Bureau of Investigation and Enforcement v. Philadelphia Gas Works,	
	Docket No.: C-2024-3052277
In Person Evidentiary	

Pages 10 - 155

Judge's Chambers
State Office Building
801 Market Street
Philadelphia, PA

Thursday, October 16, 2025
Commencing at 9:59 a.m.

INDEX TO EXHIBITS

Docket No. C-2024-3052277

Hearing Date: October 16, 2025

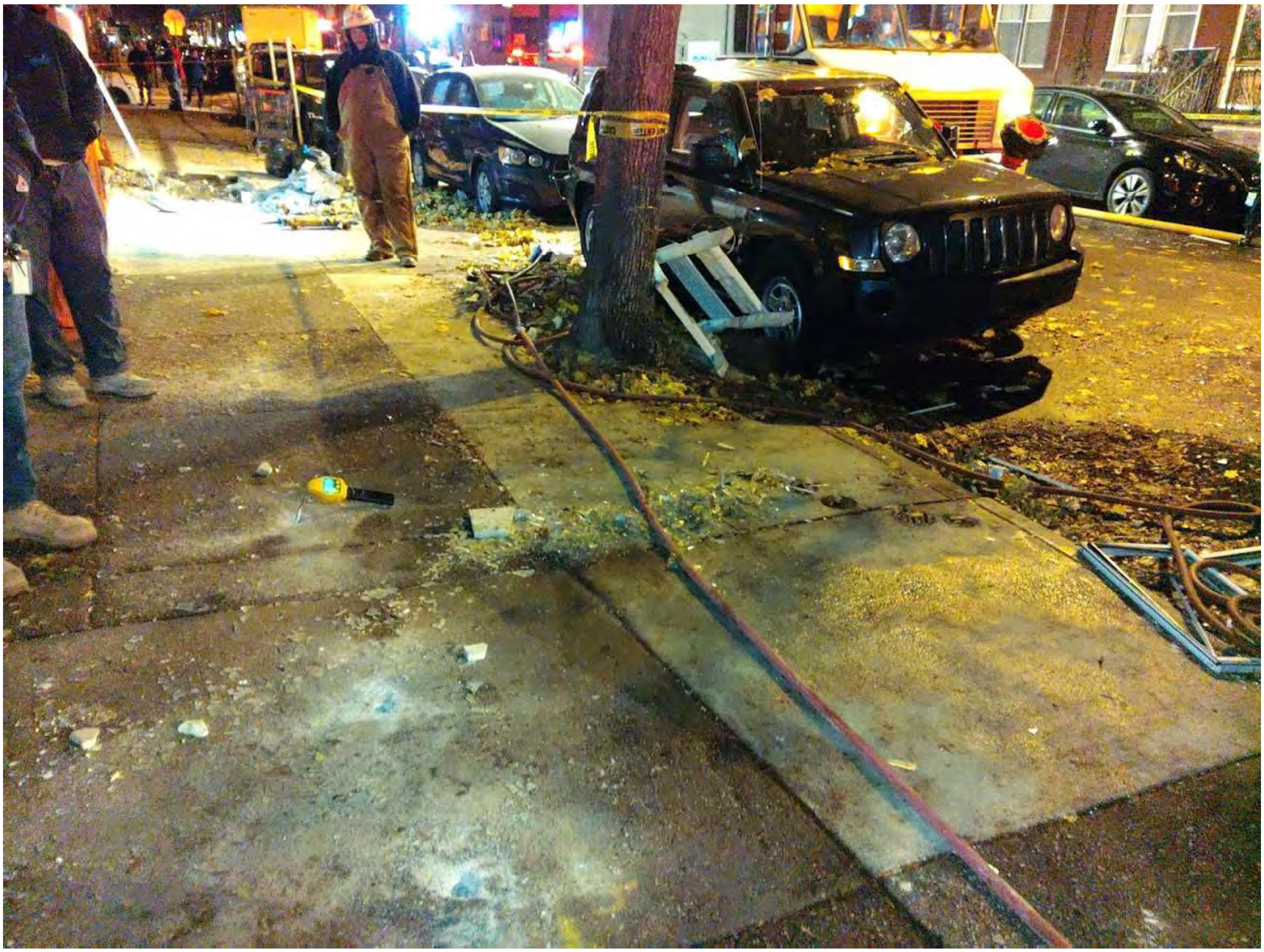
NUMBER	FOR IDENTIFICATION	IN EVIDENCE
I&E Statement Exhibit 1 Direct Testimony of Terri Cooper-Smith	20	89
I&E Exhibit 1	20	89

Joseph C. Leva with

Exhibits JCL-1 and

JCL-2

I&E Exhibit 1




817

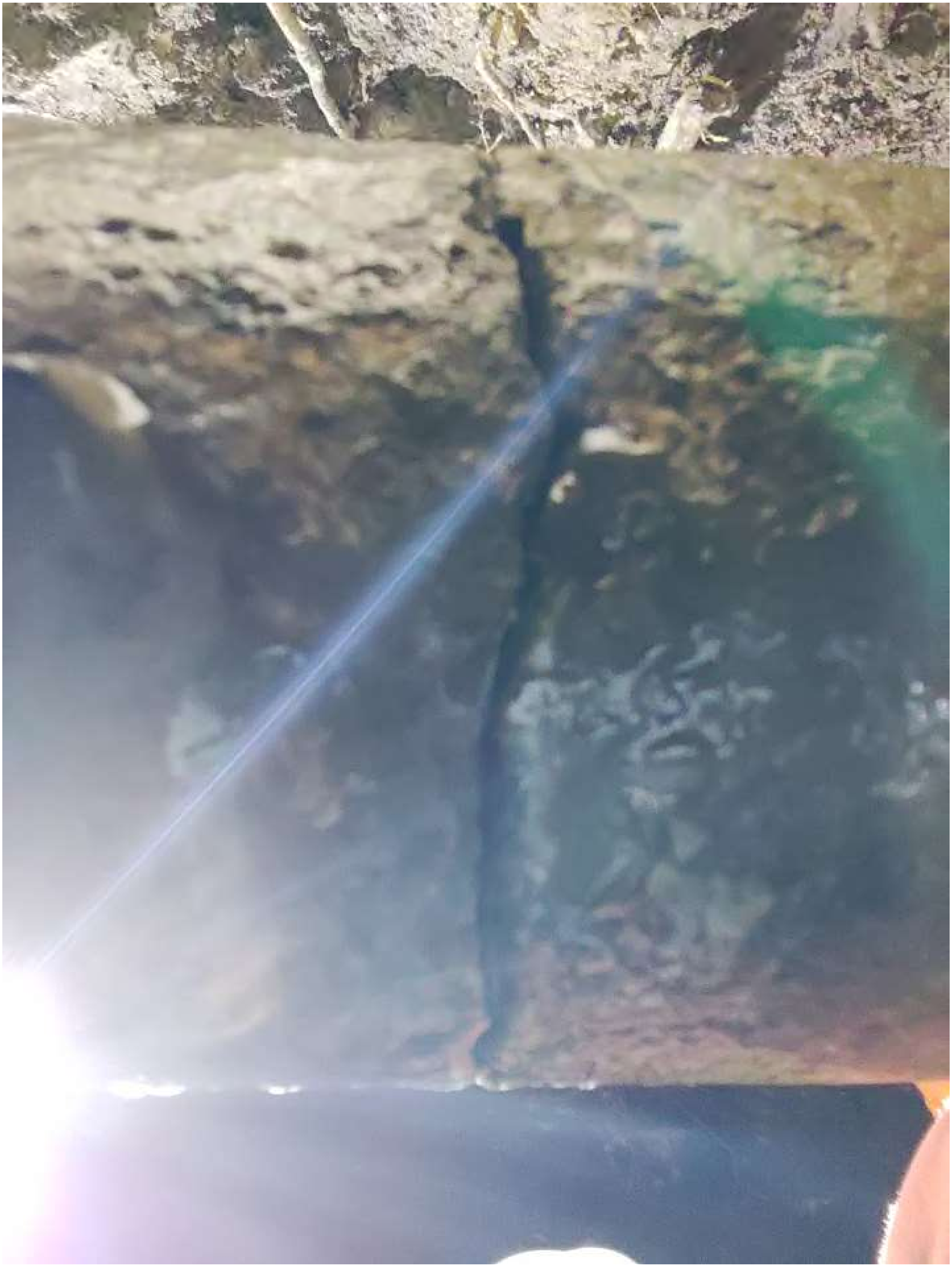
I&E Exhibit 2

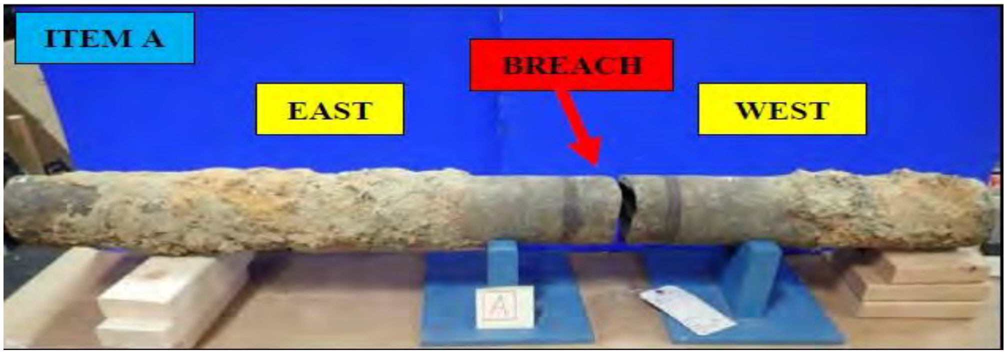
I&E Exhibit 3


Nov 30, 2021 at 9:51:20 PM
43° NE
815 Jackson St
Philadelphia PA 19148
United States
NIGHTSTICK


42 43 44 45 46 47 48 49 50 51

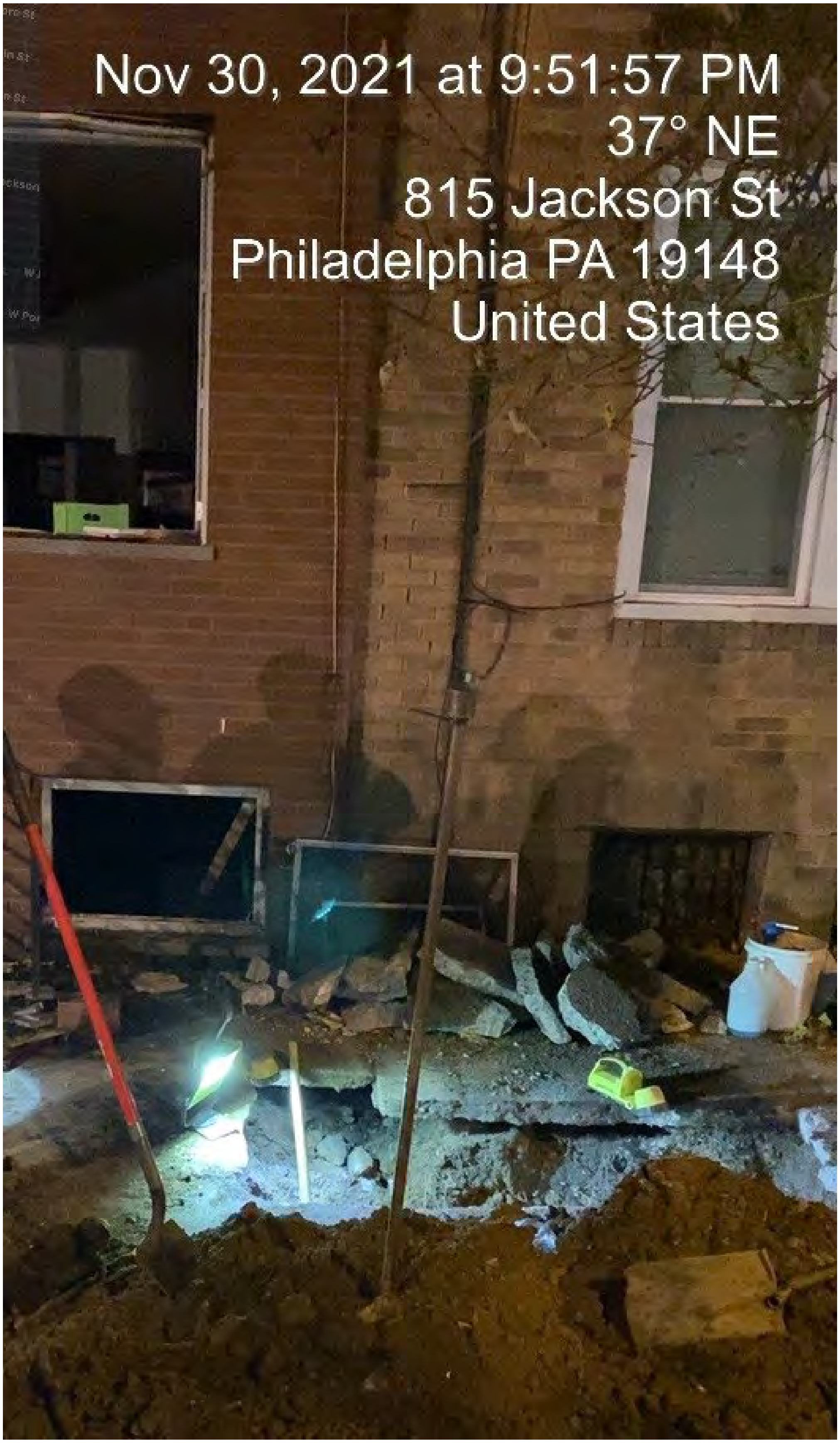
I&E Exhibit 4




ITEM A
BREACH
EAST
WEST
A

I&E Exhibit 5


Nov 30, 2021 at 9:51:45 PM
36° NE
815 Jackson St
Philadelphia PA 19148
United States


Nov 30, 2021 at 9:51:57 PM
37° NE
815 Jackson St
Philadelphia PA 19148
United States

I&E Exhibit 6

```
CDC    00000 POCS MM/DD/YY TT:TT:TT 20212072616-000 NEW  XCAV RTN

============PENNSYLVANIA UNDERGROUND UTILITY LINE PROTECTION REQUEST============
Serial Number--[20212072616]-[000] Channel#--[1252A999][0212][2019-08]
Message Type--[NEW][EXCAVATION][ROUTINE]

County--[PHILADELPHIA]    Municipality--[PHILADELPHIA CITY]          Ward--[39]
Work Site--[815 JACKSON ST]
     Nearest Intersection--[S MILDRED ST]
     Second Intersection--[S 8TH ST]
     At Intersection--[N] Between Intersections--[Y] Site Marked in White--[Y]
     Subdivision--[]
Location Information--
     []
     Caller Lat/Lon--[]
Mapped Type--[P] Mapped Lat/Lon--
     [39.922161/-75.160423,39.921836/-75.160493,39.921828/-75.160448,
      39.922157/-75.160367]
     Attachments--[http://www.pa811.org/attachments/20212072616]
Type of Work--[REPL CURB TRAP LATERAL]                       Depth--[]
Extent of Excavation--[]                Method of Excavation--[DIGGING]
Equip Type--[BH]
Street--[X] Sidewalk--[X] Pub Prop--[X] Pvt Prop--[X] Other--[]
Private Front--[X] Rear--[ ] Left--[ ] Right--[ ]

Lawful Start Dates--[29-Jul-21] thru [09-Aug-21] Response Due Date--[28-Jul-21]
    Scheduled Excavation Date--[29-Jul-21] Dig Time--[0800] Duration--[1 DAY]

Caller--[KAREN MANNIX]
Caller Phone--[215-333-5750]
Excavator--[CLEMENTS BROTHERS PLUMBING]
Address--[2030 HARTEL ST]
City--[LEVITTOWN]                                State--[PA] Zip--[19057]
FAX--[215-547-9007]              Caller Type--[B]
Email--[cbi2030@msn.com]
Work For--[CHIEV]
Onsite Contact--[SEAN CLEMENTS]
Onsite Contact Phone--[215-333-5750]
Best Time to Call--[0800-1700]
Onsite Contact Email--[cbi2030@msn.com]

Prepared--[26-Jul-21] at [1256] by [DANIEL CRAWFORD]
Remarks--
     [STREET 8FT DEEP AND 3FT X 6FT. SIDEWALK 8FT DEEP AND 4FT X 4FT.]

KA 0  KA =PECO SCKL        PD 0  PD =PHILA C WTR DPT  PSD0  PSD=PHILADELPHIA ST
PZ 0  PZ =PGW PHLA         YA 0  YA =VERIZON PA PHIL

Serial Number--[20212072616]-[000]
========== Copyright (c) 2021 by Pennsylvania One Call System, Inc. ==========
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All Responses for SN: 20212072616 as of 30-Oct-2024 14:16:31

Print Export to Excel

CDC	Member Name	Response	Notes	Response Date	Initials
KA	PECO AN EXELON COMPANY	**CLEAR. NO FACILITIES OR FACILITIES NOT INVOLVED BASED ON TICKET INFORMATION.**		7/27/2021 1:45:50 PM	CLS-WEBSVC
PD	PHILADELPHIA CITY WATER DEPARTMENT	**FIELD MARKED.**		7/27/2021 2:23:23 PM	MR-WEB
PSD	PHILADELPHIA CITY DEPARTMENT OF STREETS	**CLEAR. NO FACILITIES OR FACILITIES NOT INVOLVED BASED ON TICKET INFORMATION.**		7/26/2021 1:08:45 PM	TC-WEB
PZ	PHILADELPHIA GAS WORKS	**FIELD MARKED.**		7/29/2021 10:43:30 AM	RGR-WEBSVC
		DID NOT RESPOND THROUGH PA ONE CALL.		7/29/2021 12:04:54 AM	
YA	VERIZON PENNSYLVANIA LLC	**CLEAR. NO FACILITIES OR FACILITIES NOT INVOLVED BASED ON TICKET INFORMATION.**		7/26/2021 1:00:13 PM	PRA-WEBSVC

I&E Exhibit 7

```
CDC    00000 POCS MM/DD/YY TT:TT:TT 20212440918-000 UPDT XCAV RTN

============PENNSYLVANIA UNDERGROUND UTILITY LINE PROTECTION REQUEST============
Serial Number--[20212440918]-[000] Channel#--[0948A999][0095][2019-08]
Message Type--[UPDATE][EXCAVATION][ROUTINE]

County--[PHILADELPHIA]    Municipality--[PHILADELPHIA CITY]          Ward--[39]
Work Site--[815 JACKSON ST]
     Nearest Intersection--[S MILDRED ST]
     Second Intersection--[S 8TH ST]
     At Intersection--[N] Between Intersections--[Y] Site Marked in White--[Y]
     Subdivision--[]
Location Information--
     []
     Caller Lat/Lon--[]
Mapped Type--[P] Mapped Lat/Lon--
     [39.922161/-75.160423,39.921836/-75.160493,39.921828/-75.160448,
      39.922157/-75.160367]
     Attachments--[http://www.pa811.org/attachments/20212440918]
Type of Work--[REPL CURB TRAP LATERAL]                       Depth--[]
Extent of Excavation--[]                Method of Excavation--[DIGGING]
Equip Type--[BH]
Street--[X] Sidewalk--[X] Pub Prop--[X] Pvt Prop--[X] Other--[]
Private Front--[X] Rear--[ ] Left--[ ] Right--[ ]

Lawful Start Dates--[07-Sep-21] thru [16-Sep-21] Response Due Date--[03-Sep-21]
    Scheduled Excavation Date--[07-Sep-21] Dig Time--[0800] Duration--[1 DAY]

Caller--[KAREN MANNIX]
Caller Phone--[215-333-5750]
Excavator--[CLEMENTS BROTHERS PLUMBING]
Address--[2030 HARTEL ST]
City--[LEVITTOWN]                                State--[PA] Zip--[19057]
FAX--[215-547-9007]              Caller Type--[B]
Email--[cbi2030@msn.com]
Work For--[CHIEV]
Onsite Contact--[SEAN CLEMENTS]
Onsite Contact Phone--[215-333-5750]
Best Time to Call--[0800-1700]
Onsite Contact Email--[cbi2030@msn.com]

Prepared--[01-Sep-21] at [0950] by [KATELYNN HORVATH]
Remarks--
     [STREET 8FT DEEP AND 3FT X 6FT. SIDEWALK 8FT DEEP AND 4FT X 4FT.******===
      UPDATE 20212072616-000 --9/1/2021 0950 KMH 999===******
      UPDATE REQUESTED BY: SEAN CLEMENTS
      REASON FOR UPDATE: WORK NOT STARTED
      REMARK LINES.]

KA 0  KA =PECO SCKL        PD 0  PD =PHILA C WTR DPT  PSD0  PSD=PHILADELPHIA ST
PZ 0  PZ =PGW PHLA         YA 0  YA =VERIZON PA PHIL

Serial Number--[20212440918]-[000]
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All Responses for SN: 20212440918 as of 30-Oct-2024 14:17:18

Print Export to Excel

CDC	Member Name	Response	Notes	Response Date	Initials
KA	PECO AN EXELON COMPANY	**CLEAR. NO FACILITIES OR FACILITIES NOT INVOLVED BASED ON TICKET INFORMATION.**		9/3/2021 9:48:22 AM	CLS-WEBSVC
PD	PHILADELPHIA CITY WATER DEPARTMENT	**FIELD MARKED.**		9/2/2021 7:16:28 PM	MR-WEB
PSD	PHILADELPHIA CITY DEPARTMENT OF STREETS	**CLEAR. NO FACILITIES OR FACILITIES NOT INVOLVED BASED ON TICKET INFORMATION.**		9/1/2021 1:12:42 PM	KR-WEB
PZ	PHILADELPHIA GAS WORKS	**FIELD MARKED.**		9/3/2021 12:18:09 PM	BLO-WEBSVC
YA	VERIZON PENNSYLVANIA LLC	**CLEAR. NO FACILITIES OR FACILITIES NOT INVOLVED BASED ON TICKET INFORMATION.**		9/1/2021 9:55:00 AM	PRA-WEBSVC

