMP
DOCK
INV. 3.04 AT END
INV. 2.84 IN MH
8" VCP & Plug 2' long from inside wall MH
Boat LAUNCHING RAILS
SEE SHEET 3 FOR MORE DETAILS
Ground Surface
Top of Concrete Encasement
Flow Line
12" Type C
Top of Pipe
Bottom of Concrete Encasement
(Type D)
+0.52
Ground Surface (NOT EXACT)
+0.78
12" Type C
PROFILE
SCALES: HORIZ: 1" = 20' VERT: 1" = 4'
0+00
1+00
2+00
3+00
4+00
5+00
6+00
6+50
+10
0
-10
#1
393'
#2
139'
#3
242'
(Type A Drop)
MHQ-1
SP 298
Pump Sta
TIDE LOT 8 (City of Richmond)
12" Type C
3+92.95
MHQ-2
Fnd SP 296
(Type D)
MHQ-3
5+29.63
Fnd SP 295
City of Richmond property State of California grant June 8 1913 Chapter 317 Statutes 1913
Lot 40 is PROPERTY OF D. KELLER. LESS W/PAR OWNED BY COURTRIGHT
Boat Launching Rails
Keller's Boat House
DOCK
Shed
Plank Walkway
Plank Deck
Wood Retaining Wall
SP 297
BLOCK 3
BAY SHORE TRACT
40
39
38
37
36
35
MATCH LINE
Parking Area
ACCESS EASEMENT
WESTERN DRIVE
PLAN
SCALE: 1" = 20'
SEWERAGE CONSTRUCTION DIVISION
REFERENCES:
1. FIELD BOOK 406, 409, 410, 411 & 412 419
2. CITY 50 SCALE MAPS
7-28-60 AS BUILT
No. DATE DESCRIPTION APPRD.
REVISIONS
CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING
LINE 'Q'
SHORELINE INTERCEPTOR
STA. 0+00 TO 6+50
DRAWN BY EMH
CHECKED BY CGB
SUBMITTED
APPROVED
DIRECTOR OF PUBLIC WORKS R.C.E.
DATE 2-13
DRAWING 10-E
SHEET 4 OF 15 SHEETS



(Type D Drop)
(Type D Drop)
SEE SHEET 15
Ground Surface
Top of Concrete Encasement
FLOW LINE
S = 0.0016
Bottom of Concrete Encasement
Top of Pipe
12" Type C
INV. (-) 12.41
(-) 0.08
MH Q-4 7+71.85
MH Q-5 9+90.03
C.O. Q-6 12" T 12+95.89
+10
0
-10
6+50
7+00
8+00
9+00
10+00
11+00
12+00
13+00
PROFILE
SCALES: HORIZ: 1" = 20' VERT: 1" = 4'
PLAN
SCALE: 1" = 20'
City of Richmond property
State of California grant June 1913
Chapter 317 Statutes 1913
#4
#5
CO6
219'
305'
MH Q-4
7+71.85
8+00
N48°18'34"W
9+00
(Type D Drop)
MHQ-5
9+90.03
10+00
8" Stub
BEND @ 9+99.83
B.M. N15 in Wall Footing Elev 7.08
B.M. 'T' Cut in top of Wall Elev 9.90
SP 284
SP 293
11+00
12+00
N80°20'04"W
12" TYPE C
12+95.89
Rancho
Boundary
Pablo
Concrete
Retaining
Wall
Stone
Retaining
Wall
Steps
Existing 12" Sanitary Sewer
Toe
Cliff
MATCH LINE
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
BLOCK 3 BAY SHORE TRACT
SEWERAGE CONSTRUCTION DIVISION
REFERENCES:
1. FIELD BOOK 406, 409, 410, 411 & 412, 419
2. CITY 50 SCALE MAPS.
7-29-60 AS BUILT
No. DATE DESCRIPTION APPRD.
REVISIONS
CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING
LINE 'Q'
SHORELINE INTERCEPTOR
STA. 6+50 TO 13+00
DRAWN BY EMH
CHECKED BY CGB
SUBMITTED
APPROVED:
DIRECTOR OF PUBLIC WORKS R.C.E.
DATE 2-13-59
DRAWING NUMBER 10-E-1416
SHEET 5 OF 15 SHEETS



SEWERAGE CONSTRUCTION DIVISION

REFERENCES
1. FIELD BOOKS 406, 409, 410, 411 & 412, 413
2. CITY 50 SCALE MAPS.