I&E Exhibit 8

```
CDC    00000 POCS MM/DD/YY TT:TT:TT 20212460409-000 NEW  XCAV EMER

============PENNSYLVANIA UNDERGROUND UTILITY LINE PROTECTION REQUEST============
Serial Number--[20212460409]-[000] Channel#--[0817A999][0213][2019-08]
Message Type--[NEW][EXCAVATION][EMERGENCY]

County--[PHILADELPHIA]    Municipality--[PHILADELPHIA CITY]          Ward--[39]
Work Site--[813 JACKSON ST]
     Nearest Intersection--[S 8TH ST]
     Second Intersection--[S 9TH ST]
     At Intersection--[N] Between Intersections--[Y] Site Marked in White--[Y]
     Subdivision--[]
Location Information--
     []
     Caller Lat/Lon--[]
Mapped Type--[P] Mapped Lat/Lon--
     [39.921908/-75.160523,39.921874/-75.160258,39.921912/-75.160251,
      39.921944/-75.160521]
     Attachments--[http://www.pa811.org/attachments/20212460409]
Type of Work--[REPAIR CURB TRAP]                             Depth--[5FT]
Extent of Excavation--[2 AT 3FTX6FT]    Method of Excavation--[DIGGING]
Equip Type--[BH AND HAND TOOLS]
Street--[X] Sidewalk--[ ] Pub Prop--[ ] Pvt Prop--[ ] Other--[]
Private Front--[ ] Rear--[ ] Left--[ ] Right--[ ]

Lawful Start Dates--[         ] thru [         ] Response Due Date--[03-Sep-21]
    Scheduled Excavation Date--[03-Sep-21] Dig Time--[0830] Duration--[1 DAY]

Caller--[RICH LEPORE]
Caller Phone--[215-778-6909]
Excavator--[LEPORE PLUMBING]
Address--[44 STRATTON LN]
City--[SEWELL]                                   State--[NJ] Zip--[08080]
FAX--[856-232-0827]              Caller Type--[B]
Email--[leporeplumbing@gmail.com]
Work For--[SAL ROTA]
Onsite Contact--[RICH LEPORE]
Onsite Contact Phone--[215-778-6909]
Best Time to Call--[ANYTIME]
Onsite Contact Email--[leporeplumbing@gmail.com]

Prepared--[03-Sep-21] at [0821] by [DORIS COUSINS]
Remarks--
     [CREW ON SITE]

CM90  CM9=WILLIAMS EMER    KA 0  KA =PECO SCKL        PD 0  PD =PHILA C WTR DPT
PSD0  PSD=PHILADELPHIA ST  PZ 0  PZ =PGW PHLA         TC 0  TC =TRANSCO GAS PL
TC10  TC1=TRANSCO EMER     YA 0  YA =VERIZON PA PHIL

Serial Number--[20212460409]-[000]
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All Responses for SN: 20212460409 as of 30-Oct-2024 14:17:54

Print Export to Excel

CDC	Member Name	Response	Notes	Response Date	Initials
CM9	WILLIAMS EMER	**DID NOT RESPOND THROUGH PA ONE CALL.**		9/3/2021 10:25:17 AM	
KA	PECO AN EXELON COMPANY	**CLEAR. NO FACILITIES OR FACILITIES NOT INVOLVED BASED ON TICKET INFORMATION.**		9/3/2021 9:30:16 AM	CLS-WEBSVC
PD	PHILADELPHIA CITY WATER DEPARTMENT	**DID NOT RESPOND THROUGH PA ONE CALL.**		9/3/2021 10:25:17 AM	
PSD	PHILADELPHIA CITY DEPARTMENT OF STREETS	**CLEAR. NO FACILITIES OR FACILITIES NOT INVOLVED BASED ON TICKET INFORMATION.**		9/3/2021 9:14:49 AM	KR-WEB
PZ	PHILADELPHIA GAS WORKS	**FIELD MARKED.**		9/3/2021 9:31:48 AM	BLO-WEBSVC
TC	TRANSCONTINENTAL GAS/WILLIAMS GAS	**CLEAR. NO FACILITIES OR FACILITIES NOT INVOLVED BASED ON TICKET INFORMATION.**		9/3/2021 8:43:29 AM	MDE-WEBSVC
TC1	TRANSCONTINENTAL GAS/WILLIAMS GAS	**DID NOT RESPOND THROUGH PA ONE CALL.**		9/3/2021 10:25:17 AM	
YA	VERIZON PENNSYLVANIA LLC	**CLEAR. NO FACILITIES OR FACILITIES NOT INVOLVED BASED ON TICKET INFORMATION.**		9/3/2021 8:43:54 AM	AAA-WEBSVC

I&E Exhibit 9

AFFILIATED ENGINEERING LABORATORIES, INC.

Engineering Consultants

Physical Location:
777 New Durham Road
Edison, NJ 08817

P.O. Box 3300
Edison, NJ 08818-3300

Phone (732) 429-1200
Fax (732) 429-1201
www.affiliatedinc.net

July 15, 2022

Philadelphia Gas Works
800 West Montgomery Street
Philadelphia, Pennsylvania 19122-2806

Attention: Ms. Ellen Hugar

Re: Philadelphia Gas Works
Our File No. W-6491

Dear Ms. Hugar:

Pursuant to your request, the writer conducted a metallurgical evaluation on the submitted section of cast iron gas piping pertaining to the above referenced matter. On November 30, 2021, a gas explosion reportedly occurred at 815 Jackson Street, Philadelphia, Pennsylvania. Subsequently, Philadelphia Gas Works (PGW) launched an investigation for the source of a potential gas leak. As a result of the investigation, PGW's response team located a breach in a 4-inch diameter cast iron pipe located at/near the residence located at 815 Jackson Street (between S. 8th Street and S. Mildred Street) and attributed it to the gas leak (**Figure 1**). The breached section was excavated near the subject residence and stored at the facilities of PGW (**Figures 2 – 3**). It was understood that the Pennsylvania Public Utility Commission (PA PUC) is investigating the incident and, per Federal Pipeline Safety Regulations 49 CFR 192.617, requires that the incident pipe section be evaluated for the cause of failure. Upon which, the undersigned was retained to perform a metallurgical evaluation per the request of the PA PUC and PGW.

Re: Philadelphia Gas Works
July 15, 2022
Page 2 of 29

Figure 1

Figure 2

Figure 3

BACKGROUND INFORMATION

In reference to the PA PUC's request, PGW is to have the pipe section sent to a laboratory for analysis and *"At a minimum the testing of the cast iron pipe should include:*

- *Visual and Macroscopic examination of the cast iron pipe wall surface*
- *Fractographic examination of the cast iron*
- *Examination for graphitization of the cast iron*

- *Chemical analysis of the cast iron*
- *Hardness and toughness testing of the cast iron."*[1]

The writer was informed by PGW representatives that the pipe was installed circa 1898, indicating that it was approximately 123 years old at the time of the reported explosion. It was understood that there were no repairs performed on the subject cast iron main related to the subject residence or adjoining residences preceding the incident.

Following the guidelines and requirements set forth by the PA PUC, PGW requested that the writer prepare and submit a test protocol for approval before performing any testing on the subject cast iron pipe. As such, in order to prepare a recommended test protocol for the evaluation of the subject gas main, the writer traveled to the facilities of PGW on February 15, 2022, and performed a preliminary visual inspection of the physical evidence that has been retained by PGW as part of its investigation. **ATTACHMENT A** contains all of the photographic documentation generated during said initial inspection on February 15, 2022. Accordingly, a comprehensive protocol dated March 7, 2022 was submitted to the PA PUC and PGW (**ATTACHMENT B** – Test Protocol) with item-specific objectives, including but not limited to, X-ray radiography, chemical analysis, mechanical testing, metallography and fractography per the requirements of the PA PUC.

On April 5, 2022, an Affiliated Engineering Laboratories, Inc. (AEL) representative took possession of the incident items from PGW custody (**ATTACHMENT C** contains the Chain of Custody Transfer Form) and brought it to the facilities of AEL for a metallurgical evaluation. It may be noted that this writer's investigation was based solely on the evaluation of the items' condition per the March 7, 2022 protocol and did not address the events leading up to the reported explosion itself. The following shall serve as confirmation of the findings.

As part of the evaluation, a joint-party inspection of the physical evidence was held at the facilities of AEL to allow for all interested parties to examine the items while the testing commenced. Due to the ongoing national COVID-19 health crisis, the inspection was a one-day live-stream event broadcasted to all interested parties on April 22, 2022 while others attended in-person in a limited capacity in order to maintain safe working distance. **ATTACHMENT D** contains the April 22, 2022 sign-in sheet detailing the virtual and in-person attendees for the inspection. Subsequent to the joint-party inspection, additional sampling and testing was performed under the direction of AEL to complete the items in the protocol.

All of the photographic and videographic documentation, sketches, and laboratory data generated associated with the evaluation is included in the enclosed USB drive. Further, select photographs are included herewith for general information and future reference (Photograph Nos. 1 – 71), while the complete set of photographic documentation generated as part of the metallurgical evaluation is contained in **ATTACHMENT E** for general information.

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[1] Pennsylvania Public Utility Commission letter to PGW, Inc. Reference: L-8-21 January 7, 2022

SUMMARY OF FINDINGS

ITEM A – External stresses applied to a graphitized gas main induced a circumferential crack that initiated along the bottom of the pipe whereby gas was allowed to escape. There was no evidence of a pre-existing breach or leak location observed on the fracture surface.

SUBMITTED ITEMS

Two items were submitted for evaluation and are listed below along with the objectives for testing.

ITEM A – Cast iron pipe section with incident breach

OBJECTIVES: Characterize material and determine cause for fracture

ITEM B – Cast iron pipe segment cut/removed from section with incident breach

OBJECTIVE: Preserve for potential mechanical testing if required. Depending on the condition of **ITEM A**, **ITEM B** may be used for some, if not all, of the mechanical testing to characterize the cast iron pipe.

The subject pipe section and corresponding pipe segment were supplied inside a padlocked wooden crate whereby a key was provided to gain access (**Photo No. 1**). Two pipe sections were contained inside the crate and were identified as **ITEM A** and **ITEM B** (**Photo Nos. 2 – 3**). The pipe sections and corresponding cut/removed samples were returned to the respective crate and locked at the end of each work day, except for the samples that were shipped to an independent testing laboratory while maintaining chain of custody, which were eventually returned to the respective crate upon completion of mechanical testing and chemical analysis as per the March 7, 2022 protocol. As noted above, **ITEM B** was reserved for sampling should **ITEM A** not have sufficient length for testing per the protocol. The following testing was performed on **ITEM A** only.

Photo No. 1 (W-6491-D-005.JPG – cropped)

Photo No. 2 (W-6491-D-013.JPG – cropped)

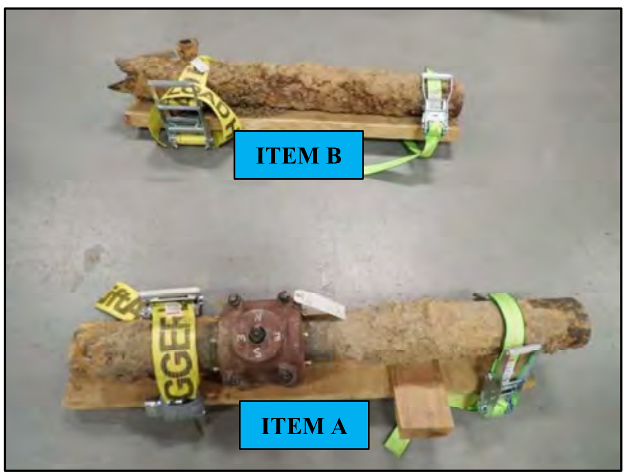

Photo No. 3 (W-6491-D-021.JPG)

SAMPLE IDENTIFICATION

As part of the metallurgical evaluation, samples were cut from **ITEM A** and were given identifications in a systematic manner. Any and all sample identifications that were created during this investigation were inscribed onto the samples themselves and a sketch detailing each item has been provided for reference purposes in **ATTACHMENT F** – Sample Identification and Dimensions.

DIMENSIONAL MEASUREMENTS

Nominal dimensions, i.e. length, diameters (inside and outside), and wall thickness were measured and are also included herewith in **ATTACHMENT F** for documentation purposes.

VISUAL EXAMINATION

ITEM A consisted of a 49-inch long, 4-inch diameter cast iron pipe with a metal pipe repair clamp (Dresser® Style 80 Repair Clamp) located in the approximate middle of the pipe section (**Photo Nos. 4 – 5**). A paper tag attached to the pipe section was marked *"DATE: 12/1/2021; LOCATION: 815 Jackson Street; DESCRIPTION: 4" CI OC gas main."* Handwritten markings found on the surface of the clamp identified the TOP of the pipe and North (N), South (S), East (E), and West (W) directions denoting orientation as installed in the ground. It was understood that during the investigation process PGW workers installed a repair clamp across the breach, which was attributed to the reported incident, to secure the damaged region.

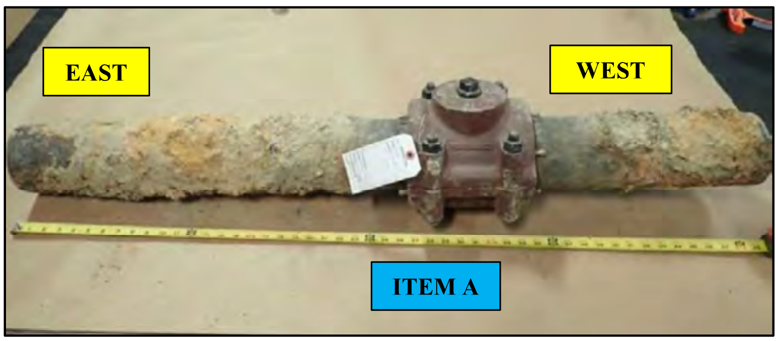

Photo No. 4 (W-6491-D-064.JPG – cropped)

Photo No. 5 (W-6491-D-077.JPG – cropped)

Both the EAST and WEST ends exhibited circumferential cuts (**Photo Nos. 6 – 7**, respectively). Visual examination of the EAST and WEST ends of **ITEM A** revealed the presence of darkened regions along cut surfaces, suggesting graphitization, which reduces the effective wall thickness by corrosion process. Due to the roughness of the cut surfaces and the fact that the breach did not occur at these ends, these ends were not ground planar for further examination. However, it may be noted that visual examination of the cut surfaces of both ends showed notably sized porosity and voids, which formed at the time of manufacturing (**Photo Nos. 8 – 9).**

Photo No. 6 (W-6491-076.JPG)

Photo No. 7 (W-6491-067.JPG)

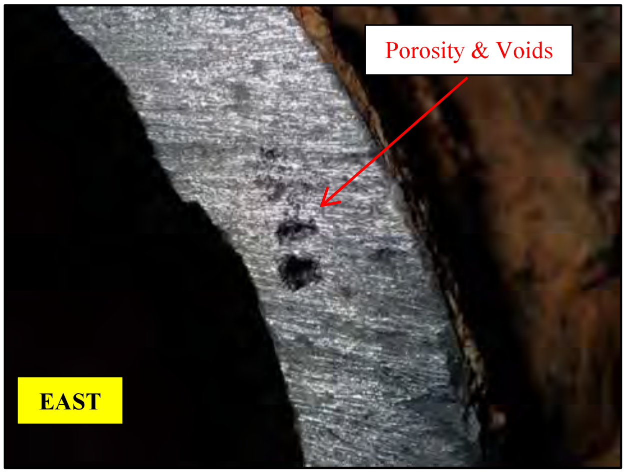

Photo No. 8 (W-6491-082.JPG)

Photo No. 9 (W-6491-069.JPG)

The outside diameter (OD) surface of **ITEM A** exhibited a buildup of soil deposits and corrosion product. Some of the material adhering to the surface was carefully removed by mechanical scraping and chipping while most of it remained tightly adhering to the pipe, indicating that it bonded to the OD surface (**Photo No. 10**). The hard soil deposits, which consisted of hardened masses of scale product, were collected and sealed in a plastic bag. Since the deposits and scale did not contain any significant amount of actual soil or dirt, but rather, were comprised of corrosion scale mixed with soil deposits, no further testing was performed on the deposits. However, the sample was labeled **ITEM A-1** and was stored for subsequent testing if deemed necessary.

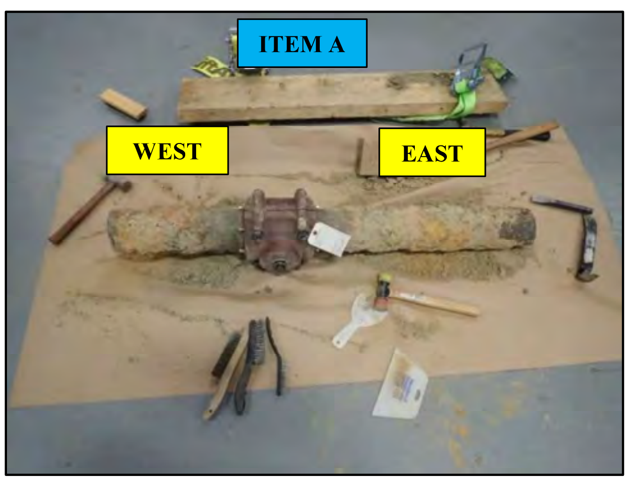

Photo No. 10 (W-6491-D-053.JPG)

The inside diameter (ID) surface of the pipe was coated with a shiny, black tar-like substance (**Photo No. 11**). The buildup along one radial axis of the pipe's diameter, formed by gravity, confirmed the orientation of the pipe, i.e. TOP and BOTTOM. The texture and softness of the coating was not consistent with any traditional means of lining the ID surface of a pipe. Rather, the material appeared to be a deposit or condensate. It was understood that PGW or its predecessor used to manufacture gas, which is generally done by processing coke. This process produces a byproduct that can condense onto surfaces such as the ID of piping. A sample of the coating can be analyzed should it be deemed warranted.

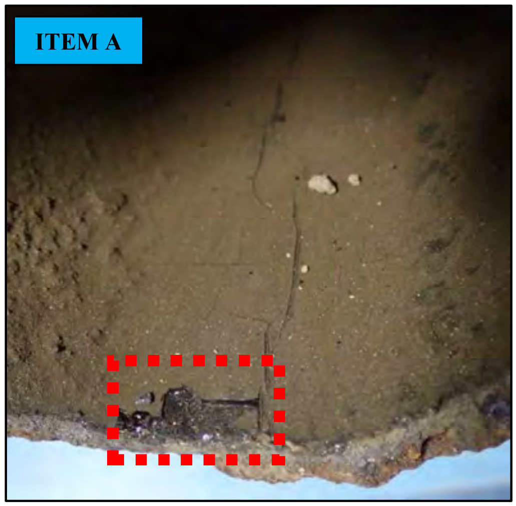

Photo No. 11 (W-6491-D-162.JPG)

After the repair clamp was removed, the breach location was exposed for further investigation (**Photo No. 12**). It was observed that the underlying pipe's OD surface was intentionally cleaned, which typically is performed in order to properly install a repair clamp. The surface must be cleaned and devoid of protrusions in order for the elastomeric gasket material to form an airtight seal around the circumference of the pipe. The breach was comprised of a single circumferential fracture that separated the cast iron main into two segments: 31-inch long EAST end and 18-inch long WEST end (approximately).

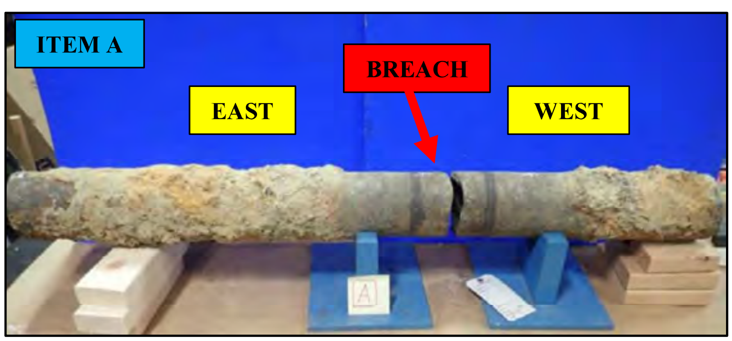

Photo No. 12 (W-6491-D-093.JPG – cropped)

Both mating fracture surfaces of **ITEM A** were visually examined in the as-received, or uncleaned, condition. The mating fracture surfaces were mirror images of each other (**Photo Nos. 13 – 14**). The BOTTOM of the cast iron main exhibited a darkened surface that spanned more than half the wall thickness. However, preliminary inspection of the mating fracture surfaces did not reveal the presence of a darkened region spanning the thickness of the wall, which would have suggested a pre-existing leak prior to the reported incident. In order to further examine the fracture topography, microstructure, mechanical properties, and chemical composition, samples had to be cut/removed.

Photo No. 13 (W-6491-D-167.JPG – cropped)

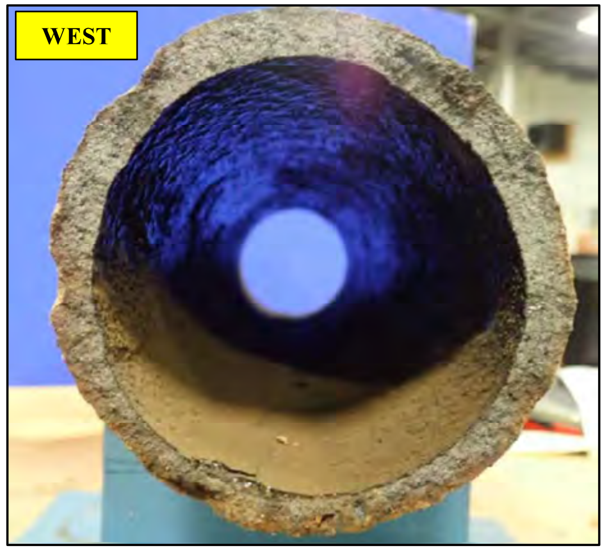

Photo No. 14 (W-6491-D-146.JPG – cropped)

In order to document the sections to be cut/removed from **ITEM A**, the sections of the mating fracture surfaces were subsequently marked and identified as follows (**Photo Nos. 15 – 16**):

A WEST end remained as "parent" item
A-1 Soil sample removed from A
A-2 Ring section removed from the WEST end adjacent to **A-3** for hardness and chemistry
A-3 Mating fracture surface on the WEST end associated with the breach
A-4 Mating fracture surface on the EAST end associated with the breach
A-5 EAST end after **A-4** was removed – reserved for mechanical testing

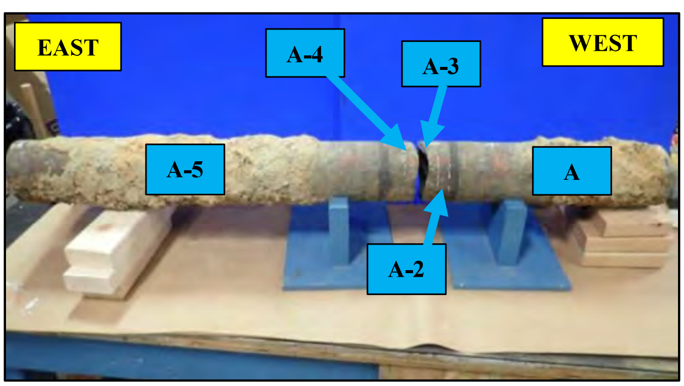

Photo No. 15 (W-6491-D-115.JPG – cropped)

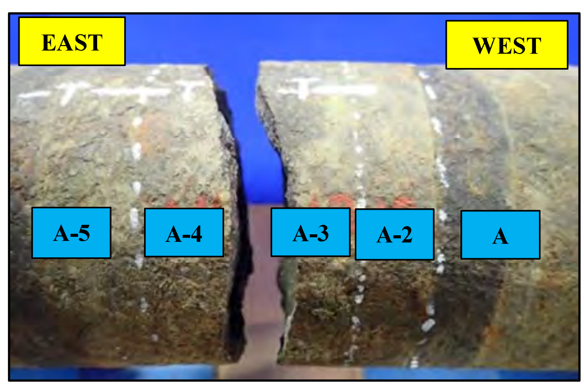

Photo No. 16 (W-6491-D-119.JPG – cropped)

The ring sections identified above were subsequently dry cut using a horizontal band saw (**Photo Nos. 17 – 18**).

Photo No. 17 (W-6491-D-233.JPG – cropped)

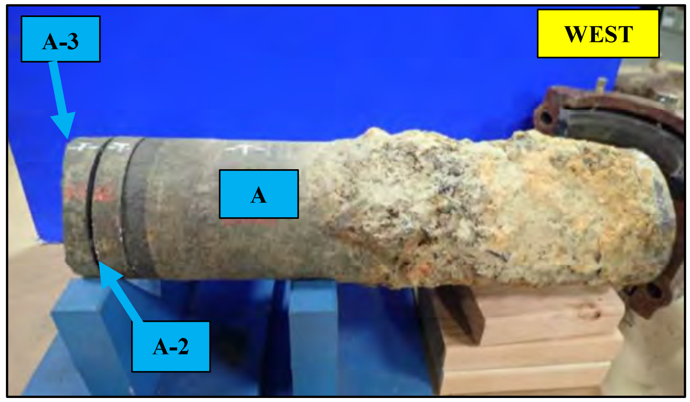

Photo No. 18 (W-6491-D-207.JPG – cropped)

The cut edges of the rings containing the mating fracture surfaces were measured for wall thickness and depth of graphitic corrosion. Sketches of the wall thickness and graphitic corrosion damage can be found in **ATTACHMENT F** – Sample Identification and Dimensions. The wall thickness measurements showed that the thickness across the pipe's cross-section was asymmetrical ranging from approximately 0.34 inch to 0.44 inch. Given the reported age of the pipe, it was suspected that the pipe was fabricated by vertical pit casting, which was the foremost process of the time. If indeed it was a product of vertical pit casting, the asymmetrical wall thickness can be attributed to a shift in the core of the pipe's mold when it was first cast. Vertical pit castings are known to exhibit such core shifting, resulting in an uneven wall thickness. In addition, examination of the cut surfaces on the ring samples cut from **ITEM A** revealed the presence of casting flaws randomly distributed within the cross-section, which is typical for a late 19th century cast iron pipe.

Varying degrees of graphitization were observed on the cut edges of ring segments **ITEM A-3** and **ITEM A-4** (**Photo Nos. 19 – 20**). There was no indication of any through-wall penetrations formed by graphitization or any other type of corrosion or mechanical damage as intersected by the cuts. The effective wall thickness of the pipe in those two cross-sections was slightly reduced (up to 15%) as a result of graphitization (**TABLE A**). Notable casting voids were observed distributed along the cut edges of both rings, thereby further reducing the effective wall thickness (**Photo No. 21**).

Photo No. 19 (W-6491-D-195.JPG)

Photo No. 20 (W-6491-E-053.JPG)

Photo No. 21 (W-6491-E-058.JPG)

TABLE A
Wall Thickness Measurements on Cut Edge

	ITEM A-3				ITEM A-4			
O'clock Position	**12**	**3**	**6**	**9**	**12**	**3**	**6**	**9**
Original Wall Thickness, in.	0.4400	0.4305	0.3595	0.3980	0.4430	0.4305	0.3360	0.4040
Depth of Graphitization	----	----	----	0.0510	0.0645	---	---	---
Effective Wall Thickness, in.	0.4400	0.4305	0.3595	0.3470	0.3785	0.4305	0.3360	0.4040
% Wall Loss	0	0	0	13	15	0	0	0

Re: Philadelphia Gas Works
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X-RAY RADIOGRAPHY

Ring sections **ITEM A-3** and **ITEM A-4**, which contained the mating fracture surfaces of the breach, along with ring section **ITEM A-2**, were subjected to radiographic studies performed by ECT Worldwide, 7W Chimney Rock Road, Unit A, Bound Brook, New Jersey, at the facilities of AEL. Chain of Custody remained with AEL the entire time during the radiographic studies. The cross-sections of the ring sections were documented.

Radiographic views were taken at various angles for documentation purposes. Radiographic imaging showed the ring sections random, localized wall thickness losses (patchy distributions of graphitic corrosion) around the respective circumferences of **ITEM A-2**, **ITEM A-3**, and **ITEM A-4** (**Photo Nos. 22 – 27**). In addition, **ITEM A-3** exhibited an agglomeration of voids near its BOTTOM (5 to 6 o'clock positions) as well as some voids near its TOP (12 o'clock position).

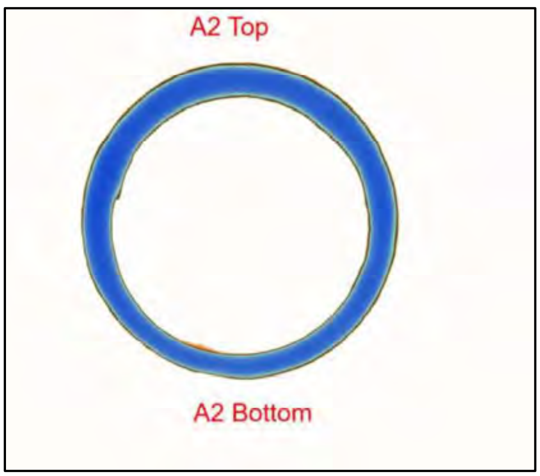

Photo No. 22 (Screenshot 2022-04-22 140045.jpg)

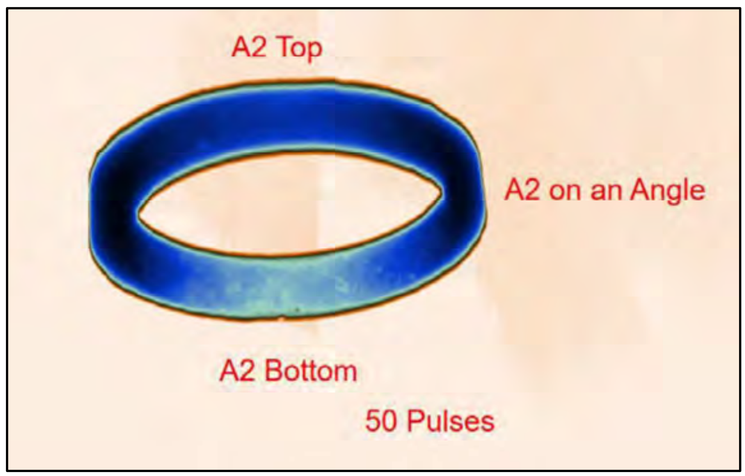

Photo No. 23 (Screenshot 2022-04-22 140416.jpg)

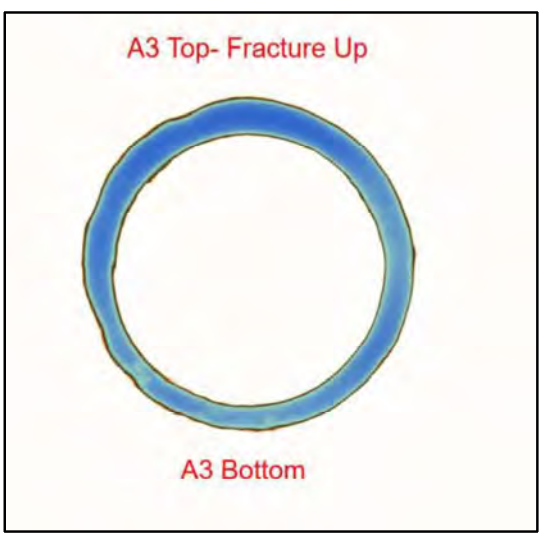

Photo No. 24 (Screenshot 2022-04-22 135751.jpg)

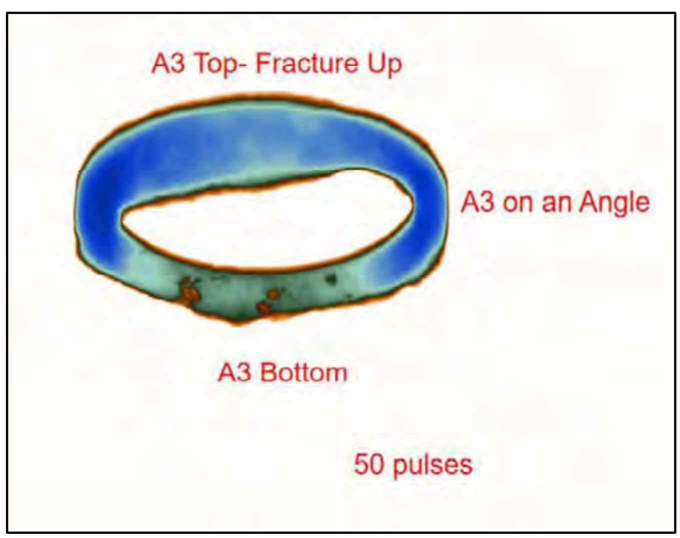

Photo No. 25 (Screenshot 2022-04-22 140210.jpg)

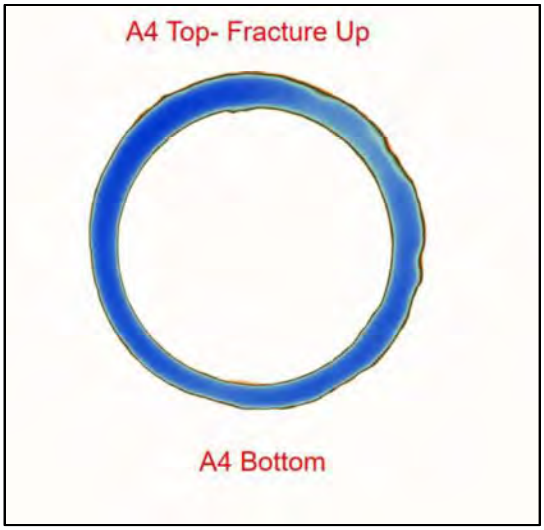

Photo No. 26 (Screenshot 2022-04-22 135953.jpg)

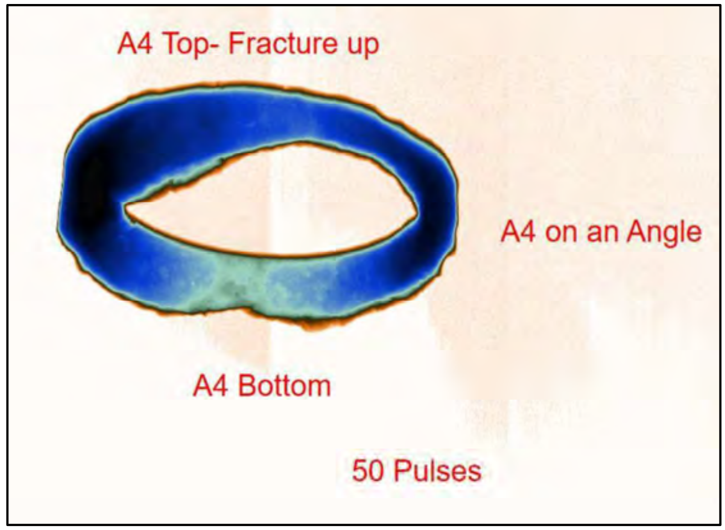

Photo No. 27 (Screenshot 2022-04-22 140256.jpg)

FRACTOGRAPHIC STUDIES

There was no evidence of plastic deformation, which is typical for gray cast iron with the application of a tensile or bending overloading condition. The topography was found to be relatively devoid of any corrosion product, aside from uniform light rusting, or a pattern of oxidation that would suggest that a crack propagated to the OD surface and caused a notable through-wall penetration for an extended period of time (**Photo Nos. 28 – 33**). There was no indication of a pre-existing leak location along the fracture surface, as evident by the uniformly colored topography. While varying degrees of graphitization (darkened regions initiating on the OD surface) were observed along the circumference of the mating fracture surfaces, the most notable graphitized region was observed near the BOTTOM of the pipe (**Photo No. 34**). As noted above, this region of the cross-section also exhibited a notable agglomeration of casting voids.

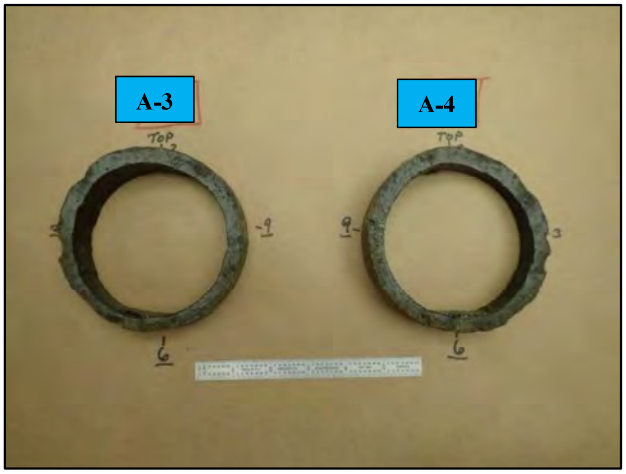

Photo No. 28 (W-6491-D-245.JPG)

Photo No. 29 (W-6491-E-072.JPG)

Photo No. 30 (W-6491-E-096.JPG)

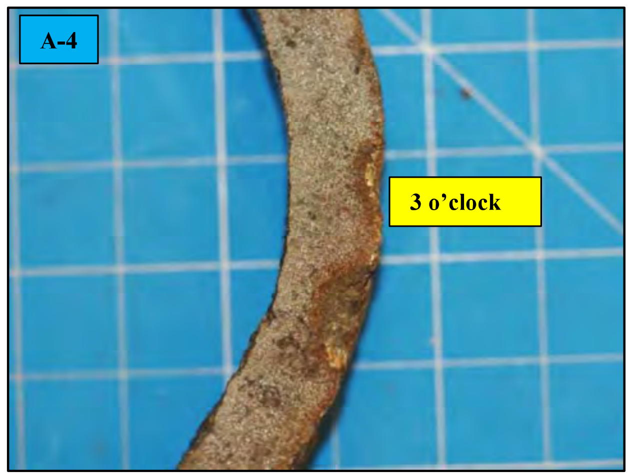

Photo No. 31 (W-6491-E-090.JPG)

Photo No. 32 (W-6491-E-086.JPG)

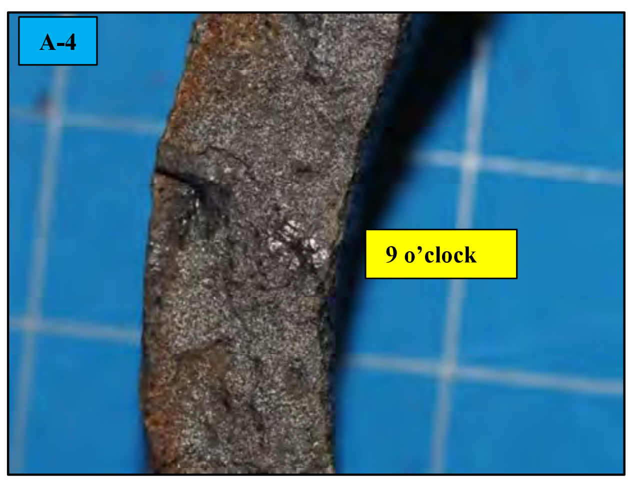

Photo No. 33 (W-6491-E-102.JPG)

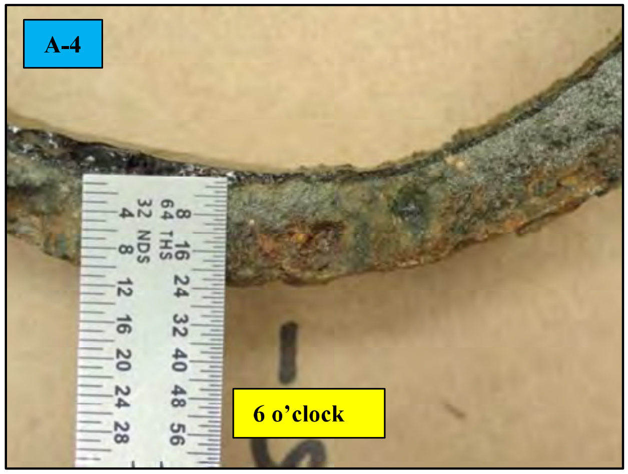

Photo No. 34 (W-6491-D-250.JPG)

The fracture surface was then examined via stereomicroscopy (**Photo Nos. 35 – 38**). Microscopic examination of the fracture surface showed brittle mode fracture of typical gray cast iron. Varying degrees of graphitization were noted along the OD surface. A notable amount of voids was observed near the 6 o'clock position.

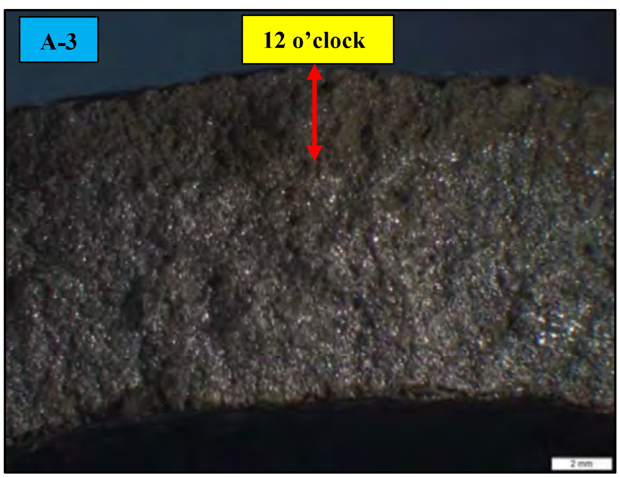

Photo No. 35 (W-6491-B-001.jpg)

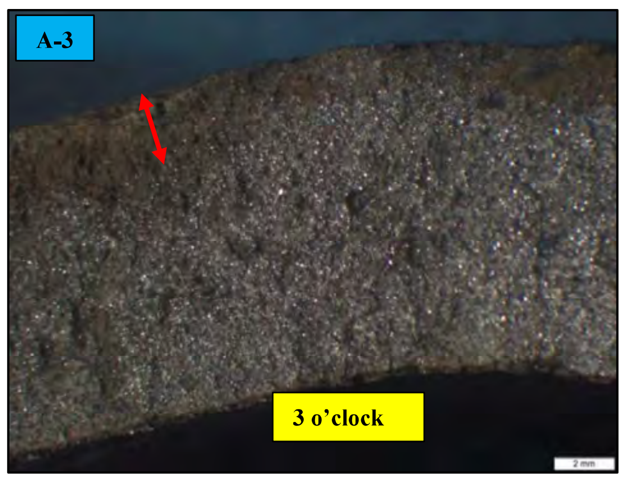

Photo No. 36 (W-6491-B-007.jpg)

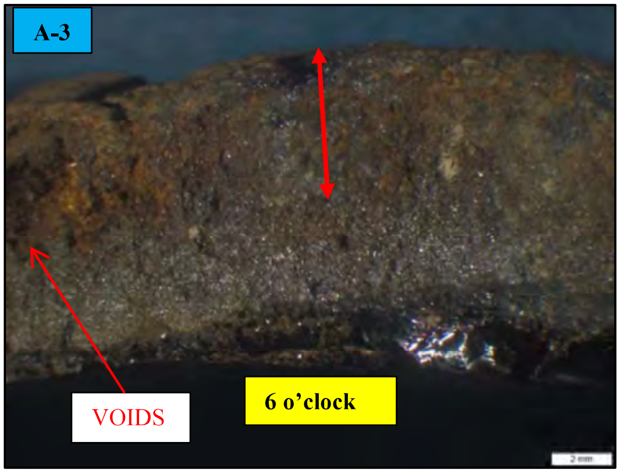

Photo No. 37 (W-6491-B-015.jpg)

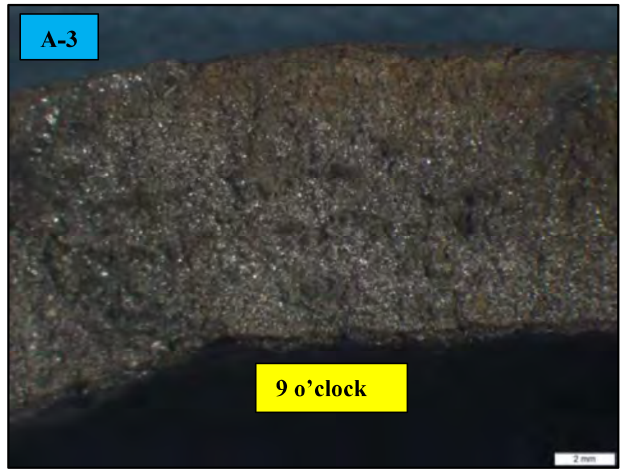

Photo No. 38 (W-6491-B-021.jpg)

Based on the as-failed conditions of the mating fracture surfaces, it was evident that a crack developed at/near the bottom of the pipe and propagated along in both the clockwise and counter-clockwise directions along its circumference until the two crack fronts arrested near the TOP. Examination of the cross-sections at the fracture as well as along cut edges revealed material loss via graphitization, which can serve as a stress riser(s) under the application of external force. Judging from the topography, the fracture resulted from a one-time overload condition. Based on the fracture profile, the fracture appeared to have initiated near the BOTTOM of the pipe where the graphitization was deepest and propagated along its circumference towards the TOP. As noted above, this region of the cross-section also exhibited a notable agglomeration of casting voids.

MICROSTRUCTURAL STUDIES

Microspecimens intersecting ring section **A-3** were prepared using standard metallographic procedure as per ASTM E3-11(2017) *"Standard Guide for Preparation of Metallographic Specimens"* (**Photo Nos. 39 – 44**). As per the protocol, a minimum of four microspecimens were taken for microstructural studies, along the circumference at the 12, 3, 6, and 9 o'clock positions and the samples were identified as **A-3-1**, **A-3-3**, **A-3-6**, **A-3-8**, respectively. In addition to the originally proposed microspecimens for ring section **A-3,** a fifth microspecimen (**A-3-5**) was prepared intersecting suspected porosity based on visual examination and radiographic studies at the 5 o'clock position. The microspecimens were then examined via Light Optical Microscopy (LOM) in both the unetched and etched conditions.

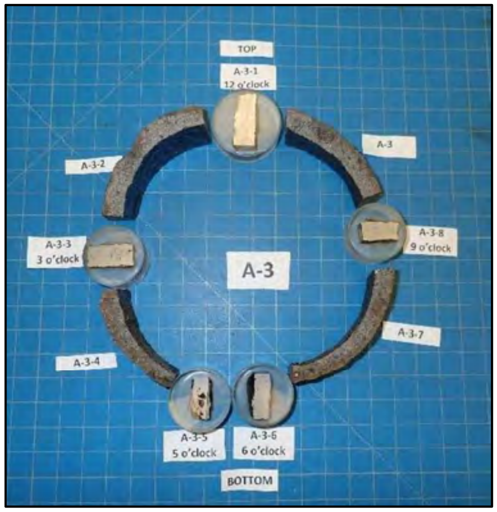

Photo No. 39 (W-6491-G-001.JPG - cropped)

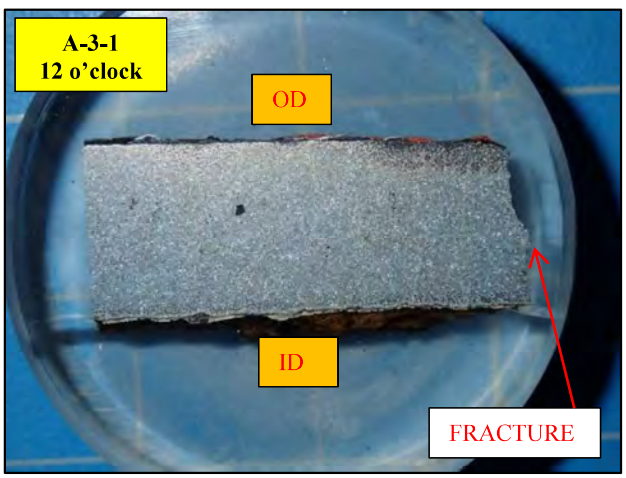

Photo No. 40 (W-6491-G-010.JPG)

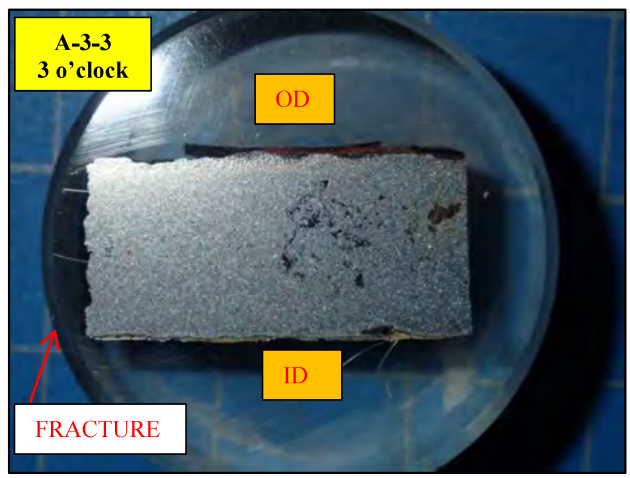

Photo No. 41 (W-6491-G-014.JPG)

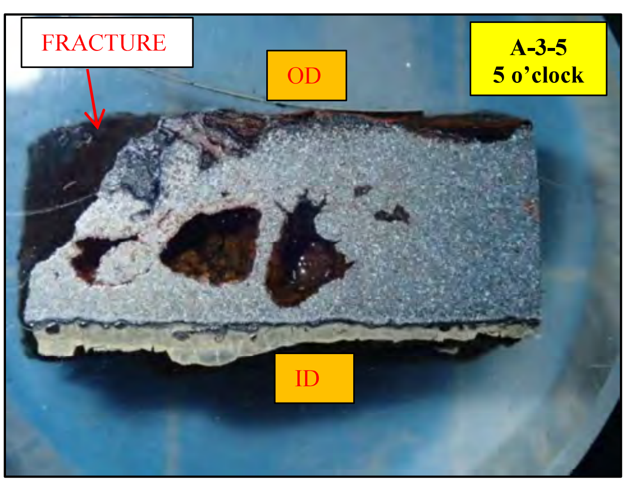

Photo No. 42 (W-6491-G-018.JPG)

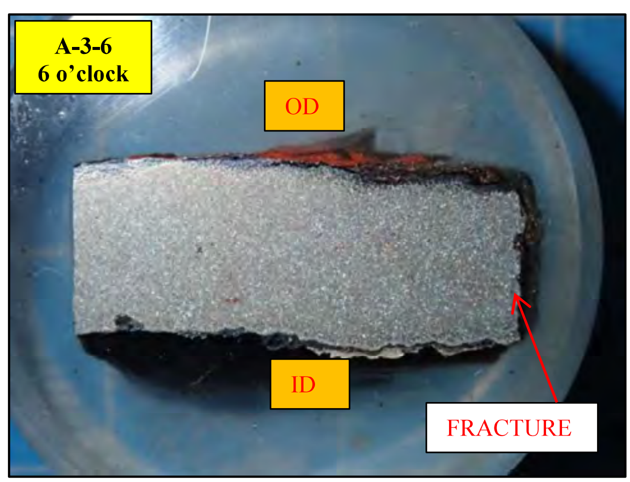

Photo No. 43 (W-6491-G-023.JPG)

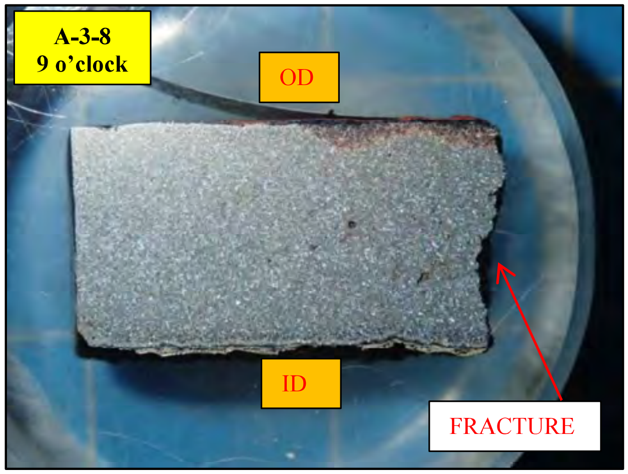

Photo No. 44 (W-6491-G-026.JPG)

Examination of the as-polished surfaces of the five microspecimens intersecting the fracture surface confirmed and documented the extent of graphitization that occurred over the 123 years of service (**Photo Nos. 45 – 49**). **TABLE B** contains the wall thickness measurements taken at the fracture. The 5 o'clock position (**A-3-5**) showed the most severe amount of corrosion damage resulting in an approximate 43% wall loss that reduced the effective wall thickness of the pipe to 57% of its original wall thickness at the fracture plane. Large-sized voids were also present in this region of the fracture, which further reduces the structural integrity of the gas main to approximately 30%. The 12 o'clock position (**A-3-1**) exhibited graphitization 20% (wall loss) of the original wall thickness while the 6 o'clock position (**A-3-6**) and 9 o'clock position (**A-3-8**) were both 13% (wall loss) at the fracture plane. The 3 o'clock position (**A-3-3**) was 11% wall loss. None of the microspecimens exhibited through-wall graphitic corrosion.

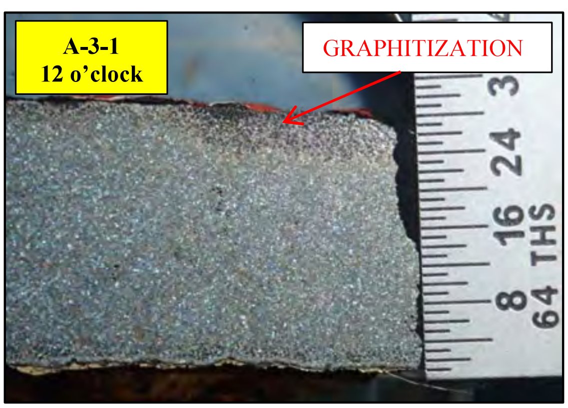

Photo No. 45 (W-6491-G-050.JPG – cropped)

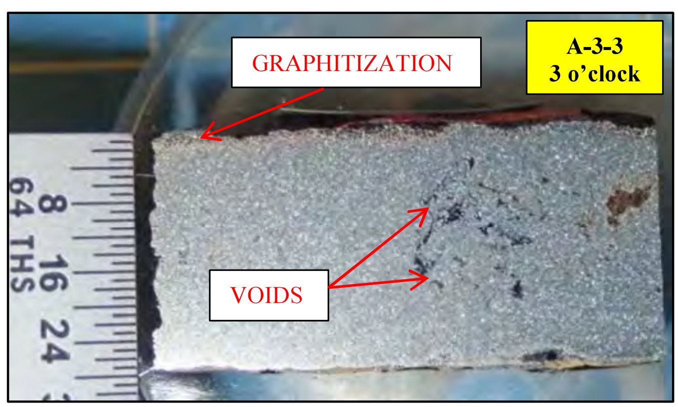

Photo No. 46 (W-6491-G-045.JPG – cropped)

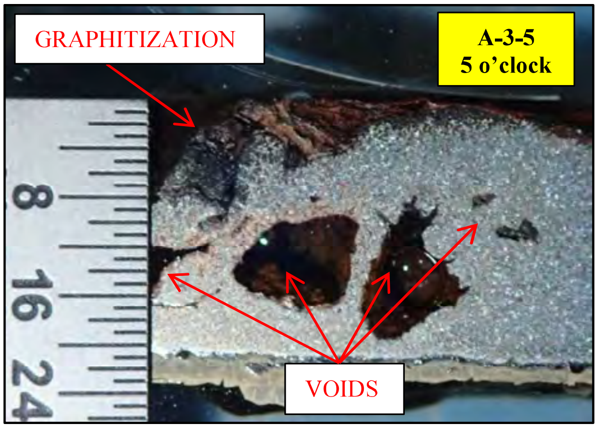

Photo No. 47 (W-6491-G-039.JPG – cropped)

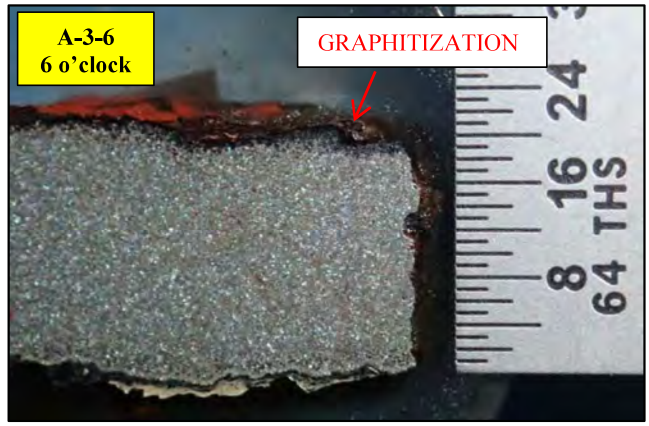

Photo No. 48 (W-6491-G-033.JPG – cropped)

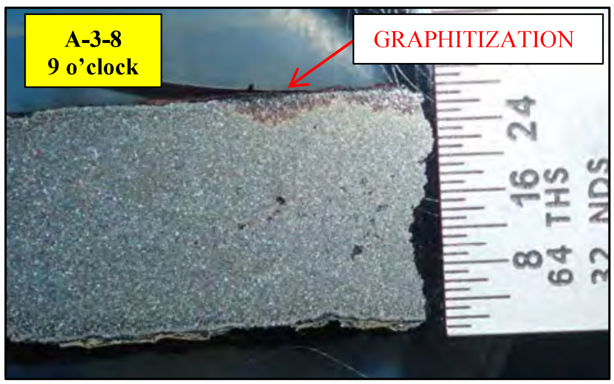

Photo No. 49 (W-6491-G-030.JPG – cropped)

TABLE B
Wall Thickness Measurements at Fracture

	ITEM A-3				
	12	**3**	**5**	**6**	**9**
Original Wall Thickness, in.	0.4400	0.4305	0.3535	0.3595	0.3980
Depth of Graphitization	0.0905	0.0465	0.1505	0.0470	0.0510
Effective Wall Thickness, in.	0.3495	0.3840	0.2030	0.3125	0.3470
% Wall Loss	20	11	43	13	13

The microspecimens were then examined via Light Optical Microscopy (LOM) in both the unetched and etched conditions. The bulk microstructure of the pipe consisted of a mixture of Type C distribution of graphite (superimposed flake sizes, random orientation) with Type B (Rosette flake graphite), flake size 3-4, in a Pearlite matrix (**Photo Nos. 50 – 53**). Type C graphite, also referred to as Kish graphite, is typical for pit cast iron pipes due to the inherent slow cooling rates. Kish graphite greatly reduces the mechanical properties of cast iron and produces a rough surface finish upon machining.

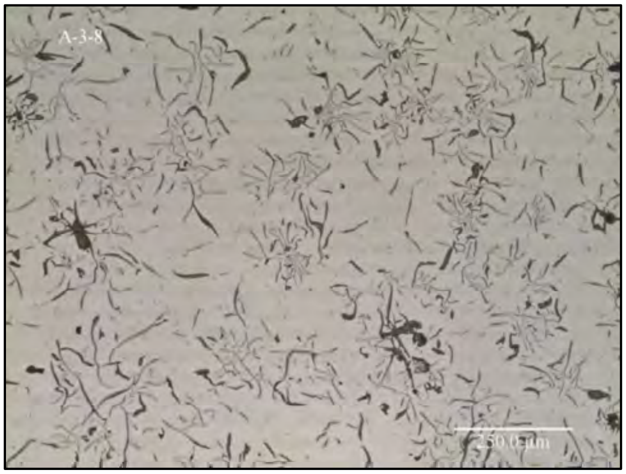

Photo No. 50 (W-6491-H-IMG_49.jpg)

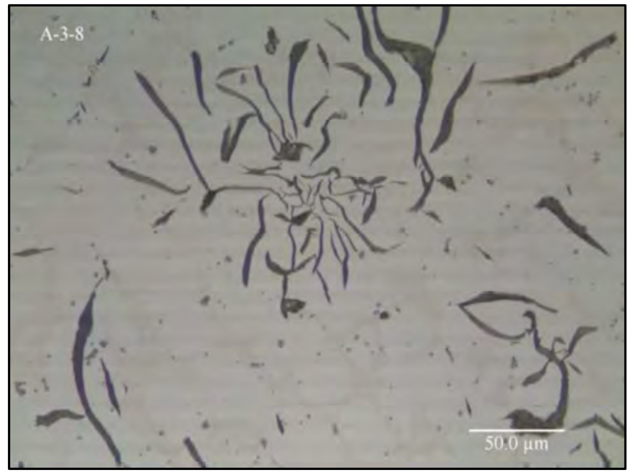

Photo No. 51 (W-6491-H-IMG_51.jpg)

Photo No. 52 (W-6491-H-IMG_100.jpg)

Photo No. 53 (W-6491-H-IMG_101.jpg)

Random distributions of iron-phosphide eutectic (Fe-P), also known as steadite phase, within a predominately Pearlite phase with some ferrite were also observed throughout the microstructure of all the specimens (**Photo No. 54 / Figure 4**). Steadite has a low melting point (1705°F) and is typically the last microstructural constituent to form upon solidification, which generally occurs at the grain boundaries.

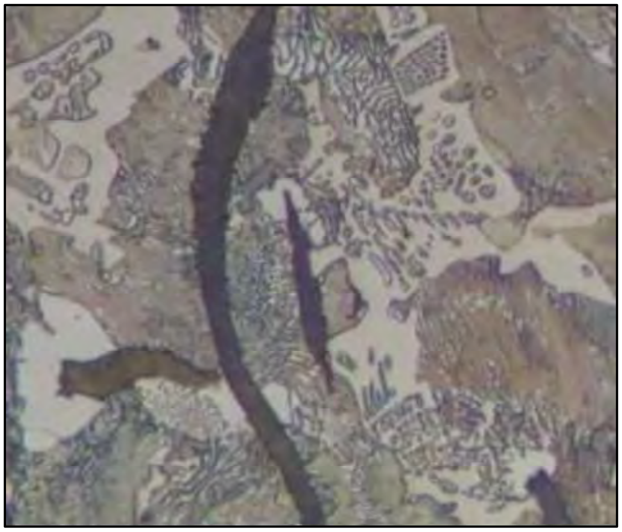

Photo No. 54 (W-6491-H-IMG_101.jpg – cropped)

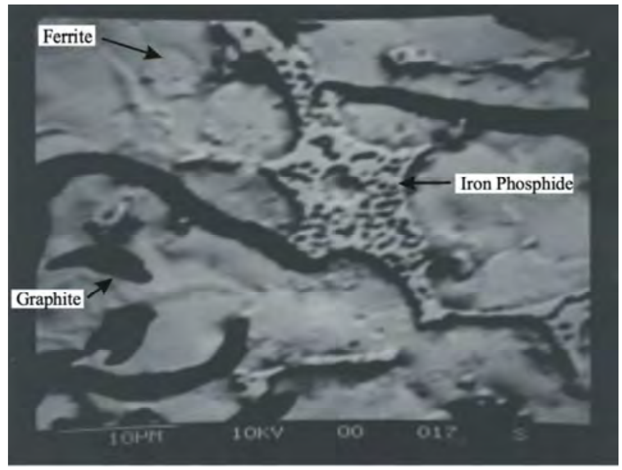

Figure 4 – Example of Steadite (Iron Phosphide)[2]

The microstructure, comprised mostly of Pearlite phase with some residual ferrite, was consistent with Class 60 type gray cast iron. However, the presence of steadite phase is a hard constituent that makes the cast iron more brittle and can decrease the mechanical properties of the casting.

Nonmetallic inclusions and casting defects and voids, i.e., porosities, slag inclusion, shrinkage, etc. ranged in severity along the circumference. All the microspecimens exhibited varying degrees of internal defects dispersed through the pipe wall thickness while the most severe was observed at the 5 o'clock position on **ITEM A-3**.

MECHANICAL TESTING (Performed by Independent Testing Laboratory – AEIS)

As part of the mechanical testing and chemical analysis, **ITEM A-2** and **ITEM A-5** were submitted to AEIS for testing by an independent testing facility (**ATTACHMENT G** – Hardness, Ring, Talbot Strip Test Report, Chemical Analysis, and associated Chain of Custody Form).[3] Hardness testing was performed as per the appropriate ASTM standards (see below) while the Ring and Talbot Strip Testing was performed as per ASA Specification A-21.3 *"Cast Iron Pit Cast Pipe for Gas"* (**ATTACHMENT H**). The samples from the mechanical testing were documented and photographed after being returned from AEIS (**Photo No. 55**).

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[2] J.M. Makar and B. Rajani, **Grey Cast Iron Water Pipe Metallurgy,** Journal of Materials in Civil Engineering, v. 12, no. 3, August 2000, pp. 245-253

[3] This attachment contains the original AEIS report S-136308 dated May 13, 2022, as well as a corrected AEIS report S-136308B. While the corrections in the updated AEIS report were related to typographical errors and proper references to ASA Specification A-21.3 *"Cast Iron Pit Cast Pipe for Gas,"* the test data remained unchanged.

Photo No. 55 (W-6491-F-002.JPG)

Hardness Testing