No.	DATE	DESCRIPTION	APPRD.
1	7-29-60	AS BUILT	

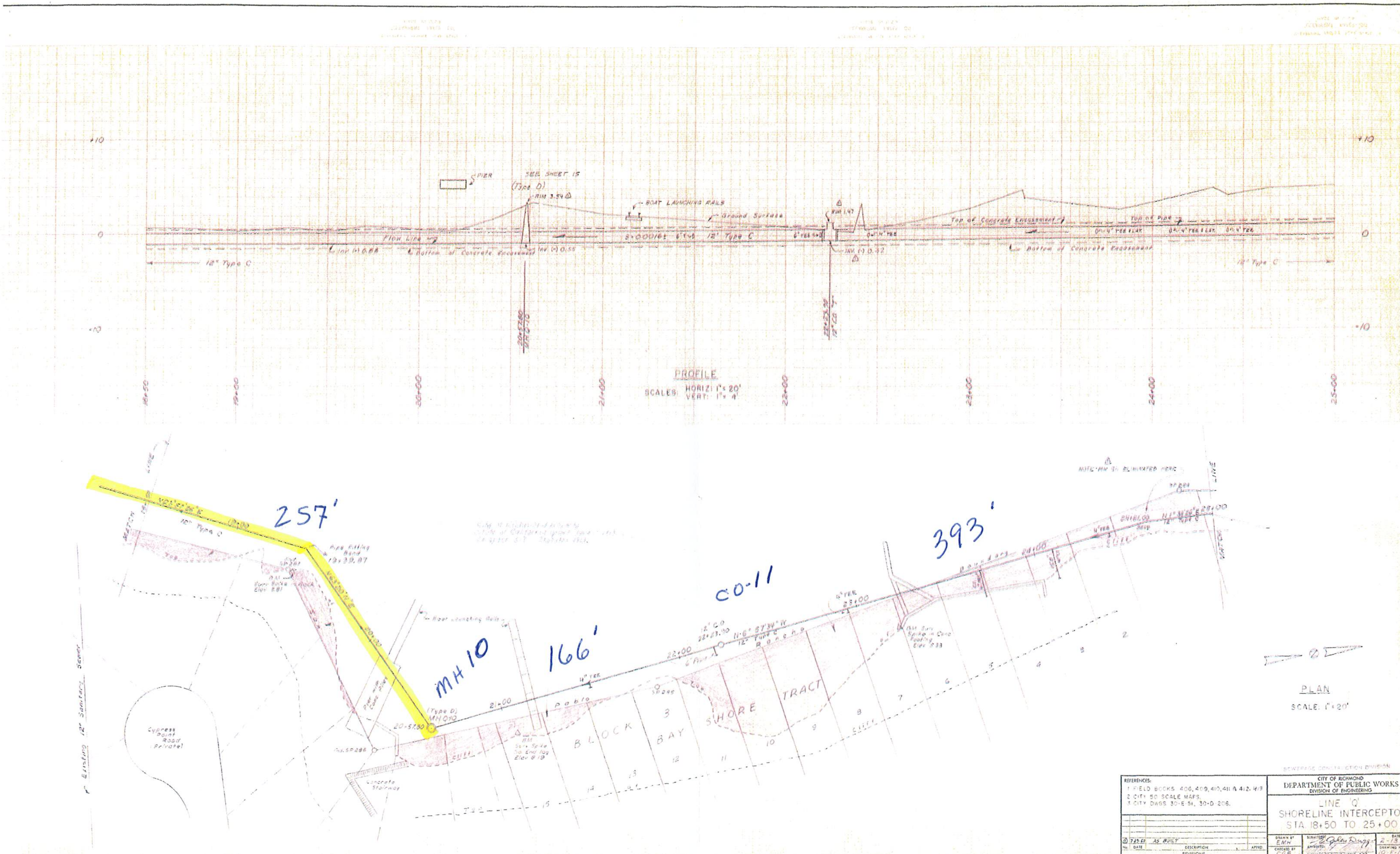
REVISIONS

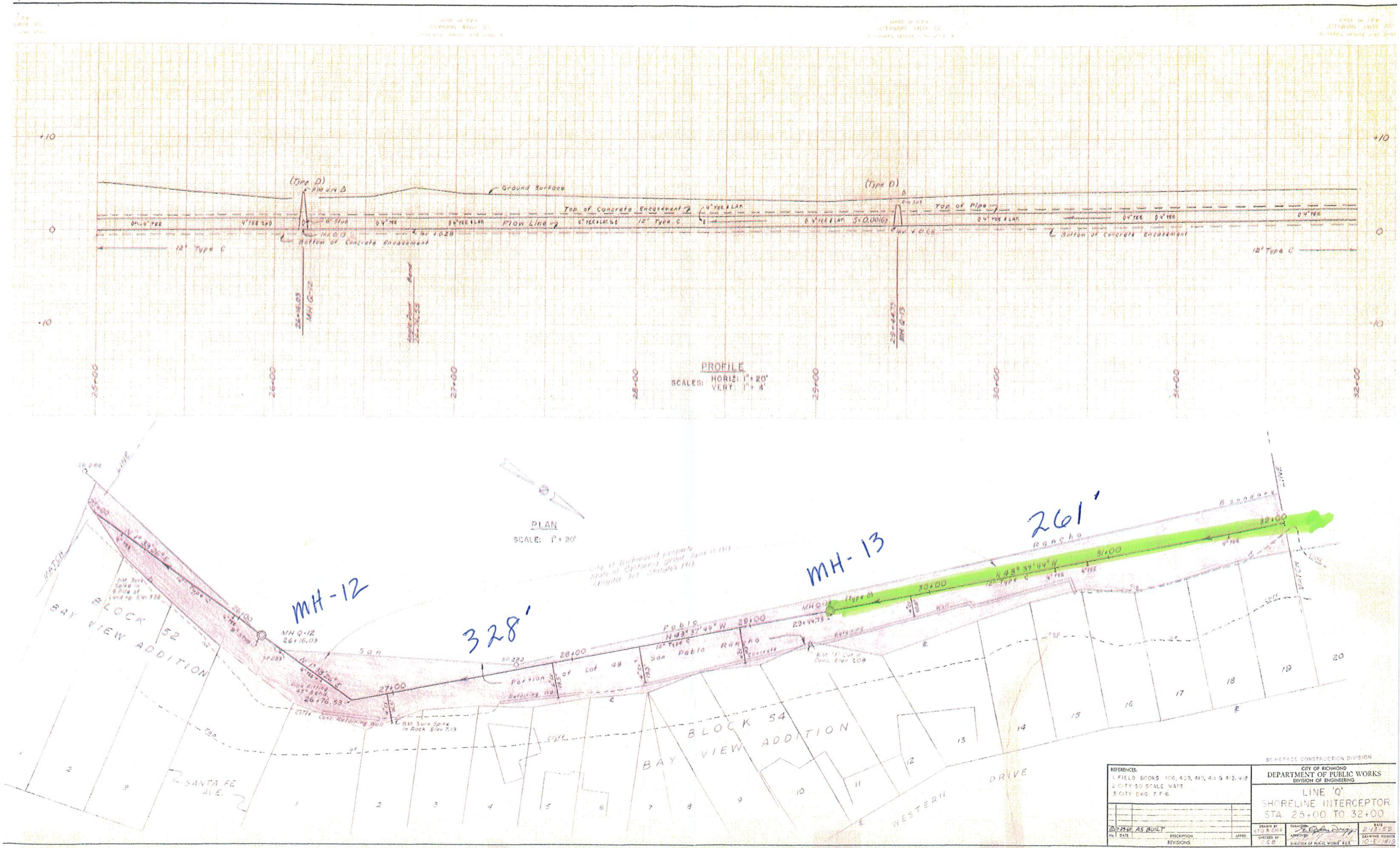
CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING

LINE 'Q'
SHORELINE INTERCEPTOR
STA. 13+00 TO 18+50

DRAWN BY: EMH
CHECKED BY: CGB
SUBMITTED / APPROVED: DIRECTOR OF PUBLIC WORKS
DATE: 2-13-59
DRAWING NUMBER: 10-E-1417

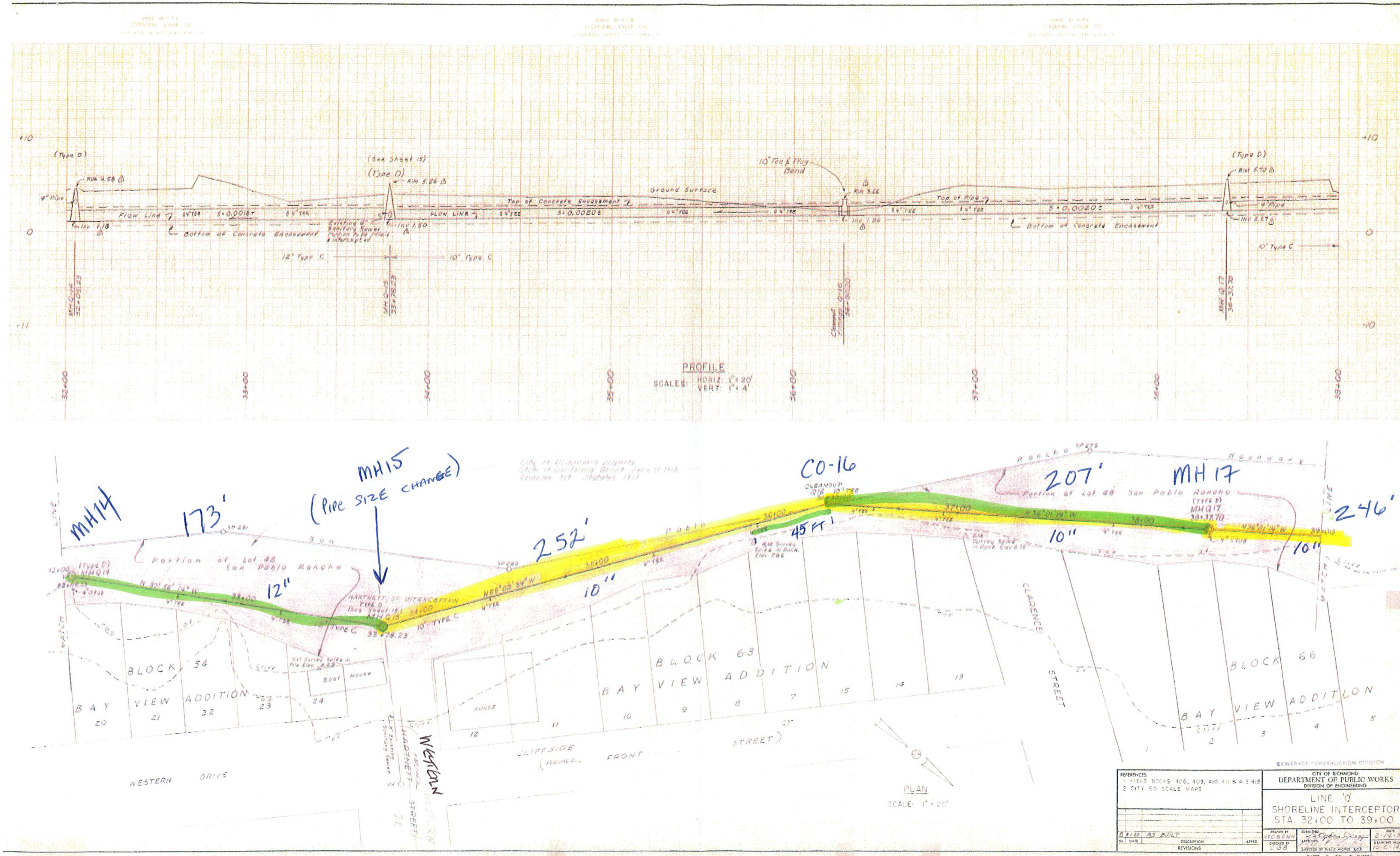
SHEET 6 OF 15 SHEETS

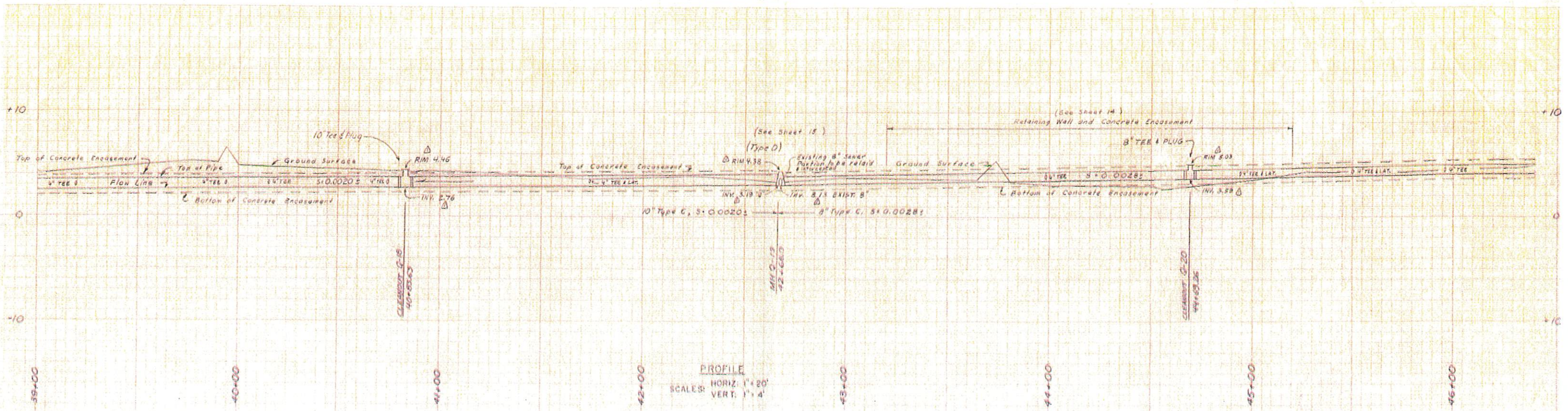

PIER
SEE SHEET 15
(Type D)
RIM 3.54
BOAT LAUNCHING RAILS
Ground Surface
RIM 1.47
Top of Concrete Encasement
Top of Pipe
Flow Line
Inv (-) 0.68
Bottom of Concrete Encasement
Inv (-) 0.55
S=0.00161 6" 1-6 12" Type C
INV (-) 0.52
12" Type C
20+57.80 MH O-10
22+23.90 12" CO
+10
0
-10
PROFILE
SCALES: HORIZ: 1"=20' VERT: 1"=4'
18+50
19+00
20+00
21+00
22+00
23+00
24+00
25+00
257'
MH 10
166'
CO-11
393'
MATCH LINE
12" Type C
Pipe Fitting Bend 19+39.87
20+00
(Type D) MHO10
20+57.80
21+00
4" TEE
22+00
12" C.O 22+23.90
12" Type C
4" TEE 23+00
24+00
24+81.00
25+00
NOTE: MH 31 ELIMINATED HERE
Cypress Point Road (Private)
Existing 12" Sanitary Sewer
Concrete Stairway
Pier with Conc. Piles
Boat Launching Rails
BM Surv Spike So End log Elev 8.19
BM Surv Spike in Conc Footing Elev 8.33
Pablo
Rancho
Boundary
BLOCK 3
BAY SHORE TRACT
Cliff
PLAN
SCALE: 1"=20'
SEWERAGE CONSTRUCTION DIVISION
REFERENCES:
1. FIELD BOOKS 406, 409, 410, 411 & 412, 419
2. CITY 50 SCALE MAPS.
3. CITY DWGS. 30-E-51, 30-D-206.
1 7-25-60 AS BUILT
No. DATE DESCRIPTION APPRD.
REVISIONS
CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING
LINE 'Q'
SHORELINE INTERCEPTOR
STA. 18+50 TO 25+00
DRAWN BY EMH
CHECKED BY CGB
SUBMITTED
APPROVED
DIRECTOR OF PUBLIC WORKS
DATE 2-13-59
DRAWING NUMBER 10-E-1418
SHEET 7 OF 15 SHEETS