Hardness testing was performed on ring segment **ITEM A-2** using Brinell scale with 3000-kg load as per ASTM E10-17 *"Standard Test Method for Brinell Hardness of Metallic Materials"* (**Photo No. 56**). Examination of the ring revealed a large-sized void at the 6 o'clock position (**Photo No. 57**). The following table contains the Brinell hardness values and equivalent Rockwell value (based on published conversion charts):

Reading No.	Brinell (HBW)
1	185
2	159
3	171
Average	172 HBW
Equivalent Rockwell	87 HRB
Required	**95 HRB max**

Photo No. 56 (W-6491-E-033.JPG)

Photo No. 57 (W-6491-E-041.JPG)

Ring Tests

One ring segment was cut/removed from the pipe segment and was tested using the three-edge bearing method, as illustrated in ASA Specification A-21.3. The breaking load and the deflection at the time of the break were recorded. The Modulus of Rupture and Secant Modulus of Elasticity were then calculated in accordance with the formula provided in Paragraph 3-18.5 of ASA Specification A-21.3. The results of the calculations are compared with the values for the Modulus of Rupture (R) and Secant Modulus of Elasticity (E_S) also specified in Paragraph 3-18.5 of ASA Specification A-21.3.

They are summarized below:

	R (psi)	**E_s (psi)**
Ring Segment	***27,500***	2,700,900
ASA Specification A-21.3	31,000 min.	15,000,000 max

The calculated values from the ring testing indicated that the Modulus of Rupture was ***NOT*** acceptable or in compliance with the requirements of ASA Specification A-21.3 but the Secant Modulus of Elasticity was considered to be acceptable and in compliance with the requirements of ASA Specification A-21.3.

Examination of the induced fracture surfaces of the Ring Test Sample revealed varying degrees of graphitization and casting voids, similar to that of previously examined and above described ring samples from the cast iron main (**Photo Nos. 58 – 65**).

Photo No. 58 (W-6491-F-035.JPG)

Photo No. 59 (W-6491-F-039.JPG)

Photo No. 60 (W-6491-F-040.JPG)

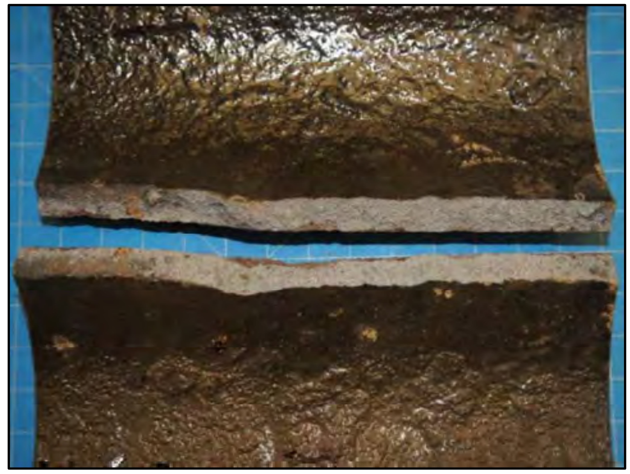

Photo No. 61 (W-6491-F-041.JPG)

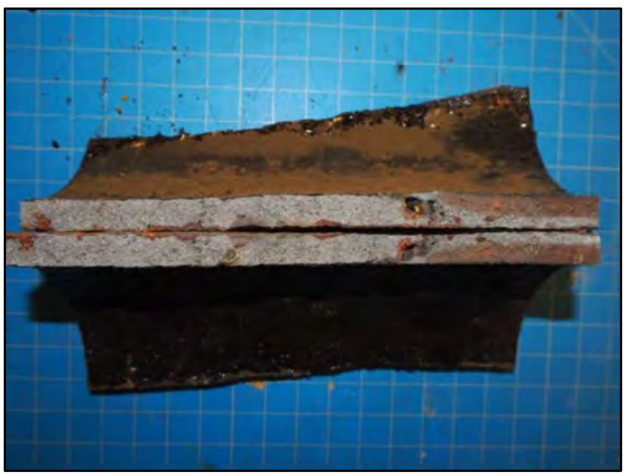

Photo No. 62 (W-6491-F-046.JPG)

Photo No. 63 (W-6491-F-047.JPG)

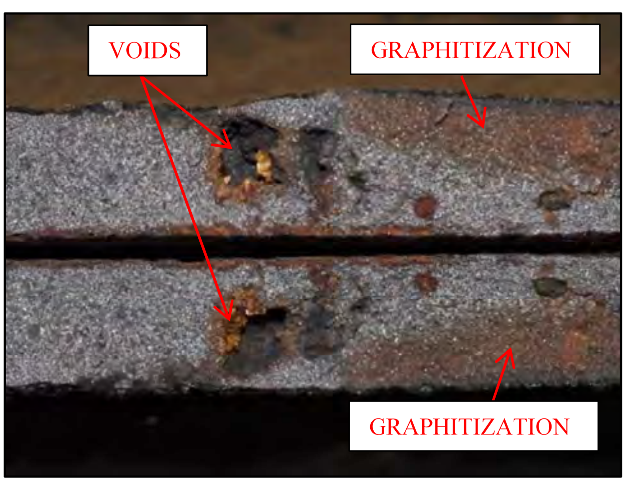

Photo No. 64 (W-6491-F-052.JPG)

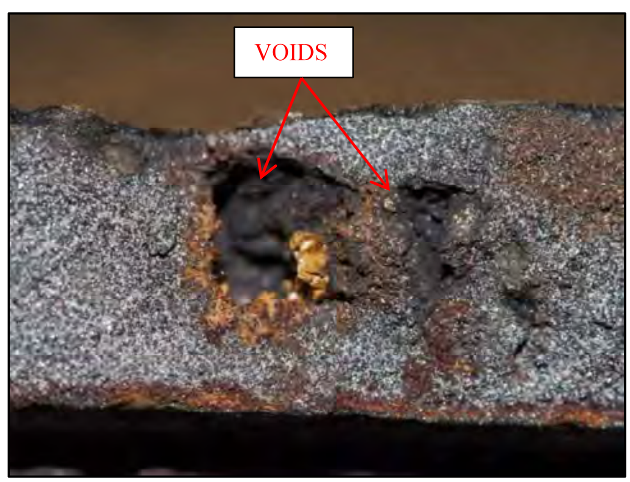

Photo No. 65 (W-6491-F-053.JPG)

Talbot Strip Tests

According to ASA Specification A-21.3, two Talbot Strips were machined longitudinally from pipe section **ITEM A-5** yielding Talbot Strip Nos. **1** and **2**.

Talbot Strip Test bars removed from pipe segment **ITEM A-5** were tested according to the method described in ASA Specification A-21.3, provided in **ATTACHMENT H**. The breaking loads and the corresponding deflections were observed and recorded (**ATTACHMENT G**).

The Modulus of Rupture (R) and Secant Modulus of Elasticity (E_S) values were then calculated in accordance with the formula provided in Paragraph 3-18.4 of ASA Specification A-21.3. The results of the calculations, provided in **ATTACHMENT G** and tabulated below, were compared with the values for R and E_S, also specified in Paragraph 3-18.4 of ASA Specification A-21.3:

Specimen No.	**(R) psi**	**(E_S) psi**
1	23,500	10,638,300
2	23,500	8,008,800
Average	**23,500**	**9,323,600**
ASA Specification A-21.3	30,000 min.	10,000,000 max.

The Modulus of Rupture values of both Talbot strip specimens were NOT acceptable (less than 30,000 psi minimum while the Secant Modulus of Elasticity for one of the Talbot strip specimens (No. 2) met the requirement of 10,000,000 psi maximum, respectively.

Examination of the Talbot strip samples after testing revealed a reduction in effective wall thickness due to graphitization (**Photo Nos. 66 – 69**). In addition to the presence of graphitization in the cross-sections of the specimens, the low values may also be attributed to the presence of steadite phase in the microstructure, as observed in the microspecimens prepared from the cast iron main.

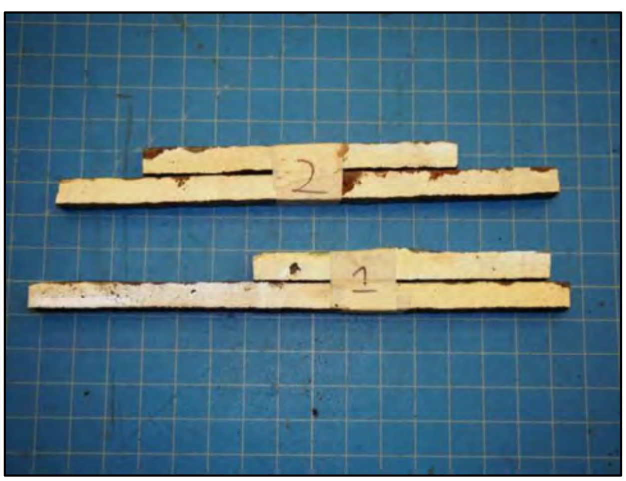

Photo No. 66 (W-6491-F-015.JPG)

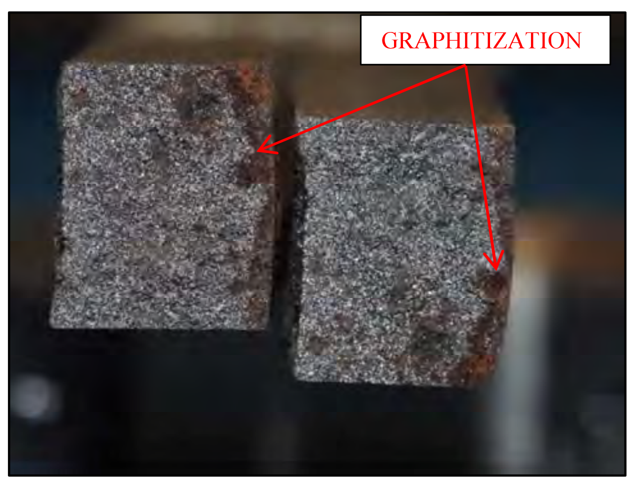

Photo No. 67 (W-6491-F-017.JPG)

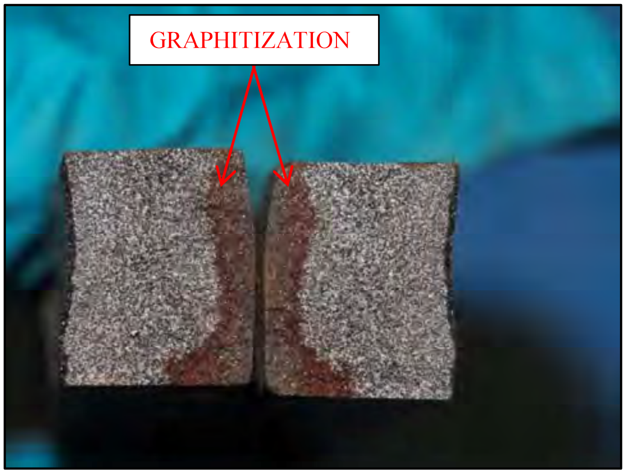

Photo No. 68 (W-6491-F-021.JPG)

Photo No. 69 (W-6491-F-024.JPG)

CHEMICAL ANALYSIS (Performed by Independent Testing Laboratory – AEIS)

Chemical analysis was performed on ring segment **ITEM A-2** via Optical Emission Spectroscopy (OES) with carbon and sulfur as per ASTM E1019-2011 *"Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques"* (**Photo Nos. 70 – 71**). **ATTACHMENT G** – Chemical Analysis Report contains the independent test report and associated Chain of Custody Form. The following table contains a summary of the results (wt%):

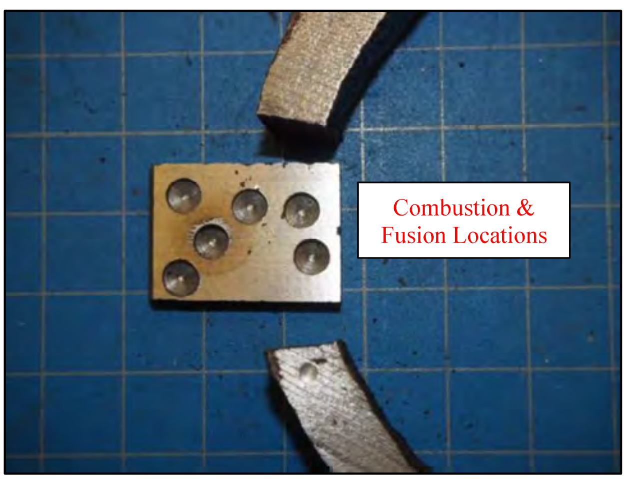

Photo No. 70 (W-6491-F-005.JPG)

Photo No. 71 (W-6491-F-006.JPG)

ELEMENT	CAST IRON PIPE (ITEM A-2)	GRAY CAST IRON (NOMINAL)	ASA A-21.3, 3-3.2 Specification*
Carbon	3.29	2.5 / 4.0	- - -
Manganese	0.33	0.2 / 1.0	- - -
Silicon	***0.63***	1.0 / 3.0	- - -
Phosphorus	***3.80***	0.02 / 1.0	0.90 max
Sulfur	0.067	0.02 / 0.25	0.12 max

ELEMENT	CAST IRON PIPE (ITEM A-2)	GRAY CAST IRON (NOMINAL)	ASA A-21.3, 3-3.2 Specification*
Chromium	0.012	- - -	- - -
Nickel	0.037	- - -	- - -
Iron	Remainder		

*Per ASA A-21.3, 3-3.2 *"ASA Specification 'Cast Iron Pit Cast Pipe for Gas'"*

As the above table shows, all elements are within the range of a gray cast iron, except for ***silicon*** and ***phosphorous*** contents. The carbon equivalent was found to be above eutectic (CE 4.3) as given by the equation given below.

Carbon equivalent calculated

$$CE = C + P/3 + Si/3 = 4.8$$

Based on the carbon equivalent, the cast iron pipe material is considered hypereutectic (greater than 4.3). To some extent, the presence of manganese, sulfur and phosphorus influence the tensile strength of plain gray cast iron. Sulfur is significant because it affects the solidification behavior of the molten iron upon casting. For this reason, the sulfur content of the melt is usually controlled within limits and with a selected ratio to the manganese content. Generally, the minimum manganese content is 1.7 times the sulfur content plus 0.12% manganese, which assures that sufficient manganese will combine with sulfur (to form manganese sulfides) instead of with iron. An excess of manganese or phosphorus can cause dispersed internal porosity. As noted in the microstructural studies noted above, several of the microspecimens exhibited internal porosity dispersed throughout the pipe wall thickness.

WEATHER DATA

The daily weather data for the month of November 2021 as well as the hourly data for November 27–30, 2021 was obtained from the National Oceanic & Atmospheric Administration (NOAA) (**ATTACHMENT I** – Weather Data). The data was collected from the Philadelphia International Airport weather station, which is the nearest weather station to the reported loss location. In the month of November 2021, the Philadelphia area experienced mostly ABOVE freezing temperatures leading up to the date of loss on November 30, 2021. November 24th registered a low temperature of 29°F with a high temperature of 49°F. As for the incident date, November 30th registered a low temperature of 31°F between 12:00 A.M. and 1:00 A.M. followed by increasingly warmer temperatures above freezing the remainder of the day.

Based on the reported weather data, it is unlikely that the ground froze during the month of November 2021. However, it is likely that the ground froze hundreds of times over the 123 years of service for the subject cast iron pipe section. Each freeze and thaw cycle induces stresses in pipes and could cause movement, albeit in small increments.

CONCLUSIONS

Based on the laboratory evaluations and the foregoing, the incident 4-inch cast iron main was suitable for its intended use when originally laid underground circa 1898. The fact that it remained in service for approximately 123 years without incident is a testament of the pipe material being acceptable for its intended use.

The fracture of the incident pipe initiated near the bottom and propagated along the circumference of the pipe. As noted above, graphitization up to 43% of the original wall thickness was observed in the pipe's cross-section, which reduced the effective wall thickness and localized mechanical integrity of the pipe. This reduction in wall thickness can serve as the crack initiation site with an applied external force. The fracture surface displayed a predominately uniform color and dull luster along the circumference while the BOTTOM portion of the mating fracture surfaces exhibited a darkened region, which contained graphitization as well as large sized casting voids, spanning approximately two-thirds of its cross-section, indicating that there was no evidence of a pre-existing leaking condition prior to the reported incident. The fracture occurred as a one-time overload condition that initiated at/near this darkened portion of the cross-section.

The cast iron main exhibited graphitic corrosion attack around its circumference whereby the mechanical strength of the wall may have been compromised, leaving patches of weak graphitized cast iron, or graphite network. The extent of observed graphitic corrosion reached approximately 43% of the wall thickness over the 123 years of service. Graphitic corrosion is a term that describes the network of graphite flakes that remain in the material after the iron oxidizes. The physical environment for the pipe plays a significant role in the deterioration rate of the cast iron material. The soil properties that affect or accelerate the corrosion rate include electrical resistivity, chemical and microbiological content, moisture content, redox potential, and aeration. With time and/or changing service environmental conditions, graphitization can lead to pipe failure or leakage.

Chemical analysis results from the subject cast iron main were found to be similar to gray cast iron with the exception of silicon and phosphorous content. The notably high phosphorous content can lead to the formation of a hard, brittle phase known as steadite. Steadite was indeed observed in the microstructure of the subject cast iron main, which is an unwanted microstructural phase that affects the mechanical properties of the material.

Gray cast iron pipes in service today were either manufactured by pit casting or centrifugally spun casting. In the mid-19th century, vertical pit casting was the most commonly used method to produce cast iron piping. Centrifugal casting was developed in the 1920s and became the primary method for producing cast iron pipe in the 1930s. Characteristically, pit cast iron generally has a lower fracture toughness and mechanical strength than that of centrifugally spun cast iron due to the presence of larger graphite flakes in the microstructure, which serve as sites for crack initiation. In addition, due to the inherent nature of the casting process, pit casting tends to have more casting defects and wall thickness variations than that of centrifugally spun casting.

Casting defects can contribute to the failure of gray cast iron pipes. Although such defects are generally expected to cause failure in a shorter span of service, i.e. less than 123 years, the presence of said defects locally weaken the pipe and serve as stress risers should external forces be applied to it whether by soil disturbances induced from repeated thermal cycling of the soil, new construction, repairs, or undermining. Pit cast pipes are known to have issues with non-uniform wall thickness, which can contribute to uneven stress distribution. In addition, inclusions, porosity, and shrinkage voids, which are unintended microstructural constituents, tend to weaken cast iron. Porosity is a common casting defect where air becomes entrapped in the solidifying melt upon cooling. Inclusions such as undissolved ferrosilicon or oxides can also become entrapped in the metal as well. Such defects can act as stress risers and allow for crack formation. Corrosion-related damage, such as graphitization, reduces the wall thickness of the pipe and thereby creates a stress riser where material wastage occurs.

In conclusion, the incident pipe experienced an external bending force acting upon it where a through-wall crack initiated and propagated near its BOTTOM, where it was weakening progressively due to graphitic corrosion towards the TOP. The combination of the graphitization and inherent casting flaws from the manufacturing process circa 1898, eventually weakened the structural integrity of the subject cast iron main. Circumferential cracking is a common mode of failure for cast iron piping, when subjected to bending forces. Due to the inherent brittle nature of gray cast iron, the pipe will not plastically deform under bending loads but rather fracture. A crack initiates at the highest stressed region, whether it be at a thinned wall due to corrosion, large-sized casting flaw, or some other stress riser, and propagates rapidly along the pipe's circumference to alleviate the stresses induced by the bending forces. Such bending forces can occur as a result of frost upheaval during freeze/thaw cycles, poor bedding, loss of soil support or external force from soil disturbances near the buried pipe or undermining.

The writer reserves the right to amend or supplement his opinions should any additional information be provided. Kindly feel free to contact the undersigned should there be any need for further discussion on this matter.

Very truly yours,

John P. Gashinski, P.E., CFEI
Engineering Consultant
Materials Scientist

JPG/np

ATTACHMENT A

W-6491-001.JPG

W-6491-002.JPG

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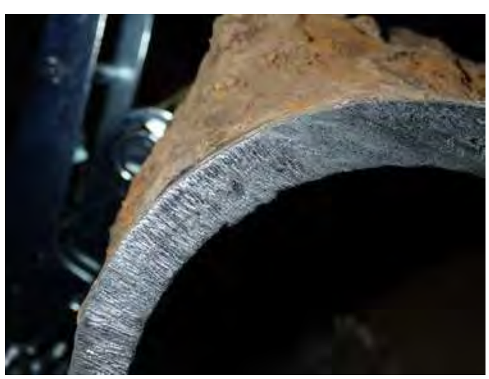

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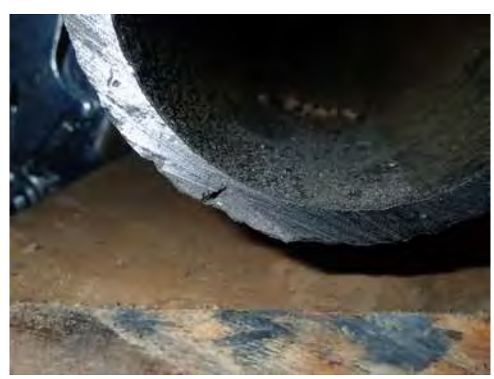

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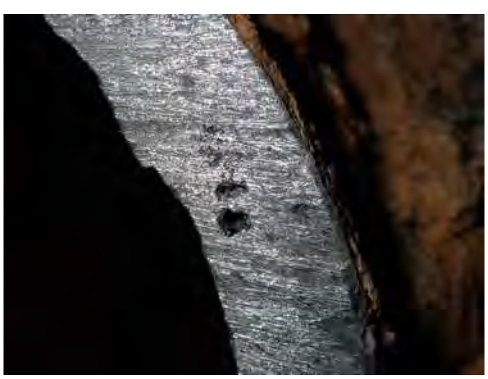

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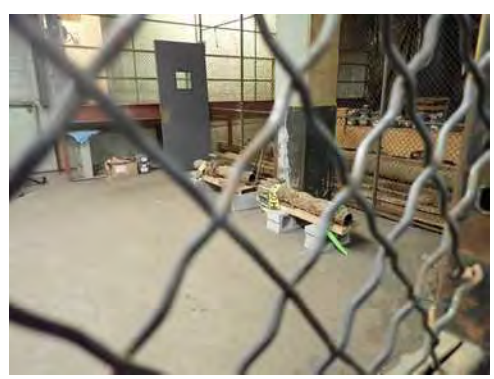

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W-6491-085.JPG

ATTACHMENT B

AFFILIATED ENGINEERING LABORATORIES, INC.
Engineering Consultants

Physical Location:
777 New Durham Road
Edison, NJ 08817

P.O. Box 3300
Edison, NJ 08818-3300

Phone (732) 429-1200
Fax (732) 429-1201
www.affiliatedinc.net

W-6491
Philadelphia Gas Works

PROTOCOL

Metallurgical evaluation of the submitted 4" cast-iron pipe section

Site Location:
815 Jackson Street
Philadelphia, PA 19148
D/L: 11/30/21

March 7, 2022

INSPECTION LOCATION

Affiliated Engineering Laboratories, Inc.
777 New Durham Road
Edison, New Jersey 08817

GENERAL

- All images, documents and test results obtained using laboratory equipment will be compiled and subject to distribution by CD mailing, flash drive, or Sharefile link.
- The proposed protocol may be added to and/or modified prior to and during the testing as circumstances may warrant. Any departures from the above protocol will be duly noted. If modifications to the protocol are needed, they can be made as mutually agreed upon by the participating groups.
- All procedures are to be performed in accordance with ASTM and/or industry standard practices.
- Videotaping is allowed if the sound recording feature is disabled. Any attendee planning on documenting any of the proceedings via videography must do so with NO SOUND during the recording.
- Chain of Custody will be maintained for each sample and sub sample. Evidence removed from the evidence storage facility for testing by an independent testing laboratory will be returned to the evidence storage facility in its post-inspection condition.
- In general, handling and preparations of material for testing will follow the protocol outlined in this document. All reasonable measures will be applied for proper handling, preparation, transfer and storage of the evidence materials.

Re: Philadelphia Gas Works – 815 Jackson Street
March 7, 2022
Page 2 of 4

<u>ITEMS</u>

A. 49-inch long 4-inch diameter cast iron pipe with pipe clamp spanning fracture location
B. 47-inch long 4-inch diameter cast iron pipe with service tap

Photo No. 1 (**ITEM A**)

Photo No. 2 (**ITEM B**)

<u>Non-destructive Evaluation</u>

1. Visual inspection of submitted pipe sections (**ITEM A** and **ITEM B**) in as-received condition.

2. Remove lightly adhering dirt/soil from exterior surface of the pipe sections (**ITEM A** and **ITEM B**) using brushes and plastic chisels. The dirt/soil will be collected should there be any request for further testing.

3. Dimensional measurements of submitted pipe sections (**ITEM A** and **ITEM B**).

4. Remove pipe clamp from **ITEM A**. Visual and macroscopic examination of the mating fracture surfaces and the surrounding areas of the cast iron sections with photographic documentation.

<u>Destructive Testing</u>

5. Two ring section samples containing the mating fracture surfaces will be cut from the corresponding pipe piece (**ITEM A**). A third ring will be cut below one of the fracture surfaces for hardness and chemical analysis.

6. X-ray Radiography will be performed on the ring section samples removed in Step No. 5.

7. The fresh cut surfaces of the ring section samples will be examined visually as well as via stereomicroscope to assess the pipe condition, i.e. extent of graphitization. The mating fracture surfaces will be examined by stereomicroscope.

    i. Cleaning of the surfaces may be needed to remove any dirt or debris that may be obscuring the topography.

ii. Ultrasonic bath with Alconox® solution

8. Microspecimens intersecting one of the mating fracture surfaces will be prepared using standard metallographic procedure in accordance with ASTM E3-11 (2017) *Standard Guide for Preparation of Metallographic Specimens*. A minimum of 4 microspecimens will be taken along the circumference at the 12, 3, 6, and 9 o'clock positions for microstructural studies. The other corresponding fracture surface ring will be preserved for any future testing or examination should it be requested at a later date.

9. Depending on the condition of the fracture surface, fractographic studies of the surfaces contained on the aforementioned microspecimens will be performed using Scanning Electron Microscopy (SEM) prior to them being encased in polymeric mounts in Step No. 8.

10. Hardness of the third ring sample (not containing a fracture surface) will be measured using a Brinell hardness tester in accordance with ASTM E10-18 *Standard Test Method for Brinell Hardness of Metallic Materials*.

    iii. A small sample of material will be cut/removed from the ring and sent to an independent testing laboratory along with the appropriate chain of custody.

11. Chemical analysis of the third ring sample (not containing a fracture surface) will be performed via Optical Emission Spectroscopy (OES). Carbon and Sulfur will be analyzed by LECO fusion process.

    iv. A small sample of material will be cut/removed from the ring and sent to an independent testing laboratory along with the appropriate chain of custody.

12. Talbot strip test samples will be machined longitudinally from one of the mating pipe pieces and bend tests will be conducted in a tensile machine. (Given the condition of the pipe material).

    v. If **ITEM A** has insufficient length, **ITEM B** will be used for sampling.
    vi. Sample material will be sent to an independent testing laboratory with the appropriate chain of custody for machining and testing.

13. Additional ring section samples will be cut from the pipe section for compressive testing which will be performed in a universal tensile machine. (Given the condition of the pipe material).

    i. If **ITEM A** has insufficient length, **ITEM B** will be used for sampling.
    ii. Sample material will be sent to an independent testing laboratory with the appropriate chain of custody for machining and testing.

Kindly feel free to contact me should there be any need for further discussion on this matter.

Very truly yours,

John P. Gashinski, PE, CFEI
Engineering Consultant
Materials Scientist

ATTACHMENT C

Affiliated
Engineering
Laboratories, Inc.

Chain of Custody

Caption: Philadelphia Gas Works - 815 Jackson Atreet

File No.: **W-6491**

Engineer: JPG

Item No.	Quantity	Description
1	2	4-ft long, 4 inch diameter cast iron pipes

	Released By	Received By	Reason
Signature:	Ellen L. Hugar	D Zawodniak	
Print Name:	ELLEN L. HUGAR	David Zawodniak	
Company:	PGW	Affiliated Engineering Labs	
Date:	4-5-22	4/5/2022	
Signature:			
Print Name:			
Company:			
Date:			

Please print and sign in the appropriate boxes above and return a copy to:

Affiliated Engineering Laboratories, Inc.
777 New Durham Road
Edison, New Jersey 08817

Phone: (732) 429-1200
Fax: (732) 429-1201
areceivable@aelgroup.net

STOCK TRANSFER

TRANSFER NO.

DATE 4/5/22

TRANSFER FROM Philadelphia Gas Works Security of Evidence Locker

TRANSFER TO Allied Engineering Lab

QUANTITY ORDERED	QUANTITY SHIPPED	DESCRIPTION	MATERIAL CODE NO.
		2 - 8ft 4" CI OC Pipe from	
		815 Jackson Street	

DRIVER David Zawodniak

ACCOUNT CHARGED

RECEIVED BY D [illegible signature]

APPROVED Ellen L. Husar

FORM [illegible]

ATTACHMENT D

W-6491 Philadelphia Gas Works – Jackson Street

Inspection 4/22/22

Attendees – 4/22/22

John Gashinski, P.E., CFEI – Affiliated Engineering Laboratories, Inc.

John Staudenmayer – Philadelphia Gas Works

Margaret Colosimo – Philadelphia Gas Works

Martin Salamonski – PAPUC

Scott S. Orr – PAPUC

Virtual Attendees – 4/22/22

Ellen Hugar – Philadelphia Gas Works

Anne Mitchell – Philadelphia Gas Works

Bernadette Betzler – Philadelphia Gas Works

AFFILIATED ENGINEERING LABORATORIES, INC.

Physical Location
777 New Durham Road
Edison, NJ 08817

P.O. Box 3300
Edison, NJ 08818-3300

Phone (732) 429-1200
Fax (732) 429-1201
www.affiliatedinc.net

Event: Philadelphia Gas Works – Jackson Street **Date:** 4/22/22 **AEL File No.**: W-6491

John P. Gashinski, P.E., C.F.E.I. ENGINEERING CONSULTANT Direct (732) 429-1256 Direct Fax (732) 429-1249 jgashinski@aelgroup.net AFFILIATED ENGINEERING LABORATORIES 777 New Durham Road Edison, New Jersey 08817 Tel. (732) 429-1200 • Fax (732) 429-1201	Representing Name Signature
Company Philadelphia Gas Works Name John Staudenmayer Address 800 W Montgomery Philadelphia PA 19122 Phone 267-244-2028 Fax Email john.staudenmayer@pgworks.com	Representing Philadelphia Gas Works Name Signature
Martin Salamonski Fixed Utility Valuation Engineer Commonwealth of Pennsylvania Public Utility Commission Bureau of Investigation & Enforcement Safety Division PAPUC PENNSYLVANIA PUBLIC UTILITY COMMISSION Commonwealth Keystone Building 400 North Street Harrisburg, PA 17120 Phone: (717) 480-1059 Fax: (717) 772-2677 E-mail: msalamonsk@pa.gov	Representing PA PUC Name MARTIN SALAMONSKI Signature
Margaret M. Colosimo ~~Manager~~, Claims & Litigation Risk Management Department Philadelphia Gas Works PGW Safe. Reliable. Service Senior Consultant 800 W. Montgomery Ave., Philadelphia, PA 19122 (215) 684-6666 Fax: (215) 684-6526 Email: Margaret.Colosimo@pgworks.com	Representing Phila Gas Works Name Signature

Rev 0-5/07

AFFILIATED ENGINEERING LABORATORIES, INC.

Physical Location
777 New Durham Road
Edison, NJ 08817

P.O. Box 3300
Edison, NJ 08818-3300

Phone (732) 429-1200
Fax (732) 429-1201
www.affiliatedinc.net

Event: Philadelphia Gas Works – Jackson Street Date: 4/22/22 AEL File No.: W-6491

PAPUC
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Scott S. Orr
Fixed Utility Valuation Engineer II
Safety Division

Commonwealth of Pennsylvania
Public Utility Commission
Bureau of Investigation & Enforcement

Commonwealth Keystone Building
400 North Street
Harrisburg, PA 17120
Phone: (717) 480-2195
Fax: (717) 772-2677
E-mail: scoorr@pa.gov

Email

Representing PA PUC
Name S. ORR
Signature

Company
Name
Address

Phone
Fax
Email

Business Card (or fill-in the blanks)

Representing
Name
Signature

Company
Name
Address

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Rev 0-5/07

ATTACHMENT E


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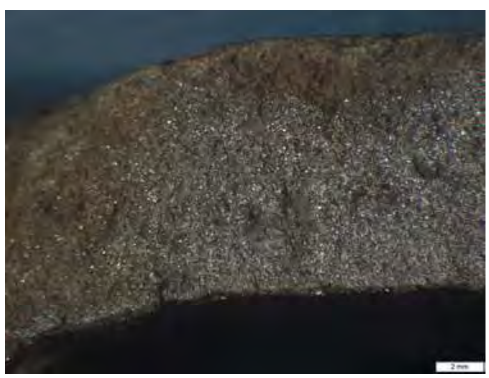
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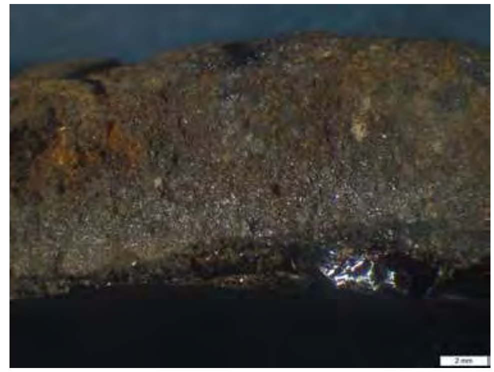
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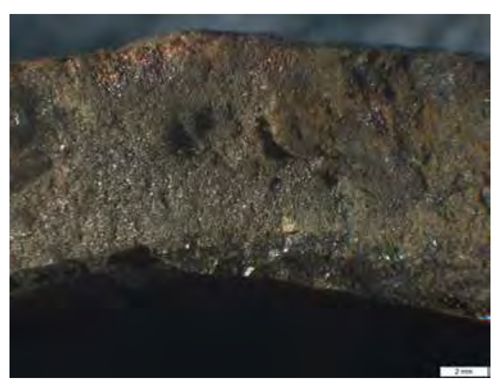
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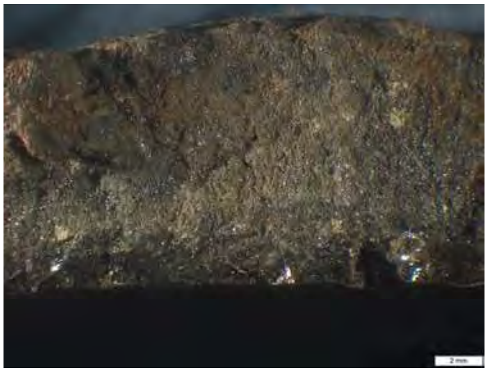
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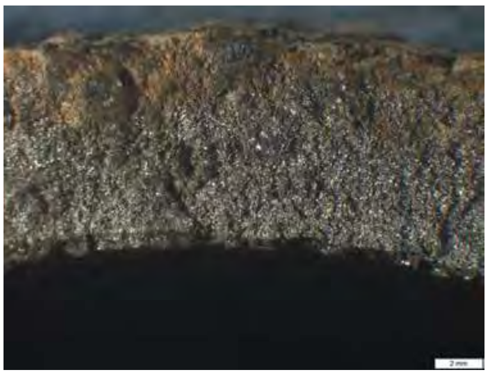
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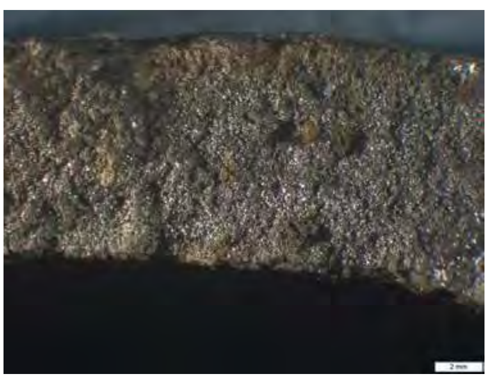
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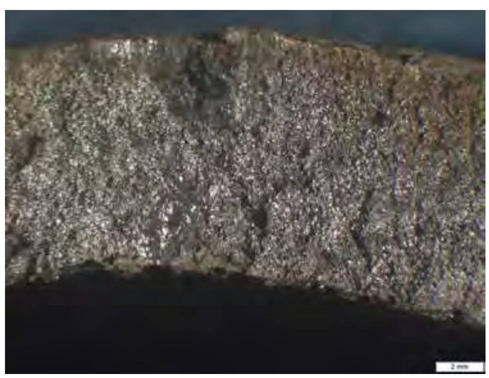
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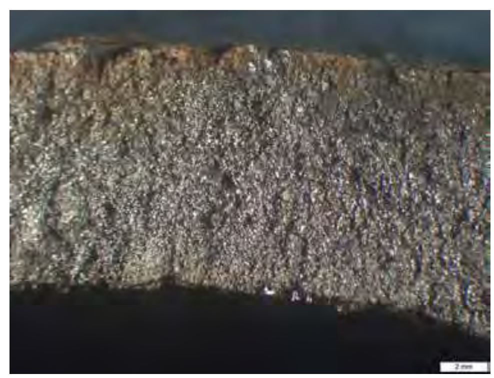
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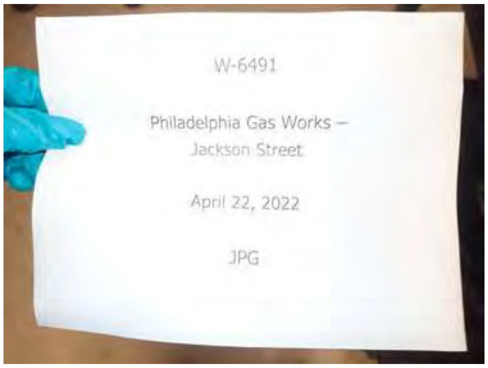

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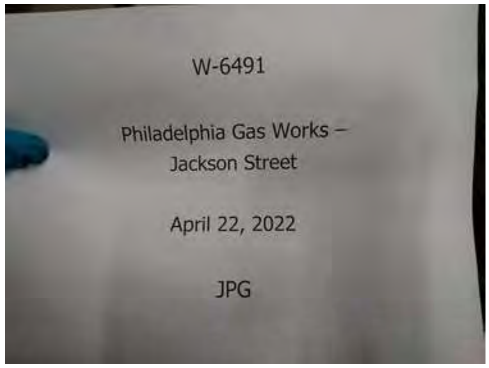

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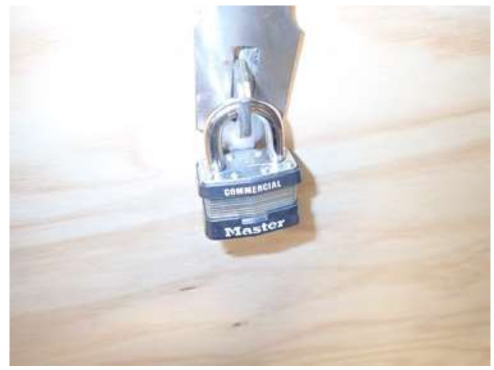

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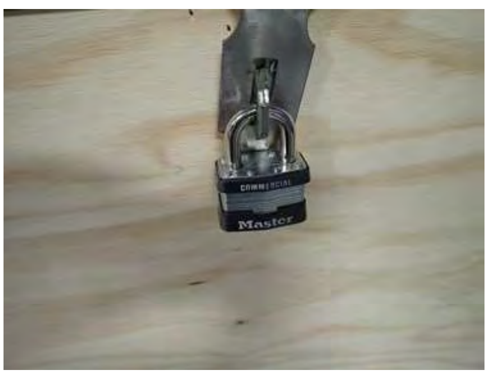

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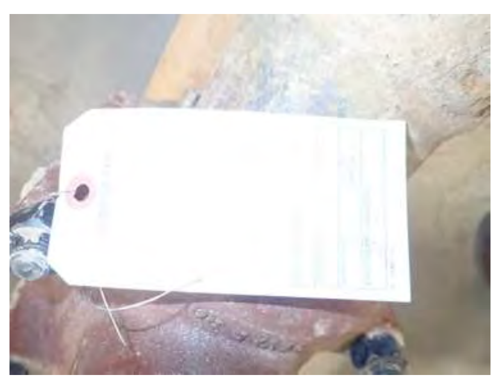

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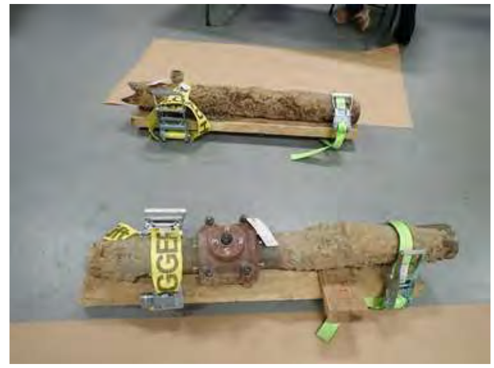

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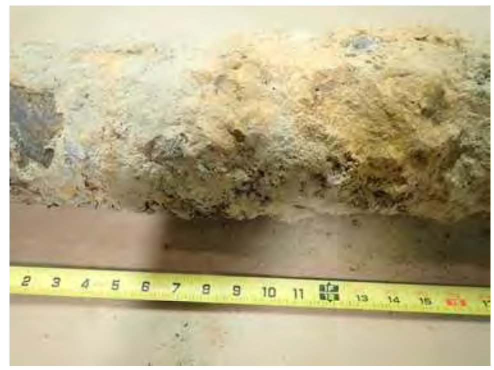

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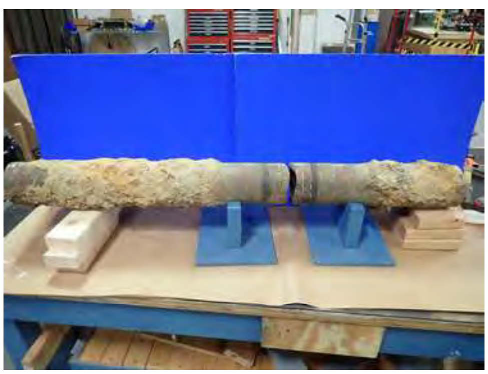
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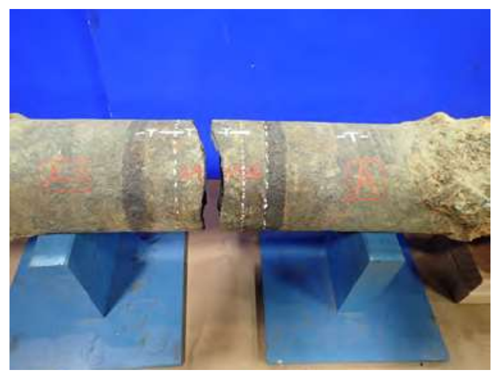
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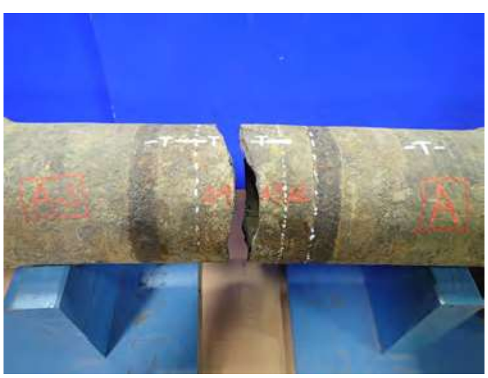
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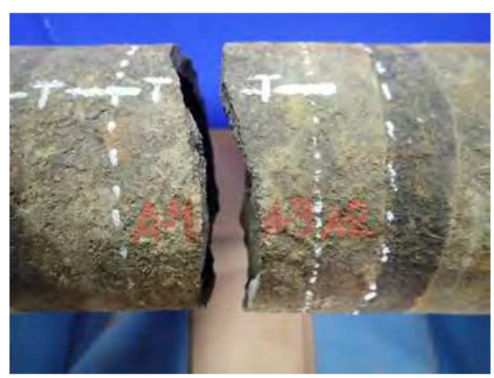
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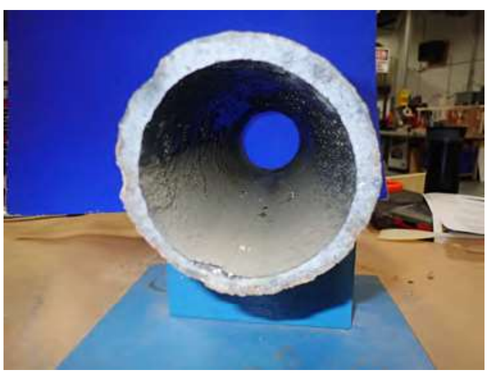
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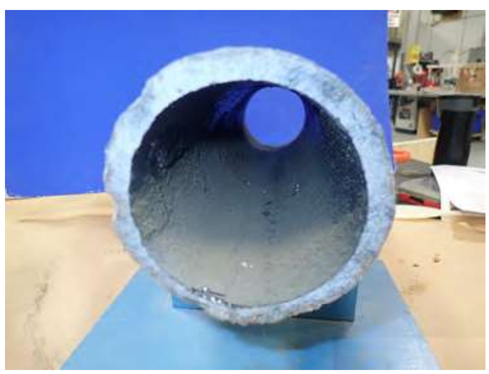
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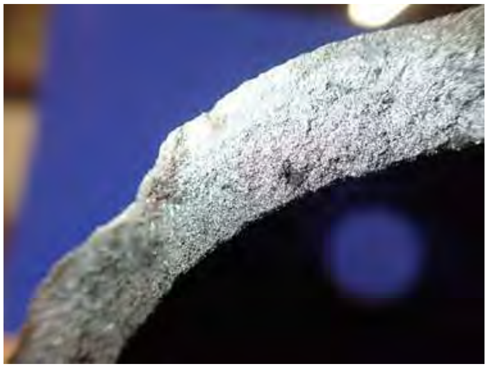
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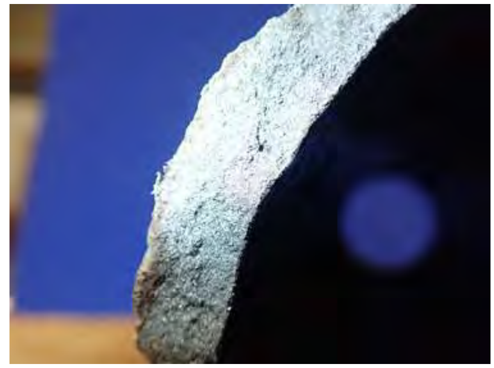
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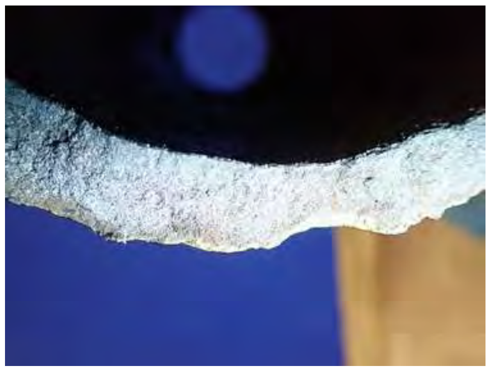
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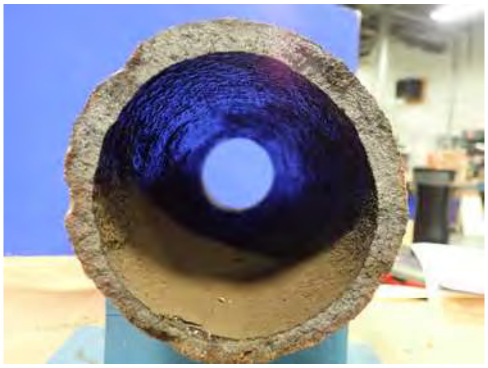
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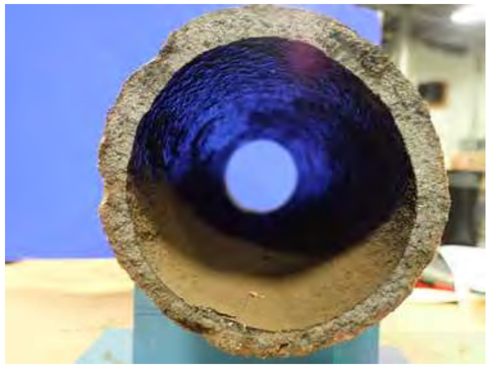
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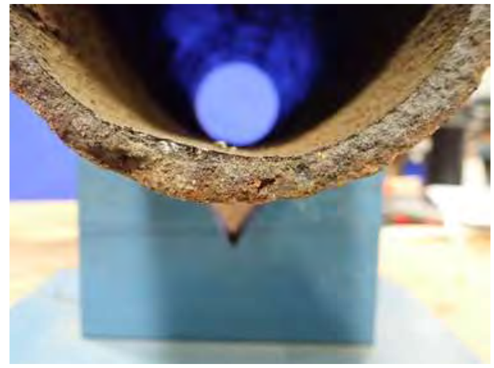
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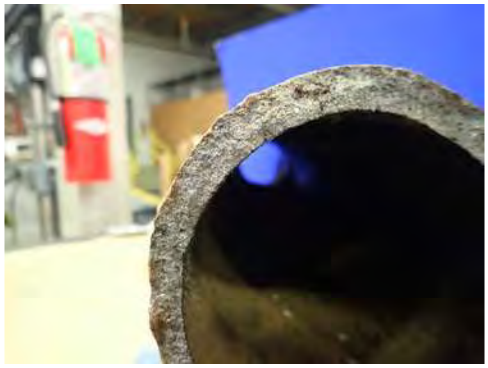
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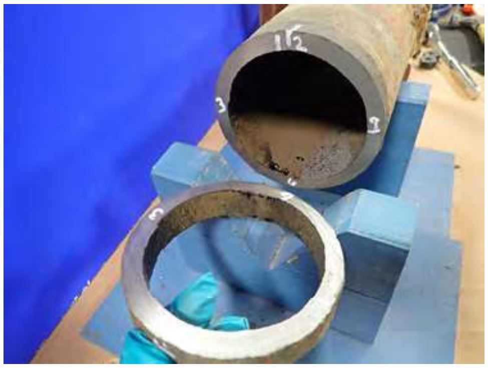

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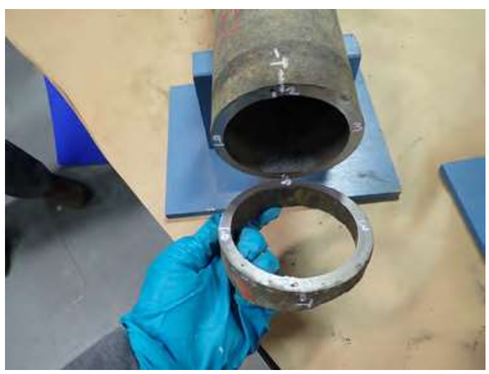

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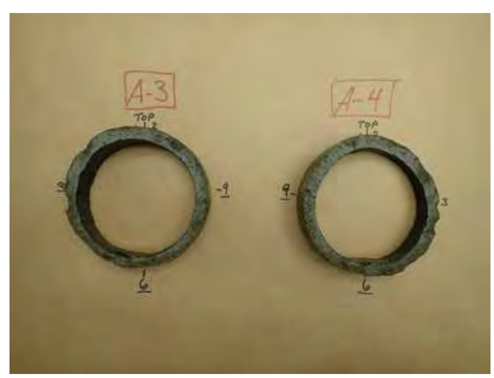

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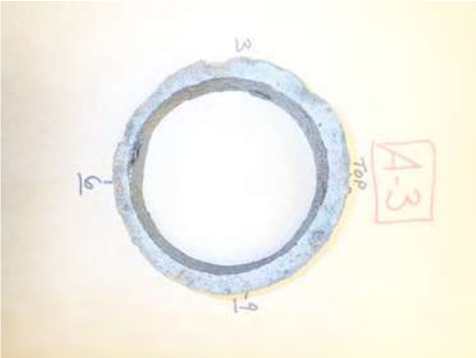

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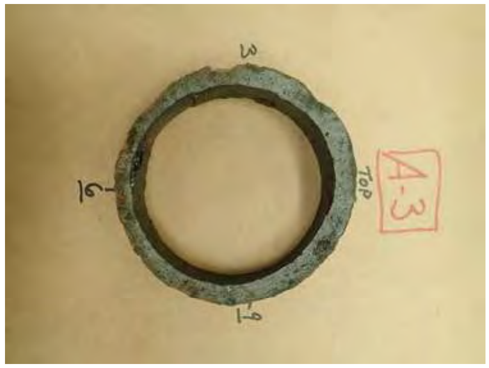

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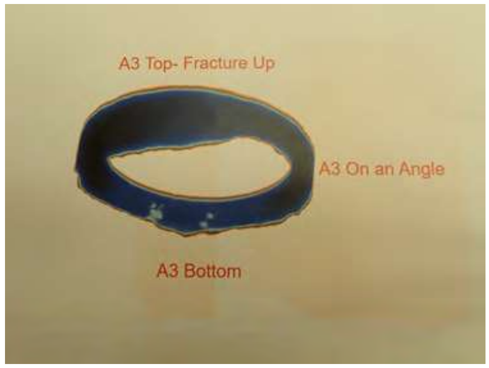

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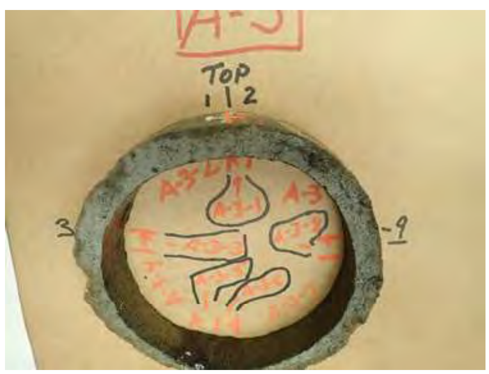

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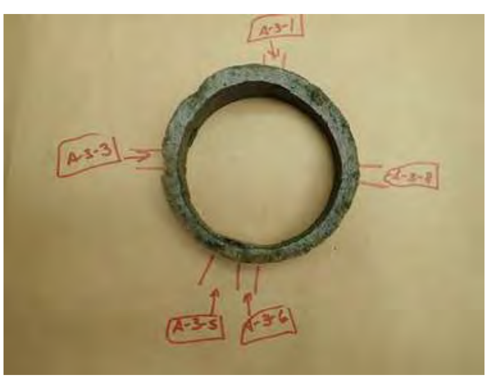

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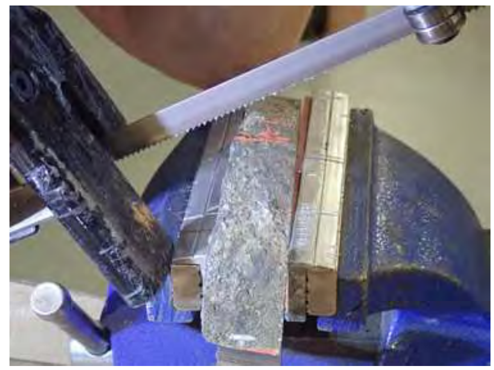

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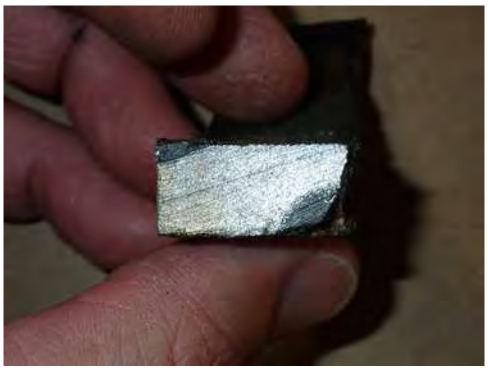
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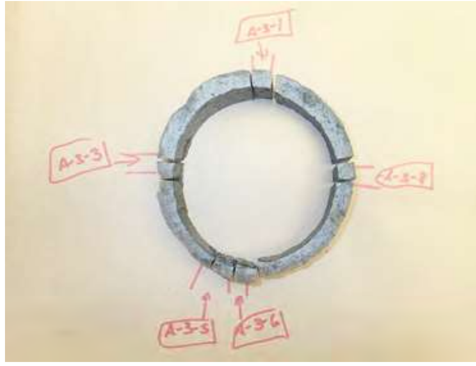

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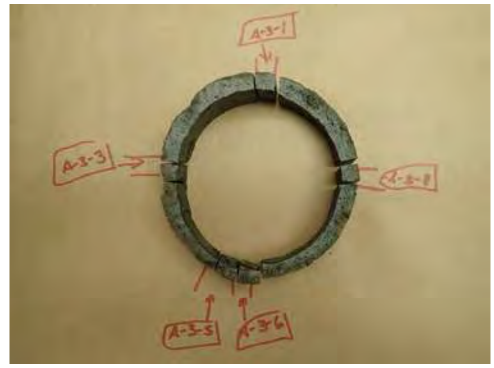

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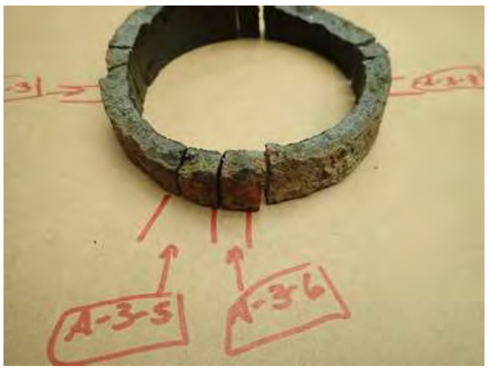

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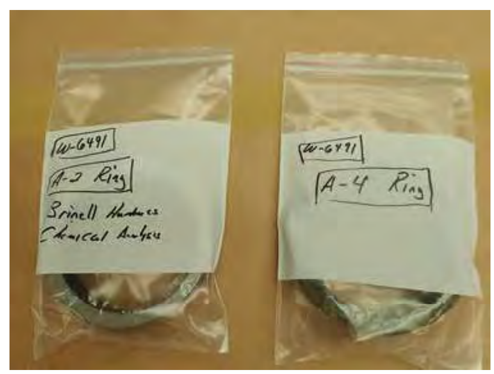

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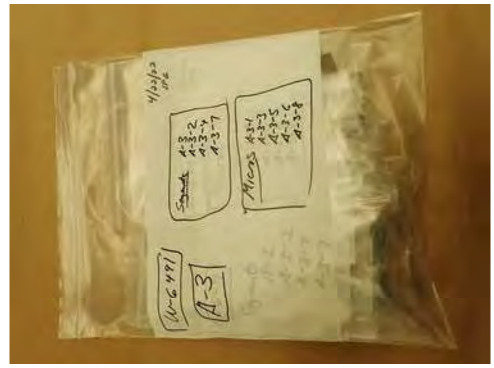

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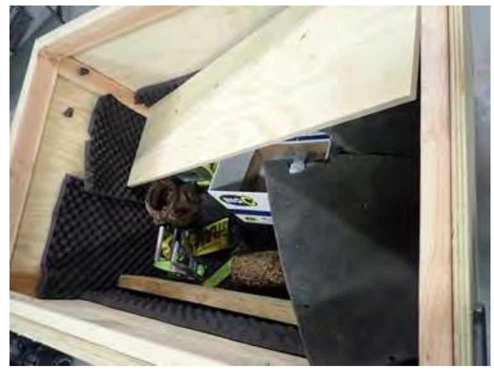

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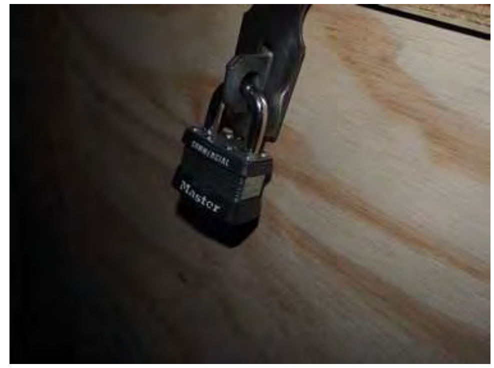

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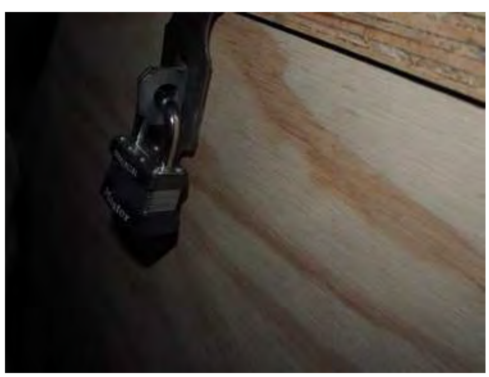
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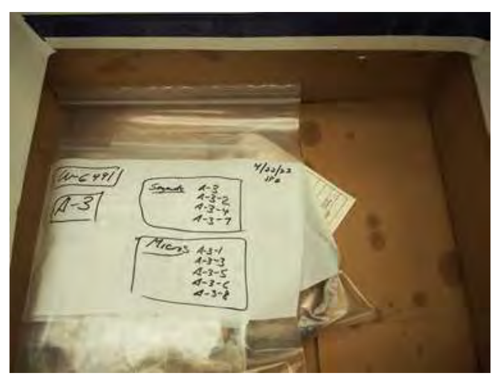

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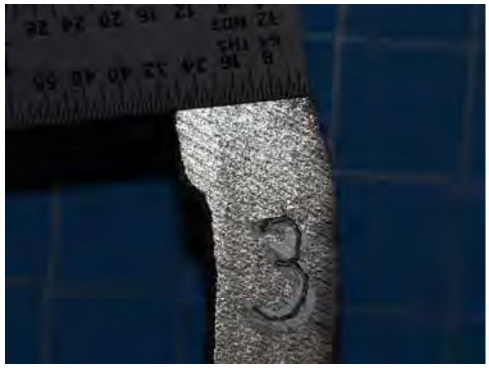

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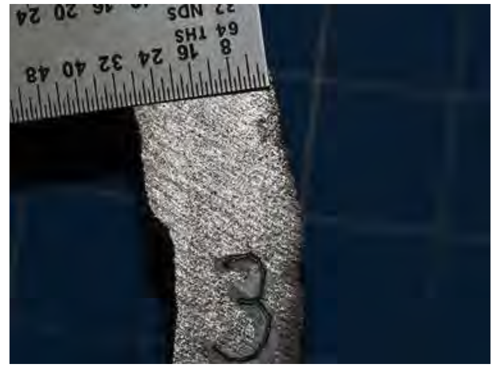

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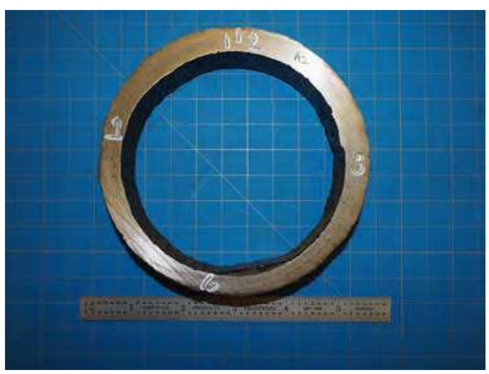

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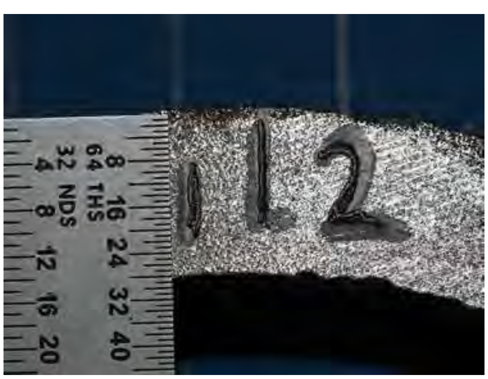
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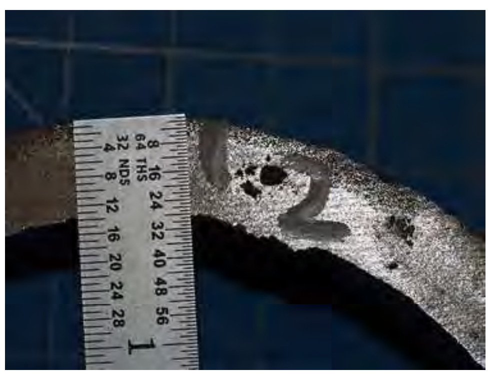

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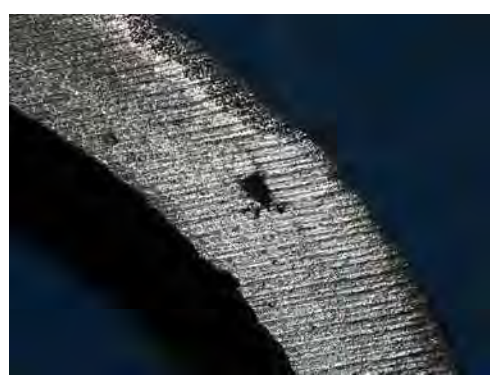

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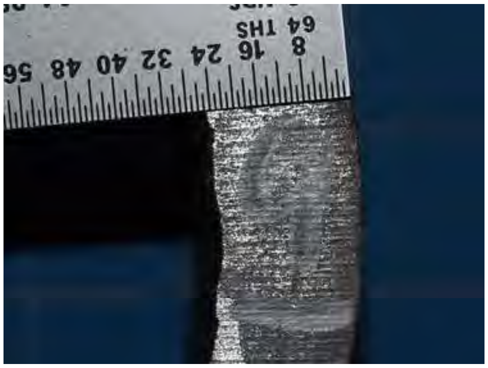

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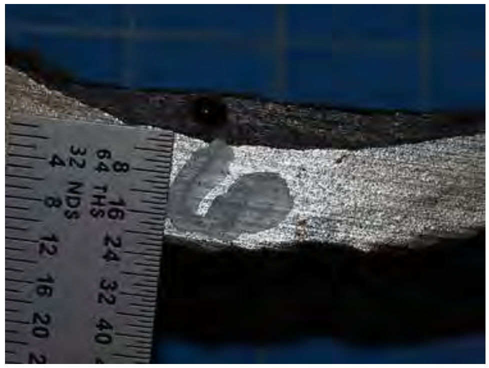

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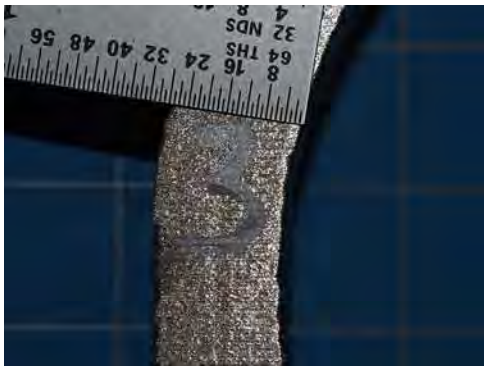

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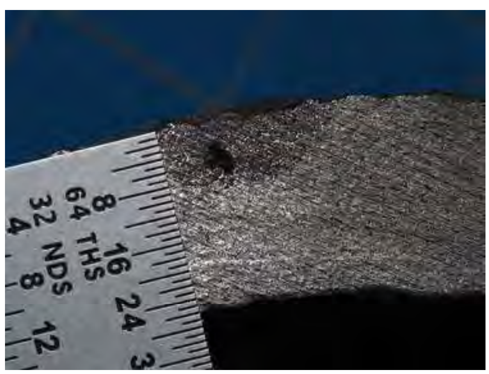

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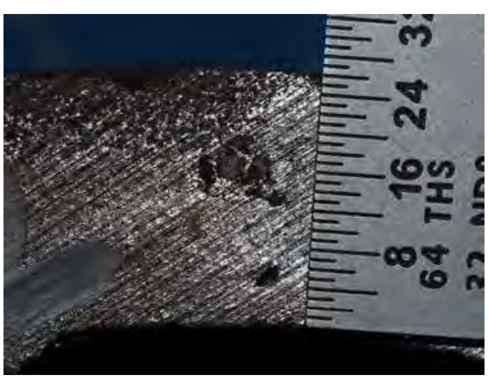

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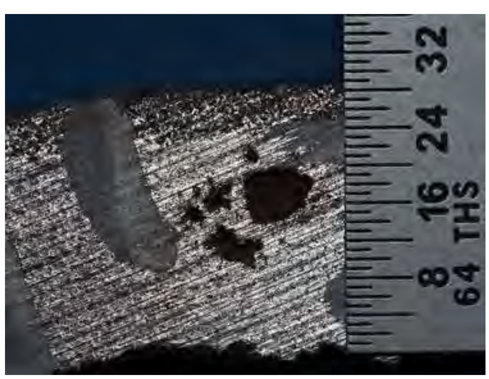

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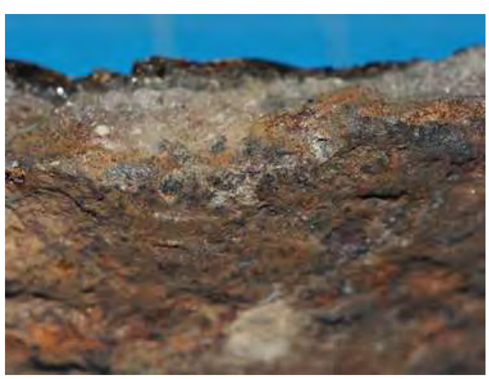

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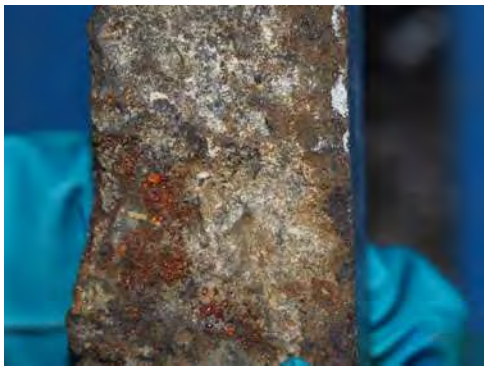

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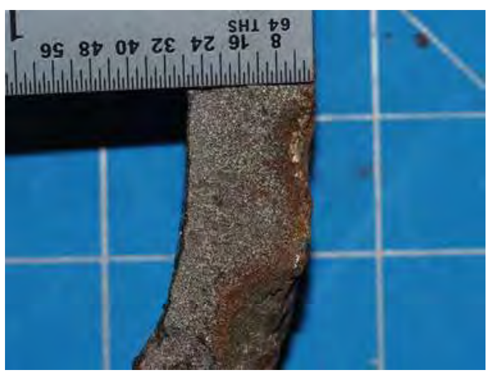

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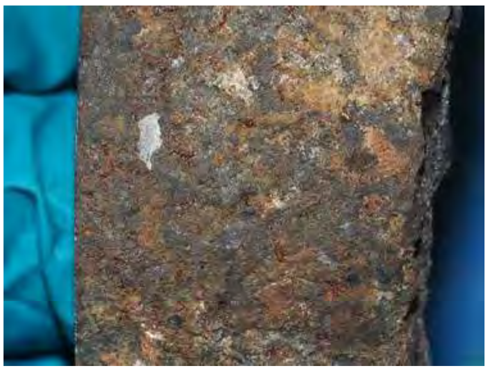

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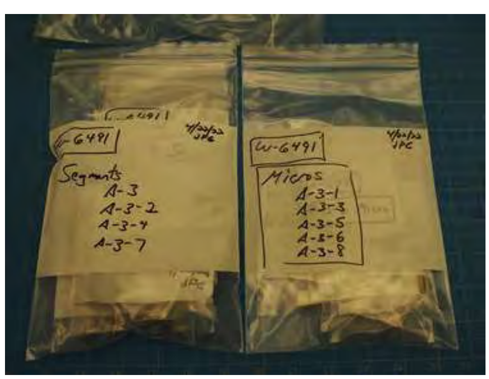

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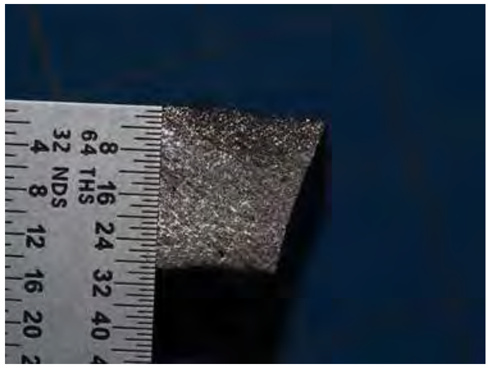

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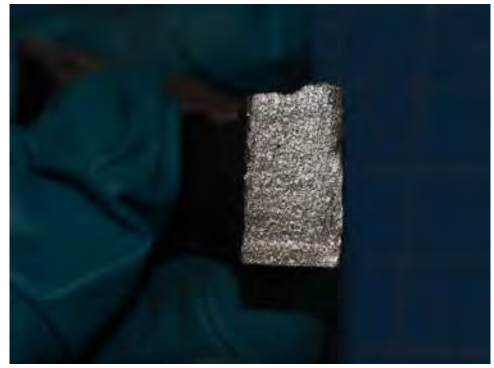

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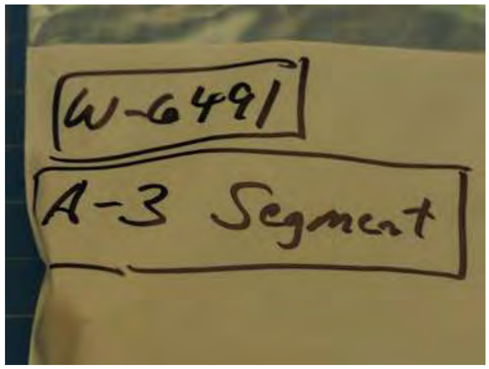

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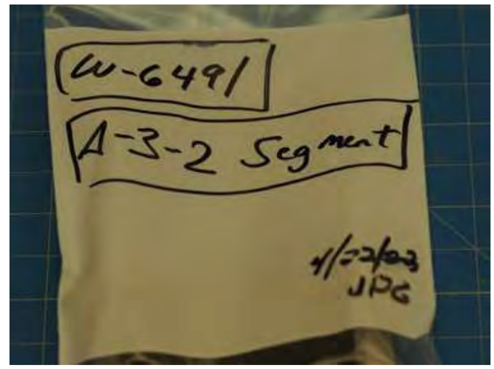

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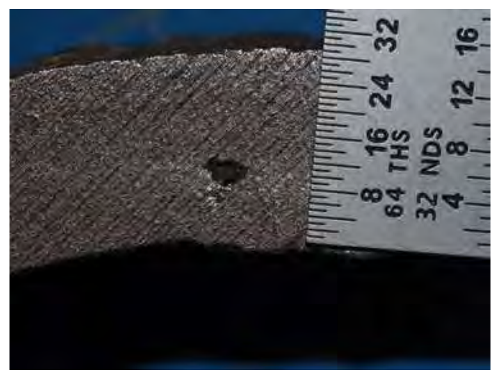

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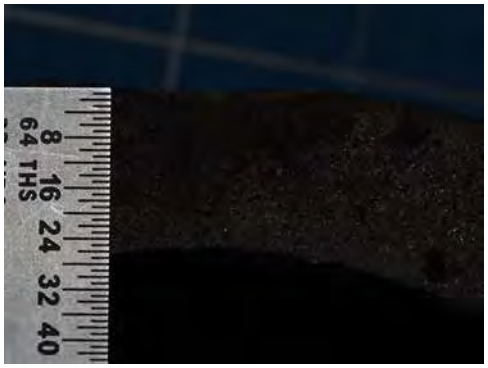

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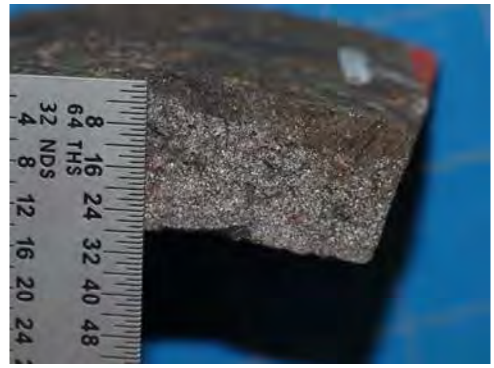

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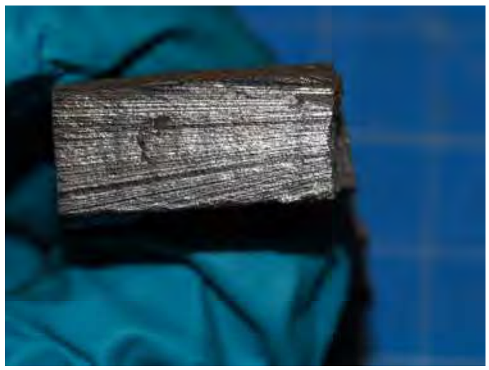

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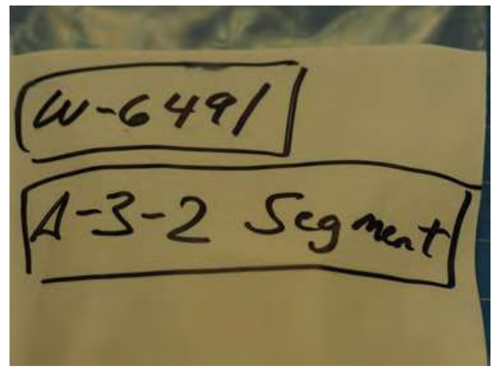

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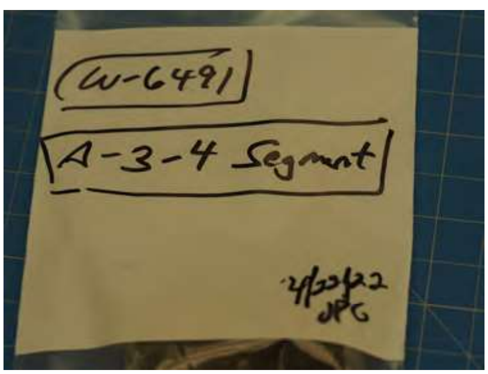

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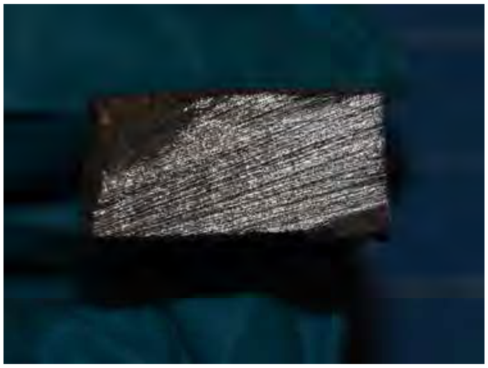

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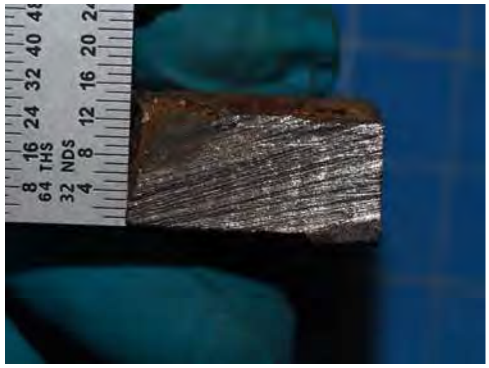

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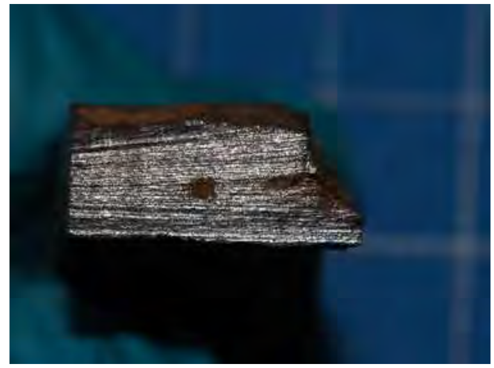

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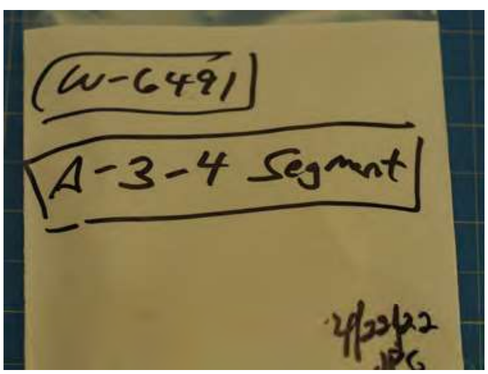

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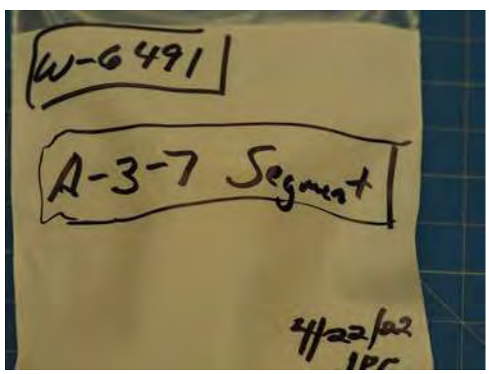

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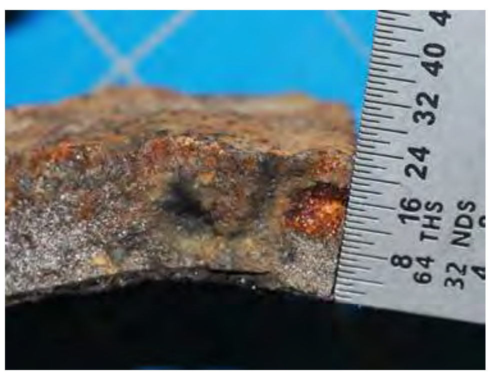

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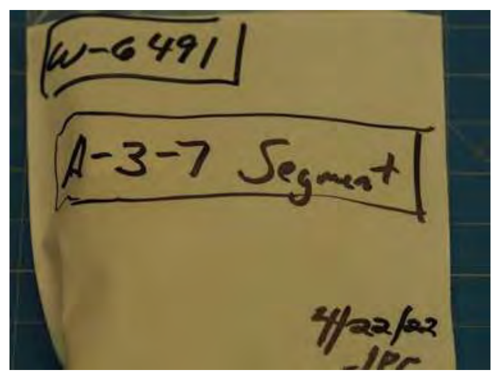

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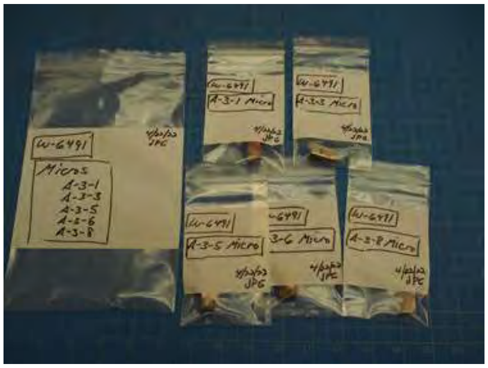

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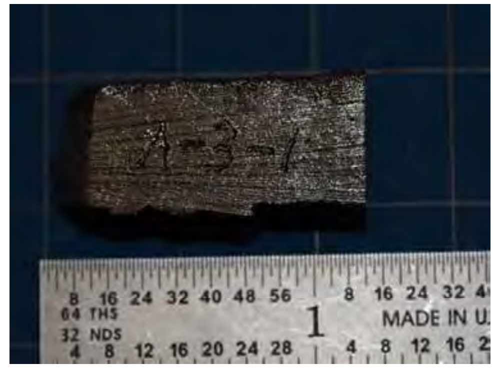

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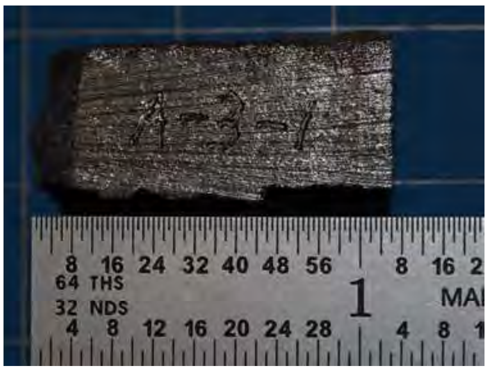

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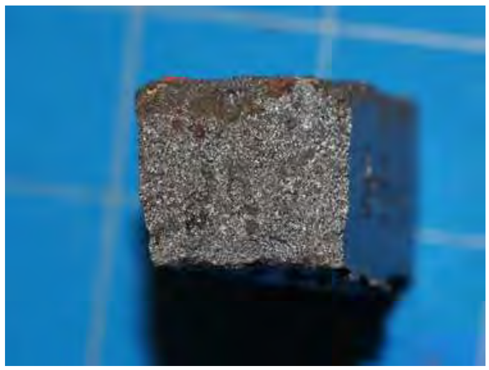

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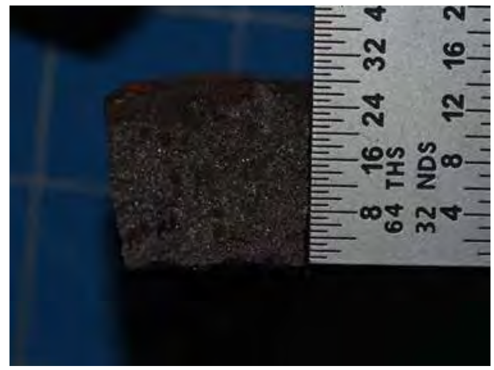

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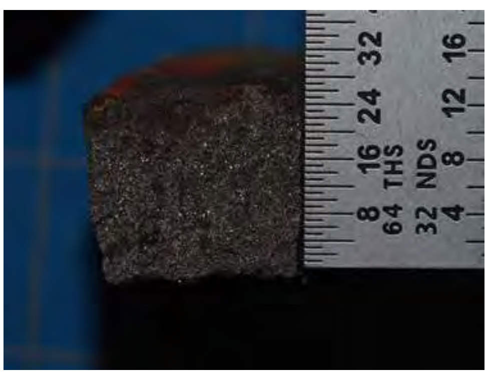

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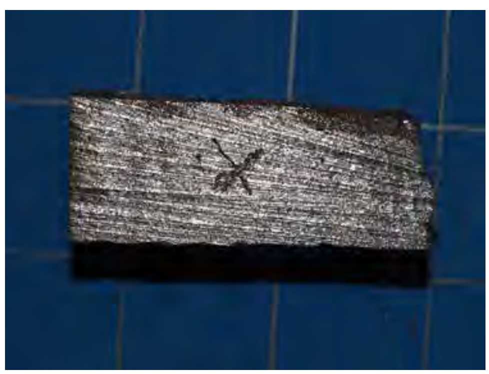

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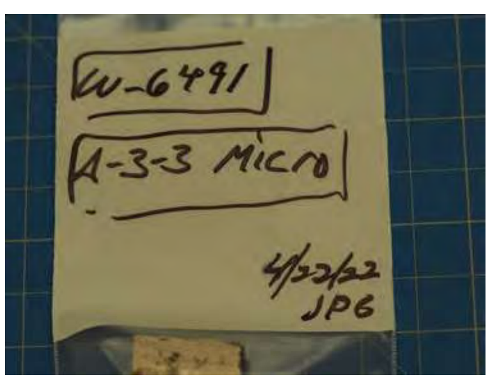

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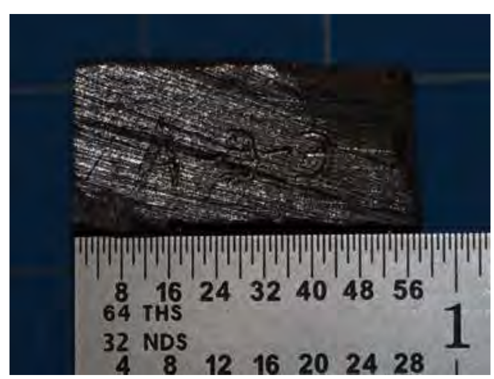

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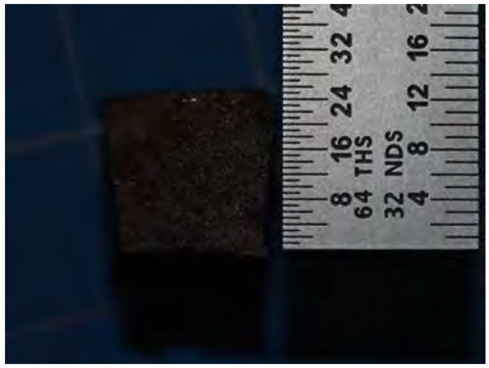

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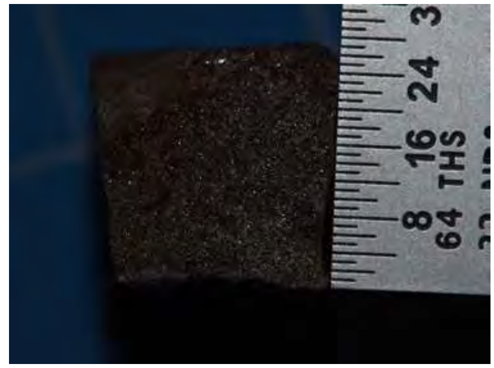

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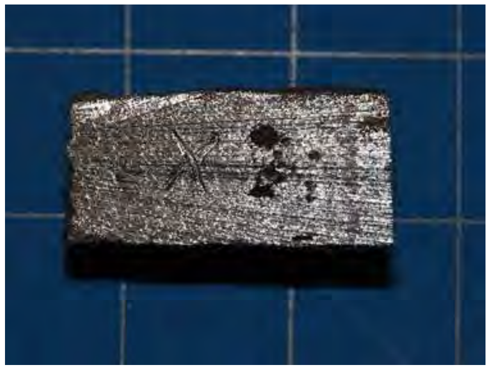

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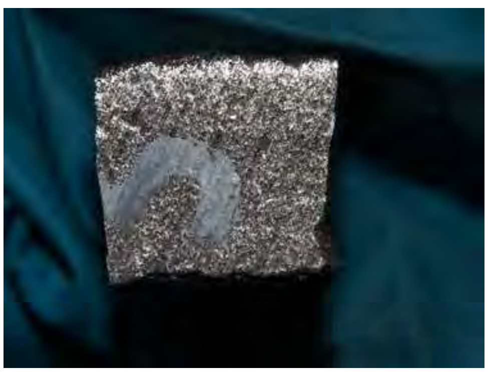

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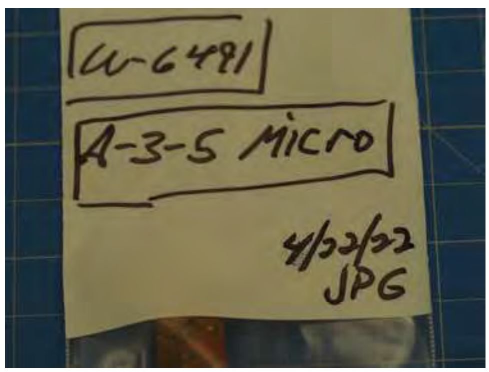

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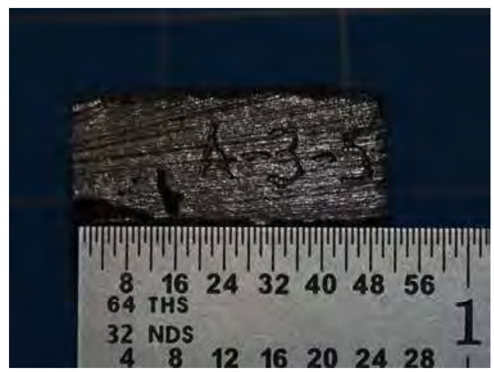

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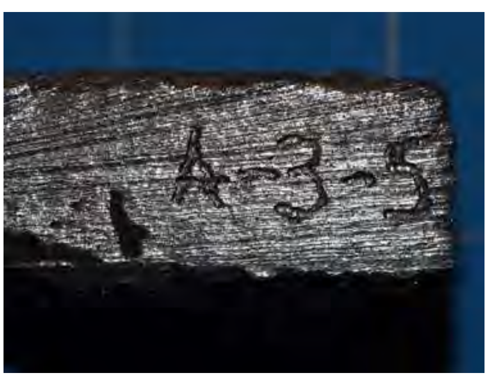

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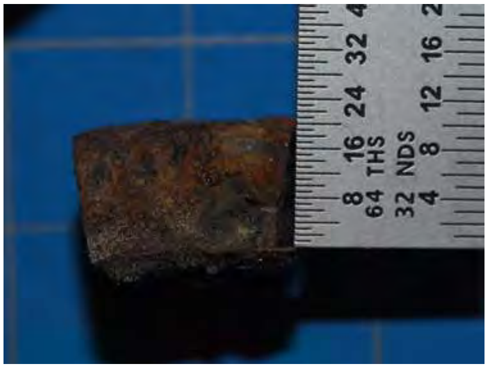

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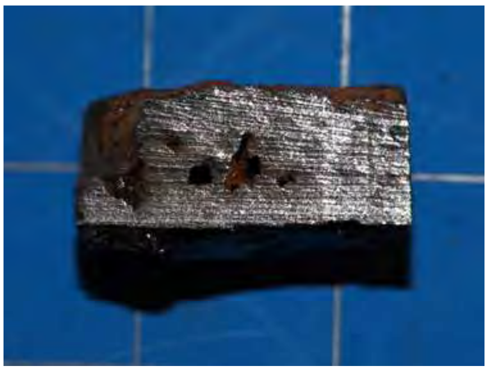
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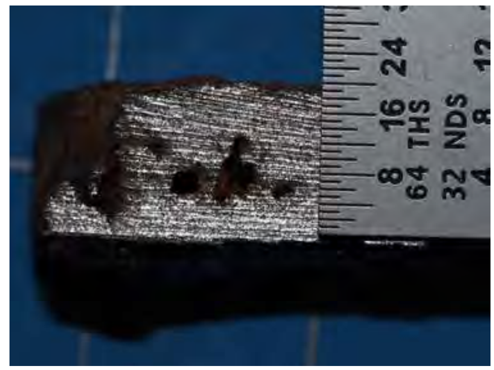

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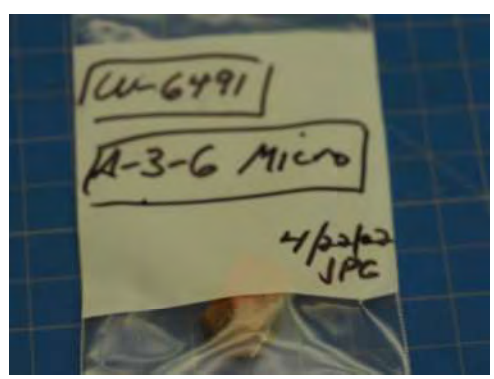

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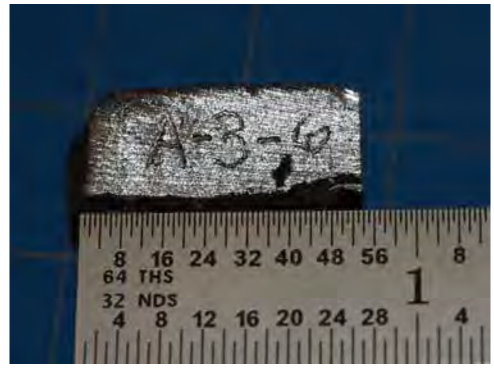

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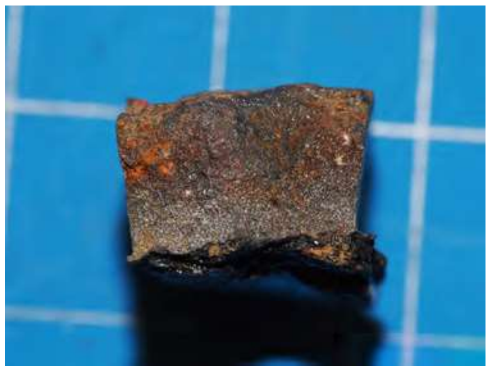

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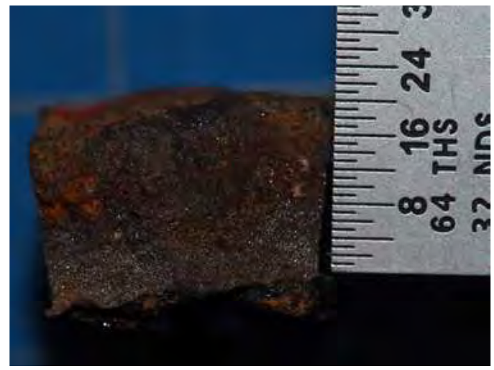

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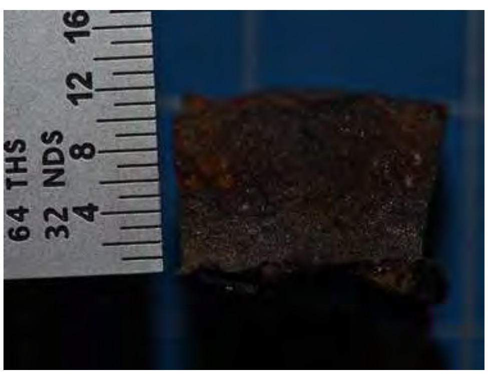

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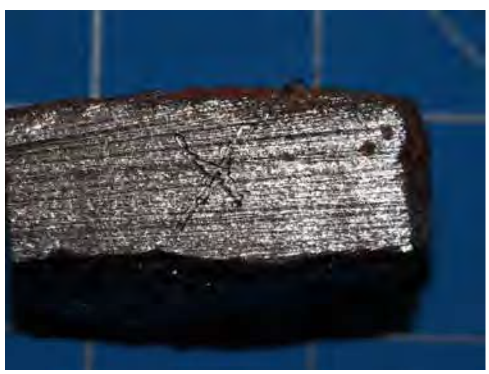

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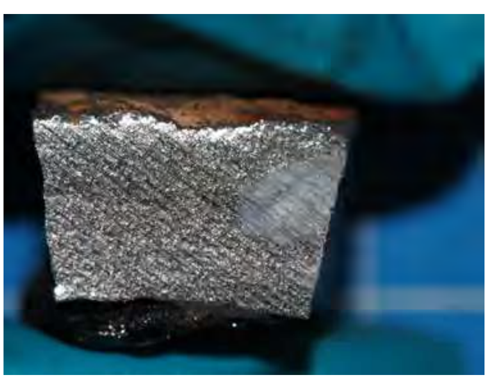

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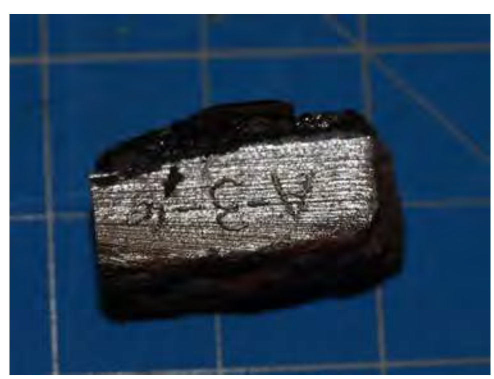

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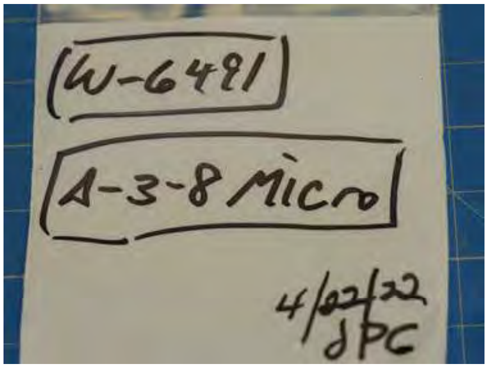

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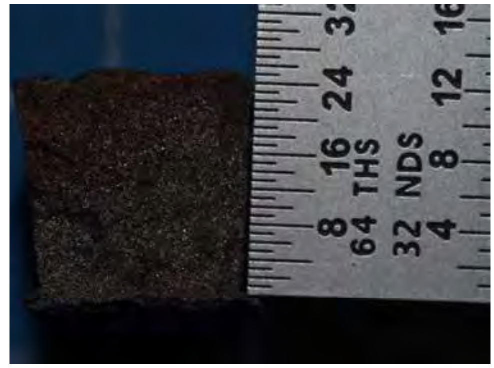

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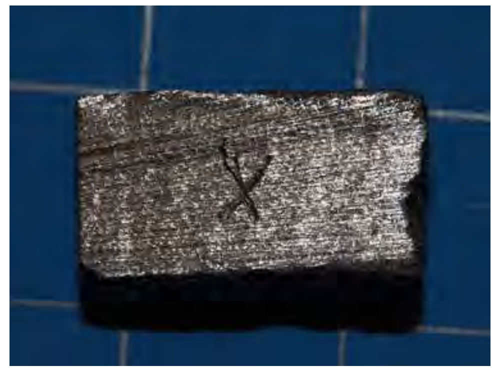

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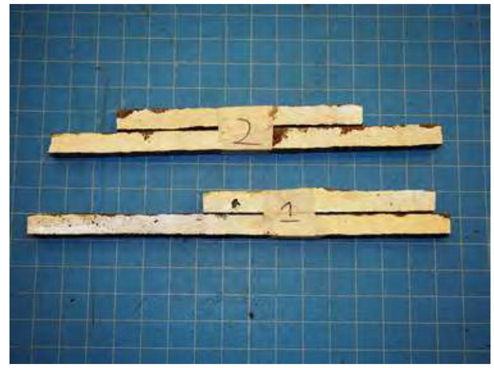

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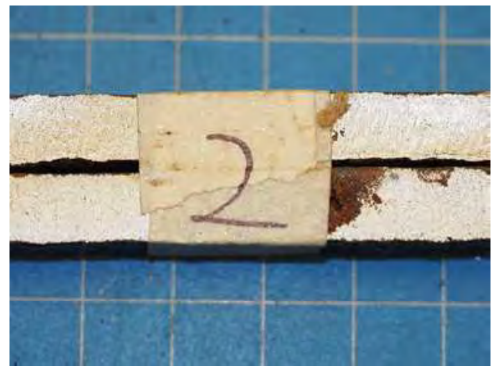

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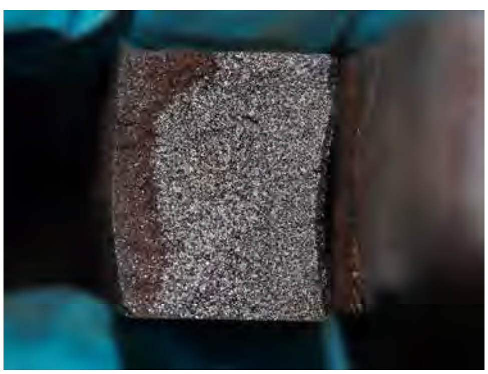

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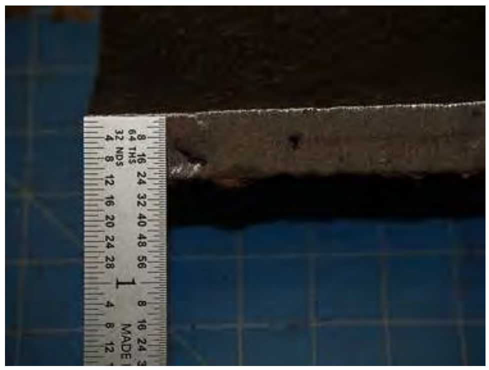

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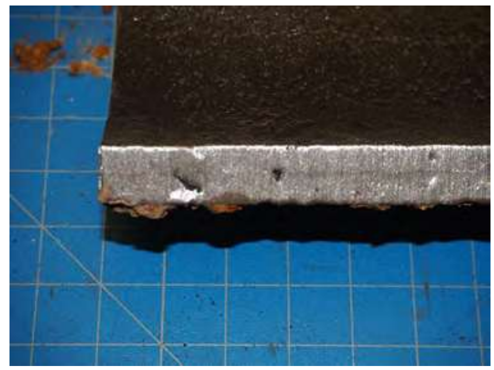

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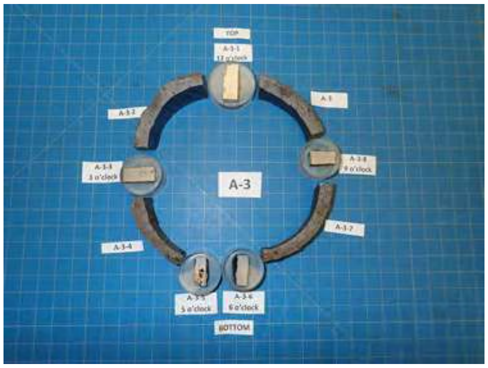

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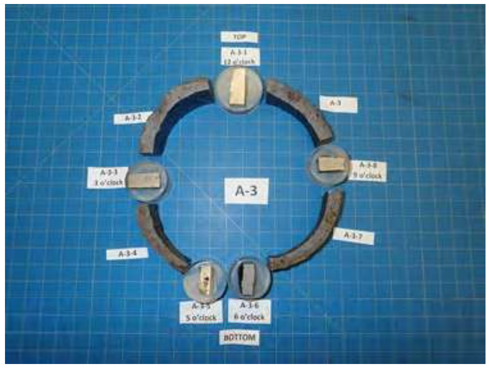

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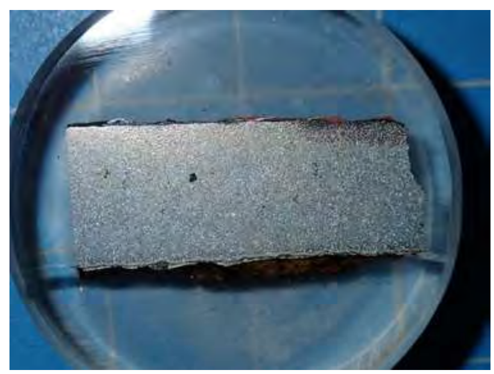

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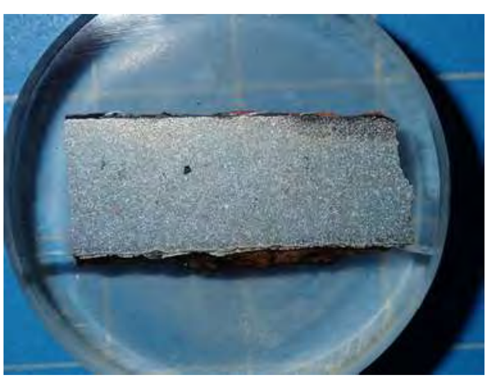

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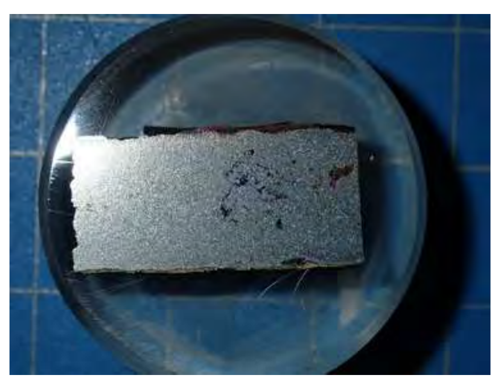

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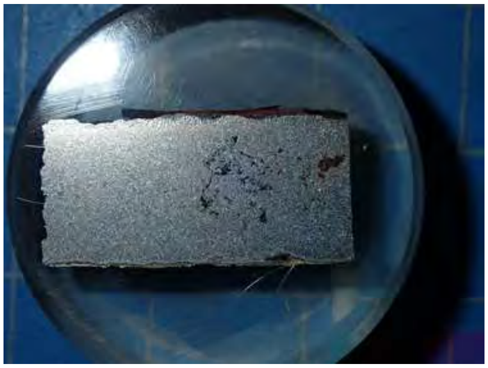

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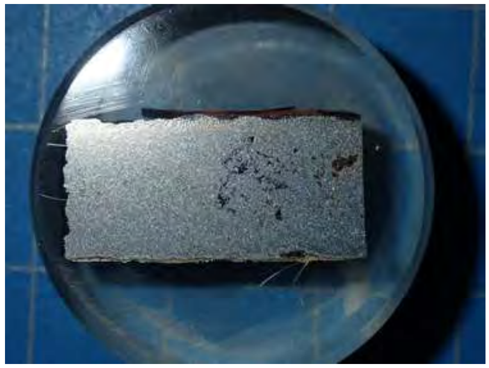

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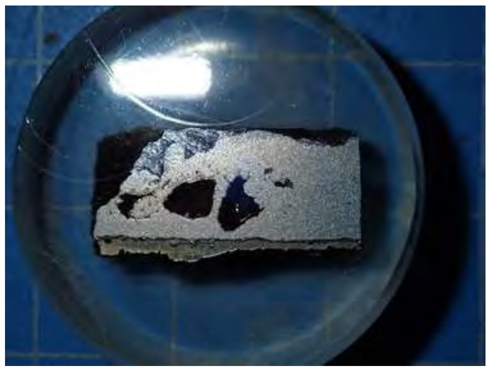

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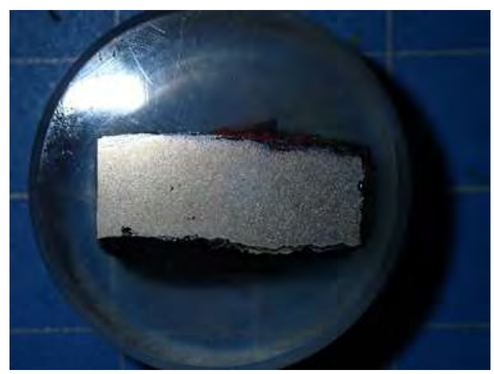

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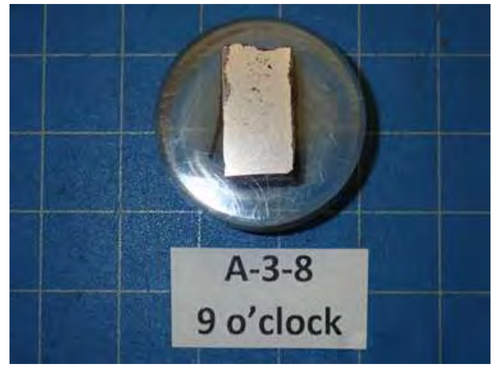

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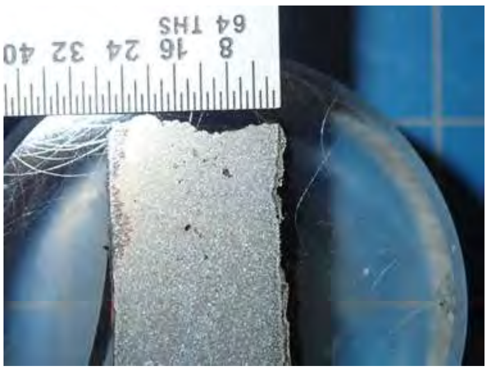
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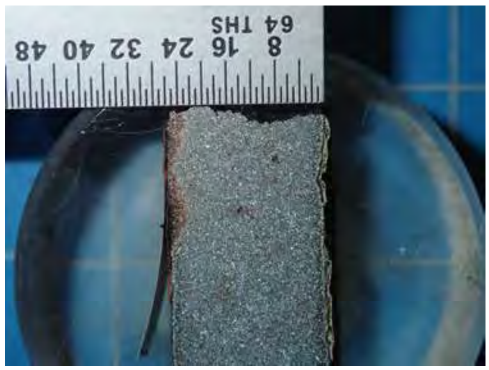
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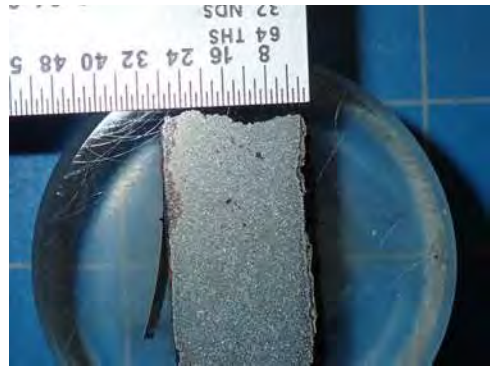
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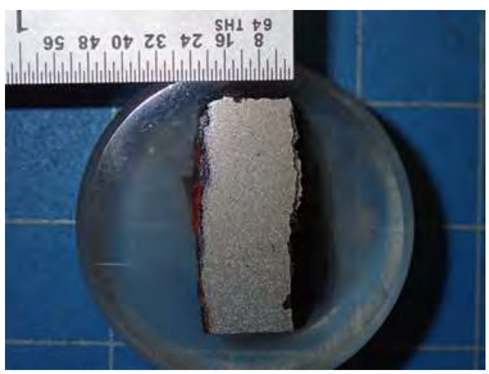
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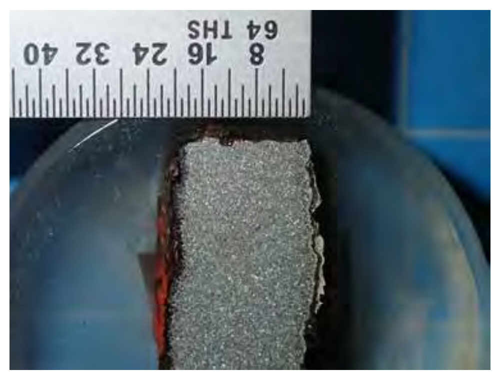
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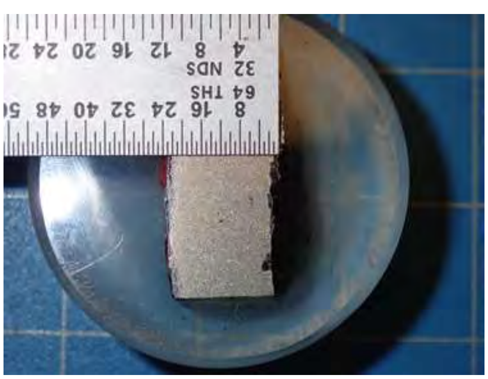
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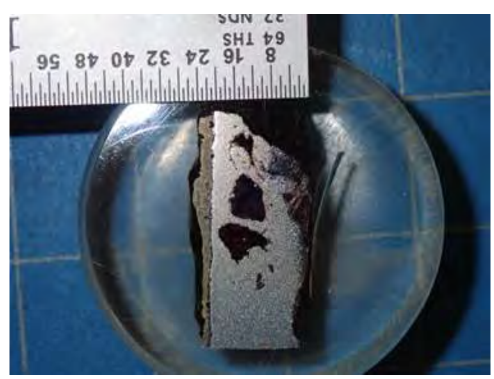
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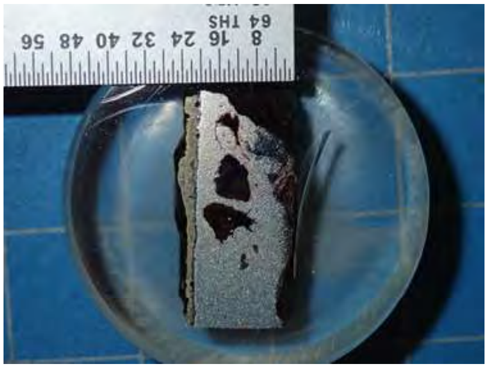
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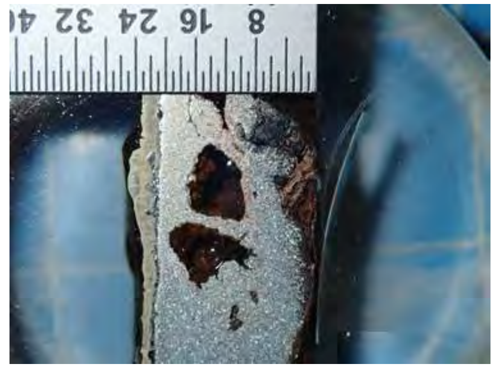
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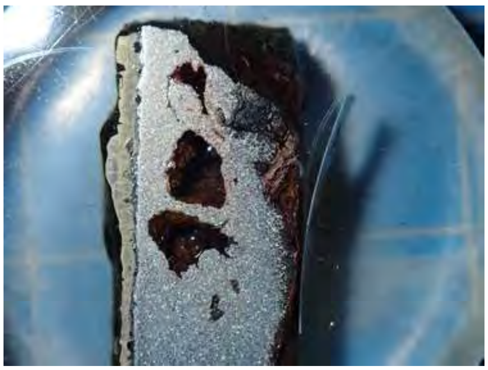
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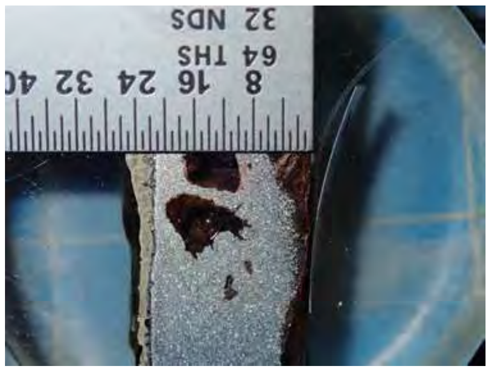
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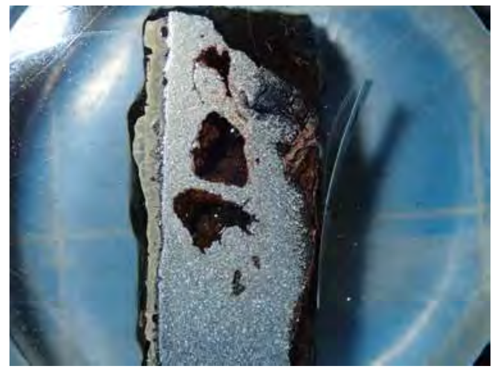
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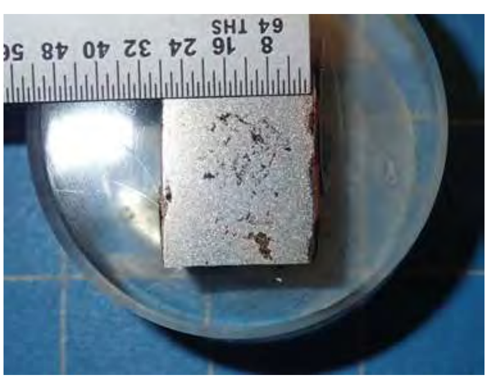
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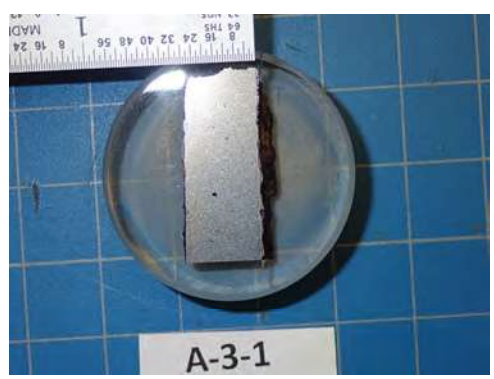

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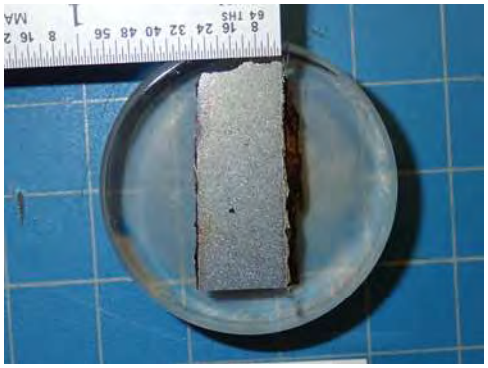

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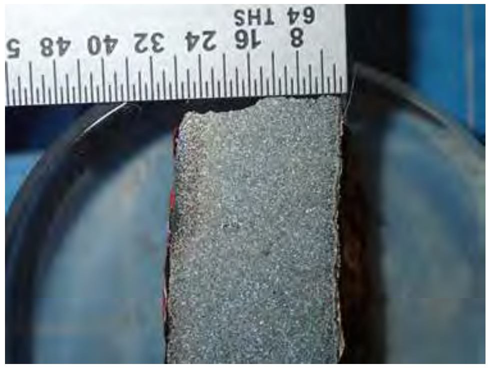

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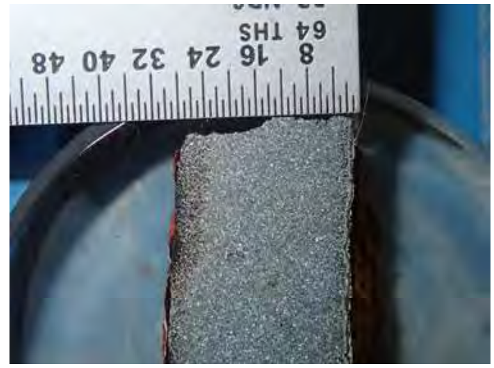

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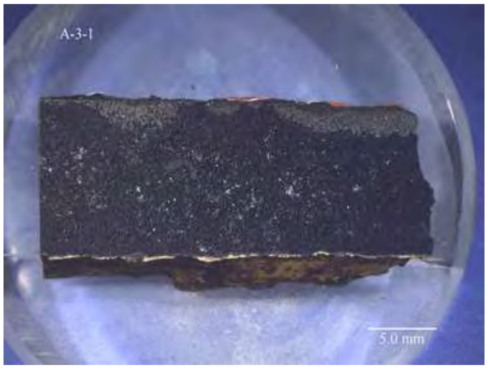

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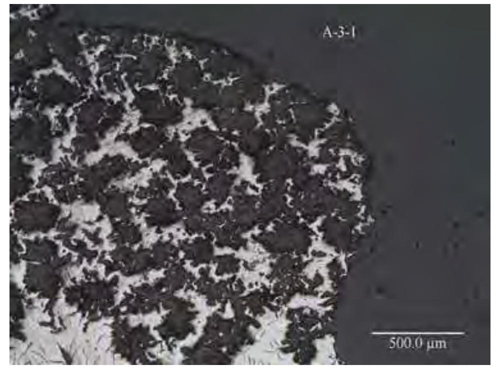

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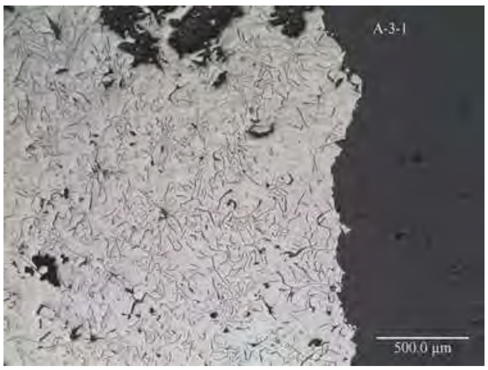

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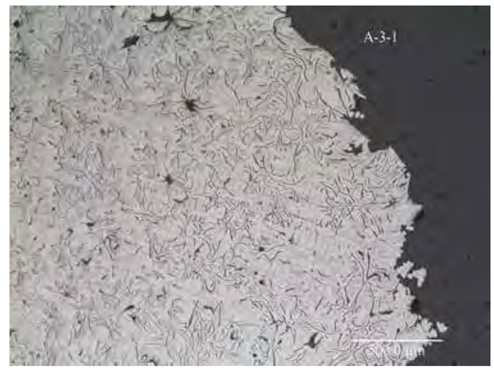

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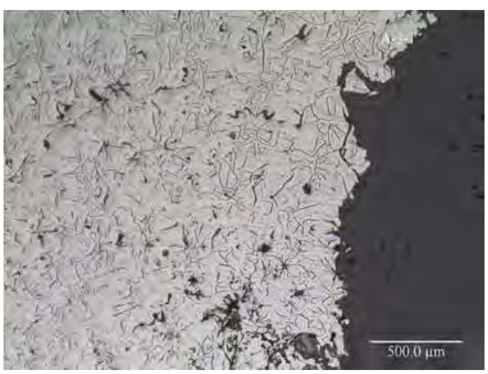

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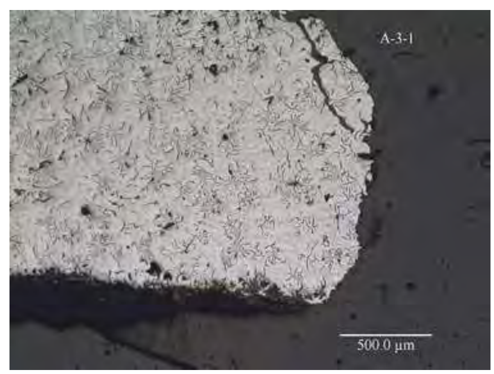

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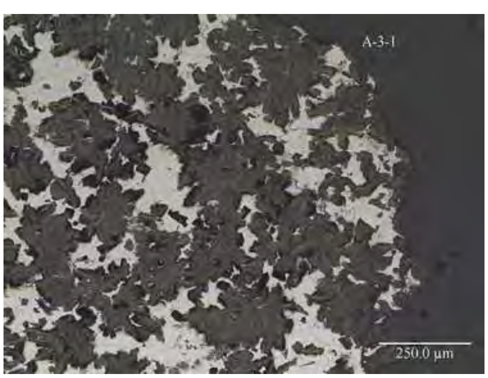

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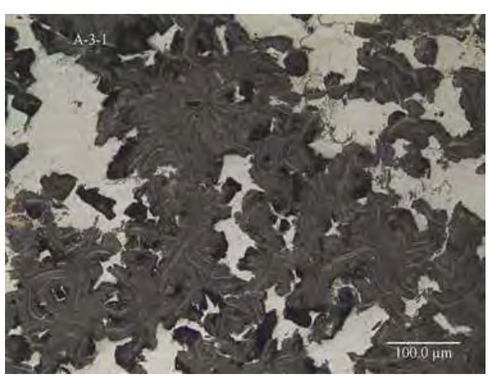

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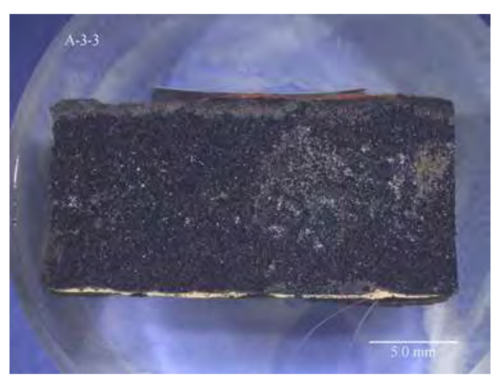

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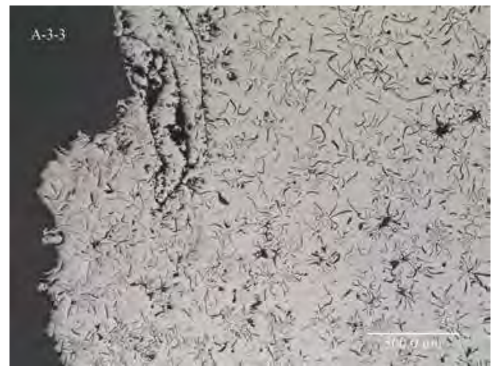

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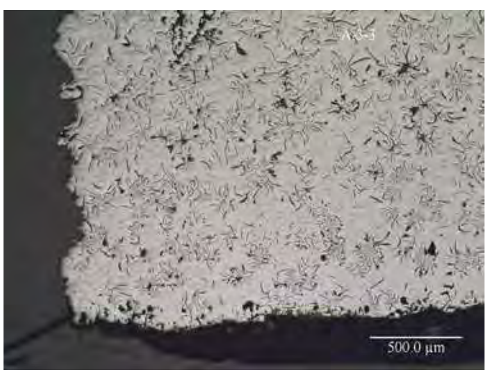

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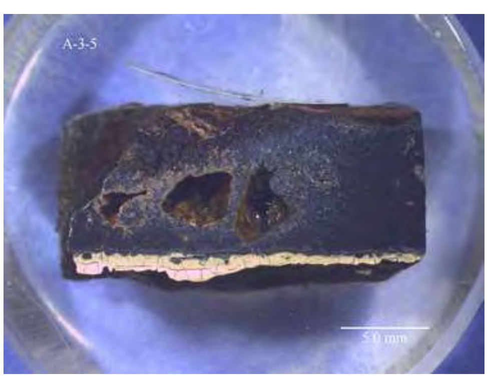

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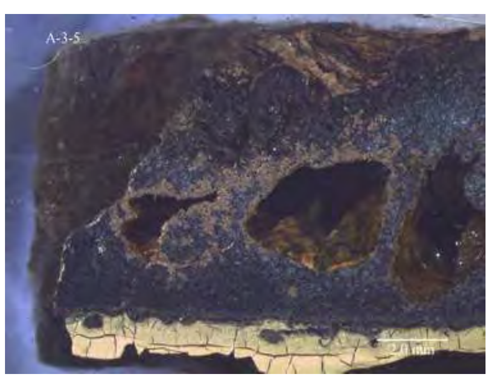

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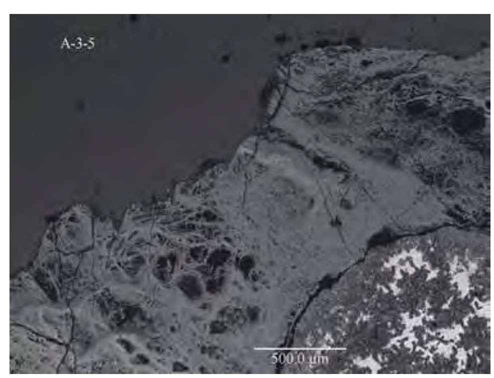

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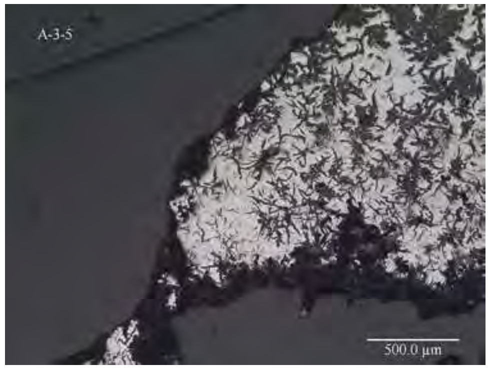

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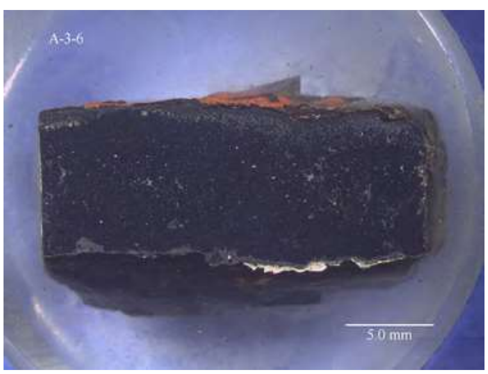

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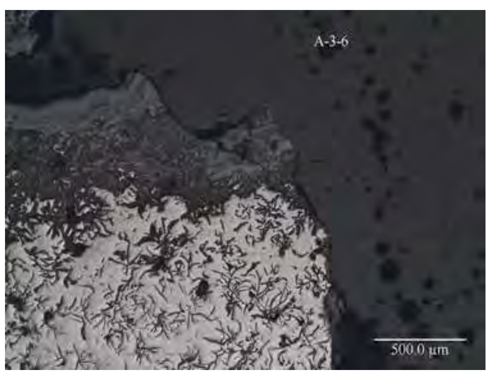

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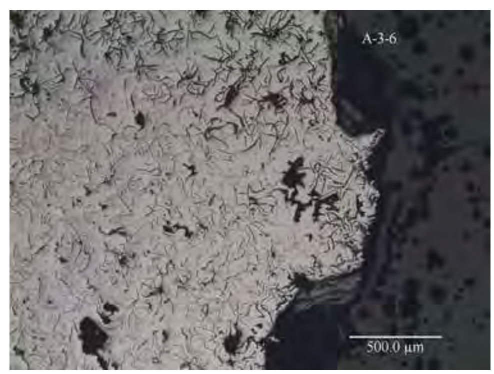

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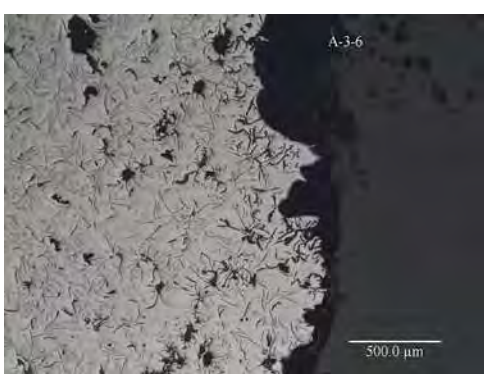

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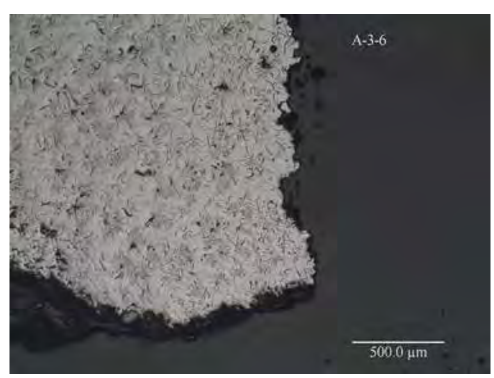

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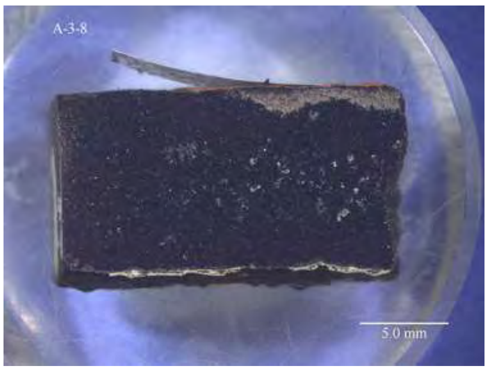

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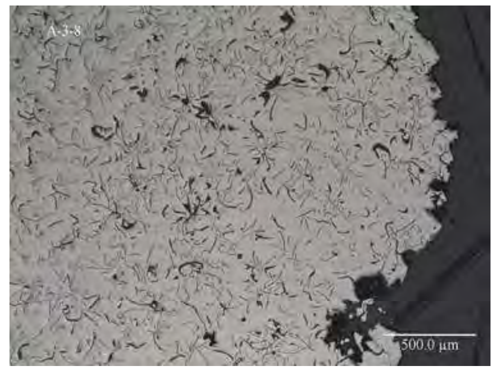

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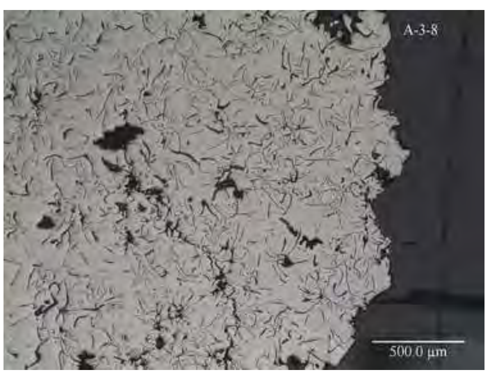

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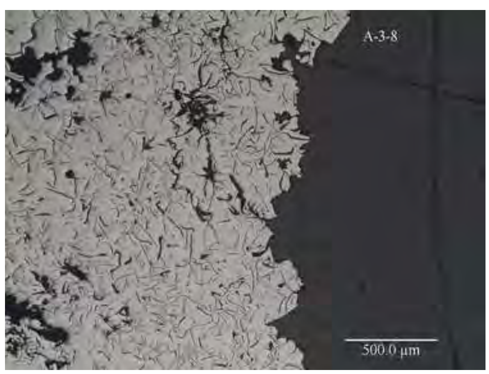

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W-6491-H-IMG_45.jpg

W-6491-H-IMG_46.jpg

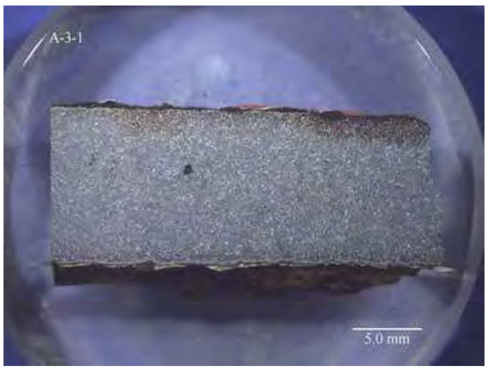
W-6491-H-IMG_47.jpg

W-6491-H-IMG_48.jpg

W-6491-H-IMG_49.jpg

W-6491-H-IMG_50.jpg

W-6491-H-IMG_51.jpg



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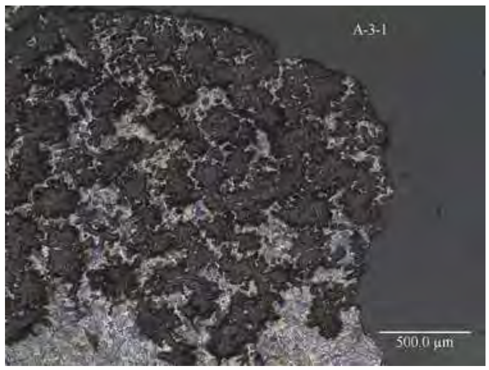

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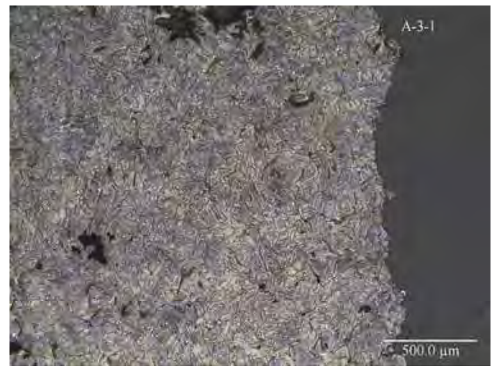

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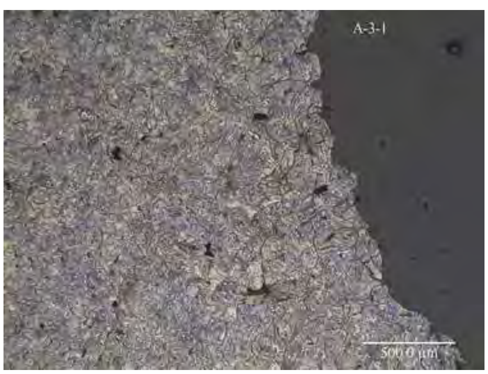

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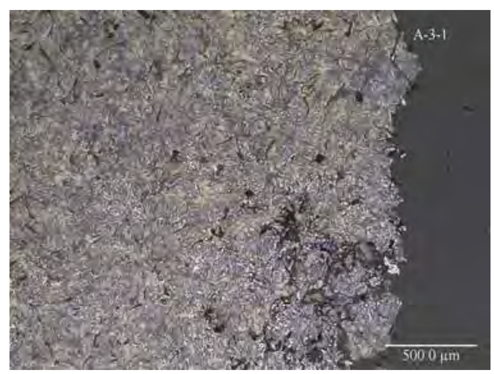

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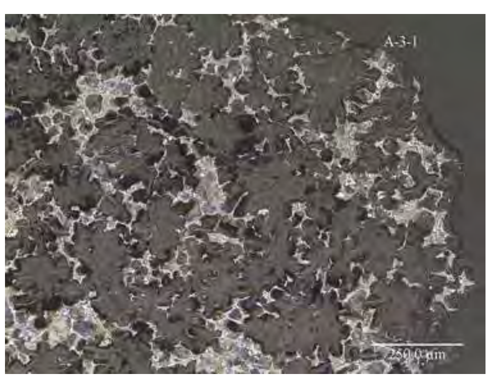

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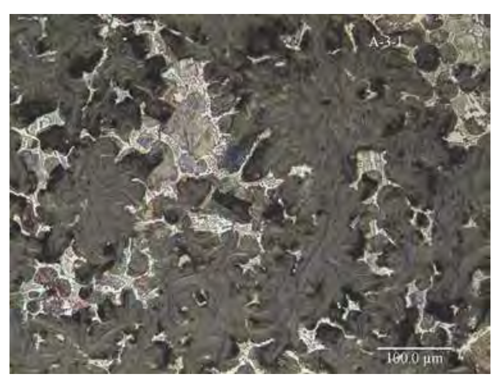

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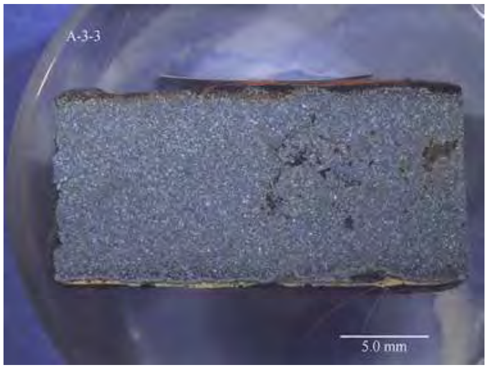

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W-6491-H-IMG_62.jpg

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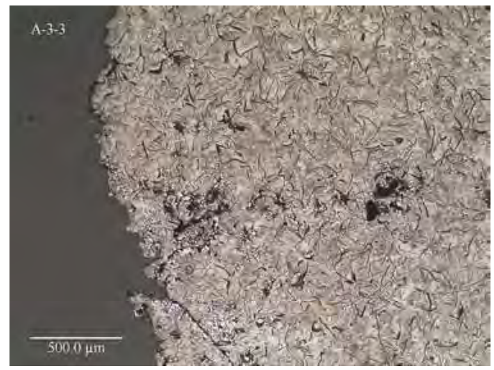

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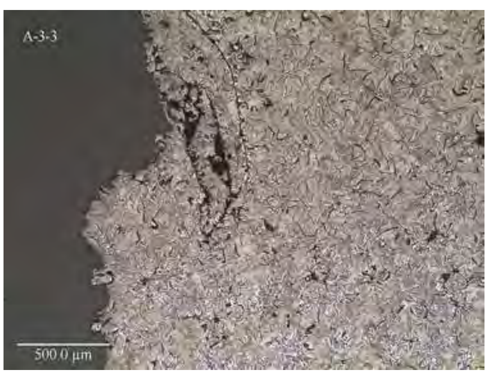

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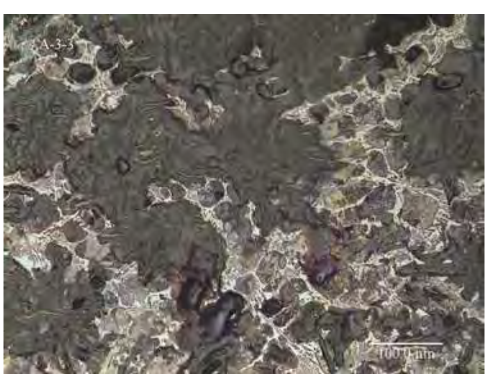

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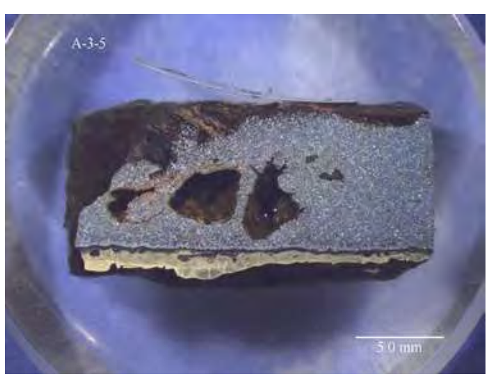

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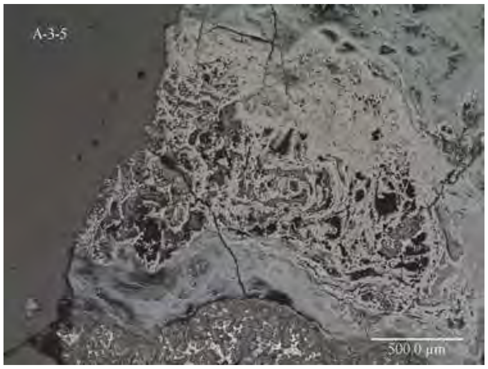

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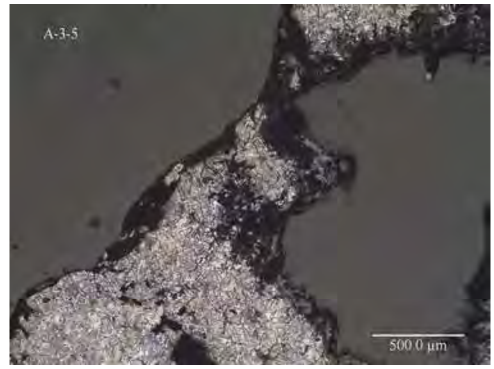

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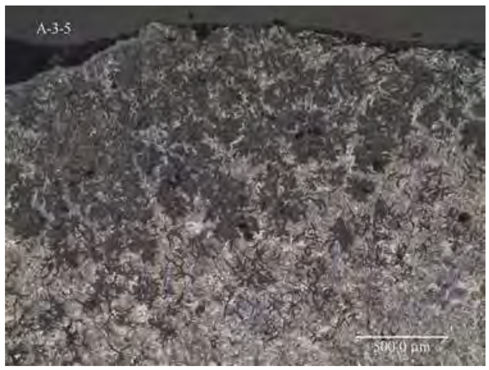

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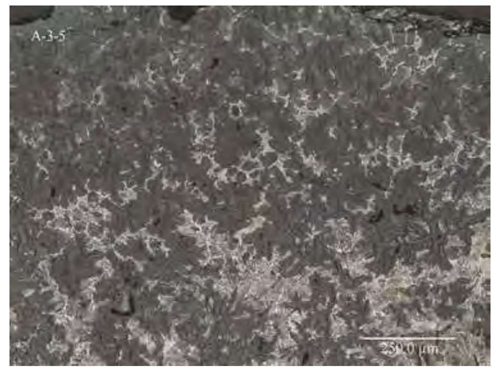

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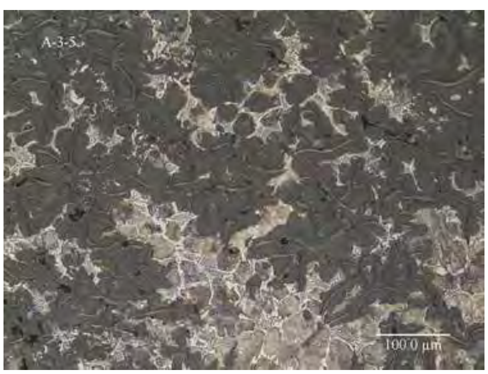

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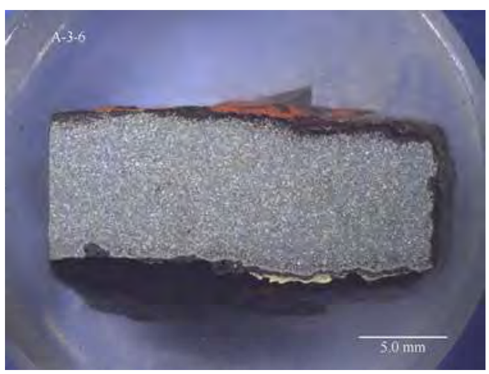

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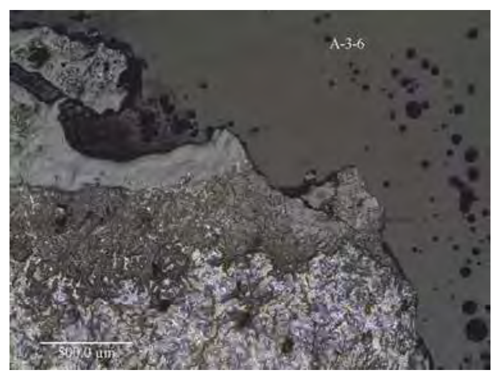

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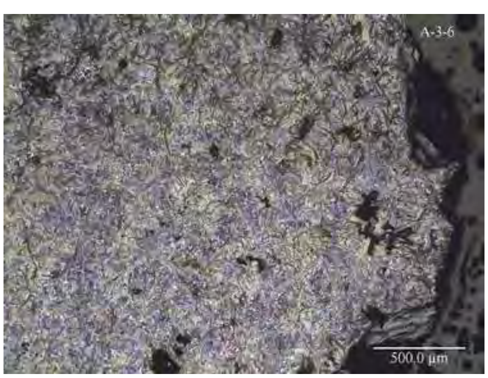

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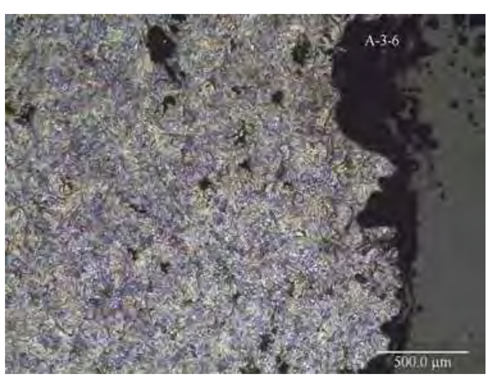

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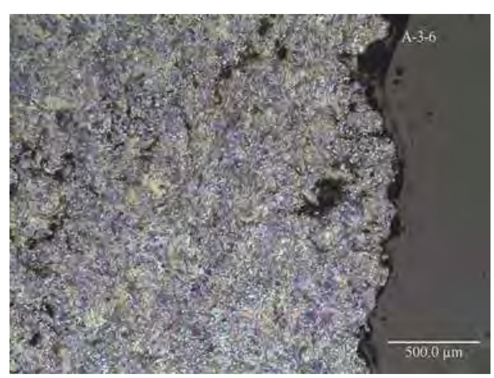

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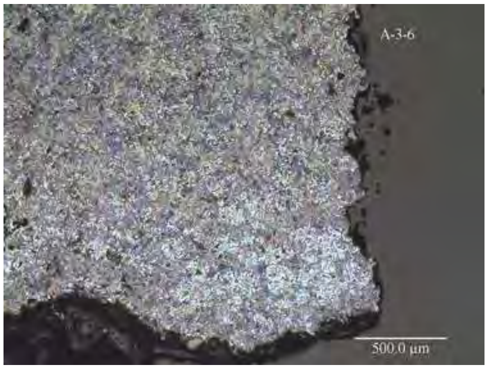

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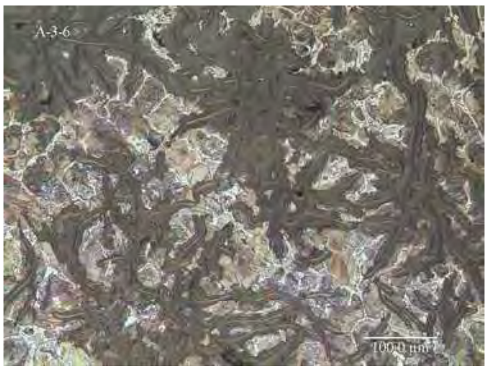

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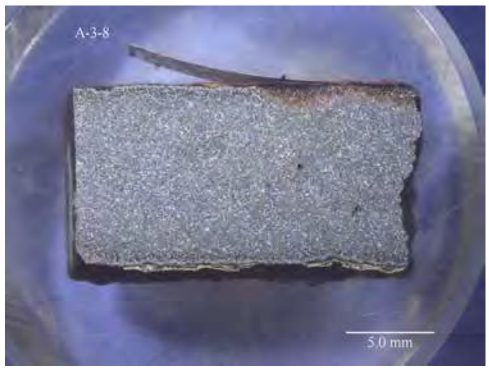

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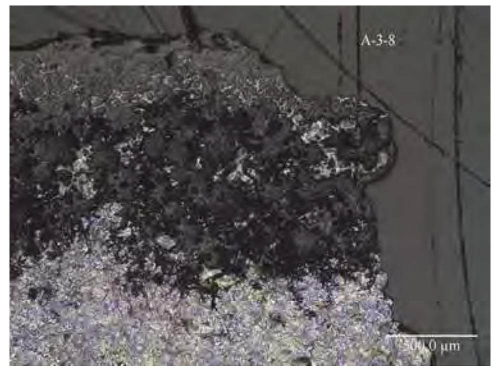

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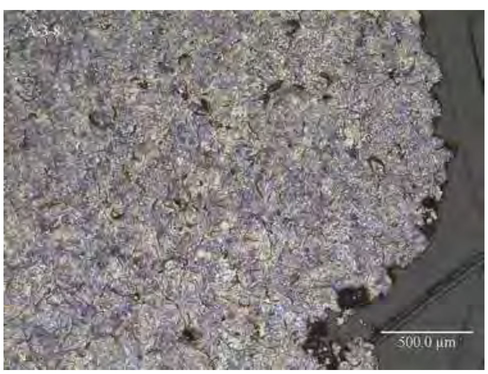

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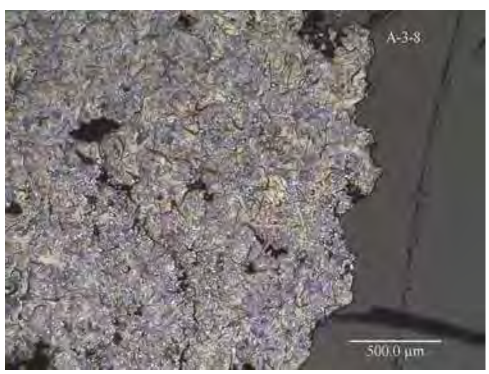

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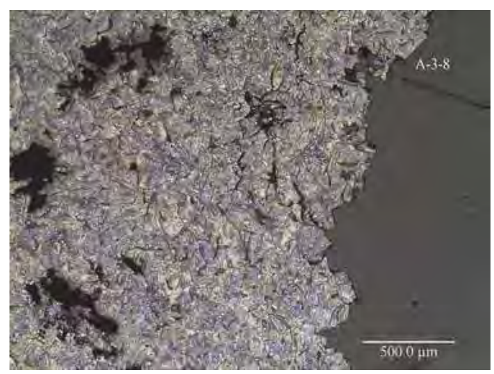

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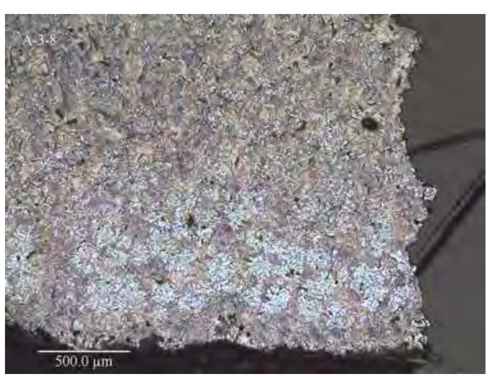

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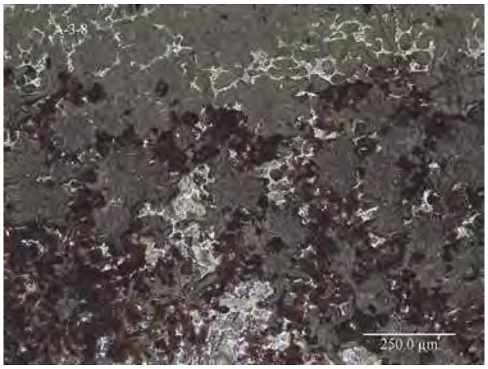

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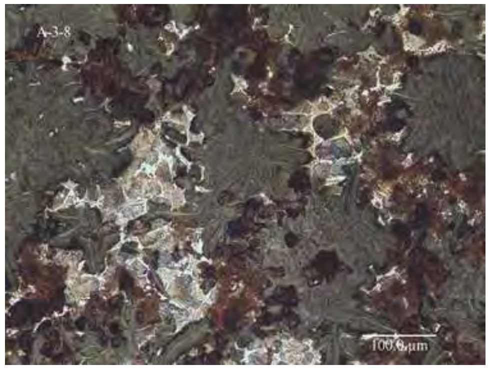

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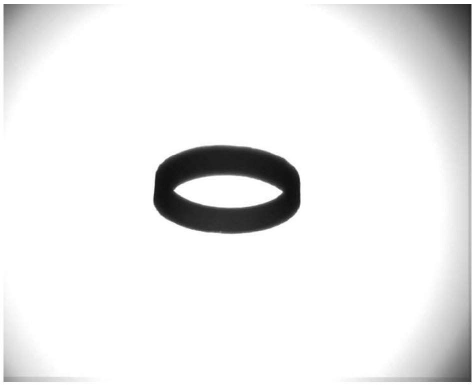
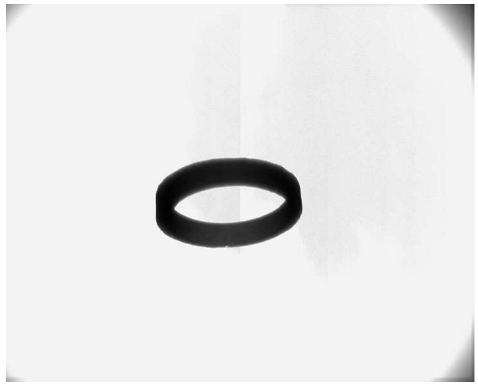
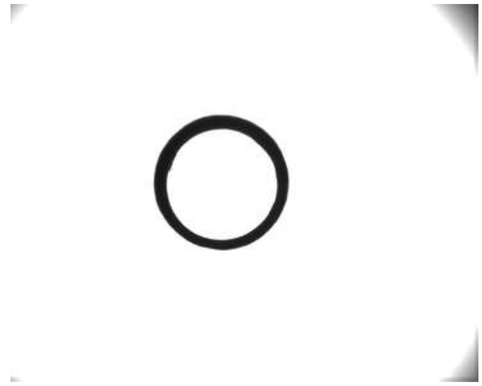
W-6491-H-IMG_99.jpg

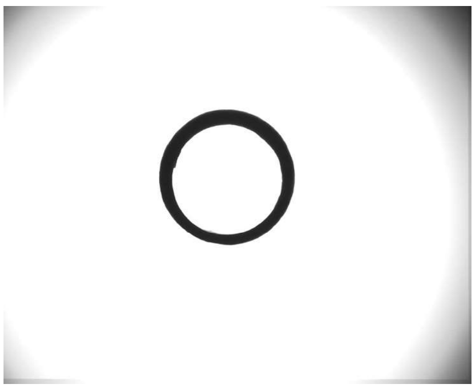
W-6491-H-IMG_100.jpg

W-6491-H-IMG_101.jpg


A2 Angled.jpg

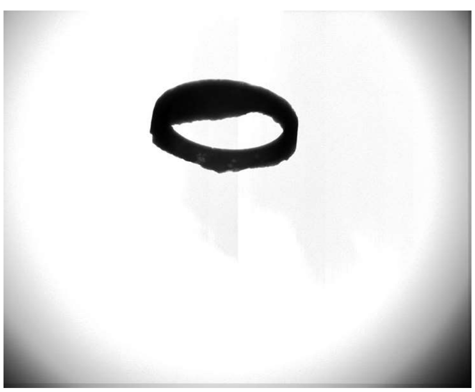

A2 on an Angle- 50 Pulses.jpg

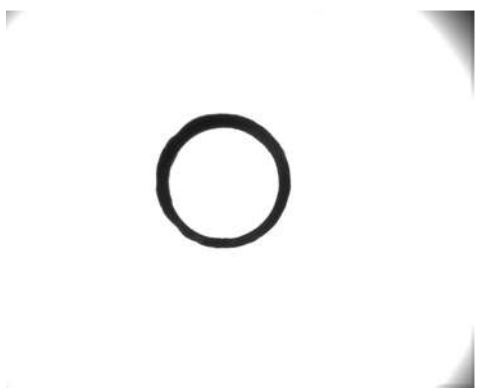

A2- 50 Pulses.jpg


A2.jpg


A3 ..jpg


A3 Angled- 50 Pulses.jpg


A3 Angled.jpg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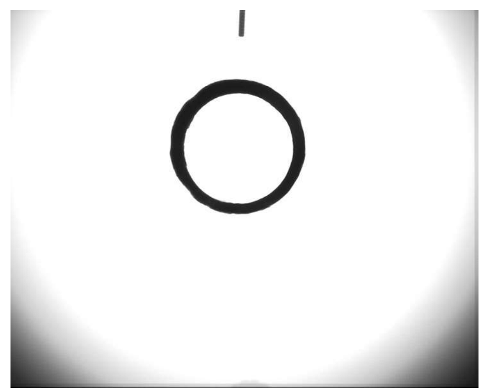
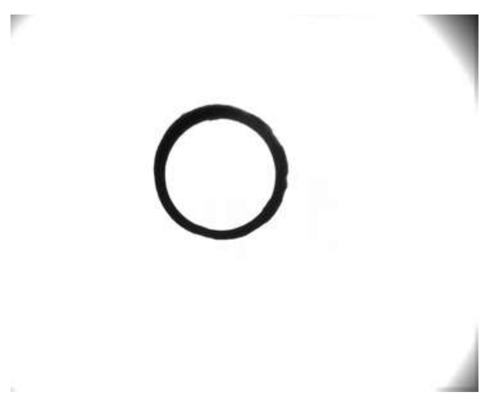

A3.jpg


A4 Angled- 50 Pulses.jpg


A4 Angled.jpg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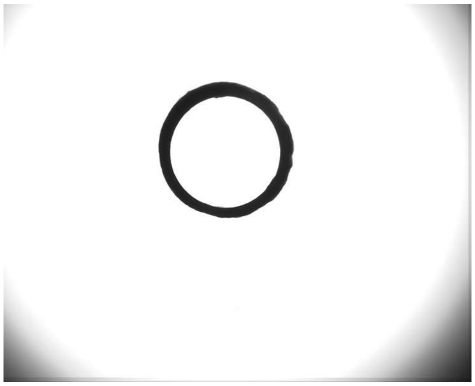
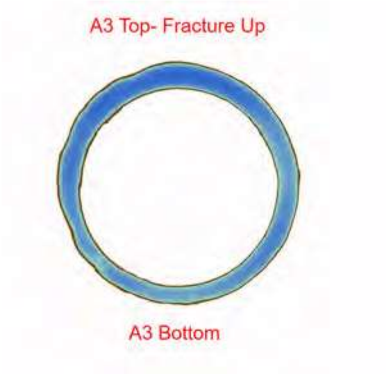


A4.jpg



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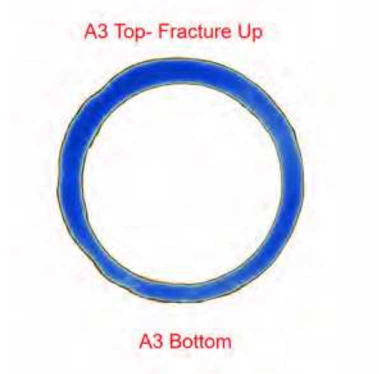

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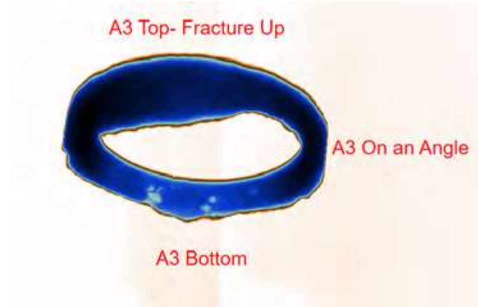

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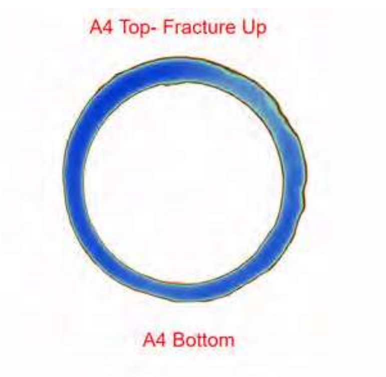

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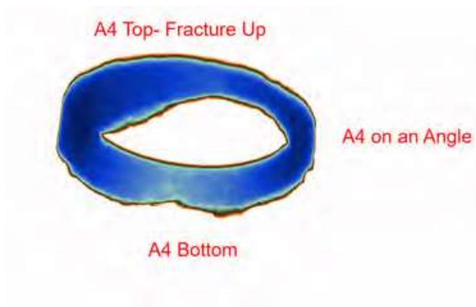

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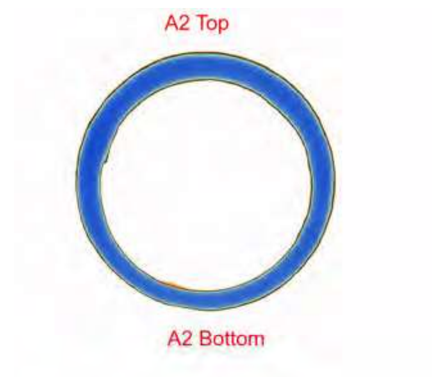

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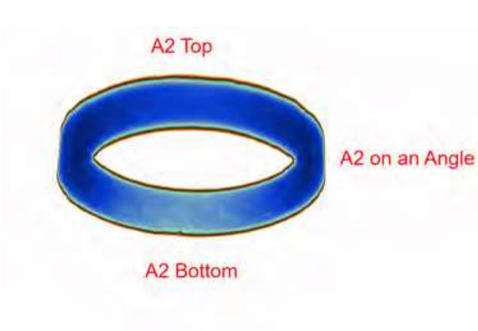

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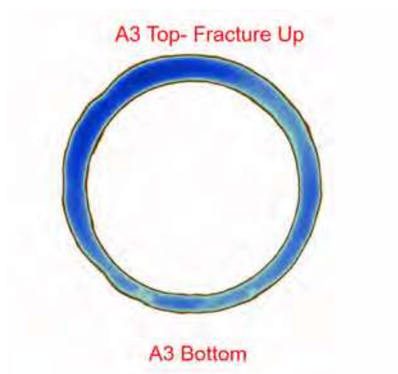

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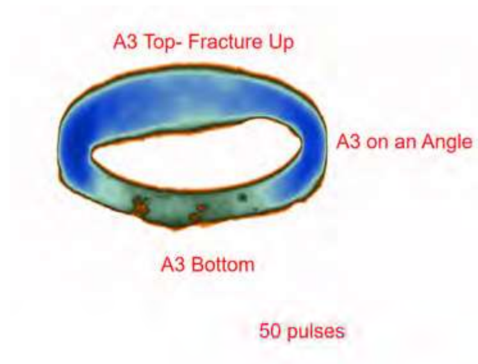

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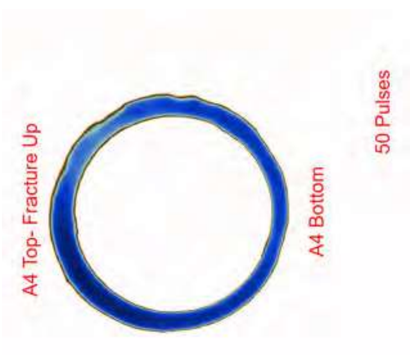

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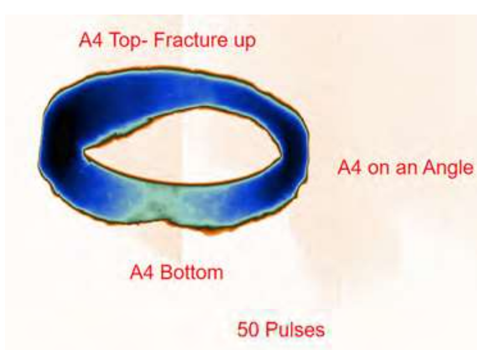

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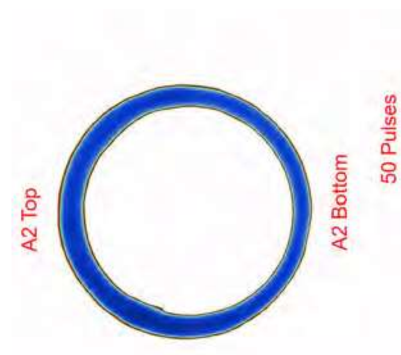

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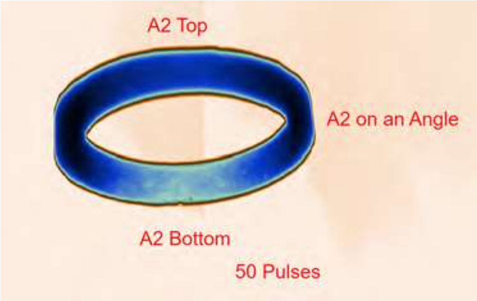

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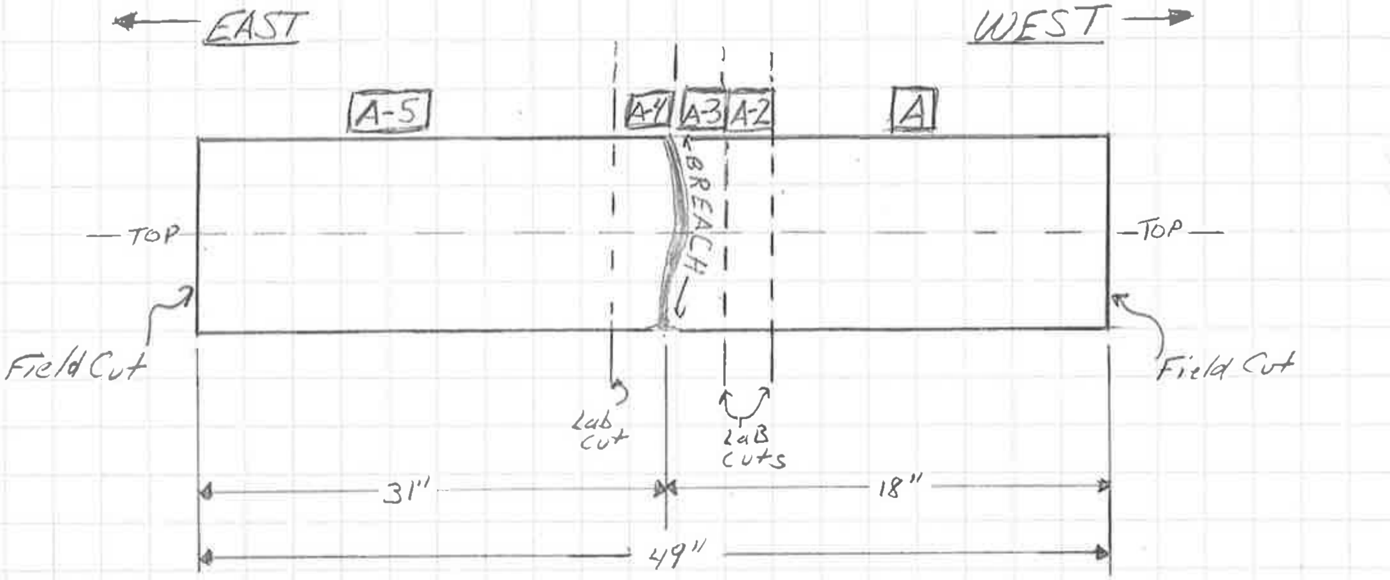
ATTACHMENT F

ITEM A

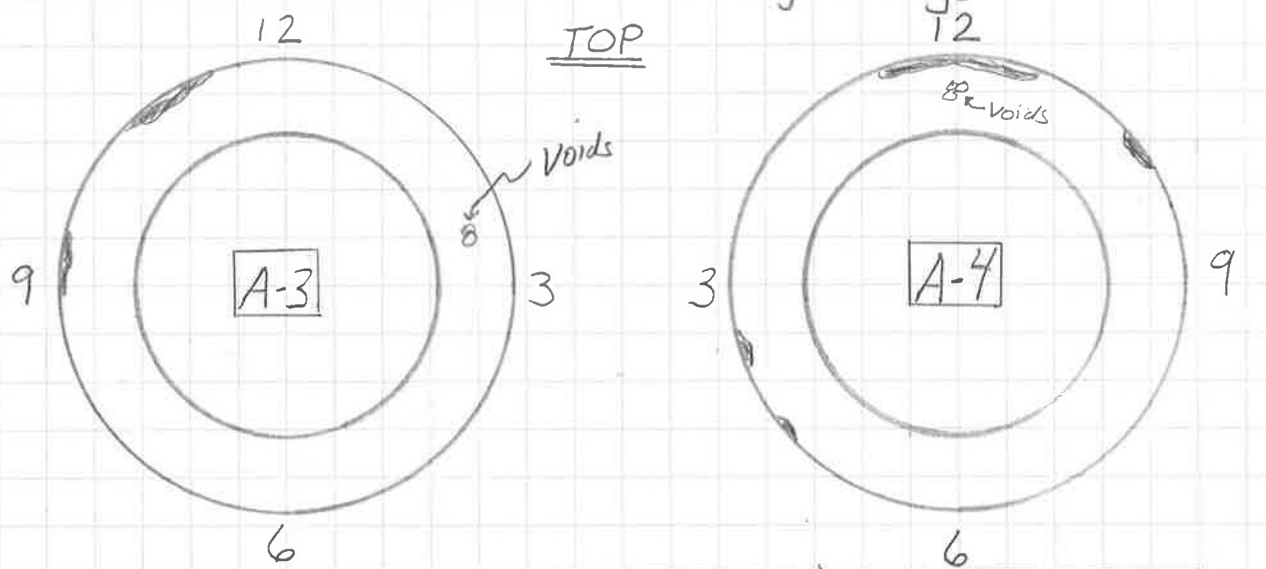


$OD_{nom} = 4.75''$
$ID_{nom} = 3.88''$

Not Drawn to scale

WALL THICKNESS

Measured on Cut Edge of Rings



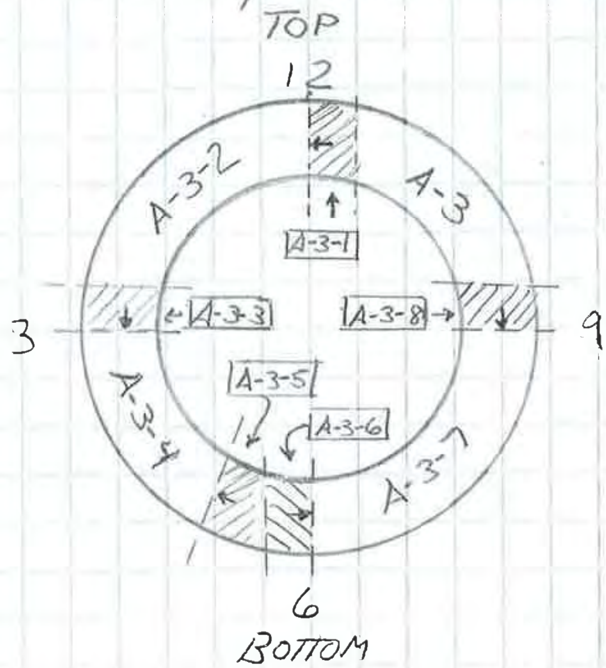
	A-3				A-4			
	12	3	6	9	12	3	6	9
Original Wall Thickness, inch	0.4400	0.4305	0.3595	0.3980	0.4430	0.4305	0.3360	0.4040
Depth of Graphitization, inch	ND	ND	ND	0.0510	0.0645	ND	ND	ND
Effective Wall Thickness, inch	0.4400	0.4305	0.3595	0.3470	0.3785	0.4305	0.3360	0.4040
% Wall Loss	0	0	0	13	15	0	0	0

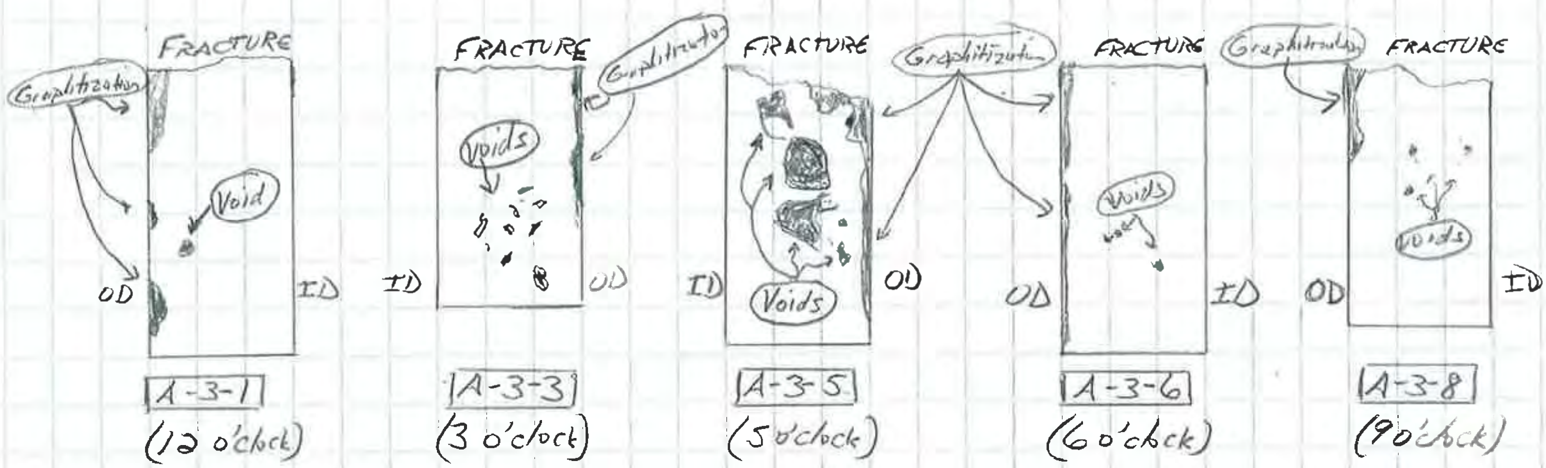
ND = Not Detected

Orientation as viewed in EAST direction

A-3 Microspecimens & Sample ID's

Fracture Surface Up





Wall Thickness Measurements at Fracture

	A-3				
	12	3	5	6	9
Original Wall Thickness, inch	0.4400	0.4305	0.3535	0.3595	0.3980
Depth of Graphitization, inch	0.0905	0.0465	0.1505	0.0470	0.0510
Effective Wall Thickness, inch	0.3495	0.3840	0.2030	0.3125	0.3470
% Wall Loss	20	11	43	13	13

Not Drawn to Scale

ATTACHMENT G

AEIS
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ATLAS EVALUATION & INSPECTION SERVICES
801 MONTROSE AVENUE, SOUTH PLAINFIELD, NJ 07080-1803
PH:(732) 388.7711 | http://www.aeis.com

REPORT OF TESTS

Client: Affiliated Engineering Laboratories, Inc.
Address: 777 New Durham Rd.
Edison, New Jersey

Reference No.: S-136308
Report Date: May 13, 2022
Order No.: P-AELI-0006

Material Description: 4-3/4 Inch Nominal Diameter by 30 Inch Length, Cast Iron Water Main.

Marked: "None "
Sampled By: Client.
Material Spec: AWWA C106- Cast-Iron Pipe Centrifugally Cast In Metal Molds

Figure No. 1 Water Main As Received

Chemical Analysis

A chemical analysis and Carbon/Sulphur analysis were made on a coupon removed from the pipe. The chemical composition of the submitted pipe **does not** conform to the AWWA C106 requirements due to a high phosphorus content.

Chemical Analysis			
Specimen ID:	**Submitted Pipe**	**Typical Gray Cast Iron**	**AWWA C106**
Carbon	3.29	**2.5/4.0**	—
Manganese	0.33	**0.2/1.0**	—
Phosphorus	**3.80**	**0.002/1.00**	**0.90 Max.**
Sulphur	0.067	**0.02/0.25**	**0.12 Max.**
Silicon	0.63	**1.0/3.0**	—
Chromium	0.012	—	—
Nickel	0.037	—	—

Client: Affiliated Engineering Laboratories, Inc.
Reference No.: S-136308
Report Date: 5/13/2022

Carbon/Sulphur Analysis

Brinell Hardness Tests

Rockwell hardness was measured on the submitted pipe with the following values were obtained. The hardness test results conform to the specified limit of AWWA C106.

Brinell Hardness Tests					
Brinell Hardness			Average	Equivalent Rockwell	Required
185 HBW	159 HBW	171 HBW	172 HBW	87 HRB	**HRB 95 Max.**

Ring Test

A ring, 6 inches in length, was cut from the submitted pipe. This ring was subjected to a compression test to determine the modulus of rupture. The modulus of rupture of the submitted pipe does not conform to the required minimum of AWWA C106.

Ring Test		
	Results	Required
Average Thickness, inch	0.426	-
Average Inside Diameter, inch	3.99	-
Breaking Load, pounds	7,100	-
Modulus of Rupture, psi	25,700	**40,000 Min.**

AEIS
Our Professional Knowledge
Your Business Advantage

Client: Affiliated Engineering Laboratories, Inc.
Reference No.: S-136308
Report Date: 5/13/2022

Talbot Test

Two longitudinal strips, 12 x ½ inch, were machined from the submitted pipe. These strips subjected to the Talbot test to determine the secant modulus of elasticity. The secant modulus of elasticity of the submitted pipe conform to the specified limit of AWWA C106.

Talbot Test				
Sample No.	1	2	Average	Required
Deflection, inch	0.094	0.125	---	-
Breaking Load, Pounds	250	250	---	-
Secant Modulus of Elasticity, Psi	11,874,400	8,937,300	10,405,850	**12,000,000 Max.**

Remarks:

The chemical analysis and modulus of rupture of the submitted water main **does not conform** to the specified minimum requirement per AWWA C106.
The hardness results and secant modulus of elasticity of the submitted water main conform to the specified minimum requirement per AWWA C106.

We certify that report is a true report of result obtained from our tests of this material.

Reviewed by: M. Shohdy
M. Shohdy
Laboratory Manager

ATLAS EVALUATION & INSPECTION SERVICES

801 MONTROSE AVENUE, SOUTH PLAINFIELD, NJ 07080-1803

PH:(732) 388.7711 | http://www.aeis.com

REPORT OF TESTS

Client: Affiliated Engineering Laboratories, Inc.

Address: 777 New Durham Rd.
Edison, New Jersey

Reference No.: S-136308B

Report Date: May 13, 2022

Order No.: P-AELI-0006

Material Description: 4-3/4 Inch Nominal Diameter by 30 Inch Length, Cast Iron Gas Pipe.

Marked: "None "

Sampled By: Client.

Material Spec: ASA specification A-21.3.

Figure No. 1 Pipe As Received

Chemical Analysis

A chemical analysis and Carbon/Sulphur analysis were made on a coupon removed from the pipe. The chemical analysis for information only since ASA specification A-21.3 does not specify any chemical requirements.

Chemical Analysis	
Specimen ID:	Submitted Pipe
Carbon	3.29
Manganese	0.33
Phosphorus	3.80
Sulphur	0.067
Silicon	0.63
Chromium	0.012
Nickel	0.037

Client: Affiliated Engineering Laboratories, Inc.
Reference No.: S-136308B
Report Date: 5/13/2022

Carbon/Sulphur Analysis

Brinell Hardness Tests

Rockwell hardness was measured on the submitted pipe with the following values were obtained. The hardness test resultsfor information only since ASA specification A-21.3 does not specify any hardness requirmnts.

Brinell Hardness Tests					
Brinell Hardness			Average	Equivalent Rockwell	Required
185 HBW	159 HBW	171 HBW	172 HBW	87 HRB	---

Ring Test

A ring, 6 inches in length, was cut from the submitted pipe. This ring was subjected to a compression test to determine the modulus of rupture. The modulus of rupture of the submitted pipe does not conform to the required minimum of ASA specification A-21.3.

Ring Test		
	Results	Required
Average Thickness, inch	0.426	-
Average Inside Diameter, inch	3.99	-
Deflection, inch	0.11	-
Breaking Load, pounds	7,100	-
Modulus of Rupture, psi	27,500	31,000 Min.
Secant Modulus of Elasticity, Psi	2,700,900	15,000,000 Max.

Client: Affiliated Engineering Laboratories, Inc.
Reference No.: S-136308B
Report Date: 5/13/2022

Talbot Test

Two longitudinal strips, 12 x ½ inch, were machined from the submitted pipe. These strips subjected to the Talbot test to determine the secant modulus of elasticity. The modulus of rupture of the submitted pipe **does not conform** to the specified limit of ASA specification A-21.3.

Talbot Test				
Sample No.	**1**	**2**	**Average**	**Required**
Deflection, inch	0.094	0.125	---	-
Breaking Load, Pounds	250	250	---	-
Modulus of Rupture, psi	**23,500**	**23,500**	23500	**30,000 Min.**
Secant Modulus of Elasticity, Psi	**10,638,300**	8,008,800	9,323,600	**10,000,000 Max.**

Remarks:

The chemical analysis and hardness test results are submitted for information only.
The modulus of rupture of the submitted pipe **does not conform** to the specified limit of ASA specification A-21.3.
"A" revision issued on July 08, 2022 to change the specification from AWWA C106 to ASA specification A-21.3. per the client request.
"B" revision issued on July 11, 2022 to change the pipe description from "Water Main" to "Gas Pipe" per the client request.

We certify that report is a true report of result obtained from our tests of this material.

Reviewed by: M. Shohdy
M. Shohdy
Laboratory Manager

Affiliated
Engineering
Laboratories, Inc.

Chain of Custody

Caption: PGW

File No.: **W-6491**

Engineer: JPG

Item No.	Quantity	Description
1	1	Ring Sample ID A-2
2	1	Pipe Sample ID A-5

	Released By	Received By	Reason
Signature:	[signature]	[signature]	
Print Name:	Dave Zawodniak	Mamdouh Showky	Testing
Company:	AEL Group	04-27-2022 AEIS	
Date:			
Signature:	[signature]	[signature]	
Print Name:	Luis Rosa	D ZAWODNIAK	Return Samples
Company:	AEIS	AEL	
Date:	5/24/22	5/24/2022	

Please print and sign in the appropriate boxes above and return a copy to:

Affiliated Engineering Laboratories, Inc.
777 New Durham Road
Edison, New Jersey 08817

Phone: (732) 429-1200
Fax: (732) 429-1201

ATTACHMENT H

ASA
A.21.3–1952

American Standard

SPECIFICATIONS

for

CAST IRON PIT CAST PIPE FOR GAS

Users of this document should make reference to "American Recommended Practice Manual for the Computation of Strength and Thickness of Cast Iron Pipe" (ASA A21.1) for complete information concerning the conditions which various thicknesses of pipe are designed to meet. The foreword of the Manual also contains a statement regarding the history of the specifications and references to other related documents.

SPONSORS

AMERICAN GAS ASSOCIATION
AMERICAN SOCIETY FOR TESTING MATERIALS
AMERICAN WATER WORKS ASSOCIATION
NEW ENGLAND WATER WORKS ASSOCIATION

ASA
A.21.3–1952

AMERICAN STANDARD SPECIFICATIONS for CAST IRON PIT CAST PIPE FOR GAS

This specification covers cast iron pit cast pipe for gas. Pit cast pipe are pipe cast vertically with dry sand molds and cores.

Section 3-1. Description of Pipe. The pipe shall be made with bell and spigot ends, plain ends or such other type of ends as may be agreed upon at the time of purchase. Pipe with bell and spigot ends shall conform accurately to the dimensions given in Table 3.1. Pipe with other types of ends shall comply with the dimensions agreed upon but in all other respects shall fulfill the specifications hereinafter given. Pipe shall be straight and shall be true circles in section, with their inner and outer surfaces concentric. They shall be at least 12 ft. in nominal laying length, except as provided for cut pipe in Sect. 3-10.

Section 3-2. Casting of Pipe. The pipe shall be cast in dry sand molds in a vertical position. Pipe 16 inches or less in diameter shall be cast with the bell end up or down as specified in the proposals. Pipe 20 inches or more in diameter shall be cast with the bell end down. The pipe shall not be stripped or taken from the pit while showing color of heat, but shall be left in the flasks for a sufficient length of time to prevent unequal contraction by subsequent exposure.

Section 3-3. Quality of Iron.

(3-3.1) All pipes shall be made of cast iron of good quality, and of such character and so adapted in chemical composition to the thickness of the pipe to be cast, that the iron in the pipe shall be strong, tough, resilient, of even grain and soft enough for satisfactory drilling and cutting and it shall comply with the physical specifications given in Sect. 3-16, 3-17, and 3-18. The metal shall be remelted in a cupola or other suitable furnace.

(3-3.2) The iron in the pipe shall not contain more than 0.90 per cent of phosphorus nor more than 0.12 per cent of sulphur. Samples for chemical analysis shall be taken by drilling completely through from skin to skin each of the acceptance test specimens: but not to exceed three specimens per heat.

Section 3-4. Quality of Castings. The pipe shall be smooth, free from scales, lumps, blisters, sand holes and defects of every nature which unfit them for the use for which they are intended. No plugging, filling, burning-in or welding will be allowed except as permitted by the purchaser.

Section 3-5. Foundry Records.

(3-5.1) *Casting*—A record of the melting and pouring temperatures of the iron shall be furnished the purchaser if requested.

(3-5.2) *Chemical Analyses*—Chemical analyses shall be made by the manufacturer from each heat to determine total carbon, manganese, phosphorus, sulphur and silicon; duplicate copies of test reports shall be furnished the purchaser on request.

Section 3-6. Marking Pipe. Every pipe shall have distinctly cast upon it the initials of the maker's name. When cast especially to order, each pipe larger than 4-inch may also have cast upon it figures showing the year in which it was cast and a number signifying the order in point of time in which it was cast, the figures denoting the year being above and the number below, thus:

1950	1950	1950
1	2	3

etc., also any initials, not exceeding four, which may be required by the purchaser. The letters and figures shall be cast on the outside and shall have dimensions as indicated below.

Diameters of Pipe, Inches, Inclusive	Height of Letter, Inches	Relief, Inch
4 to 10	¾	3/32
12 to 20	1¼	3/32
24 & larger	1¾	⅛

The weight and the class shall be conspicuously painted in white in the inside or outside of each pipe after the coating (if used) has become hard.

Section 3-7 Inspection by Purchaser.

(3-7.1) *Definition of Word "Purchaser."* Wherever the word "Purchaser" is used herein it shall be understood to mean the actual purchaser of the pipe or his authorized agents acting within the scope of the duties entrusted to them.

(3-7.2) *Power of Purchaser to Inspect.* The purchaser shall have free access at all times to all parts of any manufacturing plant which concern the manufacture of articles to be made for him. He may inspect the material, the pattern work, molding, and casting of the pipe, and the coating (if used). The forms, sizes, uniformity and conditions of all pipe herein referred to shall be subject to his inspection and approval, and he may reject, without subjection to hydrostatic test, any pipe which is not in conformity with the specifications or drawings. Any pipe rejected shall be marked "rejected" and any marks pertaining to the purchaser shall be chipped or erased from such pipe.

(3-7.3) *Manufacturer to Furnish Men and Material.* The manufacturer shall provide all tools, testing equipment, materials, labor and facilities necessary for the required testing, inspection and weighing of the pipe at the foundry.

(3-7.4) *Report of Purchaser's Inspection.* The purchaser shall make written report daily at the foundry office of all pipe rejected, noting causes for rejection.

Section 3-8. Inspection and Certification by Manufacturer. Should the purchaser have no inspector at the works, the manufacturer shall, if required by the purchaser, furnish a sworn statement that the inspection and all of the tests have been made as specified, this statement to contain the results of all specified tests.