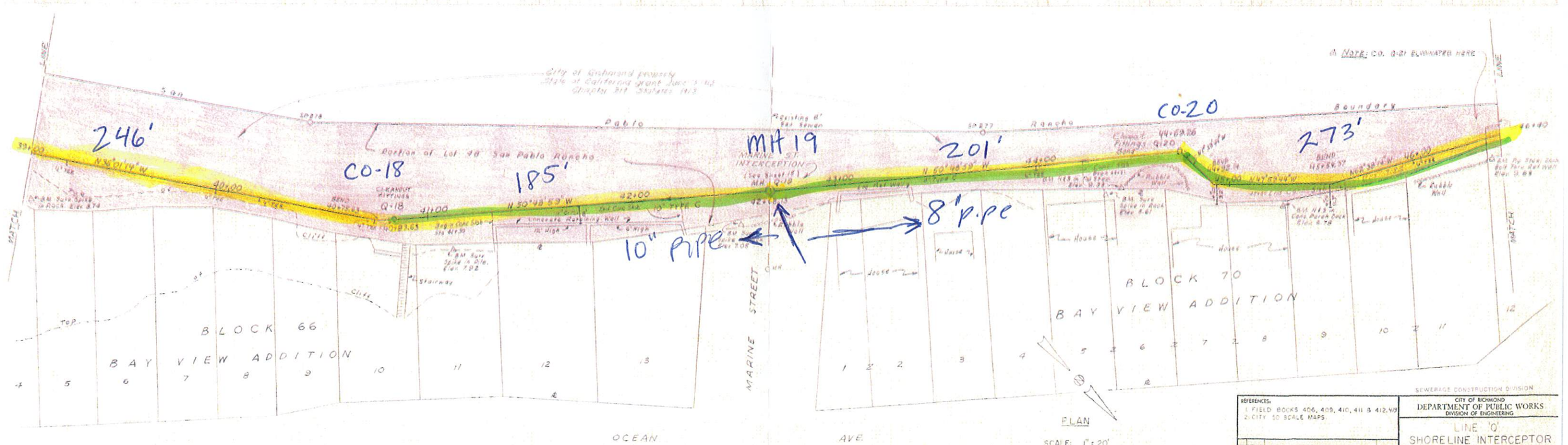


(Type D)
Ground Surface
Top of Concrete Encasement
Top of Pipe
Flow Line
Bottom of Concrete Encasement
12" Type C
S = 0.0016
MH Q-12
MH Q-13
PROFILE
SCALES: HORIZ: 1" = 20'
VERT: 1" = 4'
25+00
26+00
27+00
28+00
29+00
30+00
31+00
32+00
PLAN
SCALE: 1" = 20'
MH-12
MH-13
328'
261'
MH Q-12
26+16.03
N 43° 37' 44" W
San Pablo Rancho
Portion of Lot 48
BLOCK 52
BAY VIEW ADDITION
BLOCK 54
BAY VIEW ADDITION
SANTA FE AVE.
WESTERN DRIVE
SEWERAGE CONSTRUCTION DIVISION
REFERENCES:
1. FIELD BOOKS 406, 409, 410, 411 & 412, 419
2. CITY 50 SCALE MAPS
3. CITY DWG. 7-F-6
7-29-60 AS BUILT
No. DATE DESCRIPTION APPRD.
REVISIONS
CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING
LINE 'Q'
SHORELINE INTERCEPTOR
STA. 25+00 TO 32+00
DRAWN BY
CHECKED BY
C & B
SUBMITTED
APPROVED
DIRECTOR OF PUBLIC WORKS R.C.E.
DATE
2-13-59
DRAWING NUMBER
10-E-1419
SHEET 8 OF 15 SHEETS

W


PROFILE
SCALES: HORIZ: 1" = 20' VERT: 1" = 4'
(Type D)
RIM 4.58
4" Pipe
Flow Line
Inv. 1.18
Bottom of Concrete Encasement
S = 0.0016±
(See Sheet 15)
(Type D)
RIM 5.26
Existing 8" Sanitary Sewer
12" Type C
10" Type C
Inv 1.50
FLOW LINE
S = 0.0020±
Top of Concrete Encasement
Ground Surface
10" Tee & Plug Bend
RIM 3.66
Inv 1.96
Top of Pipe
S = 0.0020±
Bottom of Concrete Encasement
(Type D)
RIM 5.70
4" Pipe
INV 2.27
10" Type C
MH Q-14 32+05.23
MH Q-15 33+78.23
Cleanout Fittings Q-16 36+30.20
MH Q-17 38+37.70
32+00
33+00
34+00
35+00
36+00
37+00
38+00
39+00
+10
0
-10
MH14
173'
MH15
(PIPE SIZE CHANGE)
12"
252'
10"
CO-16
45 FT
207'
MH 17
10"
246'
10"
(Type D) MH Q14
N 83°56' 14" W
Portion of Lot 48 San Pablo Rancho
HARTNETT ST. INTERCEPTION
TYPE D (See Sheet 15)
MH Q15 33+78.23
10" TYPE C
12" TYPE C
N 66°02' 34" W
City of Richmond property
State of California Grant June 11 1913, Chapter 317 Statutes 1917
CLEANOUT Q16 10" TEE
BM Survey Spike in Rock
N 38°01' 14" W
(TYPE D) MH Q17 38+37.70
4" STUB
BM Survey Spike in Rock Elev 6.78
BLOCK 54
BAY VIEW ADDITION
20 21 22 23 24
Boat House
WESTERN DRIVE
HARTNETT STREET
WESTERN
BLOCK 63
BAY VIEW ADDITION
12 11 10 9 8 7 15 14 13
CLIFFSIDE (FORMER FRONT STREET)
CLARENCE STREET
BLOCK 66
BAY VIEW ADDITION
1 2 3 4 5
PLAN
SCALE: 1" = 20'
SEWERAGE CONSTRUCTION DIVISION
REFERENCES:
1. FIELD BOOKS 406, 409, 410, 411 & 413 419
2. CITY 50 SCALE MAPS
8-1-60 AS BUILT
No. DATE DESCRIPTION APP'D.
REVISIONS
CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING
LINE 'Q'
SHORELINE INTERCEPTOR
STA. 32+00 TO 39+00
DRAWN BY HTO & EMH
CHECKED BY CGB
SUBMITTED
APPROVED
DIRECTOR OF PUBLIC WORKS R.C.E.
DATE 2-14-59
DRAWING NUMBER 10-E-1420
SHEET 9 OF 15 SHEETS





PROFILE
SCALES: HORIZ. 1" = 20'
VERT. 1" = 4'

NOTE: CO. Q-21 ELIMINATED HERE

REFERENCES:
1. FIELD BOOKS 406, 408, 410, 411 & 412, 413
2. CITY 50 SCALE MAPS.