Section 3-9. Pipe to be Delivered Sound. All the pipe must be delivered in all respects sound and comformable to these specifications. The inspection shall not relieve the manufacturer of any of his obligations in this respect, and any defective pipe which may have passed the purchaser at the works or elsewhere shall be at all times liable to rejection when discovered, until the final completion and adjustment of the contract; provided, however, that the manufacturer shall not be held liable for pipe found to be cracked after they have been accepted at the agreed point of delivery, unless there shall be unmistakable evidence that the casting was originally defective or damaged before acceptance. Care shall be taken in handling the pipe not to injure the coating (if used) and no pipe or other material of any kind shall be placed in the pipe during transportation.

Section 3-10. Cut Pipe. Defective spigot ends on pipe may be cut off in a manner which will produce a square end. Cut pipe shall be shipped with plain ends or shall have an iron or steel band shrunk into a groove or welded securely on the pipe, as may be agreed upon at time of purchase. Not more than 8 per cent of the total number of pipe of each size shall be cut, and no cut pipe shall be furnished which is less than 11 ft. 0 in. in laying length, unless it has been used by purchaser's order for strip and ring tests in which case a length of not less than 10 ft. 0 in. shall be accepted.

Section 3-11. Tolerances or Maximum Permitted Variations from Standard.

(3-11.1) *Tolerances in Diameter of Pipe and Sockets.* Outside diameters of pipe barrels and spigot beads and diameters of sockets shall be kept as nearly as practicable to the specified dimensions. They shall be tested with circular gauges. Tolerances or maximum permitted variations from standard dimensions are listed below.

Nominal Diameter in Inches	Tolerance, Plus or Minus in Inches
4 to 16	.06
20 & 24	.08
30, 36 & 42	.10
48	.12
54	.15
60	.15

(3-11.2) *Tolerances in Thickness.* The tolerances, or maximum permitted variations from standard in thickness of pipe and in dimensions of bells are listed below:

Nominal Diameter in Inches, inclusive	Tolerance, Plus or Minus, in Inches
4 to 8	.07
10 to 24	.08
30 to 60	.10

NOTE: In pipe barrel thickness, tolerances .02 inch greater than those listed above shall be permissible over areas not exceeding 8 inches in length in any direction.

(3-11.3) *Allowable Percentage of Variation in Weight.* The weight of no single pipe shall be less than the nominal tabulated weight by more than 5% for pipe 16 inches or less in diameter, and 4% for pipe more than 16 inches in diameter. The total excess weight to be paid for on orders of 25 tons or more shall not exceed 3% of the nominal weight, and on orders less than 25 tons shall not exceed 5% of the nominal weight. An order is hereby defined as including all the pipe ordered under the terms of a specific contract or purchase order or a single order placed under the terms of a standing contract.

Section 3-12. Cleaning and Inspecting. All pipe shall have gates, fins and other roughnesses chipped or ground off and shall be thoroughly cleaned, checked as to dimensions and also subjected to a careful surface inspection, a hammer test, and a rolling test, before the coating (if used) is applied.

Section 3-13. Hydrostatic Test. Each pipe shall be subjected to a hydrostatic proof test.

The pipe shall be under the test pressure for at least one-half minute, and while under pressure shall be subjected to a hammer or shock test. Any pipe showing defects by leaking, sweating, or otherwise, shall be rejected. The test pressures shall be in accordance with the table on the following page.

Section 3-14. Weighing. Each length of pipe shall be weighed and the weight and class plainly marked on the outside or inside of the bell or spigot end. Unless otherwise stated in the contract, a ton shall be 2,000 lb. avoirdupois.

Section 3-15. Exterior Coatings. Coating (if used) which is to be applied to the pipe, shall be specified in the agreement made at time of purchase.

Section 3-16. Tests of Material. The acceptability of iron used in cast iron pipe as regards physical characteristics shall be determined by the testing of bars cast from the same iron as the pipe, or, if specified by the purchaser, by the testing of Talbot strips and/or rings cut from the pipe as described in Sect. 3-18. Such strip and/or ring tests shall be paid for by the purchaser at prices to be agreed upon. By special arrangement bursting tests of pipe may be made as provided in Sect. 3-19. In any case the test bars shall be made and tested and results given to the purchaser if requested. The smallest pipe on which ring tests may be required is the 6-inch. The observations and the computed results hereinafter required shall be recorded and if requested reported to the purchaser.

TABLE OF PRESSURES FOR HYDROSTATIC TESTS

Nominal Diameter of Pipe, Inches	Barrel Thickness, Inches From	To	Test Pressures, Lb. per sq.in.
4 to 12	All Thicknesses		400
16	.58	.75	300
16	.76	.95	350
20	.66	.85	250
20	.86	1.05	350
24	.74	.90	200
24	.91	1.00	300
24	1.01	1.17	400
30	.87	1.05	200
30	1.06	1.30	300
30	1.31	1.39	400
36	.97	1.15	200
36	1.16	1.45	300
36	1.46	1.54	350
42	1.07	1.35	200
42	1.36	1.60	300
42	1.61	1.71	350
48	1.18	1.50	200
48	1.51	1.90	300

Note: Unless otherwise arranged between the manufacturer and the purchaser, pipe thicker than those listed in the above table shall be tested at the highest pressures listed for the given diameter.

Section 3-17. Test Bars.

(3-17.1) *Dimensions.* Test bars shall be 2 inches wide, 1 inch thick, and not less than 26 inches long. Individual test bars may vary as much as 2 per cent from standard width, or standard thickness, or both, but the patterns and molding practice shall be such that the errors shall in general not exceed 1 per cent.

(3-17.2) *Methods of Casting.* The bars shall be cast vertically in well-faced, dry sand molds provided with suitable pouring basin and mounted on a suitable refractory foundation. Metal for the bars shall be obtained by using a small heated ladle taking its metal from the

main ladle from which the pipe is to be poured and after all alloys and other additional metal, except cast iron pipe for cooling, have been added to the main ladle and become melted. The bars shall not be removed from the mold before they have cooled to 500° F.

(3-17.3) *When Cast and to What Pipe Applicable.* Except as hereinafter provided for special cases, one pair of test bars of the metal used shall be cast with iron from the first ladle, another pair with iron from the approximately middle ladle, and a third pair with iron from the last ladle of iron taken during a day's run or heat from the cupola in which the iron for the pipe is melted. If the heat lasts for more than 6 hours, then additional pairs of bars shall be cast at approximately uniform intervals so as to give an extra pair of bars for each 3 hours during which the heat lasts in excess of 6 hours. In case the charging of the cupola is to be changed one or more times during the day's run or heat in order to produce a different iron, the time of taking test bars shall be varied in such a way as to obtain representative tests of the iron at least at the beginning and end of each period during which the iron is intended to be constant in quality; and in case such period exceeds four hours additional pairs of bars shall be taken at such times as will provide a pair of bars for each two hours during which this special mixture is used. At least one bar from each pair shall be broken, but the manufacturer shall have the right to break both bars in which case the better bar shall be taken as representative. Bars showing flaws in fracture may be disregarded.

(3-17.4) *Test Bar Requirements to Indicate Acceptable Iron; Retests may be made at Contractor's Option using Talbot Strips and/or Rings.* In order that the iron shall be acceptable the average results from the single bars representing the respective pair of bars cast during the heat or period shall comply with the requirements hereinafter specified and, in addition, no representative bar shall be more than 5 percent below the minimum requirements in either corrected breaking load or corrected deflection. In case the test bars do not measure up to these requirements the manufacturer may make one or more Talbot strip tests and/or ring tests of specimens cut from such of the pipe as may be agreed upon as best representing the iron at the time when the deficient test bars were cast. In the absence of the purchaser the manufacturer may select the pipe from which rings and/or strips shall be cut. The results from these rings and/or strips shall be kept as a foundry record available to any purchaser who requires a report of tests on the 2-inch by 1-inch bars. Any Talbot strip tests or ring tests made under this provision shall be at the expense of the manufacturer. If these supplementary Talbot strip tests and/or ring tests do not meet the requirements, the pipe cast in that heat or period, or such a part thereof as may be agreed to by the purchaser, shall be rejected.

(3-17.5) *Method of Testing.* The bars shall be broken as beams by placing them flatwise on supports 24 inches apart and applying the load at the center of the span. The breaking load and the corresponding deflection shall be observed and recorded.

(3-17.6) *Correcting Observed Breaking Loads and Deflections.* The bars shall be measured at the point of application of the load and the results corrected to standard 2 inch by 1 inch cross section by the conventional beam formula as follows:

Corrected breaking load = observed breaking load multiplied by $\frac{2}{bd^2}$

Corrected deflection at breaking = observed deflection at breaking multiplied by d

where b = measured width and
d = measured depth
of the bar at point of application of load

In the formula above the deflection and all dimensions are in inches.

(3-17.7) *Requirements as to Strength and Deflection of 2 inch by 1 inch Bars.* In order to indicate acceptable metal, the corrected breaking loads and deflections of the representative 2 inch by 1 inch test bars for a given heat or period interpreted as provided in paragraph 3-17.4 above, shall comply with such of the following tabulated requirements as pertain to the thickness range within which fall the particular pipes which are under consideration.

TABLE OF MINIMUM CORRECTED BREAKING LOADS & DEFLECTIONS

Metal Thickness of Pipe, Inches	Minimum Center Breaking Load, Pounds	Minimum Center Deflection at Breaking, Inch
Below .61	1900	.30 + .0001 (Breaking Load — 1900)
.61 to .90	2000	.30 + .0001 (Breaking Load — 2000)
.91 to 1.60	2200	.30 + .0001 (Breaking Load — 2200)
1.61 to 2.50	2300	.30 + .0001 (Breaking Load — 2300)

Note: For thicknesses exceeding 2.50 inches the form of test specimen and the test requirements shall be as agreed upon in the purchase contract.

Section 3-18. Talbot Strip Tests and Ring Tests.

(3-18.1) *Dimensions.* Rings shall have a length equal to half the nominal diameter of the pipe unless the diameter exceeds 24 inches, in which case the length of ring shall be 12 inches. Strips shall be not less than 11 inches long and for 24-inch and larger pipe may be cut from the least stressed portions of rings (see Sect. 3-18.4) after the rings have been broken. The end 2 inches of the pipe shall not be included in ring or strip.

Note: To make both ring and strip tests on a pipe will therefore require at the least (on 6 inch pipe) 16 inches of pipe, at the most (on 20 inch pipe) 23 inches of pipe, and on pipe larger than 20 inches, 14 inches of pipe.

(3-18.2) *Method of Sampling.* The purchaser who has expressly specified Talbot strip tests and/or ring tests as acceptance tests of the pipe may select at random from each run, or heat, one or more pipe from which test specimens are to be cut. In the absence of the purchaser or his representative, the pipe from which test specimens are to be taken may be selected by the manufacturer. If the purchaser should wish to test the uniformity of a run or heat, he may divide it into two or more periods and have a separate set of acceptance tests for pipe in each period.

(3-18.3) *Defective Specimens; Retests.* If any test specimen shows defective machining or obvious lack of continuity of metal, it shall be discarded and replaced by another specimen selected by the purchaser. If the test specimens first selected fail to meet the requirements specified hereinafter and the purchaser permits a retest, at least twice the number of specimens that failed shall be selected by the purchaser for retest from a pipe cast in the same run or period. In case a ring from a pipe 24 inches in diameter or larger fails to meet specifications, the purchaser may accept strip tests, two specimens to be cut from the failed ring at points of low stress as described in Sect. 3-18.4. In any case of retest the pipe cast during the run or period shall be acceptable only when all retest specimens meet the requirements. All retests shall be made at the expense of the manufacturer.

(3-18.4) *Talbot Strip Tests.* Two Talbot strips shall be machined longitudinally from each pipe selected by the purchaser for testing by this method. If ring tests are also made and the pipe are 24 inches or larger these Talbot strips may be cut from a part of the ring little stressed in the ring test, i.e., near one of the elements marked (a) in

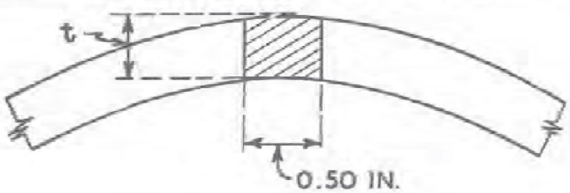


FIG. 3.1. Position from which Talbot Strip Is Cut

Fig. 3.2. (See Sect. 3-18.5.) The strips in any case will be in cross section as indicated in Fig. 3.1, i.e., will have for their width the thickness of the pipe and for their thickness 0.50 inch. Their length will be the length of the ring, 12 inches; or, if not cut from a ring, at least 11 inches. These strips shall be tested as a beam on supports 10 inches apart with loads applied perpendicularly to the machined faces at two points $3\frac{1}{3}$ inches from the supports. The breaking load and the corresponding deflection shall be observed and recorded.

The strip shall be accurately calipered at point of rupture and the modulus of rupture, R, shall be calculated by the usual beam formula which for this case reduces to the expression:

$$R = \frac{10W}{td^2}$$

The secant modulus of elasticity, E_s, in lb. per sq.in. shall be computed by the formula:

$$E_s = \frac{213W}{td^3y} = \frac{21.3R}{dy}$$

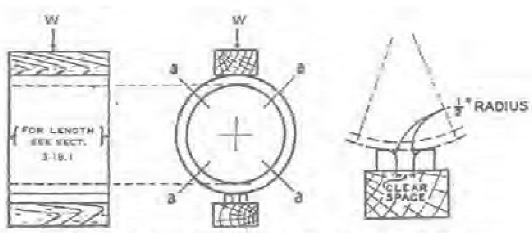


FIG. 3.2. Assembly for Ring Test

where R = modulus of rupture, lb. per sq.in.
E_s = secant modulus of elasticity, lb. per sq.in.
W = breaking load, lb.
d = depth of strip in inches (intended to be 0.50 in.)
t = width of strip, inches (pipe thickness)
y = deflection of strip at center at breaking load, inches.

To be acceptable a Talbot strip shall have the modulus of rupture, R, not less than 30,000 lb. per sq.in. and the secant modulus of elasticity, E_s, not more than 10,000,000 lb. per sq.in. If the results from either strip are up to the specifications the test shall be regarded as satisfactory.

(3-18.5) *Ring Tests.* Each ring shall be tested by the three-edge-bearing method as indicated in Fig. 3.2. The lower bearing for the ring shall consist of two strips with vertical sides having their interior top corners rounded to a radius of approximately ½ inch. The strips shall be of hard wood or of metal. If of metal a piece of leather belting about 3/16 inch thick shall be laid over them. They shall be straight and shall be securely fastened to a rigid block with their interior vertical faces spaced at a distance apart as given in the following table:

Diam. of Pipe	Clear Space
12-inch and smaller	½ inch
16-inch to 24-inch inclusive	1 inch
30-inch and larger	2 inch

The upper bearing shall be a rigid wooden block, straight and true from end to end. The upper and lower bearings shall extend the full length of the outside of the ring. The ring shall be placed symmetrically between the two bearings, and the center of application of the load shall be so placed that the vertical deformations at the two ends of the ring shall be equal. If the ring is not uniform in thickness, it shall be so placed that the thick and thin portions are near the ends of the horizontal diameter. A record of the breaking load and the corresponding vertical deformation of each ring tested shall be made. In order to be acceptable the modulus of rupture computed from the formula

$$R = 0.954\,\frac{W(d+t)}{bt^2}$$

shall be not less than 31,000 lb. per sq. in., and the secant modulus of elasticity computed from the formula which follows on page 116.

$$E_s = \frac{0.225\,W(d+t)^3}{bt^3y} - \frac{0.236\,R(d+t)^2}{ty}$$

shall not exceed 15,000,000 lb. per sq.in.

b = length of ring, inches
d = average inside diameter of ring, inches
t = average thickness of metal along line of fracture, inches
y = maximum vertical deflection of ring, inches
W = breaking load, in lb.
R = modulus of rupture, lb. per sq.in.
E_s = secant modulus of elasticity, lb. per sq.in.

The modulus of elasticity shall not be determined in rings from pipe less than 12 inches in diameter.

Section 3-19. Full-Length Bursting Tests.

By special arrangement between purchaser and manufacturer, the bursting tensile strength shall be determined by testing full length pipe (less amount cut off for ring and strip test specimens, see Section 3-18.1 and 3-18.2) to destruction by hydraulic pressure. Bells may be removed to facilitate testing. A suitable means for holding the end thrust shall be used which will not subject the pipe to endwise tension or compression, or other parasitic stresses. A calibrated pressure gauge shall be used for determining the bursting pressure. This gauge shall be connected to the interior of the test pipe by a separate connection from that which supplies water for the test. Unit tensile strength in bursting shall be obtained by the use of the formula:

$$S = \frac{Pd}{2t}$$

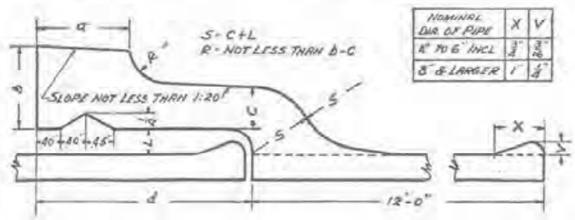
Where: S = bursting tensile strength of the iron, lbs. per sq.in.
P = internal pressure at bursting, lbs. per sq.in.
d = average inside diameter of pipe, inches
t = minimum average thickness of the pipe along the principal line of break, inches

Measurements of thickness shall be taken along the principal line of break at one foot intervals.

The minimum average thickness along the principal line of break shall be obtained by averaging the measurements at the thinnest section at a weight of two and at the adjacent sections on each side at a weight of one each or if the thinnest section is at the end of the break, by averaging this thinnest section measurement at a weight of two and the measurements of the adjacent section and the next section at a weight of one each.

Table No. 3.1

STANDARD DIMENSIONS OF BELLS, SOCKETS, SPIGOT BEADS and OUTSIDE DIAMETERS of PIT CAST PIPE FOR GAS also WEIGHTS OF BELLS AND OF SPIGOT BEADS



Nominal Diam.	Thickness of Pipe From	Thickness of Pipe To	Outside Diam. of Pipe	Dimensions of Bells: Diam. of Socket	Thickness of Joint L	Depth of Socket d	a	b	c	Wt. of Bell	Wt. of Spigot Bead
4	.40	.50	4.80	5.80	0.50	3.50	1.50	1.30	.65	25.0	0.3
6	.42	.53	6.90	7.90	0.50	3.50	1.50	1.40	.70	35.0	0.5
8	.46	.63	9.05	10.05	0.50	4.00	1.50	1.53	.78	52.0	1.1
10	.50	.60	11.10	12.10	0.50	4.00	1.50	1.50	.69	58.0	1.4
	.61	.65	11.10	12.10	0.50	4.00	1.50	1.65	.85	69.0	1.4
12	.54	.65	13.20	14.20	0.50	4.00	1.50	1.50	.70	66.0	1.6
	.66	.79	13.20	14.20	0.50	4.00	1.50	1.75	.90	84.0	1.6
16	.58	.67	17.40	18.66	0.63	4.00	1.75	1.67	.77	106.0	2.1
	.68	.85	17.40	18.66	0.63	4.00	1.75	1.90	1.00	128.0	2.1
20	.66	.82	21.60	22.86	0.63	4.00	1.75	1.87	0.87	146.0	2.6
	.83	.97	21.60	22.86	0.63	4.00	1.75	2.30	1.15	196.0	2.6
24	.74	.85	25.80	27.06	0.63	4.00	2.00	1.97	0.92	188.0	3.2
	.86	1.00	25.80	27.06	0.63	4.00	2.00	2.50	1.25	265.0	3.2
30	.87	1.01	31.74	33.00	0.63	4.50	2.00	2.30	1.15	309.0	3.9
	1.02	1.19	31.74	33.00	0.63	4.50	2.00	2.60	1.32	376.0	3.9
36	.97	1.12	37.96	39.22	0.63	4.50	2.00	2.50	1.26	419.0	4.6
	1.13	1.32	37.96	39.22	0.63	4.50	2.00	2.80	1.44	459.0	4.6
42	1.07	1.30	44.20	45.46	0.63	5.00	2.00	2.80	1.40	538.0	5.4
	1.31	1.46	44.20	45.46	0.63	5.00	2.00	3.02	1.52	609.0	5.4
48	1.18	1.30	50.50	51.76	0.63	5.00	2.00	3.00	1.50	657.0	6.1
	1.31	1.50	50.50	51.76	0.63	5.00	2.00	3.32	1.67	774.0	6.1
	1.51	1.60	50.50	51.76	0.63	5.00	2.00	3.80	1.95	890.0	6.1

All dimensions given in inches. All weights given in pounds.

Table No. 3.2

STANDARD THICKNESSES, DIAMETERS AND WEIGHTS OF PIT CAST PIPE FOR GAS

Dimensions in Inches — Weights in Pounds

Nominal Diam.	Thickness Class	Thickness	Outside Diam.	Inside Diam.	Wt. of Barrel Per Ft.	Wt. of Bead	Wt. of Bell	Wt. Based on 12 Ft. Length* Per Length	Wt. Based on 12 Ft. Length* Avg. Per Ft.
1	2	3	4	5	6	7	8	9	10
4	1	.40	4.80	4.00	17.3	0.3	25.0	235	19.6
	2	.43	4.80	3.94	18.4	0.3	25.0	245	20.4
	3	.46	4.80	3.88	19.6	0.3	25.0	260	21.7
	4	.50	4.80	3.80	21.1	0.3	25.0	280	23.3
6	1	.43	6.90	6.04	27.3	0.5	35.0	365	30.4
	2	.46	6.90	5.98	29.0	0.5	35.0	385	32.1
	3	.50	6.90	5.90	31.4	0.5	35.0	410	34.2
	4	.54	6.90	5.82	33.7	0.5	35.0	440	36.7
	5	.58	6.90	5.74	35.9	0.6	35.0	465	38.8
8	1	.46	9.05	8.13	38.7	1.1	52.0	520	43.3
	2	.50	9.05	8.05	41.9	1.1	52.0	555	46.2
	3	.54	9.05	7.97	45.0	1.1	52.0	595	49.6
	4	.58	9.05	7.89	48.2	1.1	52.0	630	52.5
	5	.63	9.05	7.79	52.0	1.1	52.0	675	56.2
10	1	.50	11.10	10.10	52.0	1.4	58.0	685	57.1
	2	.54	11.10	10.02	55.9	1.4	58.0	730	60.8
	3	.58	11.10	9.94	59.8	1.4	58.0	775	64.6
	4	.63	11.10	9.84	64.7	1.4	69.0	845	70.4
	5	.68	11.10	9.74	69.5	1.4	69.0	905	75.4
12	1	.54	13.20	12.12	67.0	1.6	66.0	870	72.5
	2	.58	13.20	12.04	71.8	1.6	66.0	930	77.5
	3	.63	13.20	11.94	77.6	1.6	66.0	1000	83.3
	4	.68	13.20	11.84	83.4	1.6	84.0	1085	90.4
	5	.73	13.20	11.74	89.2	1.6	84.0	1155	96.2
	6	.79	13.20	11.62	96.1	1.6	84.0	1240	103.3
16	1	.58	17.40	16.24	93.6	2.1	106.0	1255	104.6
	2	.63	17.40	16.14	102.6	2.1	106.0	1350	112.5
	3	.68	17.40	16.04	111.4	2.1	128.0	1465	122.1
	4	.73	17.40	15.94	119.3	2.1	128.0	1560	130.0
	5	.79	17.40	15.82	128.8	2.1	128.0	1675	139.6
	6	.85	17.40	15.70	137.9	2.1	128.0	1785	148.8
20	1	.66	21.60	20.28	135.5	2.6	146.0	1775	147.9
	2	.71	21.60	20.18	145.4	2.6	146.0	1895	157.9
	3	.77	21.60	20.06	157.2	2.6	146.0	2035	169.6
	4	.83	21.60	19.94	169.0	2.6	196.0	2225	185.4
	5	.90	21.60	19.80	182.8	2.6	196.0	2390	199.2
	6	.97	21.60	19.66	196.1	2.6	196.0	2550	212.5
24	1	.74	25.80	24.32	181.8	3.2	188.0	2375	197.9
	2	.80	25.80	24.20	196.0	3.2	188.0	2545	212.1
	3	.86	25.80	24.08	210.2	3.2	265.0	2790	232.5
	4	.93	25.80	23.94	226.7	3.2	265.0	2990	249.2
	5	1.00	25.80	23.80	243.1	3.2	265.0	3185	265.4
30	1	.87	31.74	30.00	263.3	3.9	309.0	3470	289.2
	2	.94	31.74	29.86	283.8	3.9	309.0	3720	310.0
	3	1.02	31.74	29.70	307.1	3.9	376.0	4065	338.8
	4	1.10	31.74	29.54	330.4	3.9	376.0	4345	362.1
	5	1.19	31.74	29.36	355.3	3.9	376.0	4655	387.9
36	1	.97	37.96	36.02	351.7	4.6	419.0	4645	387.1
	2	1.05	37.96	35.86	379.9	4.6	419.0	4980	415.0
	3	1.13	37.96	35.70	407.9	4.6	459.0	5360	446.7
	4	1.22	37.96	35.52	439.3	4.6	459.0	5735	477.9
	5	1.32	37.96	35.32	474.1	4.6	459.0	6155	512.9
42	1	1.07	44.20	42.06	452.3	5.4	538.0	5970	497.5
	2	1.16	44.20	41.88	489.4	5.4	538.0	6415	534.6
	3	1.25	44.20	41.70	526.2	5.4	538.0	6860	571.7
	4	1.35	44.20	41.50	567.0	5.4	609.0	7420	618.3
	5	1.46	44.20	41.28	611.6	5.4	609.0	7955	662.9
48	1	1.18	50.50	48.14	570.4	6.1	657.0	7510	625.8
	2	1.27	50.50	47.96	612.8	6.1	657.0	8015	667.9
	3	1.37	50.50	47.76	659.7	6.1	774.0	8695	724.6
	4	1.48	50.50	47.54	711.1	6.1	774.0	9315	776.2
	5	1.60	50.30	47.30	766.9	6.1	890.0	10100	841.7

*Includes Bell and Spigot Bead. Calculated weight of pipe rounded off to nearest 5 pounds.

Table No. 3.3

STANDARD THICKNESSES AND WEIGHTS OF CAST IRON PIT CAST PIPE FOR GAS

NOTE: These weights are for pipe laid without blocks, on flat bottom trench, with tamped backfill, under 5 feet of cover. For other conditions see Table 3.2 and 3.4 hereof and the Manual.

Size Inches	CLASS 10 — 10 Lb. Pressure Thickness Inches	CLASS 10 Wt. Based on 12 Ft. Length* Avg. Per Foot	CLASS 10 Wt. Based on 12 Ft. Length* Per Length	CLASS 50 — 50 Lb. Pressure Thickness Inches	CLASS 50 Wt. Based on 12 Ft. Length* Avg. Per Foot	CLASS 50 Wt. Based on 12 Ft. Length* Per Length	CLASS 100 — 100 Lb. Pressure Thickness Inches	CLASS 100 Wt. Based on 12 Ft. Length* Avg. Per Foot	CLASS 100 Wt. Based on 12 Ft. Length* Per Length	CLASS 150 — 150 Lb. Pressure Thickness Inches	CLASS 150 Wt. Based on 12 Ft. Length* Avg. Per Foot	CLASS 150 Wt. Based on 12 Ft. Length* Per Length
4	.40	19.6	235	.40	19.6	235	.40	19.6	235	.40	19.6	235
6	.43	30.4	365	.43	30.4	365	.43	30.4	365	.43	30.4	365
8	.46	43.3	520	.46	43.3	520	.46	43.3	520	.46	43.3	520
10	.50	57.1	685	.50	57.1	685	.50	57.1	685	.50	57.1	685
12	.54	72.5	870	.54	72.5	870	.54	72.5	870	.54	72.5	670
16	.58	104.6	1255	.58	104.6	1255	.58	104.6	1255			
20	.66	147.9	1775	.66	147.9	1775	.71	157.9	1895			
24	.74	197.9	2375	.74	197.9	2375	.80	212.1	2545			
30	.87	289.2	3470	.87	289.2	3470						
36	.97	387.1	4645	.97	387.1	4645						
42	1.07	497.5	5970	1.07	497.5	5970						
48	1.18	625.8	7510	1.18	625.8	7510						

*Including Bell and Spigot Bead. Calculated weight of Pipe rounded off to nearest 5 pounds

Table No. 3.4

STANDARD THICKNESSES OF CAST IRON PIT CAST PIPE FOR GAS

Thickness in Inches. Working Pressure in Pounds per Square Inch.
Thicknesses Include Allowances for Foundry Practice and Corrosion

Laying Condition A—Flat Bottom Trench, Without Blocks, Untamped Backfill
Laying Condition B—Flat Bottom Trench, Without Blocks, Tamped Backfill
Laying Condition C—Pipe Laid on Blocks, Untamped Backfill
Laying Condition D—Pipe Laid on Blocks, Tamped Backfill

Size Inches	Working Pressure	3½ FEET OF COVER Laying Condition				5 FEET OF COVER Laying Condition				8 FEET OF COVER Laying Condition			
		A	B	C	D	A	B	C	D	A	B	C	D
4	10	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.46	.40
	50	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.50	.40
	100	.40	.40	.40	.40	.40	.40	.43	.40	.40	.40	.50	.40
	150	.40	.40	.40	.40	.40	.40	.43	.40	.40	.40	.50	.40
6	10	.43	.43	.46	.43	.43	.43	.50	.43	.43	.43	.54	.43
	50	.43	.43	.46	.43	.43	.43	.50	.43	.43	.43	.54	.43
	100	.43	.43	.46	.43	.43	.43	.50	.43	.43	.43	.58	.43
	150	.43	.43	.50	.43	.43	.43	.50	.43	.43	.43	.58	.43
8	10	.46	.46	.50	.46	.46	.46	.54	.46	.46	.46	.58	.46
	50	.46	.46	.54	.46	.46	.46	.54	.46	.46	.46	.63	.46
	100	.46	.46	.54	.46	.46	.46	.58	.46	.46	.46	.63	.46
	150	.46	.46	.54	.46	.46	.46	.58	.46	.46	.46	.63	.46
10	10	.50	.50	.54	.50	.50	.50	.58	.50	.50	.50	.68	.50
	50	.50	.50	.58	.50	.50	.50	.58	.50	.50	.50	.68	.54
	100	.50	.50	.58	.50	.50	.50	.63	.50	.54	.50	.68	.54
	150	.50	.50	.58	.50	.50	.50	.63	.50	.54	.50	.68	.58
12	10	.54	.54	.58	.54	.54	.54	.63	.54	.54	.54	.68	.58
	50	.54	.54	.58	.54	.54	.54	.63	.54	.58	.54	.73	.58
	100	.54	.54	.63	.54	.54	.54	.63	.54	.58	.58	.73	.58
	150	.54	.54	.63	.58	.58	.54	.68	.58	.63	.58	.79	.63
16	10	.58	.58	.68	.58	.58	.58	.68	.63	.68	.63	.79	.68
	50	.58	.58	.68	.63	.63	.58	.73	.63	.68	.63	.79	.73
	100	.63	.58	.73	.63	.63	.58	.73	.68	.73	.68	.85	.73
20	10	.66	.66	.77	.71	.71	.66	.83	.71	.77	.71	.90	.83
	50	.71	.66	.77	.71	.71	.66	.83	.77	.77	.71	.90	.83
	100	.71	.66	.83	.77	.77	.71	.83	.77	.83	.77	.97	.83
24	10	.74	.74	.80	.74	.80	.74	.86	.80	.86	.80	.93	.86
	50	.80	.74	.86	.80	.80	.74	.93	.86	.86	.80	1.00	.93
	100	.80	.74	.93	.86	.86	.80	.93	.86	.93	.86	1.00	.93
30	10	.87	.87	.94	.87	.94	.87	1.02	.94	1.02	.87	1.10	1.02
	50	.94	.87	1.02	.94	.94	.87	1.10	1.02	1.10	.94	1.10	1.10
36	10	1.05	.97	1.05	.97	1.05	.97	1.13	1.05	1.13	.97	1.22	1.13
	50	1.05	.97	1.13	1.05	1.13	.97	1.22	1.13	1.22	1.05	1.32	1.22
42	10	1.16	1.07	1.16	1.07	1.16	1.07	1.25	1.16	1.35	1.07	1.35	1.25
	50	1.16	1.07	1.25	1.16	1.25	1.07	1.35	1.25	1.35	1.16	1.46	1.35
48	10	1.27	1.18	1.37	1.18	1.37	1.18	1.37	1.27	1.48	1.18	1.60	1.37
	50	1.27	1.18	1.37	1.27	1.37	1.18	1.48	1.37	1.48	1.27	1.60	1.48

ATTACHMENT I

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Daily Summary
November 2021

Generated on 06/23/2022

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	Temperature (F)							Degree Days (base 65F)		Sun (LST)		Weather	Precipitation (in)			Pressure (inHg)		Wind	Maximum Wind Speed = MPH, Direction = Degrees			
	Max	Min	Avg	Dep	ARH	ADP	AWB	Heat	Cool	Rise	Set	Weather Type	TLC	Snow Fall	Snow Depth	Avg Stn	Avg SL	Avg Speed	Peak Speed	Peak Dir	Sust. Speed	Sust. Dir
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01	60	48	54	1.4	57	38	47	11	0	0630	1659		0.00	0.0	0	30.03	30.10	10.6	25	290	18	320
02	53	41	47	-5.3	72	38	43	18	0	0631	1658	RA	0.02	0.0	0	30.19	30.23	7.0	21	300	16	300
03	53	37	45	-7.0	59	31	39	20	0	0632	1657		0.00	0.0	0	30.24	30.28	7.4	22	290	17	320
04	53	36	45	-6.7	57	29	38	20	0	0633	1656		0.00	0.0	0	30.29	30.31	5.0	20	350	10	350
05	54	35	45	-6.4	55	28	37	20	0	0634	1655		0.00	0.0	0	30.30	30.35	6.5	23	360	16	030
06	57	34	46	-5.1	60	31	39	19	0	0635	1653		0.00	0.0	0	30.35	30.36	5.9	17	040	14	080
07	55	37	46	-4.8	57	31	40	19	0	0636	1652		0.00	0.0	0	30.16	30.18	5.0	20	030	13	020
08	67	40	54	3.5	56	38	47	11	0	0638	1651		0.00	0.0	0	30.10	30.14	5.6	23	360	16	030
09	71	44	58	7.8	65	43	50	7	0	0639	1650		0.00	0.0	0	30.08	30.10	5.6	19	230	15	240
10	68	47	58	8.1	60	43	50	7	0	0640	1649		0.00	0.0	0	30.06	30.11	6.0	25	340	20	340
11	67	42	55	5.5	69	44	49	10	0	0641	1648		0.00	0.0	0	30.19	30.21	6.7	22	100	17	110
12	68	45	57	7.8	73	50	55	8	0	0642	1648	RA BR	0.15	0.0	0	29.93	29.94	10.3	31	140	24	230
13	62	40	51	2.1	71	38	43	14	0	0643	1647	RA	T	0.0	0	29.79	29.84	10.6	47	290	36	280
14	49	37	43	-5.6	64	31	38	22	0	0644	1646	RA	0.01	0.0	0	29.90	29.91	8.9	26	230	22	230
15	49	38	44	-4.2	60	30	38	21	0	0646	1645	RA	T	0.0	0	29.85	29.91	13.5	36	270	26	270
16	50	34	42	-5.9	59	27	36	23	0	0647	1644		0.00	0.0	0	30.13	30.19	7.9	23	270	18	260
17	66	30	48	0.5	74	40	45	17	0	0648	1644		0.00	0.0	0	30.21	30.22	4.7	24	180	15	190
18	73*	47	60	12.8	64	47	53	5	0	0649	1643	RA	0.07	0.0	0	29.99	30.02	10.8	38	310	26	310
19	49	37	43	-3.9	44	24	37	22	0	0650	1642	RA	T	0.0	0	30.24	30.32	13.3	34	310	26	300