No.	DATE	DESCRIPTION	APPD.
1	8-2-63	AS BUILT	

REVISIONS

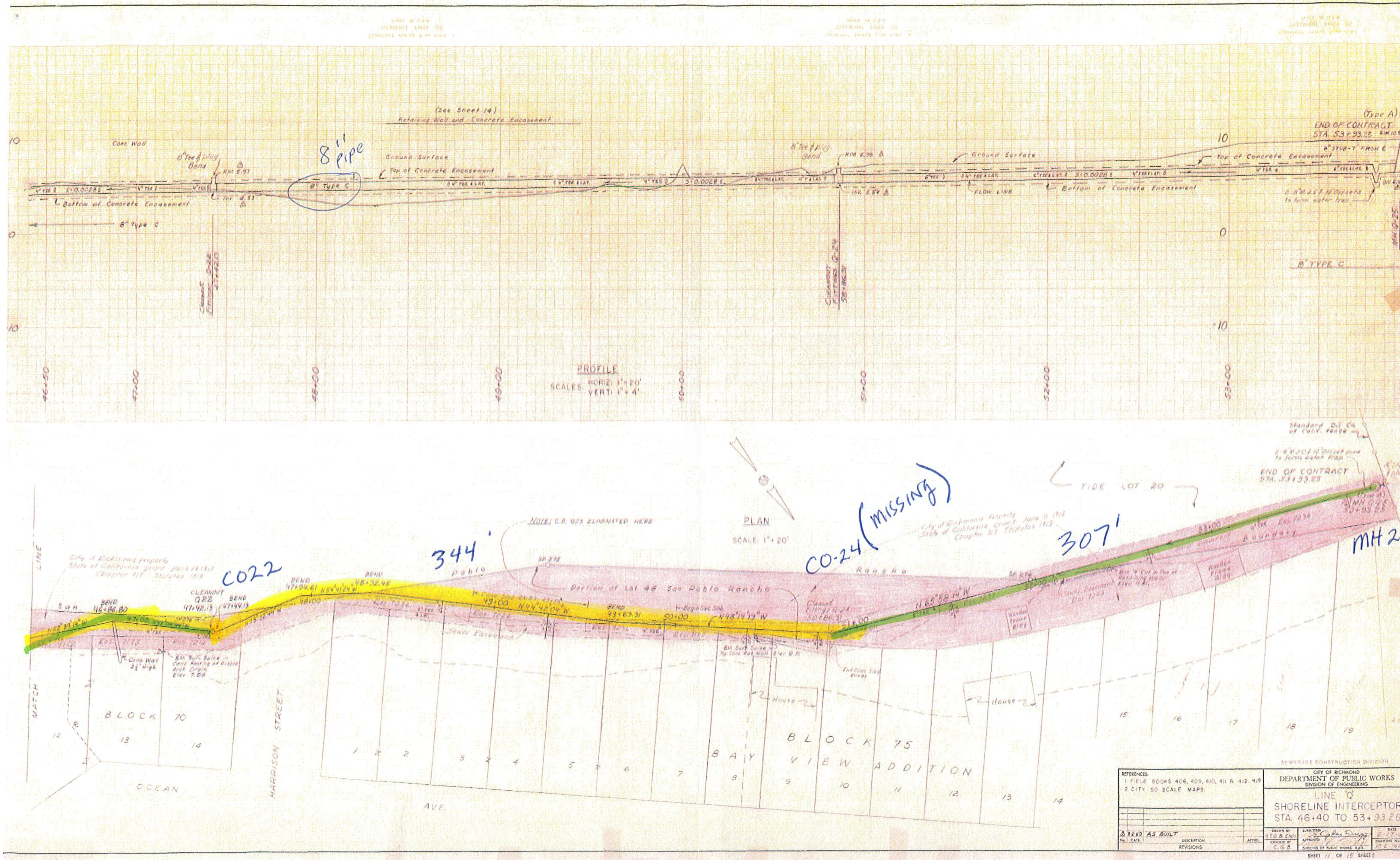
DRAWN BY: R.T.O'FERN
CHECKED BY: C.G.B.
SUBMITTED: [signature]
APPROVED: [signature]
DIRECTOR OF PUBLIC WORKS
DATE: 2-16-55
DRAWING NUMBER: 10 E-172

SEWERAGE CONSTRUCTION DIVISION

CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING

LINE "O"
SHORELINE INTERCEPTOR
STA. 39+00 TO 46+40

SHEET 10 OF 15 SHEETS



(See Sheet 14)
Retaining Wall and Concrete Encasement
(Type A)
END OF CONTRACT
STA. 53+93.25
Conc Wall
8" Tee & plug Bend
8'' Pipe
Ground Surface
Top of Concrete Encasement
Bottom of Concrete Encasement
8" Type C
FLOW LINE
8" TYPE C
PROFILE
SCALES: HORIZ: 1" = 20'
VERT: 1" = 4'
46+50
47+00
48+00
49+00
50+00
51+00
52+00
53+00
PLAN
SCALE: 1" = 20'
NOTE: C.O. Q23 ELIMINATED HERE
CO22
344'
CO-24 (MISSING)
307'
MH25
CLEANOUT Q22 47+42.13
BEND 46+86.80
BEND 47+44.13
BEND 47+94.61
BEND 48+32.48
BEND 49+69.31
N44°42'04"W
N48°14'19"W
N65°58'14"W
Portion of Lot 48 San Pablo Rancho
Sewer Easement
TIDE LOT 20
END OF CONTRACT STA. 53+93.25
Standard Oil Co. of Calif. Fence
House
BLOCK 70
BLOCK 75
BAY VIEW ADDITION
OCEAN AVE.
HARRISON STREET
MATCH LINE
REFERENCES:
1. FIELD BOOKS 406, 409, 410, 411 & 412, 419
2. CITY 50 SCALE MAPS
SEWERAGE CONSTRUCTION DIVISION
CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING
LINE 'Q'
SHORELINE INTERCEPTOR
STA. 46+40 TO 53+93.25
AS BUILT
REVISIONS
SHEET 11 OF 15 SHEETS

APPENDIX B:

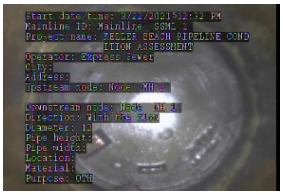
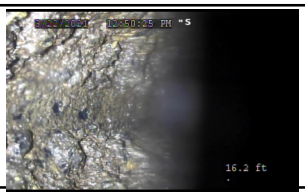
CCTV INSPECTION REPORTS

CCTV Observation Report

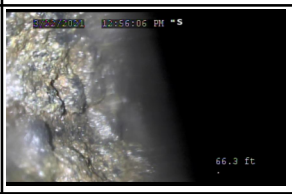
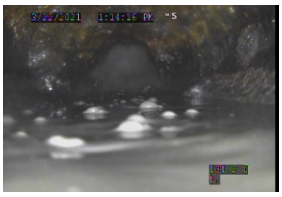
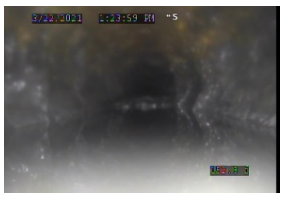
Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 3/22/2021
Street: 3+92.95
Upstream MH: MH Q-2
Downstream MH: MH Q-1

Length: 152.8' inspected out of 393' (incomplete)
Material: CI
Pipe Diameter: 12"
Direction of Video: Downstream

Distance (feet)	Code	Clock/ Position	Comment	Image
0.0	AMH		Q-2	
	MWL		>50% Only top of pipe visible	
0.5			Severe internal corrosion	
16.2			Severe internal corrosion	
16.2	MWL		20% Severe internal corrosion	
16.2	MGO		cam in pipe view 17m44s, mostly under water	

16.2	MWL		20% with vac wash	
16.2	MGP	09	unk, possible tap? (18:32)	
16.2	SCP	08-03	S01 (18:34)	

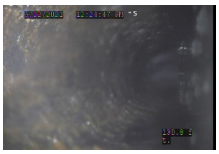
16.2	MGP	09	unk, unsure if void (18:41)	
43.5	MCU		cam tilted & aimed to soffit right after	
64.0	MCU		Camera underwater	
66.4	MGO		cam stationary 26m to 40m,	 
77.1	MGO		cam in motion but choppy video	
131.2	MWL		35%	
131.2	MGO		cam stationary, difficulty moving	
152.8	OBZ	03-09	no forward progress from here (51:30 to end of video)	  
152.8	MSA		Survey abandoned	

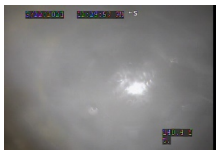
CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 3/22/2021
Street: 5+29.63
Upstream MH: MH Q-3
Downstream MH: MH Q-2