20	49	32	41	-5.5	62	29	37	24	0	0651	1641		0.00	0.0	0	30.49	30.51	3.7	15	190	12	200
21	54	39	47	0.8	74	40	44	18	0	0652	1641	RA	T	0.0	0	30.23	30.22	3.4	14	200	10	180
22	54	38	46	0.2	62	35	43	19	0	0653	1640	RA BR	0.05	0.0	0	29.87	29.91	10.2	26	320	21	320
23	46	33	40	-5.4	44	18	32	25	0	0655	1640		0.00	0.0	0	30.03	30.09	11.5	33	340	25	340
24	49	29*	39	-6.1	50	22	33	26	0	0656	1639		0.00	0.0	0	30.29	30.33	6.3	19	320	15	320
25	57	35	46	1.3	55	30	39	19	0	0657	1639	RA	T	0.0	0	30.05	30.04	6.4	14	250	12	240
26	50	40	45	0.7	58	30	39	20	0	0658	1638	RA BR	0.16	0.0	0	29.72	29.75	16.1	42	290	32	280
27	43	38	41	-3.0	44	19	32	24	0	0659	1638		0.00	0.0	0	29.88	29.94	13.7	30	290	24	300
28	53	37	45	1.4	58	29	37	20	0	0700	1638	RA	T	0.0	0	29.85	29.86	3.9	17	320	13	020
29	46	34	40	-3.2	51	24	34	25	0	0701	1637	RA	T	0.0	0	29.90	29.95	11.1	30	340	22	320
30	45	30	38	-4.9	58	27	35	27	0	0702	1637		T	0.0	0	29.98	30.01	5.9	19	210	12	230
	55.7	37.8	46.8									**Monthly Averages | Totals**	0.46			30.08	30.11	8.1				
	-0.3	-1.4	-0.8									**Departure from Normal (1981-2010)**	-2.53									

Degree Days	Monthly Total	Monthly Departure	Season-to-date Total	Season-to-date Departure
Heating	548	25	645	
Cooling	0	-1	1548	

Number of days with...	Temperature Max >=90°	Temperature Max <=32°	Temperature Min <=32°	Temperature Min <=0°	Precipitation >=0.01"	Precipitation >=0.1"	Snow >=1"	Weather T-Storms	Weather Heavy Fog
	0	0	4	0	6	2	0		

Date of 5-sec to 3-sec wind equipment change
2009-07-30

Sea Level Pressure		Date	Time
Maximum	30.59	20	0954
Minimum	29.68	13	1254

Greatest...	24-Hr... Precip	24-Hr... Snowfall	Snow Depth
	0.16	0.0	0.0
Date	26-26		

Station Augmentation

Name:PHILADELPHIA CENTER CITY, PA Lat: 39.96056 Lon: -75.14263 Elevation: N/A Distance: N/A Elements: SNOW Equipment: N/A

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Hourly Observations
November 2021

Generated on 06/23/2022

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	Time (LST)	Station Type	Sky Conditions	Visibility	Weather Type (see documentation) AU | AW | MW	Dry Bulb Temp (F)	Dry Bulb Temp (C)	Wet Bulb Temp (F)	Wet Bulb Temp (C)	Dew Point Temp (F)	Dew Point Temp (C)	Rel Hum %	Wind Speed (MPH)	Wind Dir (Deg)	Wind Gusts (MPH)	Station Press (inHg)	Press. Tend	Net 3-Hr Change (inHg)	Sea Level Press. (inHg)	Report Type	Precip Total (in)	Altimeter Setting (inHg)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
27	0054	7	FEW:02 55	10.00		39	3.9	33	0.6	23	-5.0	53	14	290	21	29.78	3	-0.01	29.81	FM-15	0.00	29.81
27	0100	4	57	9.94		39	3.9	33	0.6	23	-5.0	53	14	290		29.75	3	-0.01	29.81	FM-12		
27	0154	7	BKN:07 48	10.00		39	3.9	33	0.6	22	-5.6	50	16	280		29.81			29.83	FM-15	0.00	29.84
27	0254	7	BKN:07 50	10.00		39	3.9	32	0.0	21	-6.1	48	17	270	24	29.82			29.85	FM-15	0.00	29.85
27	0354	7	BKN:07 48	10.00		39	3.9	32	0.0	20	-6.7	46	14	290		29.83	1	-0.05	29.86	FM-15	0.00	29.86
27	0454	7	BKN:07 47	10.00		38	3.3	31	-0.6	18	-7.8	44	18	300	26	29.85			29.88	FM-15	0.00	29.88
27	0554	7	BKN:07 45	10.00		38	3.3	31	-0.6	18	-7.8	44	17	290	23	29.88			29.91	FM-15	0.00	29.91
27	0654	7	BKN:07 44	10.00		38	3.3	31	-0.6	18	-7.8	44	15	280	28	29.90	3	-0.07	29.93	FM-15	0.00	29.93
27	0700	4	41	9.94		38	3.3	31	-0.6	18	-7.8	44	15	280		29.86	3	-0.07	29.93	FM-12		
27	0754	7	BKN:07 44	10.00		38	3.3	31	-0.6	18	-7.8	44	16	310		29.92			29.95	FM-15	0.00	29.95
27	0854	7	BKN:07 45	10.00		38	3.3	31	-0.6	17	-8.3	43	14	310		29.94			29.96	FM-15	0.00	29.97
27	0954	7	BKN:07 46	10.00		39	3.9	31	-0.6	17	-8.3	41	21	290	29	29.95	1	-0.04	29.97	FM-15	0.00	29.98
27	1054	7	BKN:07 49	10.00		40	4.4	32	0.0	17	-8.3	40	21	320	28	29.94			29.97	FM-15	0.00	29.97
27	1154	7	BKN:07 49	10.00		41	5.0	33	0.6	18	-7.8	39	18	320	26	29.93			29.96	FM-15	0.00	29.96
27	1254	7	BKN:07 50 BKN:07 260	10.00		42	5.6	33	0.6	18	-7.8	38	17	290	25	29.91	8	+0.03	29.94	FM-15	0.00	29.94
27	1300	4	57	9.94		42	5.6	33	0.6	18	-7.8	38	17	290		29.88	8	+0.03	29.94	FM-12		
27	1354	7	SCT:04 50 BKN:07 260	10.00		42	5.6	33	0.6	17	-8.3	36	18	280		29.92			29.94	FM-15	0.00	29.95
27	1454	7	FEW:02 50 BKN:07 260	10.00		41	5.0	33	0.6	18	-7.8	39	14	310		29.91			29.94	FM-15	0.00	29.94
27	1554	7	FEW:02 50 BKN:07 260	10.00		40	4.4	32	0.0	18	-7.8	41	13	280		29.93	3	-0.01	29.96	FM-15	0.00	29.96
27	1654	7	FEW:02 50 BKN:07 260	10.00		39	3.9	32	0.0	19	-7.2	45	13	290		29.93			29.96	FM-15	0.00	29.96
27	1754	7	FEW:02 100 BKN:07 260	10.00		39	3.9	32	0.0	19	-7.2	45	7	290		29.94			29.96	FM-15	0.00	29.97
27	1854	7	BKN:07 140 BKN:07 260	10.00		39	3.9	32	0.0	19	-7.2	45	9	270		29.96	3	-0.03	29.98	FM-15	0.00	29.99
27	1900	4		9.94		39	3.9	32	0.0	19	-7.2	45	9	270		29.93	3	-0.03	29.98	FM-12		
27	1954	7	FEW:02 120 BKN:07 160 BKN:07 250	10.00		39	3.9	32	0.0	19	-7.2	45	8	280		29.95			29.98	FM-15	0.00	29.98
27	2054	7	FEW:02 120 BKN:07 160 BKN:07 250	10.00		38	3.3	32	0.0	20	-6.7	48	7	250		29.95			29.98	FM-15	0.00	29.98
27	2154	7	BKN:07 85 OVC:08 100	10.00		39	3.9	32	0.0	21	-6.1	48	8	250		29.95	6	+0.01	29.98	FM-15	0.00	29.98
27	2254	7	BKN:07 85 OVC:08 100	10.00		38	3.3	32	0.0	22	-5.6	52	7	200		29.95			29.97	FM-15	0.00	29.98
27	2338	7	BKN:07 85 OVC:08 100	10.00		39	3.9	33	0.6	22	-5.6	50	5	210		29.94				FM-16		29.97
27	2354	7	BKN:07 55 OVC:08 70	10.00		39	3.9	32	0.0	21	-6.1	48	7	230		29.94			29.97	FM-15	0.00	29.97

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National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	Time (LST)	Remarks
27	0054	MET12111/27/21 00:54:02 METAR KPHL 270554Z 29012G18KT 10SM FEW055 04/M05 A2981 RMK AO2 SLP094 T00391050 10050 20039 53005 (DKH)
27	0100	SYN08672408 32766 22912 10039 21050 30073 40094 53005 90554 333 10083 20039 91018 555 92706=
27	0154	MET10011/27/21 01:54:02 METAR KPHL 270654Z 28014KT 10SM BKN048 04/M06 A2984 RMK AO2 SLP103 T00391056 (DKH)
27	0254	MET10311/27/21 02:54:02 METAR KPHL 270754Z 27015G21KT 10SM BKN050 04/M06 A2985 RMK AO2 SLP107 T00391061 (DKH)
27	0354	MET10611/27/21 03:54:02 METAR KPHL 270854Z 29012KT 10SM BKN048 04/M07 A2986 RMK AO2 SLP112 T00391067 51018 (DKH)
27	0454	MET12111/27/21 04:54:02 METAR KPHL 270954Z 30016G23KT 10SM BKN047 03/M08 A2988 RMK AO2 PK WND 29026/0907 SLP119 T00331078 (DKH)
27	0554	MET10311/27/21 05:54:02 METAR KPHL 271054Z 29015G20KT 10SM BKN045 03/M08 A2991 RMK AO2 SLP127 T00331078 (SDK)
27	0654	MET12711/27/21 06:54:02 METAR KPHL 271154Z 28013G24KT 10SM BKN044 03/M08 A2993 RMK AO2 SLP136 70001 T00331078 10039 20033 53024 (SDK)
27	0700	SYN09272408 32666 62813 10033 21078 30113 40136 53024 91154 333 10100 20033 70003 91024 555 92712=
27	0754	MET10011/27/21 07:54:02 METAR KPHL 271254Z 31014KT 10SM BKN044 03/M08 A2995 RMK AO2 SLP142 T00331078 (SDK)
27	0854	MET10011/27/21 08:54:02 METAR KPHL 271354Z 31012KT 10SM BKN045 03/M08 A2997 RMK AO2 SLP147 T00331083 (SDK)
27	0954	MET10911/27/21 09:54:02 METAR KPHL 271454Z 29018G25KT 10SM BKN046 04/M08 A2998 RMK AO2 SLP150 T00391083 51014 (SDK)
27	1054	MET10311/27/21 10:54:02 METAR KPHL 271554Z 32018G24KT 10SM BKN049 04/M08 A2997 RMK AO2 SLP149 T00441083 (SDK)
27	1154	MET10311/27/21 11:54:02 METAR KPHL 271654Z 32016G23KT 10SM BKN049 05/M08 A2996 RMK AO2 SLP144 T00501078 (SDK)
27	1254	MET12811/27/21 12:54:02 METAR KPHL 271754Z 29015G22KT 10SM BKN050 BKN260 06/M08 A2994 RMK AO2 SLP139 T00561078 10056 20033 58011 (SDK)
27	1300	SYN08672408 32766 62915 10056 21078 30117 40139 58011 91754 333 10056 20033 91022 555 92718=
27	1354	MET10611/27/21 13:54:02 METAR KPHL 271854Z 28016KT 10SM SCT050 BKN260 06/M08 A2995 RMK AO2 SLP140 T00561083 (SS)
27	1454	MET10611/27/21 14:54:02 METAR KPHL 271954Z 31012KT 10SM FEW050 BKN260 05/M08 A2994 RMK AO2 SLP138 T00501078 (SS)
27	1554	MET11211/27/21 15:54:02 METAR KPHL 272054Z 28011KT 10SM FEW050 BKN260 04/M08 A2996 RMK AO2 SLP144 T00441078 53005 (SS)
27	1654	MET10611/27/21 16:54:02 METAR KPHL 272154Z 29011KT 10SM FEW050 BKN260 04/M07 A2996 RMK AO2 SLP145 T00391072 (SS)
27	1754	MET10611/27/21 17:54:02 METAR KPHL 272254Z 29006KT 10SM FEW100 BKN260 04/M07 A2997 RMK AO2 SLP147 T00391072 (SS)
27	1854	MET12411/27/21 18:54:02 METAR KPHL 272354Z 27008KT 10SM BKN140 BKN260 04/M07 A2999 RMK AO2 SLP154 T00391072 10061 20039 53010 (SS)
27	1900	SYN08072408 32966 62708 10039 21072 30134 40154 53010 92354 333 10061 20033 555 92800=
27	1954	MET10811/27/21 19:54:01 METAR KPHL 280054Z 28007KT 10SM FEW120 BKN160 BKN250 04/M07 A2998 RMK AO2 SLP153 T00391072
27	2054	MET10811/27/21 20:54:01 METAR KPHL 280154Z 25006KT 10SM FEW120 BKN160 BKN250 03/M07 A2998 RMK AO2 SLP151 T00331067
27	2154	MET10711/27/21 21:54:01 METAR KPHL 280254Z 25007KT 10SM BKN085 OVC100 04/M06 A2998 RMK AO2 SLP151 T00391061 56003
27	2254	MET10111/27/21 22:54:02 METAR KPHL 280354Z 20006KT 10SM BKN085 OVC100 03/M06 A2998 RMK AO2 SLP150 T00331056
27	2338	MET09411/27/21 23:38:02 SPECI KPHL 280438Z 21004KT 10SM BKN085 OVC100 04/M06 A2997 RMK AO2 T00391056
27	2354	MET11111/27/21 23:54:02 METAR KPHL 280454Z 23006KT 10SM BKN055 OVC070 04/M06 A2997 RMK AO2 SLP149 T00391061 400610033

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151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	For Hour (LST) Ending at																								Date
	1 AM	**2 AM**	**3 AM**	**4 AM**	**5 AM**	**6 AM**	**7 AM**	**8 AM**	**9 AM**	**10 AM**	**11 AM**	**NOON**	**1 PM**	**2 PM**	**3 PM**	**4 PM**	**5 PM**	**6 PM**	**7 PM**	**8 PM**	**9 PM**	**10 PM**	**11 PM**	**MID**	
01																									01
02										T	T	T	T	0.01	T	0.01	T	T							02
03																									03
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11																									11
12				T		T	T	0.04	T	0.05	0.05	0.01													12
13													T	T	T										13
14																			T	T	T	0.01	T		14
15					T	T	T	T																	15
16																									16
17																									17
18																				T	T	0.06	T	0.01	18
19		T	T																						19
20																									20
21																			T						21
22		T	T	0.01	0.01	T	0.03	T																	22
23																									23
24																									24
25																								T	25
26	0.01	0.04	0.04	0.03	0.01		0.02	0.01	T																26
27																									27
28																								T	28
29	T																								29
30													T												30

Maximum Short Duration Precipitation

Time Period (Minutes)	**5**	**10**	**15**	**20**	**30**	**45**	**60**	**80**	**100**	**120**	**150**	**180**
Precipitation (inches)	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.09	0.10	0.11	0.12
Ending Date Time (yyyy-mm-dd hh:mi)	2021-11-12 09:18	2021-11-12 09:18	2021-11-12 09:18	2021-11-18 21:39	2021-11-18 21:39	2021-11-18 21:39	2021-11-18 21:39	2021-11-26 02:59	2021-11-12 10:53	2021-11-12 10:56	2021-11-12 11:20	2021-11-26 03:48

Hourly, daily, and monthly totals on the Daily Summary page and the Hourly Precipitation Table are shown as reported by the instrumentation at the site. However, NWS does not edit hourly values for its ASOS sites, but may edit the daily and monthly totals for selected sites which will be reflected on the Daily Summary page.

T = Trace
s = Suspect
* = Erroneous
blank = No precipitation observed
M = Missing

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Daily Summary
November 2021

Generated on 06/23/2022

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	Temperature (F)							Degree Days (base 65F)		Sun (LST)		Weather	Precipitation (in)			Pressure (inHg)		Wind	Maximum Wind Speed = MPH Direction = Degrees			
	Max	Min	Avg	Dep	ARH	ADP	AWB	Heat	Cool	Rise	Set	Weather Type	TLC	Snow Fall	Snow Depth	Avg Stn	Avg SL	Avg Speed	Peak Speed	Peak Dir	Sust. Speed	Sust. Dir
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01	60	48	54	1.4	57	38	47	11	0	0630	1659		0.00	0.0	0	30.03	30.10	10.6	25	290	18	320
02	53	41	47	-5.3	72	38	43	18	0	0631	1658	RA	0.02	0.0	0	30.19	30.23	7.0	21	300	16	300
03	53	37	45	-7.0	59	31	39	20	0	0632	1657		0.00	0.0	0	30.24	30.28	7.4	22	290	17	320
04	53	36	45	-6.7	57	29	38	20	0	0633	1656		0.00	0.0	0	30.29	30.31	5.0	20	350	10	350
05	54	35	45	-6.4	55	28	37	20	0	0634	1655		0.00	0.0	0	30.30	30.35	6.5	23	360	16	030
06	57	34	46	-5.1	60	31	39	19	0	0635	1653		0.00	0.0	0	30.35	30.36	5.9	17	040	14	080
07	55	37	46	-4.8	57	31	40	19	0	0636	1652		0.00	0.0	0	30.16	30.18	5.0	20	030	13	020
08	67	40	54	3.5	56	38	47	11	0	0638	1651		0.00	0.0	0	30.10	30.14	5.6	23	360	16	030
09	71	44	58	7.8	65	43	50	7	0	0639	1650		0.00	0.0	0	30.08	30.10	5.6	19	230	15	240
10	68	47	58	8.1	60	43	50	7	0	0640	1649		0.00	0.0	0	30.06	30.11	6.0	25	340	20	340
11	67	42	55	5.5	69	44	49	10	0	0641	1648		0.00	0.0	0	30.19	30.21	6.7	22	100	17	110
12	68	45	57	7.8	73	50	55	8	0	0642	1648	RA BR	0.15	0.0	0	29.93	29.94	10.3	31	140	24	230
13	62	40	51	2.1	71	38	43	14	0	0643	1647	RA	T	0.0	0	29.79	29.84	10.6	47	290	36	280
14	49	37	43	-5.6	64	31	38	22	0	0644	1646	RA	0.01	0.0	0	29.90	29.91	8.9	26	230	22	230
15	49	38	44	-4.2	60	30	38	21	0	0646	1645	RA	T	0.0	0	29.85	29.91	13.5	36	270	26	270
16	50	34	42	-5.9	59	27	36	23	0	0647	1644		0.00	0.0	0	30.13	30.19	7.9	23	270	18	260
17	66	30	48	0.5	74	40	45	17	0	0648	1644		0.00	0.0	0	30.21	30.22	4.7	24	180	15	190
18	73*	47	60	12.8	64	47	53	5	0	0649	1643	RA	0.07	0.0	0	29.99	30.02	10.8	38	310	26	310
19	49	37	43	-3.9	44	24	37	22	0	0650	1642	RA	T	0.0	0	30.24	30.32	13.3	34	310	26	300
20	49	32	41	-5.5	62	29	37	24	0	0651	1641		0.00	0.0	0	30.49	30.51	3.7	15	190	12	200
21	54	39	47	0.8	74	40	44	18	0	0652	1641	RA	T	0.0	0	30.23	30.22	3.4	14	200	10	180
22	54	38	46	0.2	62	35	43	19	0	0653	1640	RA BR	0.05	0.0	0	29.87	29.91	10.2	26	320	21	320
23	46	33	40	-5.4	44	18	32	25	0	0655	1640		0.00	0.0	0	30.03	30.09	11.5	33	340	25	340
24	49	29*	39	-6.1	50	22	33	26	0	0656	1639		0.00	0.0	0	30.29	30.33	6.3	19	320	15	320
25	57	35	46	1.3	55	30	39	19	0	0657	1639	RA	T	0.0	0	30.05	30.04	6.4	14	250	12	240
26	50	40	45	0.7	58	30	39	20	0	0658	1638	RA BR	0.16	0.0	0	29.72	29.75	16.1	42	290	32	280
27	43	38	41	-3.0	44	19	32	24	0	0659	1638		0.00	0.0	0	29.88	29.94	13.7	30	290	24	300
28	53	37	45	1.4	58	29	37	20	0	0700	1638	RA	T	0.0	0	29.85	29.86	3.9	17	320	13	020
29	46	34	40	-3.2	51	24	34	25	0	0701	1637	RA	T	0.0	0	29.90	29.95	11.1	30	340	22	320
30	45	30	38	-4.9	58	27	35	27	0	0702	1637		T	0.0	0	29.98	30.01	5.9	19	210	12	230
	55.7	37.8	46.8									Monthly Averages | Totals	0.46			30.08	30.11	8.1				
	-0.3	-1.4	-0.8									Departure from Normal (1981-2010)	-2.53									

Degree Days	Monthly Total	Monthly Departure	Season-to-date Total	Season-to-date Departure
Heating	548	25	645	
Cooling	0	-1	1548	

Number of days with...

Temperature Max >=90°	Temperature Max <=32°	Temperature Min <=32°	Temperature Min <=0°	Precipitation >=0.01"	Precipitation >=0.1"	Snow >=1"	Weather T-Storms	Weather Heavy Fog
0	0	4	0	6	2	0		

Date of 5-sec to 3-sec wind equipment change
2009-07-30

Sea Level Pressure		Date	Time
Maximum	30.59	20	0954
Minimum	29.68	13	1254

Greatest...	24-Hr... Precip	24-Hr... Snowfall	Snow Depth
	0.16	0.0	0.0
Date	26-26		

Station Augmentation

Name:PHILADELPHIA CENTER CITY, PA Lat: 39.96056 Lon: -75.14263 Elevation: N/A Distance: N/A Elements: SNOW Equipment: N/A

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
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Local Climatological Data
Hourly Observations
November 2021
Generated on 06/23/2022

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	Time (LST)	Station Type	Sky Conditions	Visibility	Weather Type (see documentation) AU | AW | MW	Dry Bulb Temp (F)	Dry Bulb Temp (C)	Wet Bulb Temp (F)	Wet Bulb Temp (C)	Dew Point Temp (F)	Dew Point Temp (C)	Rel Hum %	Wind Speed (MPH)	Wind Dir (Deg)	Wind Gusts (MPH)	Station Press (inHg)	Press. Tend	Net 3-Hr Change (inHg)	Sea Level Press. (inHg)	Report Type	Precip Total (in)	Altimeter Setting (inHg)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
28	0054	7	SCT:04 50 OVC:08 60	10.00		39	3.9	33	0.6	23	-5.0	53	5	250		29.94	8	+0.01	29.97	FM-15	0.00	29.97
28	0100	4	57	9.94		39	3.9	33	0.6	23	-5.0	53	5	250		29.91	8	+0.01	29.97	FM-12		
28	0154	7	BKN:07 60 OVC:08 80	10.00		38	3.3	33	0.6	24	-4.4	57	0	000		29.93			29.96	FM-15	0.00	29.96
28	0254	7	BKN:07 65 OVC:08 80	10.00		37	2.8	33	0.6	26	-3.3	65	0	000		29.91			29.93	FM-15	0.00	29.94
28	0354	7	OVC:08 80	10.00		38	3.3	33	0.6	24	-4.4	57	6	070		29.90	6	+0.04	29.92	FM-15	0.00	29.93
28	0454	7	OVC:08 65	10.00		37	2.8	32	0.0	24	-4.4	59	6	130		29.87			29.90	FM-15	0.00	29.90
28	0554	7	BKN:07 60 OVC:08 80	10.00		37	2.8	33	0.6	26	-3.3	65	5	110		29.86			29.89	FM-15	0.00	29.89
28	0654	7	FEW:02 55 SCT:04 80 BKN:07 100	10.00		37	2.8	34	1.1	28	-2.2	70	7	110		29.85	6	+0.05	29.88	FM-15	0.00	29.88
28	0700	4	57	9.94		37	2.8	34	1.1	28	-2.2	70	7	110		29.81	6	+0.05	29.88	FM-12		
28	0754	7	SCT:04 60 OVC:08 100	10.00		39	3.9	35	1.7	29	-1.7	67	3	080		29.85			29.88	FM-15	0.00	29.88
28	0854	7	SCT:04 55 BKN:07 70 BKN:07 100	10.00		40	4.4	36	2.2	29	-1.7	65	5	090		29.84			29.87	FM-15	0.00	29.87
28	0954	7	FEW:02 50 SCT:04 70 BKN:07 90	10.00		44	6.7	39	3.9	31	-0.6	60	3	VRB		29.85	5	0.00	29.87	FM-15	0.00	29.88
28	1054	7	SCT:04 60 BKN:07 85	10.00		45	7.2	39	3.9	31	-0.6	58	3	220		29.83			29.85	FM-15	0.00	29.86
28	1154	7	FEW:02 50 BKN:07 75	10.00		47	8.3	40	4.4	31	-0.6	54	6	270		29.80			29.83	FM-15	0.00	29.83
28	1254	7	FEW:02 50 BKN:07 70	10.00		49	9.4	41	5.0	31	-0.6	50	7	250		29.78	8	+0.06	29.81	FM-15	0.00	29.81
28	1300	4	57	9.94		49	9.4	41	5.0	31	-0.6	50	7	250		29.75	8	+0.06	29.81	FM-12		
28	1354	7	FEW:02 45 SCT:04 65	10.00		51	10.6	42	5.6	31	-0.6	46	3	VRB		29.76			29.79	FM-15	0.00	29.79
28	1454	7	FEW:02 49 SCT:04 65	10.00		53	11.7	43	6.1	31	-0.6	43	9	310	17	29.77			29.79	FM-15	0.00	29.80
28	1554	7	BKN:07 49	10.00		51	10.6	42	5.6	30	-1.1	44	11	340		29.79	3	-0.01	29.82	FM-15	0.00	29.82
28	1654	7	SCT:04 50	10.00		47	8.3	40	4.4	30	-1.1	52	7	360		29.80			29.83	FM-15	0.00	29.83
28	1754	7	SCT:04 50	10.00		45	7.2	38	3.3	29	-1.7	54	0	000		29.81			29.84	FM-15	0.00	29.84
28	1854	7	SCT:04 65	10.00		45	7.2	38	3.3	29	-1.7	54	3	030		29.83	3	-0.04	29.85	FM-15	0.00	29.86
28	1900	4	57	9.94		45	7.2	38	3.3	29	-1.7	54	3	030		29.80	3	-0.04	29.85	FM-12		
28	1954	7	BKN:07 50 OVC:08 85	10.00		43	6.1	38	3.3	31	-0.6	63	0	000		29.84			29.86	FM-15	0.00	29.87
28	2054	7	BKN:07 50 OVC:08 75	10.00		44	6.7	39	3.9	32	0.0	63	0	000		29.82			29.85	FM-15	0.00	29.85
28	2154	7	OVC:08 55	10.00		44	6.7	39	3.9	33	0.6	65	0	000		29.82	8	+0.01	29.85	FM-15	0.00	29.85
28	2254	7	OVC:08 65	10.00		44	6.7	40	4.4	34	1.1	68	0	000		29.81			29.84	FM-15	0.00	29.84
28	2346	7	SCT:04 50 OVC:08 70	8.00	-RA:02 |RA |RA	44	6.7	39	3.9	32	0.0	63	5	300		29.82				FM-16	T	29.85
28	2354	7	SCT:04 50 OVC:08 70	8.00	-RA:02 |RA |RA	44	6.7	39	3.9	32	0.0	63	3	310		29.83			29.86	FM-15	T	29.86

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Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	Time (LST)	Remarks
28	0054	MET12511/28/21 00:54:02 METAR KPHL 280554Z 25004KT 10SM SCT050 OVC060 04/M05 A2997 RMK AO2 SLP148 T00391050 10039 20033 58003 (VLP)
28	0100	SYN08072408 32766 82504 10039 21050 30127 40148 58003 90554 333 10039 20033 555 92806=
28	0154	MET10711/28/21 01:54:02 METAR KPHL 280654Z 00000KT 10SM BKN060 OVC080 03/M04 A2996 RMK AO2 SLP144 T00331044 (VLP)
28	0254	MET10711/28/21 02:54:02 METAR KPHL 280754Z 00000KT 10SM BKN065 OVC080 03/M03 A2994 RMK AO2 SLP137 T00281033 (VLP)
28	0354	MET10611/28/21 03:54:02 METAR KPHL 280854Z 07005KT 10SM OVC080 03/M04 A2993 RMK AO2 SLP133 T00331044 56014 (VLP)
28	0454	MET10011/28/21 04:54:02 METAR KPHL 280954Z 13005KT 10SM OVC065 03/M04 A2990 RMK AO2 SLP124 T00281044 (VLP)
28	0554	MET10711/28/21 05:54:02 METAR KPHL 281054Z 11004KT 10SM BKN060 OVC080 03/M03 A2989 RMK AO2 SLP121 T00281033 (DKH)
28	0654	MET13211/28/21 06:54:02 METAR KPHL 281154Z 11006KT 10SM FEW055 SCT080 BKN100 03/M02 A2988 RMK AO2 SLP117 T00281022 10039 20028 56017 (DKH)
28	0700	SYN08072408 32766 61106 10028 21022 30096 40117 56017 91154 333 10061 20028 555 92812=
28	0754	MET10711/28/21 07:54:02 METAR KPHL 281254Z 08003KT 10SM SCT060 OVC100 04/M02 A2988 RMK AO2 SLP117 T00391017 (DKH)
28	0854	MET11411/28/21 08:54:02 METAR KPHL 281354Z 09004KT 10SM SCT055 BKN070 BKN100 04/M02 A2987 RMK AO2 SLP115 T00441017 (DKH)
28	0954	MET12011/28/21 09:54:02 METAR KPHL 281454Z VRB03KT 10SM FEW050 SCT070 BKN090 07/M01 A2988 RMK AO2 SLP116 T00671006 55000 (DKH)
28	1054	MET10711/28/21 10:54:02 METAR KPHL 281554Z 22003KT 10SM SCT060 BKN085 07/M01 A2986 RMK AO2 SLP109 T00721006 (DKH)
28	1154	MET10711/28/21 11:54:02 METAR KPHL 281654Z 27005KT 10SM FEW050 BKN075 08/M01 A2983 RMK AO2 SLP102 T00831006 (DKH)
28	1254	MET12511/28/21 12:54:02 METAR KPHL 281754Z 25006KT 10SM FEW050 BKN070 09/M01 A2981 RMK AO2 SLP094 T00941006 10094 20028 58022 (DKH)
28	1300	SYN08072408 32766 62506 10094 21006 30073 40094 58022 91754 333 10094 20028 555 92818=
28	1354	MET10711/28/21 13:54:02 METAR KPHL 281854Z VRB03KT 10SM FEW045 SCT065 11/M01 A2979 RMK AO2 SLP088 T01061006 (DKH)
28	1454	MET11011/28/21 14:54:02 METAR KPHL 281954Z 31008G15KT 10SM FEW049 SCT065 12/M01 A2980 RMK AO2 SLP089 T01171006 (MLC)
28	1554	MET10611/28/21 15:54:02 METAR KPHL 282054Z 34010KT 10SM BKN049 11/M01 A2982 RMK AO2 SLP097 T01061011 53003 (MLC)
28	1654	MET10011/28/21 16:54:02 METAR KPHL 282154Z 36006KT 10SM SCT050 08/M01 A2983 RMK AO2 SLP101 T00831011 (MLC)
28	1754	MET10011/28/21 17:54:02 METAR KPHL 282254Z 00000KT 10SM SCT050 07/M02 A2984 RMK AO2 SLP104 T00721017 (MLC)
28	1854	MET11811/28/21 18:54:02 METAR KPHL 282354Z 03003KT 10SM SCT065 07/M02 A2986 RMK AO2 SLP110 T00721017 10117 20067 53014 (MLC)
28	1900	SYN08072408 32766 40303 10072 21017 30090 40110 53014 92354 333 10117 20028 555 92900=
28	1954	MET10711/28/21 19:54:03 METAR KPHL 290054Z 00000KT 10SM BKN050 OVC085 06/M01 A2987 RMK AO2 SLP113 T00611006 (MLC)
28	2054	MET10611/28/21 20:54:03 METAR KPHL 290154Z 00000KT 10SM BKN050 OVC075 07/00 A2985 RMK AO2 SLP107 T00670000 (MLC)
28	2154	MET10511/28/21 21:54:03 METAR KPHL 290254Z 00000KT 10SM OVC055 07/01 A2985 RMK AO2 SLP108 T00670006 58003 (LPA)
28	2254	MET09911/28/21 22:54:03 METAR KPHL 290354Z 00000KT 10SM OVC065 07/01 A2984 RMK AO2 SLP105 T00670011 (LPA)
28	2346	MET11411/28/21 23:46:03 SPECI KPHL 290446Z 30004KT 8SM -RA SCT050 OVC070 07/00 A2985 RMK AO2 RAB46 P0000 T00670000 (LPA)
28	2354	MET13111/28/21 23:54:03 METAR KPHL 290454Z 31003KT 8SM -RA SCT050 OVC070 07/00 A2986 RMK AO2 RAB46 SLP111 P0000 T00670000 401170028 (LPA)

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Date	For Hour (LST) Ending at																								Date
	1 AM	**2 AM**	**3 AM**	**4 AM**	**5 AM**	**6 AM**	**7 AM**	**8 AM**	**9 AM**	**10 AM**	**11 AM**	**NOON**	**1 PM**	**2 PM**	**3 PM**	**4 PM**	**5 PM**	**6 PM**	**7 PM**	**8 PM**	**9 PM**	**10 PM**	**11 PM**	**MID**	
01																									01
02										T	T	T	T	0.01	T	0.01	T	T							02
03																									03
04																									04
05																									05
06																									06
07																									07
08																									08
09																									09
10																									10
11																									11
12				T		T	T	0.04	T	0.05	0.05	0.01													12
13													T	T	T										13
14																			T	T	T	0.01	T		14
15					T	T	T	T																	15
16																									16
17																									17
18																				T	T	0.06	T	0.01	18
19		T	T																						19
20																									20
21																			T						21
22		T	T	0.01	0.01	T	0.03	T																	22
23																									23
24																									24
25																								T	25
26	0.01	0.04	0.04	0.03	0.01		0.02	0.01	T																26
27																									27
28																								T	28
29	T																								29
30													T												30

Maximum Short Duration Precipitation

Time Period (Minutes)	**5**	**10**	**15**	**20**	**30**	**45**	**60**	**80**	**100**	**120**	**150**	**180**
Precipitation (inches)	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.09	0.10	0.11	0.12
Ending Date Time (yyyy-mm-dd hh:mi)	2021-11-12 09:18	2021-11-12 09:18	2021-11-12 09:18	2021-11-18 21:39	2021-11-18 21:39	2021-11-18 21:39	2021-11-18 21:39	2021-11-26 02:59	2021-11-12 10:53	2021-11-12 10:56	2021-11-12 11:20	2021-11-26 03:48

Hourly, daily, and monthly totals on the Daily Summary page and the Hourly Precipitation Table are shown as reported by the instrumentation at the site. However, NWS does not edit hourly values for its ASOS sites, but may edit the daily and monthly totals for selected sites which will be reflected on the Daily Summary page.

T = Trace
s = Suspect
* = Erroneous
blank = No precipitation observed
M = Missing

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Daily Summary
November 2021

Generated on 06/23/2022

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	Temperature (F)							Degree Days (base 65F)		Sun (LST)		Weather	Precipitation (in)			Pressure (inHg)		Wind	Maximum Wind Speed = MPH, Direction = Degrees			
	Max	Min	Avg	Dep	ARH	ADP	AWB	Heat	Cool	Rise	Set	Weather Type	TLC	Snow Fall	Snow Depth	Avg Stn	Avg SL	Avg Speed	Peak Speed	Peak Dir	Sust. Speed	Sust. Dir
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01	60	48	54	1.4	57	38	47	11	0	0630	1659		0.00	0.0	0	30.03	30.10	10.6	25	290	18	320
02	53	41	47	-5.3	72	38	43	18	0	0631	1658	RA	0.02	0.0	0	30.19	30.23	7.0	21	300	16	300
03	53	37	45	-7.0	59	31	39	20	0	0632	1657		0.00	0.0	0	30.24	30.28	7.4	22	290	17	320
04	53	36	45	-6.7	57	29	38	20	0	0633	1656		0.00	0.0	0	30.29	30.31	5.0	20	350	10	350
05	54	35	45	-6.4	55	28	37	20	0	0634	1655		0.00	0.0	0	30.30	30.35	6.5	23	360	16	030
06	57	34	46	-5.1	60	31	39	19	0	0635	1653		0.00	0.0	0	30.35	30.36	5.9	17	040	14	080
07	55	37	46	-4.8	57	31	40	19	0	0636	1652		0.00	0.0	0	30.16	30.18	5.0	20	030	13	020
08	67	40	54	3.5	56	38	47	11	0	0638	1651		0.00	0.0	0	30.10	30.14	5.6	23	360	16	030
09	71	44	58	7.8	65	43	50	7	0	0639	1650		0.00	0.0	0	30.08	30.10	5.6	19	230	15	240
10	68	47	58	8.1	60	43	50	7	0	0640	1649		0.00	0.0	0	30.06	30.11	6.0	25	340	20	340
11	67	42	55	5.5	69	44	49	10	0	0641	1648		0.00	0.0	0	30.19	30.21	6.7	22	100	17	110
12	68	45	57	7.8	73	50	55	8	0	0642	1648	RA BR	0.15	0.0	0	29.93	29.94	10.3	31	140	24	230
13	62	40	51	2.1	71	38	43	14	0	0643	1647	RA	T	0.0	0	29.79	29.84	10.6	47	290	36	280
14	49	37	43	-5.6	64	31	38	22	0	0644	1646	RA	0.01	0.0	0	29.90	29.91	8.9	26	230	22	230
15	49	38	44	-4.2	60	30	38	21	0	0646	1645	RA	T	0.0	0	29.85	29.91	13.5	36	270	26	270
16	50	34	42	-5.9	59	27	36	23	0	0647	1644		0.00	0.0	0	30.13	30.19	7.9	23	270	18	260
17	66	30	48	0.5	74	40	45	17	0	0648	1644		0.00	0.0	0	30.21	30.22	4.7	24	180	15	190
18	73*	47	60	12.8	64	47	53	5	0	0649	1643	RA	0.07	0.0	0	29.99	30.02	10.8	38	310	26	310
19	49	37	43	-3.9	44	24	37	22	0	0650	1642	RA	T	0.0	0	30.24	30.32	13.3	34	310	26	300
20	49	32	41	-5.5	62	29	37	24	0	0651	1641		0.00	0.0	0	30.49	30.51	3.7	15	190	12	200
21	54	39	47	0.8	74	40	44	18	0	0652	1641	RA	T	0.0	0	30.23	30.22	3.4	14	200	10	180
22	54	38	46	0.2	62	35	43	19	0	0653	1640	RA BR	0.05	0.0	0	29.87	29.91	10.2	26	320	21	320
23	46	33	40	-5.4	44	18	32	25	0	0655	1640		0.00	0.0	0	30.03	30.09	11.5	33	340	25	340
24	49	29*	39	-6.1	50	22	33	26	0	0656	1639		0.00	0.0	0	30.29	30.33	6.3	19	320	15	320
25	57	35	46	1.3	55	30	39	19	0	0657	1639	RA	T	0.0	0	30.05	30.04	6.4	14	250	12	240
26	50	40	45	0.7	58	30	39	20	0	0658	1638	RA BR	0.16	0.0	0	29.72	29.75	16.1	42	290	32	280
27	43	38	41	-3.0	44	19	32	24	0	0659	1638		0.00	0.0	0	29.88	29.94	13.7	30	290	24	300
28	53	37	45	1.4	58	29	37	20	0	0700	1638	RA	T	0.0	0	29.85	29.86	3.9	17	320	13	020
29	46	34	40	-3.2	51	24	34	25	0	0701	1637	RA	T	0.0	0	29.90	29.95	11.1	30	340	22	320
30	45	30	38	-4.9	58	27	35	27	0	0702	1637		T	0.0	0	29.98	30.01	5.9	19	210	12	230
	55.7	37.8	46.8									Monthly Averages | Totals	0.46			30.08	30.11	8.1				
	-0.3	-1.4	-0.8									Departure from Normal (1981-2010)	-2.53									

Degree Days

	Monthly Total	Monthly Departure	Season-to-date Total	Season-to-date Departure
Heating	548	25	645	
Cooling	0	-1	1548	

Number of days with...

Temperature Max >=90°	Temperature Max <=32°	Temperature Min <=32°	Temperature Min <=0°	Precipitation >=0.01"	Precipitation >=0.1"	Snow >=1"	Weather T-Storms	Weather Heavy Fog
0	0	4	0	6	2	0		

Date of 5-sec to 3-sec wind equipment change

2009-07-30

Sea Level Pressure

	Value	Date	Time
Maximum	30.59	20	0954
Minimum	29.68	13	1254

Greatest...

	24-Hr... Precip	24-Hr... Snowfall	Snow Depth
	0.16	0.0	0.0
Date	26-26		

Station Augmentation

Name:PHILADELPHIA CENTER CITY, PA Lat: 39.96056 Lon: -75.14263 Elevation: N/A Distance: N/A Elements: SNOW Equipment: N/A

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
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Local Climatological Data
Hourly Observations
November 2021
Generated on 06/23/2022

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	Time (LST)	Station Type	Sky Conditions	Visibility	Weather Type (see documentation) AU | AW | MW	Dry Bulb Temp (F)	Dry Bulb Temp (C)	Wet Bulb Temp (F)	Wet Bulb Temp (C)	Dew Point Temp (F)	Dew Point Temp (C)	Rel Hum %	Wind Speed (MPH)	Wind Dir (Deg)	Wind Gusts (MPH)	Station Press (inHg)	Press. Tend	Net 3-Hr Change (inHg)	Sea Level Press. (inHg)	Report Type	Precip Total (in)	Altimeter Setting (inHg)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
29	0031	7	BKN:07 39 OVC:08 50	10.00	-RA:02 |RA |RA	44	6.7	39	3.9	31	-0.6	60	14	310		29.83				FM-16	T	29.86
29	0054	7	BKN:07 40 OVC:08 60	10.00		43	6.1	38	3.3	31	-0.6	63	9	280		29.82	8	0.00	29.85	FM-15	T	29.85
29	0100	4	41	9.94		43	6.1	38	3.3	31	-0.6	63	9	280		29.78	8	0.00	29.85	FM-12		
29	0154	7	FEW:02 40 OVC:08 80	10.00		43	6.1	37	2.8	29	-1.7	58	8	280		29.82			29.85	FM-15	0.00	29.85
29	0254	7	OVC:08 80	10.00		42	5.6	36	2.2	27	-2.8	55	13	300		29.83			29.86	FM-15	0.00	29.86
29	0354	7	BKN:07 80	10.00		41	5.0	35	1.7	26	-3.3	55	13	310		29.84	3	-0.02	29.87	FM-15	0.00	29.87
29	0454	7	BKN:07 90 OVC:08 110	10.00		40	4.4	34	1.1	25	-3.9	55	14	310		29.85			29.88	FM-15	0.00	29.88
29	0554	7	BKN:07 95	10.00		40	4.4	34	1.1	25	-3.9	55	11	310		29.87			29.89	FM-15	0.00	29.90
29	0654	7	FEW:02 100	10.00		38	3.3	33	0.6	24	-4.4	57	10	290		29.89	3	-0.05	29.92	FM-15	0.00	29.92
29	0700	4		9.94		38	3.3	33	0.6	24	-4.4	57	10	290		29.85	3	-0.05	29.92	FM-12		
29	0754	7	SCT:04 50 SCT:04 100	10.00		38	3.3	33	0.6	24	-4.4	57	8	300		29.91			29.94	FM-15	0.00	29.94