Total Length: 139' - complete inspection
Material: CI
Pipe Diameter: 12"
Direction of Video: Downstream

Distance (feet)	Code	Clock/Position	Comment	Image
0.0	AMH		Q-3	
0.0	MWL		20% with power wash	
0.0	SZ	09-04	S01, is this SCP?	 
15.1	SZ		F01	
15.1	SZ	07-05	S02, throughout line	
99.5	OBR	04-08	20%, removed by jet wash	
105.3	DAZ	05, 07	S03	
122.7	DAZ		F03	
123.9	MWL(S)		40%, S04	 
130.8	MGO		cam rotated 90 degrees	
132.1	MGO		equip issue, cam has no traction	

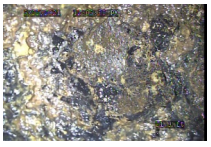
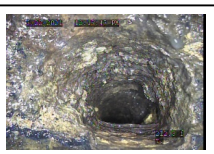
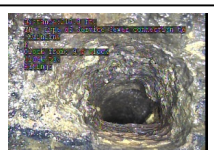
140.4	AMH		Q-2, adjusted from 137.3		

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 3/22/2021
Street: 7+71.85
Upstream MH: MH Q-4
Downstream MH: MH Q-3

Total Length: 242' - complete inspection
Material: CI
Pipe Diameter: 12"
Direction of Video: Downstream

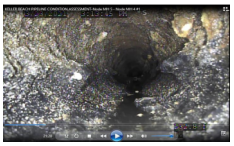
Distance (feet)	Code	Clock/Position	Comment	Image
0.0	AMH		Q-4	
0.0	MWL		10%	
0.0	SCP	07-04	S01	
6.0	OBZ	04-08		
21.9	MGP	10	possible TFC	  
46.0	MWL		5%	
78.8	TFA	09	adjusted distance, was 82.5 on approach	 
101.3	OBZ	04-08	S02 repetitive	
210.3	TFA	09	adjusted distance, was 212.3 on approach	 
237.4	AMH		Q-3, dist adjusted from 239.4	 

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 3/23/2021
Street: 9+90.03
Upstream MH: MH Q-5
Downstream MH: MH Q-4

Total Length: Unknown distance inspected out of 219' (incomplete)
Material: CI
Pipe Diameter: 12"
Direction of Video: Downstream

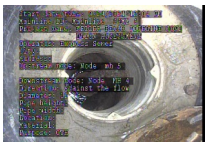
Distance (feet)	Code	Clock/Position	Comment	Image
0* Minutes of video because distance indicator was not working	AMH		Q-5	
0.0	MWL		20%	
0.0	SCP	07-05	S01	
16:12	MGP		dist adjusted to 232.8 prior to start of survey	 
17:00	MGO		distance remains 232.8 during survey	
17:59	OBZ	04-08		
18:09	MWL		5%	
21:20	IR	2:00	Infiltration runner	
46:47	OBZ	03-09	30% blocked	
47:33 to end	MGO-MSA		no progress, would eventually lose visibility (possibly MCU), not completed	

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 3/24/2021
Street: 9+90.03
Upstream MH: MH Q-5
Downstream MH: MH Q-4

Total Length: 96' out of 219' (incomplete)
Material: CI
Pipe Diameter: 12"
Direction of Video: Upstream

Distance (feet)	Code	Clock/Position	Comment	Image
0.0	AMH		Q-4:	
0.0	MWL	20%	Lateral at manhole	 
0.0	SCP	07-05	S01	
17.6	MGO		cam unsteady	
20.7	SCP			
22.3	MWL		40%	
88.9	MGP		debris	
96.1	MWL		5%	
96.1	MSA		Abandoned, 2 of 2	 

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 4/2/2021
Street: 12+95.89
Upstream MH: CO Q-6
Downstream MH: MH Q-5
Total Length: 319.8'
Material: CI
Pipe Diameter: 12"
Direction of Video: Downstream (reverse)

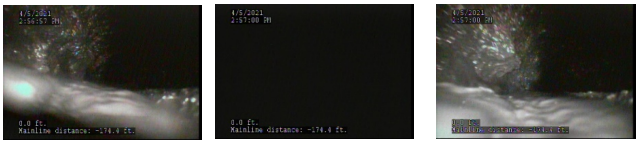
Distance (feet)	Code	Clock/Position	Comment	Image
0.0	AMH		At MH Q-5	
0.0	MCU		S01	Camera underwater (no image)
319.8	MCU		F01	Camera underwater (no image)
319.8	ACO		At MH Q-6	
319.8	MGO		camera on grade, in reverse (pulled); distance remains 319.8	
10:56	SCP	07-05	S02	
11:47	MWL		20%	
12:11	MCU		S03	Camera underwater (no image)
20:53	MCU		F03	Camera underwater (no image)
23:03	MCU		S04	Camera underwater (no image)
34:03	MGO		camera stopped, 14.3' distance; possibly at bend	
34:24	MGO		end of survey	

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 4/5/2021
Street: 16+52.06
Upstream MH: CO Q-8
Downstream MH: CO Q-6

Total Length: Unknown distance out of 357'
Material: CI
Pipe Diameter: 12"
Direction of Video: Downstream

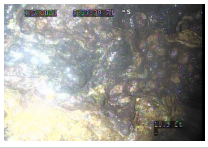
Distance (feet)	Code	Clock/Position	Comment	Image
0.00	ACO		At CO Q-8	
	MGP		16:08 - 16:19 per survey, 6 seconds: Camera in reverse, mostly MCU, DAE/DAGS 08-09	
0.00	MSA		no usable footage	

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 4/7/2021
Street: 18+08.07
Upstream MH: MH Q-9
Downstream MH: CO Q-8

Total Length: 21.7' inspected out of 182' (incomplete)
Material: CI
Pipe Diameter: 12"
Direction of Video: Downstream

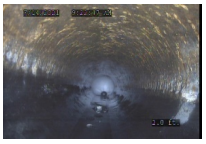
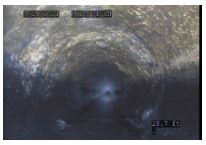
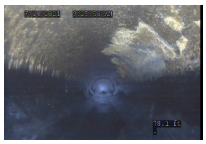
Distance (feet)	Code	Clock/Position	Comment	Image
0.0	AMH		Q-9	
0.0	MWL			
4.9	SCP	03		
5.9	MWL		50%	
6.5	MCU		Camera underwater	
7.3	MGP		out of MCU	
8.9	MGP		possible RMB	
9.0	MCU			Camera underwater (no images)
11.7	DAE	09-03	S01	
13.9	DAE	09-03	S01, distance adjusted	
6.0	MGP		distance adjusted from 13.9	
6.0	MCU			Camera underwater (no images)
10.9	MGP		out of MCU, distance adjusted	
13.1	MCU		S02	Camera underwater (no images)
				Camera underwater (no images)
21.7	MCU		F02	Camera underwater (no images)
21.7	MSA		no forward progress	Camera underwater (no images)

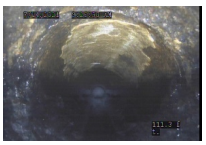
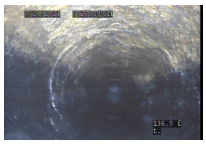
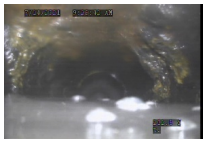
CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 7/14/2021
Street: 32+05.23
Upstream MH: MH Q-14
Downstream MH: MH Q-13