29	0854	7	FEW:02 55	10.00		39	3.9	34	1.1	25	-3.9	57	11	300		29.92			29.95	FM-15	0.00	29.95
29	0954	7	FEW:02 35 FEW:02 55	10.00		42	5.6	35	1.7	25	-3.9	51	13	320		29.92	1	-0.04	29.95	FM-15	0.00	29.95
29	1054	7	BKN:07 38	10.00		44	6.7	37	2.8	25	-3.9	47	20	320		29.92			29.95	FM-15	0.00	29.95
29	1154	7	BKN:07 40	10.00		44	6.7	37	2.8	25	-3.9	47	18	330		29.91			29.93	FM-15	0.00	29.94
29	1254	7	BKN:07 45 BKN:07 60	10.00		45	7.2	37	2.8	23	-5.0	42	16	310	25	29.90	6	+0.02	29.93	FM-15	0.00	29.93
29	1300	4	41	9.94		45	7.2	37	2.8	23	-5.0	42	16	310		29.86	6	+0.02	29.93	FM-12		
29	1354	7	BKN:07 50	10.00		44	6.7	36	2.2	22	-5.6	41	16	320		29.91			29.94	FM-15	0.00	29.94
29	1454	7	BKN:07 55	10.00		43	6.1	35	1.7	22	-5.6	43	14	320	22	29.92			29.95	FM-15	0.00	29.95
29	1554	7	BKN:07 50	10.00		42	5.6	34	1.1	21	-6.1	43	16	320	22	29.94	3	-0.04	29.97	FM-15	0.00	29.97
29	1654	7	SCT:04 50	10.00		42	5.6	34	1.1	21	-6.1	43	8	VRB		29.96			29.99	FM-15	0.00	29.99
29	1754	7	FEW:02 50	10.00		40	4.4	33	0.6	21	-6.1	47	5	320		29.97			30.00	FM-15	0.00	30.00
29	1854	7	CLR:00	10.00		40	4.4	33	0.6	21	-6.1	47	5	300		29.98	1	-0.04	30.01	FM-15	0.00	30.01
29	1900	4		9.94		40	4.4	33	0.6	21	-6.1	47	5	300		29.94	1	-0.04	30.01	FM-12		
29	1954	7	CLR:00	10.00		37	2.8	31	-0.6	21	-6.1	52	8	270		30.00			30.03	FM-15	0.00	30.03
29	2054	7	CLR:00	10.00		37	2.8	31	-0.6	21	-6.1	52	8	260		30.01			30.03	FM-15	0.00	30.04
29	2154	7	CLR:00	10.00		35	1.7	30	-1.1	21	-6.1	57	10	260		30.02	1	-0.04	30.05	FM-15	0.00	30.05
29	2254	7	CLR:00	10.00		35	1.7	30	-1.1	21	-6.1	57	6	270		30.02			30.05	FM-15	0.00	30.05
29	2354	7	FEW:02 250	10.00		34	1.1	29	-1.7	21	-6.1	59	7	260		30.02			30.05	FM-15	0.00	30.05

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National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	Time (LST)	Remarks
29	0031	MET11011/29/21 00:31:02 SPECI KPHL 290531Z 31012KT 10SM -RA BKN039 OVC050 07/M01 A2986 RMK AO2 P0000 T00671006 (LPA)
29	0054	MET14311/29/21 00:54:02 METAR KPHL 290554Z 28008KT 10SM BKN040 OVC060 06/M01 A2985 RMK AO2 RAE49 SLP107 P0000 60000 T00611006 10072 20056 58001 (LPA)
29	0100	SYN08672408 12666 82808 10061 21006 30086 40107 58001 69901 90554 333 10072 20028 555 92906=
29	0154	MET10711/29/21 01:54:02 METAR KPHL 290654Z 28007KT 10SM FEW040 OVC080 06/M02 A2985 RMK AO2 SLP108 T00611017 (LPA)
29	0254	MET10011/29/21 02:54:02 METAR KPHL 290754Z 30011KT 10SM OVC080 06/M03 A2986 RMK AO2 SLP112 T00561028 (LPA)
29	0354	MET10611/29/21 03:54:02 METAR KPHL 290854Z 31011KT 10SM BKN080 05/M03 A2987 RMK AO2 SLP115 T00501033 53008 (LPA)
29	0454	MET10711/29/21 04:54:02 METAR KPHL 290954Z 31012KT 10SM BKN090 OVC110 04/M04 A2988 RMK AO2 SLP117 T00441039 (LPA)
29	0554	MET10011/29/21 05:54:02 METAR KPHL 291054Z 31010KT 10SM BKN095 04/M04 A2990 RMK AO2 SLP123 T00441039 (LPA)
29	0654	MET11811/29/21 06:54:02 METAR KPHL 291154Z 29009KT 10SM FEW100 03/M04 A2992 RMK AO2 SLP132 T00331044 10061 20033 53016 (GAH)
29	0700	SYN08072408 32966 22909 10033 21044 30110 40132 53016 91154 333 10117 20033 555 92912=
29	0754	MET10711/29/21 07:54:02 METAR KPHL 291254Z 30007KT 10SM SCT050 SCT100 03/M04 A2994 RMK AO2 SLP138 T00331044 (GAH)
29	0854	MET10011/29/21 08:54:02 METAR KPHL 291354Z 30010KT 10SM FEW055 04/M04 A2995 RMK AO2 SLP141 T00391039 (GAH)
29	0954	MET11311/29/21 09:54:02 METAR KPHL 291454Z 32011KT 10SM FEW035 FEW055 06/M04 A2995 RMK AO2 SLP143 T00561039 51012 (GAH)
29	1054	MET10011/29/21 10:54:02 METAR KPHL 291554Z 32017KT 10SM BKN038 07/M04 A2995 RMK AO2 SLP141 T00671039 (GAH)
29	1154	MET10011/29/21 11:54:02 METAR KPHL 291654Z 33016KT 10SM BKN040 07/M04 A2994 RMK AO2 SLP137 T00671039 (GAH)
29	1254	MET14611/29/21 12:54:02 METAR KPHL 291754Z 31014G22KT 10SM BKN045 BKN060 07/M05 A2993 RMK AO2 PK WND 34026/1724 SLP136 T00721050 10072 20028 56007 (GAH)
29	1300	SYN08672408 32666 63114 10072 21050 30113 40136 56007 91754 333 10072 20028 91022 555 92918=
29	1354	MET10011/29/21 13:54:02 METAR KPHL 291854Z 32014KT 10SM BKN050 07/M06 A2994 RMK AO2 SLP138 T00671056 (SDK)
29	1454	MET10311/29/21 14:54:02 METAR KPHL 291954Z 32012G19KT 10SM BKN055 06/M06 A2995 RMK AO2 SLP142 T00611056 (SDK)
29	1554	MET10911/29/21 15:54:02 METAR KPHL 292054Z 32014G19KT 10SM BKN050 06/M06 A2997 RMK AO2 SLP148 T00561061 53013 (SDK)
29	1654	MET10011/29/21 16:54:02 METAR KPHL 292154Z 31007KT 10SM SCT050 06/M06 A2999 RMK AO2 SLP156 T00561061 (SDK)
29	1754	MET10011/29/21 17:54:02 METAR KPHL 292254Z 32004KT 10SM FEW050 04/M06 A3000 RMK AO2 SLP160 T00441061 (SDK)
29	1854	MET11511/29/21 18:54:02 METAR KPHL 292354Z 30004KT 10SM CLR 04/M06 A3001 RMK AO2 SLP163 T00441061 10078 20044 51015 (SDK)
29	1900	SYN08072408 32966 03004 10044 21061 30140 40163 51015 92354 333 10078 20033 555 93000=
29	1954	MET09711/29/21 19:54:03 METAR KPHL 300054Z 27007KT 10SM CLR 03/M06 A3003 RMK AO2 SLP169 T00281061 (SDK)
29	2054	MET09711/29/21 20:54:03 METAR KPHL 300154Z 26007KT 10SM CLR 03/M06 A3004 RMK AO2 SLP171 T00281061 (SDK)
29	2154	MET10311/29/21 21:54:03 METAR KPHL 300254Z 26009KT 10SM CLR 02/M06 A3005 RMK AO2 SLP175 T00171061 51013 (LPA)
29	2254	MET09711/29/21 22:54:03 METAR KPHL 300354Z 27005KT 10SM CLR 02/M06 A3005 RMK AO2 SLP176 T00171061 (LPA)
29	2354	MET11011/29/21 23:54:03 METAR KPHL 300454Z 26006KT 10SM FEW250 01/M06 A3005 RMK AO2 SLP176 T00111061 400780011 (LPA)

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November 2021

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National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	For Hour (LST) Ending at																								Date
	1 AM	**2 AM**	**3 AM**	**4 AM**	**5 AM**	**6 AM**	**7 AM**	**8 AM**	**9 AM**	**10 AM**	**11 AM**	**NOON**	**1 PM**	**2 PM**	**3 PM**	**4 PM**	**5 PM**	**6 PM**	**7 PM**	**8 PM**	**9 PM**	**10 PM**	**11 PM**	**MID**	
01																									01
02										T	T	T	T	0.01	T	0.01	T	T							02
03																									03
04																									04
05																									05
06																									06
07																									07
08																									08
09																									09
10																									10
11																									11
12				T		T	T	0.04	T	0.05	0.05	0.01													12
13													T	T	T										13
14																			T	T	T	0.01	T		14
15					T	T	T	T																	15
16																									16
17																									17
18																				T	T	0.06	T	0.01	18
19		T	T																						19
20																									20
21																			T						21
22		T	T	0.01	0.01	T	0.03	T																	22
23																									23
24																									24
25																								T	25
26	0.01	0.04	0.04	0.03	0.01		0.02	0.01	T																26
27																									27
28																								T	28
29	T																								29
30													T												30

Maximum Short Duration Precipitation

Time Period (Minutes)	**5**	**10**	**15**	**20**	**30**	**45**	**60**	**80**	**100**	**120**	**150**	**180**
Precipitation (inches)	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.09	0.10	0.11	0.12
Ending Date Time (yyyy-mm-dd hh:mi)	2021-11-12 09:18	2021-11-12 09:18	2021-11-12 09:18	2021-11-18 21:39	2021-11-18 21:39	2021-11-18 21:39	2021-11-18 21:39	2021-11-26 02:59	2021-11-12 10:53	2021-11-12 10:56	2021-11-12 11:20	2021-11-26 03:48

Hourly, daily, and monthly totals on the Daily Summary page and the Hourly Precipitation Table are shown as reported by the instrumentation at the site. However, NWS does not edit hourly values for its ASOS sites, but may edit the daily and monthly totals for selected sites which will be reflected on the Daily Summary page.

T = Trace
s = Suspect
* = Erroneous
blank = No precipitation observed
M = Missing

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Daily Summary
November 2021

Generated on 06/23/2022

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	Temperature (F)							Degree Days (base 65F)		Sun (LST)		Weather	Precipitation (in)			Pressure (inHg)		Wind	Maximum Wind Speed = MPH / Direction = Degrees			
	Max	Min	Avg	Dep	ARH	ADP	AWB	Heat	Cool	Rise	Set	Weather Type	TLC	Snow Fall	Snow Depth	Avg Stn	Avg SL	Avg Speed	Peak Speed	Peak Dir	Sust. Speed	Sust. Dir
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01	60	48	54	1.4	57	38	47	11	0	0630	1659		0.00	0.0	0	30.03	30.10	10.6	25	290	18	320
02	53	41	47	-5.3	72	38	43	18	0	0631	1658	RA	0.02	0.0	0	30.19	30.23	7.0	21	300	16	300
03	53	37	45	-7.0	59	31	39	20	0	0632	1657		0.00	0.0	0	30.24	30.28	7.4	22	290	17	320
04	53	36	45	-6.7	57	29	38	20	0	0633	1656		0.00	0.0	0	30.29	30.31	5.0	20	350	10	350
05	54	35	45	-6.4	55	28	37	20	0	0634	1655		0.00	0.0	0	30.30	30.35	6.5	23	360	16	030
06	57	34	46	-5.1	60	31	39	19	0	0635	1653		0.00	0.0	0	30.35	30.36	5.9	17	040	14	080
07	55	37	46	-4.8	57	31	40	19	0	0636	1652		0.00	0.0	0	30.16	30.18	5.0	20	030	13	020
08	67	40	54	3.5	56	38	47	11	0	0638	1651		0.00	0.0	0	30.10	30.14	5.6	23	360	16	030
09	71	44	58	7.8	65	43	50	7	0	0639	1650		0.00	0.0	0	30.08	30.10	5.6	19	230	15	240
10	68	47	58	8.1	60	43	50	7	0	0640	1649		0.00	0.0	0	30.06	30.11	6.0	25	340	20	340
11	67	42	55	5.5	69	44	49	10	0	0641	1648		0.00	0.0	0	30.19	30.21	6.7	22	100	17	110
12	68	45	57	7.8	73	50	55	8	0	0642	1648	RA BR	0.15	0.0	0	29.93	29.94	10.3	31	140	24	230
13	62	40	51	2.1	71	38	43	14	0	0643	1647	RA	T	0.0	0	29.79	29.84	10.6	47	290	36	280
14	49	37	43	-5.6	64	31	38	22	0	0644	1646	RA	0.01	0.0	0	29.90	29.91	8.9	26	230	22	230
15	49	38	44	-4.2	60	30	38	21	0	0646	1645	RA	T	0.0	0	29.85	29.91	13.5	36	270	26	270
16	50	34	42	-5.9	59	27	36	23	0	0647	1644		0.00	0.0	0	30.13	30.19	7.9	23	270	18	260
17	66	30	48	0.5	74	40	45	17	0	0648	1644		0.00	0.0	0	30.21	30.22	4.7	24	180	15	190
18	73*	47	60	12.8	64	47	53	5	0	0649	1643	RA	0.07	0.0	0	29.99	30.02	10.8	38	310	26	310
19	49	37	43	-3.9	44	24	37	22	0	0650	1642	RA	T	0.0	0	30.24	30.32	13.3	34	310	26	300
20	49	32	41	-5.5	62	29	37	24	0	0651	1641		0.00	0.0	0	30.49	30.51	3.7	15	190	12	200
21	54	39	47	0.8	74	40	44	18	0	0652	1641	RA	T	0.0	0	30.23	30.22	3.4	14	200	10	180
22	54	38	46	0.2	62	35	43	19	0	0653	1640	RA BR	0.05	0.0	0	29.87	29.91	10.2	26	320	21	320
23	46	33	40	-5.4	44	18	32	25	0	0655	1640		0.00	0.0	0	30.03	30.09	11.5	33	340	25	340
24	49	29*	39	-6.1	50	22	33	26	0	0656	1639		0.00	0.0	0	30.29	30.33	6.3	19	320	15	320
25	57	35	46	1.3	55	30	39	19	0	0657	1639	RA	T	0.0	0	30.05	30.04	6.4	14	250	12	240
26	50	40	45	0.7	58	30	39	20	0	0658	1638	RA BR	0.16	0.0	0	29.72	29.75	16.1	42	290	32	280
27	43	38	41	-3.0	44	19	32	24	0	0659	1638		0.00	0.0	0	29.88	29.94	13.7	30	290	24	300
28	53	37	45	1.4	58	29	37	20	0	0700	1638	RA	T	0.0	0	29.85	29.86	3.9	17	320	13	020
29	46	34	40	-3.2	51	24	34	25	0	0701	1637	RA	T	0.0	0	29.90	29.95	11.1	30	340	22	320
30	45	30	38	-4.9	58	27	35	27	0	0702	1637		T	0.0	0	29.98	30.01	5.9	19	210	12	230
	55.7	37.8	46.8									**Monthly Averages | Totals**	0.46			30.08	30.11	8.1				
	-0.3	-1.4	-0.8									**Departure from Normal (1981-2010)**	-2.53									

Degree Days

	Monthly Total	Monthly Departure	Season-to-date Total	Season-to-date Departure
Heating	548	25	645	
Cooling	0	-1	1548	

Number of days with...

Temperature Max >=90°	Temperature Max <=32°	Temperature Min <=32°	Temperature Min <=0°	Precipitation >=0.01"	Precipitation >=0.1"	Snow >=1"	Weather T-Storms	Weather Heavy Fog
0	0	4	0	6	2	0		

Date of 5-sec to 3-sec wind equipment change

2009-07-30

Sea Level Pressure

	Value	Date	Time
Maximum	30.59	20	0954
Minimum	29.68	13	1254

Greatest...

	24-Hr... Precip	24-Hr... Snowfall	Snow Depth
Value	0.16	0.0	0.0
Date	26-26		

Station Augmentation

Name:PHILADELPHIA CENTER CITY, PA Lat: 39.96056 Lon: -75.14263 Elevation: N/A Distance: N/A Elements: SNOW Equipment: N/A

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
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Local Climatological Data
Hourly Observations
November 2021
Generated on 06/23/2022

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	Time (LST)	Station Type	Sky Conditions	Visibility	Weather Type (see documentation) AU | AW | MW	Dry Bulb Temp (F)	Dry Bulb Temp (C)	Wet Bulb Temp (F)	Wet Bulb Temp (C)	Dew Point Temp (F)	Dew Point Temp (C)	Rel Hum %	Wind Speed (MPH)	Wind Dir (Deg)	Wind Gusts (MPH)	Station Press (inHg)	Press. Tend	Net 3-Hr Change (inHg)	Sea Level Press. (inHg)	Report Type	Precip Total (in)	Altimeter Setting (inHg)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
30	0054	7	FEW:02 50	10.00		31	-0.6	27	-2.8	20	-6.7	64	5	250		30.01	8	+0.01	30.04	FM-15	0.00	30.04
30	0100	4	57	9.94		31	-0.6	27	-2.8	20	-6.7	64	5	250		29.98	8	+0.01	30.04	FM-12		
30	0154	7	SCT:04 55	10.00		33	0.6	29	-1.7	21	-6.1	61	7	240		30.03			30.06	FM-15	0.00	30.06
30	0254	7	OVC:08 60	10.00		35	1.7	31	-0.6	24	-4.4	64	5	230		30.03			30.05	FM-15	0.00	30.06
30	0354	7	OVC:08 60	10.00		36	2.2	33	0.6	27	-2.8	70	5	230		30.02	0	-0.01	30.05	FM-15	0.00	30.05
30	0454	7	SCT:04 60 OVC:08 130	10.00		35	1.7	32	0.0	26	-3.3	70	5	230		30.01			30.04	FM-15	0.00	30.04
30	0554	7	SCT:04 65 BKN:07 110 OVC:08 160	10.00		36	2.2	32	0.0	26	-3.3	67	6	230		30.02			30.05	FM-15	0.00	30.05
30	0654	7	BKN:07 65 BKN:07 80 OVC:08 160	10.00		37	2.8	33	0.6	25	-3.9	62	7	220		30.02	3	0.00	30.05	FM-15	0.00	30.05
30	0700	4	57	9.94		37	2.8	33	0.6	25	-3.9	62	7	220		29.98	3	0.00	30.05	FM-12		
30	0754	7	BKN:07 70 OVC:08 160	10.00		38	3.3	33	0.6	24	-4.4	57	10	230		30.03			30.05	FM-15	0.00	30.06
30	0854	7	OVC:08 75	10.00		40	4.4	34	1.1	25	-3.9	55	0	000		30.01			30.04	FM-15	0.00	30.04
30	0954	7	OVC:08 70	10.00		40	4.4	35	1.7	26	-3.3	58	6	190		30.02	5	+0.01	30.05	FM-15	0.00	30.05
30	1054	7	FEW:02 50 SCT:04 70 OVC:08 90	10.00		41	5.0	35	1.7	26	-3.3	55	7	190		29.99			30.02	FM-15	0.00	30.02
30	1154	7	FEW:02 50 OVC:08 65	10.00		43	6.1	37	2.8	28	-2.2	56	6	190		29.97			29.99	FM-15	0.00	30.00
30	1254	7	SCT:04 50 OVC:08 65	10.00		43	6.1	37	2.8	29	-1.7	58	9	200		29.94	8	+0.08	29.96	FM-15	T	29.97
30	1300	4	57	9.94		43	6.1	37	2.8	29	-1.7	58	9	200		29.91	8	+0.08	29.96	FM-12		
30	1354	7	FEW:02 50 OVC:08 65	10.00		44	6.7	38	3.3	28	-2.2	53	6	190		29.92			29.94	FM-15	0.00	29.95
30	1454	7	OVC:08 60	10.00		44	6.7	38	3.3	28	-2.2	53	8	200		29.92			29.94	FM-15	0.00	29.95
30	1554	7	OVC:08 55	10.00		45	7.2	38	3.3	29	-1.7	54	6	200		29.91	6	+0.03	29.94	FM-15	0.00	29.94
30	1654	7	FEW:02 50 OVC:08 65	10.00		45	7.2	38	3.3	29	-1.7	54	7	230		29.92			29.95	FM-15	0.00	29.95
30	1754	7	OVC:08 60	10.00		45	7.2	38	3.3	28	-2.2	52	9	230		29.94			29.97	FM-15	0.00	29.97
30	1854	7	OVC:08 55	10.00		45	7.2	38	3.3	27	-2.8	49	7	230		29.95	3	-0.04	29.98	FM-15	0.00	29.98
30	1900	4	57	9.94		45	7.2	38	3.3	27	-2.8	49	7	230		29.91	3	-0.04	29.98	FM-12		
30	1954	7	OVC:08 55	10.00		44	6.7	38	3.3	28	-2.2	53	5	210		29.96			29.99	FM-15	0.00	29.99
30	2054	7	OVC:08 55	10.00		43	6.1	37	2.8	29	-1.7	58	7	190		29.96			29.99	FM-15	0.00	29.99
30	2154	7	BKN:07 60	10.00		43	6.1	37	2.8	29	-1.7	58	0	000		29.96	1	-0.01	29.99	FM-15	0.00	29.99
30	2254	7	BKN:07 65 OVC:08 85	10.00		42	5.6	37	2.8	30	-1.1	62	5	200		29.97			30.00	FM-15	0.00	30.00
30	2354	7	SCT:04 70 BKN:07 85	10.00		40	4.4	36	2.2	29	-1.7	65	7	200		29.97			30.00	FM-15	0.00	30.00

U.S. Department of Commerce
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Hourly Remarks
November 2021
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National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	Time (LST)	Remarks
30	0054	MET11911/30/21 00:54:02 METAR KPHL 300554Z 25004KT 10SM FEW050 M01/M07 A3004 RMK AO2 SLP173 T10061067 10044 21006 58002 (LPA)
30	0100	SYN08072408 32766 22504 11006 21067 30151 40173 58002 90554 333 10061 21006 555 93006=
30	0154	MET10011/30/21 01:54:02 METAR KPHL 300654Z 24006KT 10SM SCT055 01/M06 A3006 RMK AO2 SLP178 T00061061 (LPA)
30	0254	MET10011/30/21 02:54:02 METAR KPHL 300754Z 23004KT 10SM OVC060 02/M04 A3006 RMK AO2 SLP177 T00171044 (LPA)
30	0354	MET10611/30/21 03:54:02 METAR KPHL 300854Z 23004KT 10SM OVC060 02/M03 A3005 RMK AO2 SLP175 T00221028 50003 (LPA)
30	0454	MET10711/30/21 04:54:02 METAR KPHL 300954Z 23004KT 10SM SCT060 OVC130 02/M03 A3004 RMK AO2 SLP173 T00171033 (LPA)
30	0554	MET11411/30/21 05:54:02 METAR KPHL 301054Z 23005KT 10SM SCT065 BKN110 OVC160 02/M03 A3005 RMK AO2 SLP177 T00221033 (LPA)
30	0654	MET13211/30/21 06:54:02 METAR KPHL 301154Z 22006KT 10SM BKN065 BKN080 OVC160 03/M04 A3005 RMK AO2 SLP177 T00281039 10028 21011 53001 (GAH)
30	0700	SYN08072408 32766 82206 10028 21039 30154 40177 53001 91154 333 10078 21011 555 93012=
30	0754	MET10711/30/21 07:54:02 METAR KPHL 301254Z 23009KT 10SM BKN070 OVC160 03/M04 A3006 RMK AO2 SLP177 T00331044 (GAH)
30	0854	MET10011/30/21 08:54:02 METAR KPHL 301354Z 00000KT 10SM OVC075 04/M04 A3004 RMK AO2 SLP173 T00441039 (GAH)
30	0954	MET10611/30/21 09:54:02 METAR KPHL 301454Z 19005KT 10SM OVC070 04/M03 A3005 RMK AO2 SLP175 T00441033 55002 (GAH)
30	1054	MET11411/30/21 10:54:02 METAR KPHL 301554Z 19006KT 10SM FEW050 SCT070 OVC090 05/M03 A3002 RMK AO2 SLP166 T00501033 (GAH)
30	1154	MET10711/30/21 11:54:02 METAR KPHL 301654Z 19005KT 10SM FEW050 OVC065 06/M02 A3000 RMK AO2 SLP157 T00611022 (GAH)
30	1254	MET14611/30/21 12:54:02 METAR KPHL 301754Z 20008KT 10SM SCT050 OVC065 06/M02 A2997 RMK AO2 RAB08E40 SLP147 P0000 60000 T00611017 10067 20022 58027 (GAH)
30	1300	SYN08672408 12766 82008 10061 21017 30127 40147 58027 69901 91754 333 10067 20022 555 93018=
30	1354	MET10711/30/21 13:54:02 METAR KPHL 301854Z 19005KT 10SM FEW050 OVC065 07/M02 A2995 RMK AO2 SLP140 T00671022 (GAH)
30	1454	MET09911/30/21 14:54:02 METAR KPHL 301954Z 20007KT 10SM OVC060 07/M02 A2995 RMK AO2 SLP140 T00671022 (SS)
30	1554	MET10511/30/21 15:54:02 METAR KPHL 302054Z 20005KT 10SM OVC055 07/M02 A2994 RMK AO2 SLP138 T00721017 56009 (SS)
30	1654	MET10611/30/21 16:54:02 METAR KPHL 302154Z 23006KT 10SM FEW050 OVC065 07/M02 A2995 RMK AO2 SLP141 T00721017 (SS)
30	1754	MET09911/30/21 17:54:02 METAR KPHL 302254Z 23008KT 10SM OVC060 07/M02 A2997 RMK AO2 SLP148 T00721022 (SS)
30	1854	MET11711/30/21 18:54:02 METAR KPHL 302354Z 23006KT 10SM OVC055 07/M03 A2998 RMK AO2 SLP153 T00721028 10072 20061 53015 (SS)
30	1900	SYN08072408 32766 82306 10072 21028 30130 40153 53015 92354 333 10072 20022 555 90100=
30	1954	MET09911/30/21 19:54:03 METAR KPHL 010054Z 21004KT 10SM OVC055 07/M02 A2999 RMK AO2 SLP156 T00671022 (SS)
30	2054	MET09911/30/21 20:54:03 METAR KPHL 010154Z 19006KT 10SM OVC055 06/M02 A2999 RMK AO2 SLP155 T00611017 (SS)
30	2154	MET10611/30/21 21:54:03 METAR KPHL 010254Z 00000KT 10SM BKN060 06/M02 A2999 RMK AO2 SLP156 T00611017 51003 (LPA)
30	2254	MET10711/30/21 22:54:03 METAR KPHL 010354Z 20004KT 10SM BKN065 OVC085 06/M01 A3000 RMK AO2 SLP160 T00561011 (LPA)
30	2354	MET11711/30/21 23:54:03 METAR KPHL 010454Z 20006KT 10SM SCT070 BKN085 04/M02 A3000 RMK AO2 SLP160 T00441017 400721011 (LPA)

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November 2021

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National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 7 ft. Lat: 39.8733° N Lon: -75.2268° W
Station: **PHILADELPHIA INTERNATIONAL AIRPORT, PA US WBAN: 72408013739 (KPHL)**

Date	For Hour (LST) Ending at																								Date
	1 AM	**2 AM**	**3 AM**	**4 AM**	**5 AM**	**6 AM**	**7 AM**	**8 AM**	**9 AM**	**10 AM**	**11 AM**	**NOON**	**1 PM**	**2 PM**	**3 PM**	**4 PM**	**5 PM**	**6 PM**	**7 PM**	**8 PM**	**9 PM**	**10 PM**	**11 PM**	**MID**	
01																									01
02										T	T	T	T	0.01	T	0.01	T	T							02
03																									03
04																									04
05																									05
06																									06
07																									07
08																									08
09																									09
10																									10
11																									11
12				T		T	T	0.04	T	0.05	0.05	0.01													12
13													T	T	T										13
14																			T	T	T	0.01	T		14
15					T	T	T	T																	15
16																									16
17																									17
18																				T	T	0.06	T	0.01	18
19		T	T																						19
20																									20
21																			T						21
22		T	T	0.01	0.01	T	0.03	T																	22
23																									23
24																									24
25																								T	25
26	0.01	0.04	0.04	0.03	0.01		0.02	0.01	T																26
27																									27
28																								T	28
29	T																								29
30													T												30

Maximum Short Duration Precipitation

Time Period (Minutes)	**5**	**10**	**15**	**20**	**30**	**45**	**60**	**80**	**100**	**120**	**150**	**180**
Precipitation (inches)	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.09	0.10	0.11	0.12
Ending Date Time (yyyy-mm-dd hh:mi)	2021-11-12 09:18	2021-11-12 09:18	2021-11-12 09:18	2021-11-18 21:39	2021-11-18 21:39	2021-11-18 21:39	2021-11-18 21:39	2021-11-26 02:59	2021-11-12 10:53	2021-11-12 10:56	2021-11-12 11:20	2021-11-26 03:48

Hourly, daily, and monthly totals on the Daily Summary page and the Hourly Precipitation Table are shown as reported by the instrumentation at the site. However, NWS does not edit hourly values for its ASOS sites, but may edit the daily and monthly totals for selected sites which will be reflected on the Daily Summary page.

T = Trace
s = Suspect
* = Erroneous
blank = No precipitation observed
M = Missing

I&E Exhibit 10

October 6, 2022

Ms. Jane Lamb
Philadelphia Gas Works
800 West Montgomery Avenue
Philadelphia, PA 19122

Insured:	Philadelphia Gas Works
Claimant:	Kimheng Veang
Address:	815 Jackson Street Philadelphia, PA 19148
D/O/L:	11/30/21
Your File No:	2021033550
FCNA File No:	104307

Dear Ms. Lamb:

On December 9, 2021 you contacted our office and requested we conduct an investigation into the origin and cause of the fire and explosion damage that occurred to the subject premises on November 30, 2021. I contacted neighbors regarding the subject loss and contacted John Goetz, Fire Investigator, for the damaged property on January 10, 2022 and scheduled an inspection of the property located at 815 Jackson Street, Philadelphia, PA on January 12, 2022. Present at this site inspection were Fire Investigator Gus Tkacas representing the homeowner of 815 Jackson Street, Mechanical Specialist Michael Zazula representing Clemens Brothers Plumbing, representatives from Philadelphia Gas Works and this writer.

Our investigation has been conducted in accordance with National Fire Protection Association (NFPA) 921 2021 Edition, (NFPA) 1033 (Reapproved 2021), and ASTM International consensus standard guidelines, which outline current fire investigation methodology and scientific practice intended to determine the most reasonable scientific explanation for this fire incident and its damage accounting for all significant data and information.

SCOPE OF SERVICES

At your request, we:

1. Performed a visual observation of the residence from the exterior to the interior, including the electrical outlets and circuit breaker panel. The most significant fire damage occurred in the basement area.

2. Provided a verbal report of our findings.

3. Prepared this initial written report and attached photographs summarizing my findings to date.

BACKGROUND

It is reported that on November 30, 2021, an explosion and subsequent fire originated in the basement of this structure.

The subject structure is a two-story, three-bedroom rowhome located in the middle of the row (refer to photograph 1). There is also a full unfinished basement where all utilities were located. The exterior is brick and the interior support system is frame. The house is approximately 14' in width and approximately 40' in length. This dwelling reportedly was built in 1925 and is therefore approximately 97 years old. The dwelling was owner occupied at the time of this incident and protected by single station battery operated smoke detectors.

On September 7, 2021, representatives from Clemens Brothers Plumbing excavated the sidewalk, curb and asphalt street surface in front of 815 Jackson Street to install a lateral curb trap for the dwelling's sewer trap. Preexisting piping for the sewer trap reportedly was over 100 years old. According to Mr. Zazula representing Clemens Brothers, a backhoe was used for the excavation and a section of sidewalk and the street surface had been replaced with a new asphalt surface.

The street surface where the excavation occurred directly in front of 815 Jackson Street was sunken downward several inches. It appeared that the unearthing of soil caused an underground cavity that can affect and compromise underground utilities such as the underground natural gas piping, water piping and sewer piping located adjacent to the curbside excavation work of contractor Clemens Brothers Company.

OBJECTIVE

The purpose of the site investigation and this report are to discuss the condition of the subject premises and to set forth my opinions as to the origin and cause of the subject fire/explosion loss.

ANALYSIS

My investigation established that this fire/explosion originated within the basement area of 815 Jackson Street. Representatives from Philadelphia Gas Works responded to the explosion and subsequent fire and were dispatched to the area of 8th Street and Jackson Street. Technicians from PGW arrived and checked the Jackson Street area for possible fugitive gas leaks. Gas meter equipment immediately discovered a leak in the area of 815 Jackson Street and PGW personnel then shut off gas service to the area and technicians isolated the area of the suspected gas leak. Technicians later excavated the area of the suspected gas leak and discovered an underground natural gas line had a breach/crack on piping. The subject pipe reportedly was originally installed around 1889, and there were no known previous complaints by neighbors about detecting odors of leaking gas nor were there any complaints to PGW regarding leaking gas prior to this fire/explosion event.

It appears the fugitive gas leaked and migrated through the ground and entered utility chase ways at basement level of 815 Jackson Street. Escaping gas vapors were most likely ignited by natural gas fired appliances at basement level. A natural gas fired heater, natural gas fired hot water and natural gas fired dryer were all located at basement level. Burn patterns were consistent with migrating natural gas vapors, being ignited by an open flame appliance. It is noted that an older vintage natural gas fired heater in the basement was devoid of the cover for the flame chamber of that appliance.

Investigation revealed there was no obvious fault or failure of the natural gas meter located in the basement, and the second stage regulator appeared to be in pristine condition even after the explosion/fire event, and the associated gas piping at basement level also appeared to be in good condition.

Fire damage from direct flame impingement was relegated to the basement area. There was minor heat and smoke damage throughout the first and second floors of the dwelling. Windows located in the basement and first floor levels were damaged by the explosion.

As part of my investigation, I reviewed the report of Metallurgist John Guzinski of Affiliated Engineering. Mr. Guzinski conducted a lab analysis of the fractured gas line and opined that although the fractured pipe was over 100 years old, most of the associated piping was in relatively good condition. Mr. Guzinski also opined that undermining of soil by any means can cause movement of piping or create stress on piping. It is also significant that backfill materials including stone, dirt and other fill materials can adversely affect the structural integrity of underground piping.

It is known that natural gas explosions can be directly related to gas pipes being undermined by water main breaks or excavation that displace pipes from their original position. Displaced excavated soil/earth that initially served to brace and secure pipes must be replaced in a similar fashion to maintain support and integrity of the existing gas pipes, and I concur with the conclusions of Mr. Guzinski.

In summary, this fire/explosion event occurred when escaping natural gas vapors from a crack in underground gas piping migrated over time into the basement area of 815 Jackson Street. Fugitive escaping gas vapors were most likely ignited by a natural gas fired appliance located at basement level, thus causing a low-level explosion and subsequent fire. The potential exists that work performed by Clemens Brothers Plumbing on September 7, 2021, while excavating underground soil for a lateral curb trap replacement, compromised the natural gas piping that was later found to be damaged.

CONCLUSIONS

Based on my education, experience, training and scene evaluation, and to a reasonable degree of scientific certainty, the following conclusions are provided:

1. This fire/explosion originated within a clearly defined area of fire origin in the dwelling's basement area.

2. All of the damage to the structure and its contents are scientifically explained by a fugitive gas leak entering the dwelling at basement level.

3. Leaking gas vapors were ignited by a natural gas fired appliance at basement level.

4. Excavation, backfilling, replacement of soil and asphalt surfaces by Clemens Brothers Plumbing, while completing a lateral curb trap, most likely contributed to the damage/cracking of the underground natural gas pipe and subsequent escape and migration of gas vapors that entered the subject residence of 815 Jackson Street.

I reserve the right to supplement the findings and opinions set for in this report should new information become available and as my investigation of this fire/explosion event continues.

Respectfully submitted,

Forensic Consultants of North America, LLC

James M. Jones

James M. Jones, C.F.E.I.

Attachments: Photographs

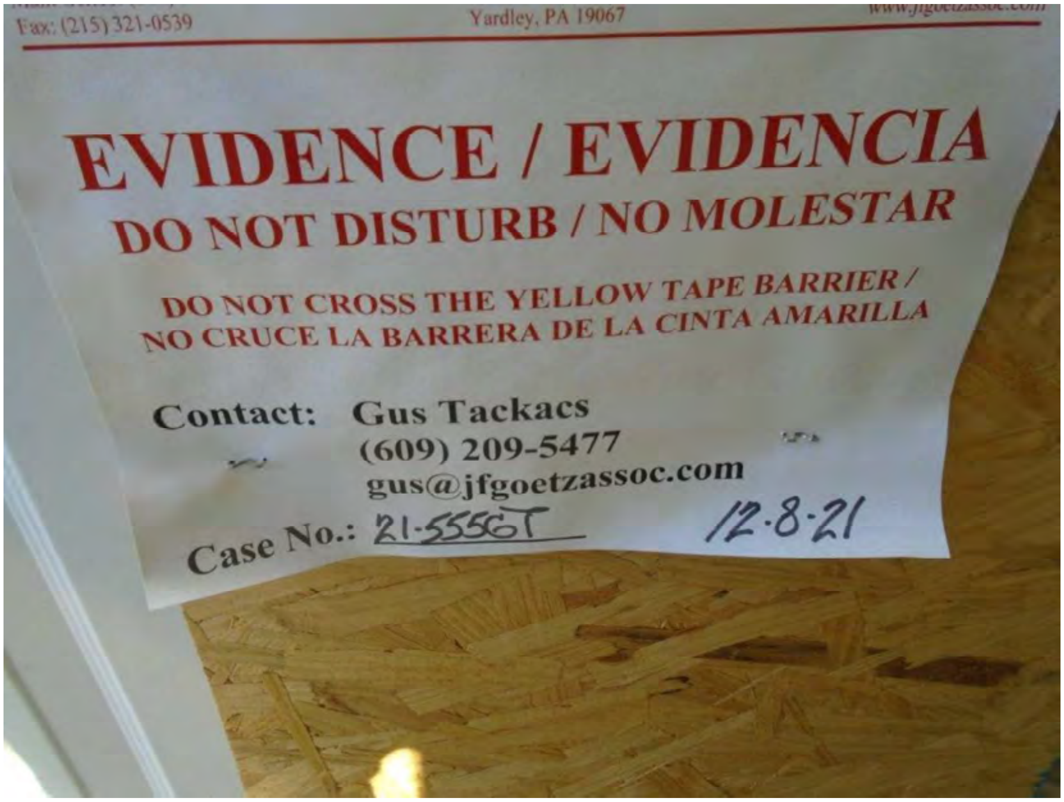
ATTACHMENTS

Photograph #1: Front view of 815 Jackson Street.

Photograph #2: Front view of 815 Jackson Street.

Photograph #3: 800 block of Jackson Street.

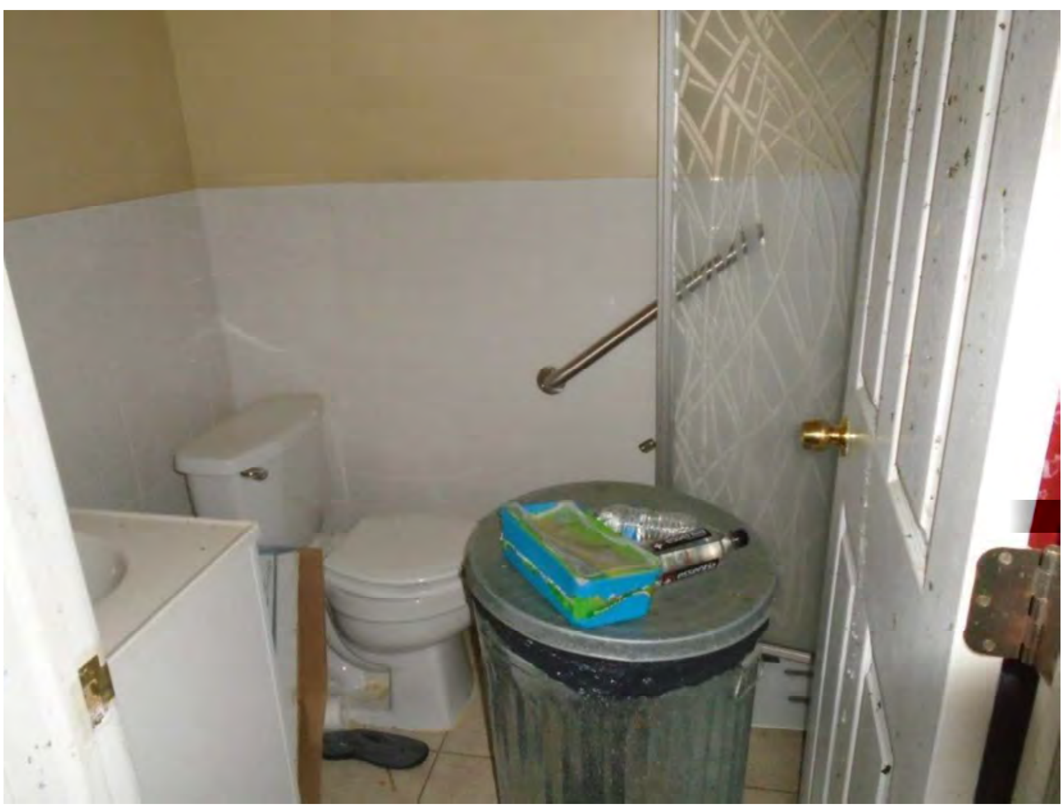
Photograph #4: Gas pipe lateral to 818 Jackson Street.