Total Length: 260 - complete inspection
Material: CI
Pipe Diameter: 12"
Direction of Video: Downstream

Distance (feet)	Code	Clock/Position	Comment	Image
0.0	AMH		Q-14	
0.0	MWL		20%	
0.0	MGP		prewash, MWL to 5%	
0.0	SRI	09-03	S01	
10.3	SCP	08-05	at joint	 
28.7	SCP	08-04		
71.3	SCP	08-02		
78.1	SSS	02	S01	
85.4	SSS		F01	
102.5	SSS	10	S02	
109.4	SSS	F02		
109.4	SCP	07-05	at joint	

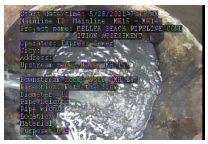
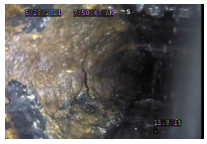
111.3	SSS	11-01		
116.1	SSS	02		
123.4	SSS	10-03		
126.6	SCP	09-05	at joint	
136.9	SSS	10-03	S03	
154.4	MWL		20%	
161.1	TBI	11	1-inch intrusion	
197.0	MWLS		50%, S04	 
203.8	SCP	09-04		
210.0	SCP	09-04	at joint	
215.3	MGP	03		
232.2	H or SCP	01		
231.2	MGO-MCU		cam aimed at soffit	Camera underwater (no image)
255.5	MCU			Camera underwater (no image)
260.0	AMH		Q-13	

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 5/28/2021
Street: 33+78.23
Upstream MH: MH Q-15
Downstream MH: MH Q-14

Total Length: Unknown distance out of 173' - incomplete
Material: CI
Pipe Diameter: 12"
Direction of Video: Downstream

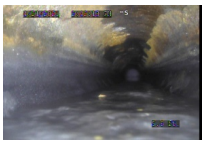
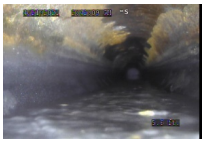
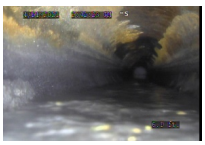
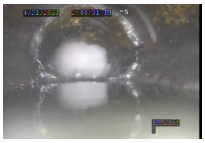
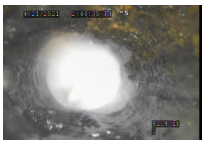
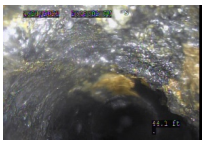
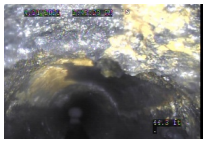
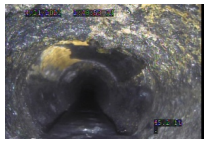
Distance (feet)	Code	Clock/Position	Comment	Image
0.0	AMH		Q-15	
0.0	MWL		25%	
0.0	SSS	09-03	S01	
7.3	MGO		cam titled 90 deg left	
15.8	SSS		F01	
15.8	SCP	09-03	S02	
19.7	MCU			Camera underwater (no image)
53.8				
54.4	MCU			Camera underwater (no image)
74.6	OBZ	02-09		
-	MGO-MSA		poor visibility, multiple blackouts/MCU thorughout remainder of video (from 44-min mark to end)	

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 4/21/2021
Street: 36+30.20
Upstream MH: CO Q-16
Downstream MH: MH Q-15

Total Length: 45' out of 252' (incomplete)
Material: CI
Pipe Diameter: 10"
Direction of Video: Downstream

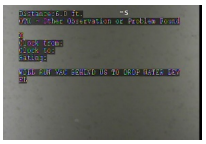
Distance (feet)	Code	Clock/Position	Comment	Image
0.0	ACO		At CO Q-16	
0.0	MWL		50%	
0.0	DAE	09-03	S01	
3.9	MCU			Camera underwater (no image)
5.6	DAE		F01	
5.6	MWL		25%	
6.0	SSC	10-02	S02	
40.2	SSC		F02	
41.4	SCP	12-12	at/near joint	 
44.3 to 45.2	MGP	12-03		 
45.3	MSA		Abandoned, equipment retrieved	Inspection incomplete due to severe corrosion obstruction

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 4/22/2021
Street: 36+30.20
Upstream MH: CO Q-16
Downstream MH: MH Q-15

Total Length: 15.3' out of 252' (incomplete)
Material: CI
Pipe Diameter: 10"
Direction of Video: Upstream

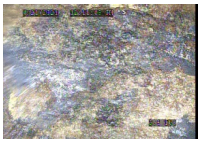
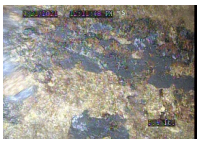
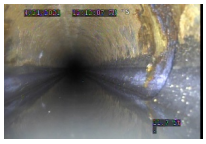
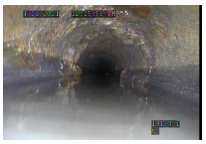
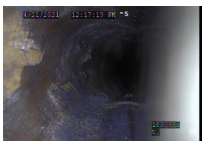
Distance (feet)	Code	Clock/Position	Comment	Image
0.00	AMH		Q-15	
0.00	MWL		100%	
0.00	MGP		Surcharged up the structure	
0.00	MCU			Camera underwater (no image)
6.00	MGP		will attempt vac behind cam	
15.30	MSA		Abandoned	

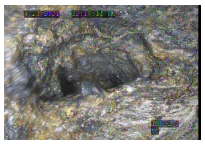
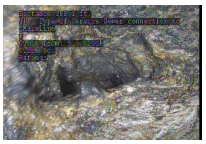
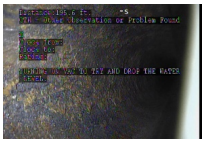
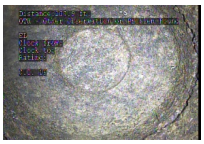
CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 4/21/2021
Street: 38+37.70
Upstream MH: MH Q-17
Downstream MH: CO Q-16

Total Length: 207.9 - complete inspection
Material: CI
Pipe Diameter: 10"
Direction of Video: Downstream

Distance (feet)	Code	Clock/Position	Comment	Image
0.0	AMH			
0.0	MWL			
9.4	SSS	08-12	S01, repetitive throughout	  
11.7	SRI	09-03	S02	
111.2	MWL		40%	
141.3	SCP	08-04		 
147.4	SCP	08-04		 
148.1	MGP		cam mostly submerged, difficulty with forward motion	
163.9	SCP	08-04		 
184.2	SCP	08-04		

188.1	TF		09, w/ OBZ 03-09, 50%	 
188.3	MWL		40%, submerged	
195.6	MGP		used VAC to drop MWL, unsure if there's MWLS	
203.0	MGO		cam stationary for minutes, no forward progress	Difficulty passing bend in pipe
207.9	ACO		Q-16; mid-line, looks more like TFC 11 o'clock	  

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 4/30/2021
Street: 40+83.63
Upstream MH: CO Q-18
Downstream MH: MH Q-17
Total Length: 246 - complete inspection
Material: CI
Pipe Diameter: 10"
Direction of Video: Downstream (Push camera with hydronozzle in reverse)

Distance (feet)	Code	Clock/Position	Comment	Image
0.0	ACO		At CO Q-18	
0.0	MWL		surcharged at structure	
0.0	MGO		footage out of focus, appears to be pushing cam on grade/invert; distance remains 0.0' throughout	
06:51	MGP-AMH		At MH Q-17 per survey note; cam on grade (not centered/elevated); blurred, out of focus; footage by video timestamp, not by distance, cam in reverse	
07:49	MGO		start of reverse footage	
07:57	MWL		40%, out of focus	
07:58	MCU			Camera underwater (no image)
08:05	OBZ	05-07	S01, debris	
08:47	MGO		cam unstable	
09:23	MGO		cam unstable	
14:05	ACO		At CO Q-18, end of reverse footage	

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 4/29/2021
Street: 42+68.13
Upstream MH: MH Q-19
Downstream MH: CO Q-18

Total Length: 185 - complete inspection
Material: CI
Pipe Diameter: 10"
Direction of Video: Upstream (Push camera with hydronozzle in reverse)

Distance (feet)	Code	Clock/Position	Comment	Image
0.0	AMH		Q-19	
0.2	MWL		20% (20:53)	
0.5	SSS	10-02	S01, throughout pipe	
24.9	MGP		abrupt drop	
29.3	MWL		10%	
42.5	TBI	11	4" lat, 2" intrusion	 
91.9	obz	04-08		
94.4	TF	09	4" lat	
134.6	OBZ	03-09	50% blocked, chain flailed	 
140.7	MGO		blackout, no activity 10:35 - 42:00	
94.8	MGP		42:00 resumed, dist from 140.7, may have been retrieved	
119.1	MGO		turbulent footage (44:39)	
124.9	MCU		(46:07)	Camera underwater (no image)

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 4/29/2021
Street: 42+68.13
Upstream MH: MH Q-19
Downstream MH: CO Q-18

Total Length: 185 - complete inspection
Material: CI
Pipe Diameter: 10"
Direction of Video: Upstream (Push camera with hydronozzle in reverse)

Distance (feet)	Code	Clock/Position	Comment	Image
131.5	MGO		cam tilted 90d counterclockwise	
132.7	MCU			Camera underwater (no image)
156.5	MGO		blacked out approx 5min	
159.7	MGO		cam too close to cleaning equip, very poor visibility	
173.4	MGO-MCU		blackout, no visibility (1:01:13 to 1:44:05)	Camera underwater (no image)
173.7	MGO		turbulent footage, cam very close to cleaning equip	
189.2	ACO		Q-18	
189.2	MGO		reverse survey, no new findings	
0.0	AMH		Q-19	

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 5/4/2021
Street: 44+69.26
Upstream MH: CO Q-20
Downstream MH: MH Q-19

Total Length: 201' - inspection complete
Material: CI
Pipe Diameter: 8"
Direction of Video: Downstream

Distance (feet)	Code	Clock/Position	Comment	Image
0.00	ACO		At CO Q-20	 
0.00	MWL			
12' 11"	DAGS	03-06	at joint maybe	
16' 0"	MGO		cam unsteady	
73' 10"	MCU			Camera underwater (no image)
111' 10"	MWL		10%	
112' 7"	MCU		S01	Camera underwater (no image)
200' 5"	MCU		F01	Camera underwater (no image)
201' 1"	MGO-MCU		no visibility	Camera underwater (no image)
200' 8"	MGO		retrieved, reverse	
185' 2"	SSS-SCP	03-09	unclear	
154' 5"	MGO		turbulent, cam unsteady	
5' 3"	TB	10	not panned, no other info	
-0' 1"	MGP			
-0' 5"	MGP			
-0' 5"	ACO		Q-20	

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 5/4/2021
Street: 47+42.13
Upstream MH: CO Q-22
Downstream MH: CO Q-20

Total Length: 273' - complete inspection
Material: CI
Pipe Diameter: 8"
Direction of Video: Downstream

Distance (feet)	Code	Clock/Position	Comment	Image
0' 0"	ACO		Q-22; turbulent & very poor visibility throughout	
2' 6"	MWL		20%	
2' 6"	TF	09	not panned, other info	
8' 9"	DAZ	04-08	S01	
197' 4 "	MGO		no visibility 04:41 to 06:16	
275' 0"	ACO		Q-20, start of backwards survey	
273' 7'	MCU			Camera underwater (no image)
262' 7"	MGO		poor visibility throughout, unable to perform assessment	

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 3/22/2021
Street: 58+86.31
Upstream MH: CO Q-24
Downstream MH: CO Q-22

Total Length: 344' - complete inspection but low value due to blurry image
Material: CI
Pipe Diameter: 8"
Direction of Video: DS per header

Distance (feet)	Code	Clock/Position	Comment	Image
0.0	ACO		At CO Q-24	
0.0	MWL		15%	
0.0	MGO			pushed on grade, 0.0' throughout; footage out of focus
17:05	MGP-ACO		cam on grade (not centered/elevated); blurred, out of focus; footage by video timestamp, not by distance, cam in reverse	
17:19	MCU		S01	Camera underwater (no image)
18:47	MCU		F01	Camera underwater (no image)
18:54	MWL		15%	
18:59	MGO		cam out of focus, poor video quality, unable to review	
24:07	DAGS	04-07	S02	 
24:25	DAGS		F02	
26:54	ACO			

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 5/14/2021
Street: 53+93.25
Upstream MH: MH Q-25
Downstream MH: CO Q-24

Total Length: 70' out of 307' - incomplete
Material: CI
Pipe Diameter: 8"
Direction of Video: Upstream

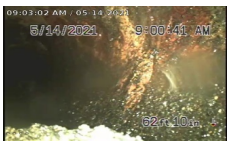
Distance (feet)	Code	Clock/Position	Comment	Image
0.0	ACO		Q-24	
2' 1"	MGP		Start of survey	
2' 1"	MGO		push cam very unsteady; poor image quality; splashback at forward motion, frequent MCU	
3' 9"	MWS		30%	
57' 9"	DZ or RBB	03-05		 
58' 9"	T	03	no other info	
67' 5"	T	03	no other info	 
70' 0"	MSA		Abandoned, 2 of 2	

CCTV Observation Report

Client: NCE/City of Richmond
Project Name: Keller Beach Sewer CCTV Assessment

Date of CCTV: 5/14/2021
Street: 53+93.25
Upstream MH: MH Q-25
Downstream MH: CO Q-24

Total Length: 274' out of 307' - incomplete
Material: CI
Pipe Diameter: 8"
Direction of Video: Downstream

Distance (feet)	Code	Clock/Position	Comment	Image
0' 0"	AMH		Q-25	
1' 3"	MCU-MGO		turbulent, poor visibility	
15' 4"	MWL		5%	
25' 8"	SSS	11-05	at joint	
36' 1"	MGO		cam aimed at 3 o'cl barrel	
62' 10"	SCP	02-04		
78' 6"	MGP		debris	
203' 0"	MGP		in reverse, general condition ok	
257' 10"	MGP		in reverse, general condition ok	
274' 0"	MSA		11:13, will continue from CO Q-24 per survey	