Photograph #5: Evidence placard at 815 Jackson Street.

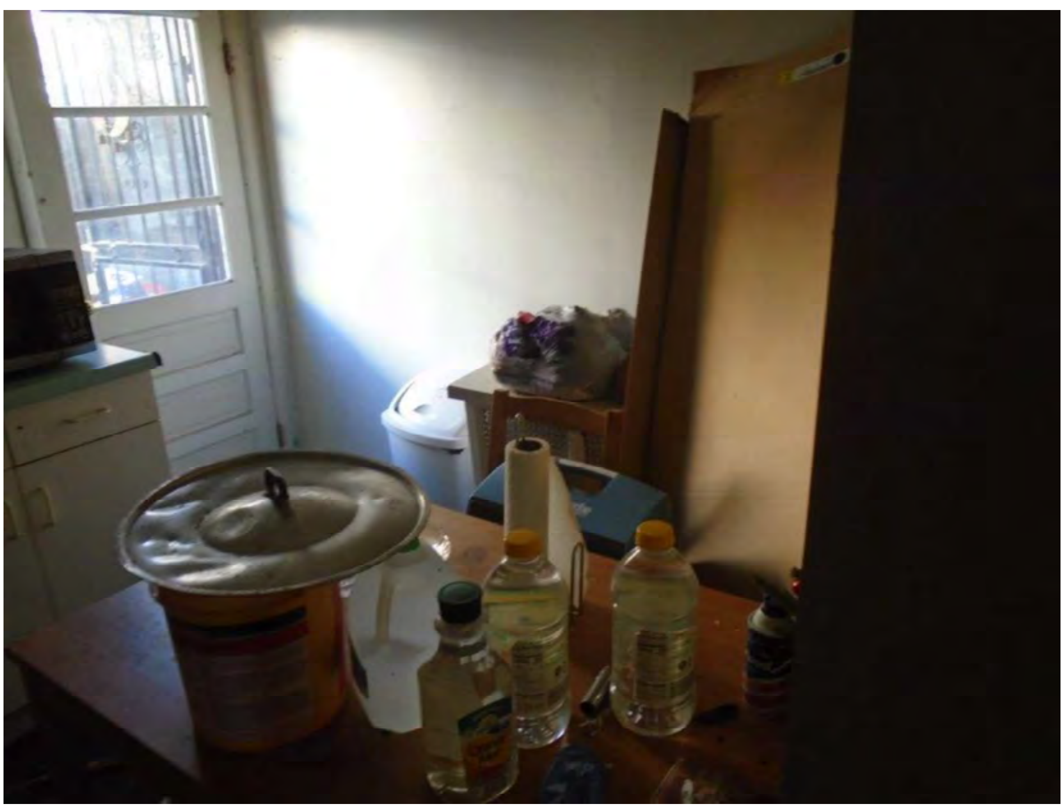
Photograph #6: Living room at 815 Jackson Street.

Photograph #7: Living room.



Photograph #8: Bathroom.

Photograph #9: Kitchen.



Photograph #10: Kitchen.

Photograph #11: Damaged living room wall at stairwell.

Photograph #12: Front window broken out in living room.

Photograph #13: Natural gas pipes located in basement at 815 Jackson Street.

Photograph #14: Natural gas pipes located in basement at 815 Jackson Street.

Photograph #15: Burned rags on basement floor.

Photograph #16: Natural gas pipes in basement.

Photograph #17: Gas pipes where gas meter was located.

Photograph #18: Electric meter in basement.

Photograph #19: Circuit breaker panel in basement.

Photograph #20: Associated wiring from circuit breaker panel.

Photograph #21: Natural gas pipes in basement.

Photograph #22: Natural gas pipes in basement.

Photograph #23: Natural gas pipes in basement.

Photograph #24: Storage items in basement.

Photograph #25: Gas pipes in basement/heat stains on drainpipes.

Photograph #26: Heat stains on drainpipes in basement.

Photograph #27: Natural gas-fired heater in basement.

Photograph #28: Flue pipes for heater.

Photograph #29: Natural gas-fired hot water heater located in basement.

Photograph #30: Flame chamber for hot water.

Photograph #31: Flame chamber for hot water.

Photograph #32: Flame chamber for heater.

Photograph #33: Flame chamber for gas dryer.

Photograph #34: Melted plastic bag located on dryer.

Photograph #35: Gas pipes in basement.

Photograph #36: Gas pipes in basement.

Photograph #37: Sidewalk area in the front of 815 Jackson Street where plumber worked.

Photograph #38: Sidewalk area in the front of 815 Jackson Street where plumber worked.

Photograph #39: Sidewalk area in the front of 815 Jackson Street where plumber worked.

Photograph #40: Sidewalk area in the front of 815 Jackson Street where plumber worked.

Photograph #41: Ground undermined in the front of 815 Jackson Street.

Photograph #42: Ground undermined in the front of 815 Jackson Street.

Photograph #43: Ground undermined in the front of 815 Jackson Street.

Photograph #44: Ground undermined in the front of 815 Jackson Street.

Photograph #45: Ground undermined in the front of 815 Jackson Street.

I&E Exhibit 11

PGW	FIELD OPERATIONS **DISTRIBUTION DEPARTMENT** Effective Date: 9/1/13	SUMMARY OF DISTRIBUTION DEPARTMENT DAMAGE PREVENTION PROGRAM Bulletin Number 312 Supersedes: Document dated 2/2012

I. **To:** Distribution Department personnel and other relevant entities.

II Damage Prevention Mission Statement

- To remain in full compliance with all federal and state requirements with regard to underground pipeline facilities damage prevention.
- To be a member of the Pennsylvania One Call System, Inc. and to participate actively in public and contractor awareness education programs, promoting safe excavating practices and the use of the one call system (811).
- To assist contractors and other excavators with timely and accurate mark-outs, and to communicate effectively with them
- To offer safety rechecks on on-going job sites, when time and conditions permit.
- To observe contractor activities when necessary and to offer assistance to safeguard PGW facilities during construction.
- To communicate the need for a shared responsibility/partnership among the excavation community to dig responsibly, minimize costly delays, environmental damage, property damage, and personal injury.

III Prevention of Damage to Pipeline Facilities and Structures

A. Excavation, Demolition and Blasting

- PGW is a member of the Pennsylvania One Call System. PGW actively participates in and sponsors contractor awareness events in the Philadelphia area. Upon receipt of notice of excavation, demolition or blasting, the location of pipeline facilities shall be determined and an inspector shall be dispatched to the work site as required, in order to mark the location of pipeline facilities. On major construction projects or where important pipeline facilities may be affected, a supervisor shall determine the need to assign a full time inspector or watchman during the period of construction.
- In conjunction with inspections at all City gate stations (normally made once each shift, seven days a week by Gas Processing personnel), the employee making such

inspections shall, to the extent practicable, travel the route of natural gas supply lines.

- Wherever pipeline facilities are or may be endangered, the appropriate supervisor shall be promptly informed. The supervisor shall, after consulting with his/her superiors, institute necessary actions such as patrolling, supporting, replacing, relocating or removing from service the affected gas facilities.

- Upon receipt of notice of blasting or implosion, the supervisor shall contact the Superintendent of Maintenance and Operations or above who will determine the need for a leak survey, both prior and after blasting, based on the type and location of PGW facilities. The Philadelphia Fire Marshall's office usually notifies PGW of any permits extended to contractors for blasting.

B. <u>Failure of Other than PGW Underground Facilities</u>

Upon receipt of notice of water or sewer system failures, or surface conditions, such as cavities or cave-ins which may be caused by such failures, the location of gas pipeline facilities shall be determined. Where pipeline facilities may be affected, appropriate personnel shall be dispatched promptly to determine the effect of the failure on pipeline facilities. Inspection and necessary follow-up action shall be in accordance with the "Protection of PGW Facilities from Underground Street Troubles" procedure.

IV. Associated Procedure(s)

DD Bulletin#54: Procedure on Underground Street Troubles
DD Bulletin#24: Prevention of Damage to Underground Control Line
DD Bulletin#198: PGW Use of Directional Drilling To Lay Mains or Services
DD Bulletin#201: Damage Prevention Policy Regarding Trenchless Technology
DD Bulletin#211: Excavation Interference with All Other Utility Lines Procedure
PGW Damage Prevention Program Brochure

V. Handbooks

Foreman’s Handbook

VI. Attachments

N/A

	FIELD OPERATIONS **DISTRIBUTION DEPARTMENT** Effective Date: 9/1/13	SUMMARY OF DISTRIBUTION DEPARTMENT DAMAGE PREVENTION PROGRAM Bulletin Number 312 Supersedes: Document dated 2/2012

VII. Transaction Listing

TR-2013-12

Prepared by A. Awad

Approved by:

Signature on File

Raymond J. Welte
Director, Field Operations & Planning

Signature on File

Michael H. Jones
Vice President, Technical Compliance

I&E Exhibit 12

FIELD OPERATIONS

DISTRIBUTION DEPARTMENT

Effective Date: 6/3/20

INSTRUCTIONS FOR DISTRIBUTION DEPARTMENT DAMAGE PREVENTION INSPECTORS

Bulletin #313
Supersedes: 8/2/16

I. Purpose

To provide clear instructions for Distribution Department damage prevention inspectors regarding the various duties of their job.

II. Definitions

AIMS – Advanced Intelligent Mobile Solution: An automated LAN (Local Area Network) to mobile field application designed to generate, dispatch, and document work orders for FSD and Distribution workforce.

3rd Party – all construction activities other than PGW and PGW sub-contractors

III. Procedure

A. Objectives

The following are the main functions of PGW Damage Prevention Inspectors:

1. To inspect third party construction activities for the main purpose of protecting PGW underground structures and facilities.

2. To communicate with excavators, and give them proper and accurate information concerning the location of PGW underground structures by properly marking all PGW structures in the vicinity of excavator's work.

3. To respond to all Pennsylvania One Call System (POCS) tickets assigned to them through the AIMS application in a timely manner.

4. Keeping PGW supervisors informed of conditions found in the field concerning all known third party construction activities.

5. To act as, assist, and guide PGW watchman on construction sites.

6. To respond to all reports of third party damages to PGW facilities during business hours, complete the "Damage Prevention Report" form in AIMS, and assist the Distribution Supervisor reporting to the damage with any pertinent information as requested.

7. To perform patrols along the routes of all transmission mains and other critical pipelines in the distribution system. These pipeline patrols must be done on a weekly basis, but not to exceed two weeks. Records of all patrol activities will be noted and recorded in AIMS system.

8. Inspectors must be completely familiar with the Distribution Department detail main maps (DMM), general main maps (GMM), service cards & UFD/AIMS service lists, and AIMS Damage Prevention application and orders.

9. Inspectors must be completely familiar with and advocate the current PA One Call Law "Underground Utility Line Protection Act 50".

B. Equipment

Each Damage Prevention Inspector should have available, at all times, such items as the following:

1. POCS tickets orders (in AIMS)
2. PGW DMM maps (on field laptop)
3. Service lists (through field laptop)
4. Distribution Standards & Foreman's Handbook (on field laptop)
5. Several cans of yellow paint and yellow keel crayon
6. Yellow wire staff marking flags
7. POCS paraphernalia such as flyers, brochures, and the "Pa Act 50"
8. Flashlight
9. 6' rule and measuring wheel
10. Wax sealant and wrap*
11. Line locator (when needed)
12. Cell phone

*Wax wrap should not be given to any contractor.

C. Prioritization

The inspector will cover a variety of third party construction jobs and should prioritize the work in his/her area. The following priority list should be used as a guide. The Inspector must use good judgment to plan the workday and accomplish company goals.

Visit all Pennsylvania One Call ticket locations on time (prior to the end of their shift on the response due date on the ticket).

- Emergency Damage to a Gas Facility: Immediately
- Emergency: Same day, as soon as practicable
- Routine: Within three (3) business days of the POCS notification (day one is the date of the notification)
- Insufficient notice: Communicate with the excavator as soon as possible.
- Re-notify within two (2) hours

2. Re-visits to on-going jobs with watchman.

3. Re-visits to on-going jobs without watchman, particularly any jobs in which PGW facilities will be undermined, in order to report and/or recommend replacement or protection to the supervisor.

4. Visit any contractor who is suspected not to have called Pennsylvania One Call. The Inspector must provide the contractor with a copy of the current "Pa Act 50" and advocate the use of the 811 system.

5. Visit any underground street trouble encountered and report the same to Distribution Dispatching and supervisor.

6. Perform pipeline patrols along the route of all transmission mains and other high pressure mains that have been identified as critical structures. (See instructions for Natural Gas Patrols for details)

D. General Instructions

1. Plan the work. Call contractors to schedule large quantities of mark outs or to seek clarification. **Do not assume.** Inspectors must be alert and ready to volunteer information concerning PGW structures to all contractors who are excavating <u>whether notice was received or not</u>. The Inspector will educate and advise all excavators of their responsibility under the Pa One Call Act and inform them to call the Pennsylvania One Call System (811).

2. The Inspector should be acquainted with the correct and various methods of shoring and sheathing used by the contractors and whether the shoring is suitable for the protection of PGW underground structures. Be aware of insufficient shoring which could potentially cause damage to PGW

facilities. There are many alarm signals the Inspector should look for on his/her tour of inspection, such as:

- Parting of footway from the curb.
- Parting of footway from the walls of buildings, front steps, or other building appurtenances.
- Splitting or cracked roadways.
- Lack of support for PGW structures

3. These signals should not be ignored. The Inspector should, when such conditions are found, observe the service pipes at the front foundation wall for any pipe movement or disturbance of wall surface around the head of the service. If such conditions are encountered, notify the <u>supervisor</u> immediately. Certain excavations should be carefully inspected after heavy rainfalls, looking for trench erosion and when found should be brought to the attention of the contractor, City Inspector and the PGW supervisor.

4. Shallow PGW structures should be carefully watched. Heavy equipment will not be permitted to traverse over any shallow gas pipes. <u>Special attention should be given to protruding structures such as drip rods and high-head extensions for main and service valves.</u>

5. When the inspector comes across an excavation that is in direct conflict with PGW structure, he/she must notify the contractor as well as the PGW supervisor.

6. Undermined gas mains will be reported immediately to the PGW supervisor. Slope lines shall be carefully watched; 2feet-horizontal for every 1 foot- vertical.

7. Wherever a transmission pipeline or distribution pipeline operating in the 35 psig system or higher and district regulators are involved, an inspector must inform the supervisor immediately, who will then take the appropriate actions.

8. Machine excavation in the area of district regulators is prohibited. The supervisor will be notified immediately of any activity in the area, and outside control should be considered by the pressure supervisor.

9. **All excavations within the slope line (1foot vertical x 2 feet horizontal) of a transmission pipeline must be monitored by a PGW watchman.**

10. Any trenchless technology operation which may be in proximity to PGW structures requires close attention by the inspector. This must be brought, verbally, to the attention of the supervisor who will then plan a course of action, which should include a watchman or an Inspector's observation. **The use of trenchless technology is prohibited near a transmission pipeline.**

11. When a hydra-hammer or steel ball is used for breaking paving, consideration will be given to the type of main (steel or cast iron) and depth of same. Any contractor using a Vermeer trenching machine must be strictly enforced to comply with the 18 inch tolerance zone from any PGW structures. Consider requesting a watchman in such situations.

12. When a demolition POCS ticket is covered by the inspector, they must notify the one-call clerk, or dispatch (out of hours) for verification when the service to the building is still active. Notification of a distribution supervisor is also recommended. The demolition contractor will be notified and informed to cease the demolition until the service is abandoned.

13. Special attention should be given by the inspector to any encroachment of new buildings and other structures on gas main and service lines. All such encroachments must be immediately reported to the supervisor.

14. When marking gas services, special attention should be given to any offsets (such as 45s and 90s) within the service line. All offsets should be clearly identified and marked by the inspector.

15. Steel mains and services under cathodic protection will require special attention to avoid damage to wires as well as coating. Coating damages on gas mains when found should be measured accurately and a work order issued for immediate repairs.

16. Contractors working in deep yet un-shored excavations should be brought to the attention of the PGW supervisor.

17. When damages to PGW structures are encountered, a PGW Facilities Damage Report will be issued by the Inspector in AIMS, <u>whether or not an OAR is issued.</u> The report will list the date, contractor information, exact location of the damage, type and size of damaged facility, type of equipment used, reason for the damage, and the type of construction in progress. Notify the supervisor for possible OAR. <u>Remember that only the supervisor has the authority to issue or absolve an OAR.</u> The inspector is primarily responsible for an accurate detailed report as to what happened.

NOTE: Do not discuss fault, liability or cost issues with the contractor.

18. **<u>Notify the excavator every time there is a note on the Detail Main Map stating that a location of a mapped structure near the scope of the excavation site is unknown. For example: Location of Dead End or location of a main with respect to the curb. Once located, contact planning to have the Detail Main Map revised.</u>**

E. <u>Pipeline Patrol Procedures</u>

When performing a pipeline patrol, the inspector should be looking for any activity or changes in the environment that could affect the safety of the pipeline. An activity or changes found **must** be reported to the Supervisor immediately and documented in the corresponding AIMS order. The Supervisor will then immediately investigate and start remediation procedures if necessary and report his/her findings to the Superintendent of Operations & Maintenance. The following is a sampling of items the inspector should always report or act upon:

- Any excavations (including backfilled openings that are not familiar to the inspectors), grading, demolition, or other construction activity which could result in damage to a pipeline, loss of support due to settlement or shifting of soil around a pipeline, undermining or damage to a pipeline support, or loss of cover or excess fill.

- Atmospheric corrosion or physical deterioration of exposed pipe, pipeline, spans, and structural pipeline supports (such as bridges, pilings, headwalls, casing and foundations).

- Land subsidence, earth slippage, soil erosion, extensive tree root growth, flooding, climatic conditions, soil accumulation and other natural causes that can create additional external loading.

- Damage to pipeline markers, the need to replace them, or add additional pipeline markers. (Look to see that emergency contact information is clear and visible on all markers).

- Changes in population density around pipeline path. Look in particular for new buildings being constructed, daycare centers or schools being opened, and new housing complexes being built.

- Evidence of vandalism or tampering, or damage to the pipelines.

- Encroachment of buildings or other structures on pipeline right-of-ways.

- Any other abnormal or unusual conditions.

IV. Associated Documentation

Relevant Code

Pennsylvania Underground Utility Line Protection Act - ACT 50

Associated Documents

Foreman's Handbook Section XII

- DD #312 - Summary of Distribution Department Damage Prevention Program
- Foreign Construction Areas - Natural Gas Main/Route Maps
- Foreign Construction Area Map by Ward Numbers (Ward Map)
- PGW Damage Prevention Program Brochure

Attachments

N/A

V. Handbooks

Foreman's Handbook

VI. Transaction Listing

TR-2013-13

FIELD OPERATIONS

DISTRIBUTION DEPARTMENT

INSTRUCTIONS FOR DISTRIBUTION DEPARTMENT DAMAGE PREVENTION INSPECTORS

Effective Date: 6/3/20

Bulletin #313
Supersedes: 8/2/16

I&E Exhibit 13

	FIELD OPERATIONS **DISTRIBUTION DEPARTMENT** Effective Date: 6/10/20	**PROTECTION OF PGW FACILITIES FROM UNDERGROUND STREET TROUBLES** Bulletin #54 Supersedes: Bulletin #54 dated 4/15/11

I. Purpose

Dispatching and investigating failures of underground structures such as water and sewer mains that could reduce or eliminate support of PGW pipelines.

II. Definitions

Refer to Glossary

III. General Information

Underground troubles are usually brought to PGW's attention due to a condition observed on the street surface; or as a result of a pre-existing condition encountered in the performance of PGW work but not caused by PGW activity. Some underground troubles are:

- Water Leaks
- Washouts
- Sewer System Failure – Signs of a sewer system failure are as follows: cavity, cave-in, or paving faults such as a surface crack, settlement, or depression in the street or curb area.
- Paving depressions – These may be caused by settlement in "area" fill or settlement caused by poor backfill.

IV. Procedure

A. General Dispatching Procedure

A record of all such troubles whether the result of a telephone message or an observation on the street will be generated in AIMS by the Dispatcher as a Trouble Order for the Underground Street Trouble (UST).

If there is a report of a gas leak at the same location where there is an underground street trouble, the crew or inspector on site will be required to request a Leak Order. The Dispatcher will generate a Leak Order in AIMS. When a combination gas leak and underground street trouble occurs at the same time and location, a comment should be made in the comments tab of the Underground Street order that refer to a leak order being generated.

<u>It is important to emphasize that every complaint of underground street troubles must immediately be brought to the attention of the Dispatcher in the same manner as gas leaks.</u>

The decision to dispatch such trouble orders to an inspector, a crew and/or a supervisor relies on the judgment of the Dispatcher. From the description of the trouble, the general factors that affect his/her decision are:

1. Origin of the Notice

   a) POCS Notice – These notices can be handled by an Inspector during normal working hours. The Dispatcher will generate an Underground Street Trouble order in AIMS. The Inspector will also notify the Dispatcher if the situation warrants an immediate visit of a Distribution crew and/or supervisor. If the Inspector can determine at the time that PGW is not involved due to the distance of our structures from the UST and the containment of the UST problem, the job may be finaled at this point.

   b) Inspector Notice:
   <u>Normal Working Hours</u> - When an inspector is conducting a routine mark out on a designated location (address) and a UST is detected the inspector will generate a UST request order through AIMS and back that request up with a phone call to the Pa One Call clerk. The clerk will document the UST and forward it to the Dispatcher, and also call the proper city agency regarding the UST. The Dispatcher will issue an UST order in AIMS.

   <u>Out of Hours</u> – The inspector will request a UST order through AIMS and back that request up with a phone call to the Dispatcher. The Dispatcher will generate an UST order in AIMS and call the proper city agency regarding the UST.

   c) Direct call from the City, Police, Fire, Water Department, Highway Department, etc.

   d) PGW employee observation during the course of their work; for example, during a leak survey, leak investigation, main replacement or new business work.

   e) Other utility or customer.

2. Investigation of a UST - The magnitude and proximity (to PGW structures) of the underground trouble is important to observe and report.

Look for key indicators:

a) PGW involvement
b) Distance of the problem to PGW structures
c) Undermining
d) Status of the UST repair
e) Leak associated with the problem

Answers to any of the following questions may be important criteria to help the Dispatcher formulate his/her decision to issue further recheck or final of the order.

- In the case of water leaks:
  - Is the volume of water described?
  - Is the paving surface disturbed?
  - Is earth being washed to the surface or through underground ducts in the form of mud?
- In the case of cavity or cave in:
  - Is the depth or size described?
  - Is the affected paving surface area described?
- Have there been numerous complaints of either kind of case in a short period of time?
- What is the distance of PGW company structures related to the underground trouble?
  - Is there an opening so that gas can escape?
  - If a cavity is suspected and there is no surface evidence of water, is there an audible low of water?
  - Are any foregoing descriptions accompanied by statements of poor water pressure?
  - Are there reports that a gas odor is also noticeable or that a gas main or service is visibly affected?

In addition to calling 311, it will be our practice to continue to notify other local utilities which may also be affected by the underground street trouble which has been discovered.

B. <u>Dispatching/Auditing Procedure</u>

1. <u>Order Initiation Procedure - POCS Notice</u>

a) Normal Working Hours – POCS notices for UST activities will be dispatched to Foreign Construction Inspectors. The Dispatcher will generate an

Underground Street Trouble order in AIMS. They will in turn determine the need to initiate further investigation by a crew and/or Supervisor.

b) Out of Hours – Dispatch a crew as soon as possible.

c) All initial UST orders will be generated in AIMS.

d)

e) The original order shall be sent to the assigned crew for an initial visit report.

f) When the initial visit report is completed by the Foreman in AIMS, the initial visit report shall be audited using the same methods as street leak orders.

g) When an initial visit report is received from a Damage Prevention Inspector the auditor shall proceed to perpetuate the next visit or final the job.

2. <u>Order Perpetuation Procedure</u>

When auditing the initial visit report, note the important information which has been recorded by the Foreman in order to determine the next step to take. Look for key indicators:

a) PGW involvement
b) Distance of the problem to PGW structures
c) Undermining
d) Status of the UST repair
e) Leak associated with the problem

The Auditor will choose an appropriate re-inspection date based on the information given. The Auditor will then initiate a follow up UST order in AIMS transferring as much information as necessary.

Any report indicating PGW structures undermined must be referred to the Area Supervisor, as a follow up order. The recheck UST will be viewed and acted on by the Area Supervisor. If the Area Supervisor receives a call to report a UST, they must fill out a report with recommendations and submit the same to the Auditors.

3. Unresolved UST's

Any UST that has gone unrepaired for a longer than necessary period of time should be reviewed by the Area Supervisor and Chief Dispatcher. The Chief Dispatcher will provide updates to the Superintendent of Operations and Maintenance if the UST has not been repaired after a reasonable amount of time and has the potential to negatively affect PGW facilities.

C. Final of UST History

Auditor's Finals

1. One Visit Final – In some cases, one initial visit will be sufficient. If the report indicates **PGW not involved** and **UST repairs made**, the Auditor has the authority to final the job.

2. Two Visit Final – If after 2 visits both reports indicate no indication of any visible signs of a problem or activity and company structures are safe, the Auditor has the authority to final the job.

3. Supervisor Final – Whenever structures were actually sited as being involved with some type of underground street problem or the auditor feels there is a need to have a final visit by a Supervisor, the auditor will notify the local supervisor. The Supervisor will review the area in question and final the history based on the information on the history and his/her experience.

D. Additional UST Investigation points

There can be no standard procedure that would include all the conditions that may be encountered due to variations of conditions and other factors that in each case require experience and good judgment. It will help to describe in a general way a few variations of conditions and list a few minimum requirements.

- Expand the investigation as needed. In each case accessible manholes should be be examined.

In sewer manholes, observe for such conditions as abnormal volumes of water, unusual clarity of water, or water clouded by mud or other earth content, bricks or any unnatural debris.

- Unusual conditions observed in sewers, such as these specifically named above, or the existence of water, either still or running, in other manholes, indicates a suspicious condition that will require a thorough and complete investigation to determine the source of the water leak related to the point it enters the sewer system or the duct line.

- It is important that this point be related to the nearest PGW underground structure. The sound of running or leaking water in a drain vent, at a water stop, at a water service or a fire plug, is an almost infallible lead to important underground trouble.

In the case of a cavity, walk and inspect the area in question. and knock the spoon bar onto the street surface.

Whenever an underground street trouble is separated by a reasonable distance from gas mains or services, barholes are required to determine the solidity of the foundation under PGW structures.

The Foreman, at his/her discretion, may make an exploratory opening. If a safety hazard exists, a supervisor must be dispatched to the site. Blocking up or securing mains with wooden or steel beams may be necessary. Additional precautionary steps may be taken such as cutting or abandoning mains or stopping the flow of gas through the use of grease or bags and stoppers.

Any water leak where the shut off or reduction of water leakage, by cock or valve operation, will reduce the danger to PGW company structures, PGW should request the Water Department to take such steps.

IV. Associated Documentation

Relevant Code

Protecting Cast Iron Pipelines 192.755
Damage Prevention Program 192.614

Associated Bulletin

Bulletin #276 - Procedure for PA One Call Activities (TR 2010-09)

Attachments

N/A

V. Handbooks

Foreman’s Handbook

Dispatcher's Manual
Supervisor's Handbook

VI. Transaction Listing
TR-2010-03

Approved by:

____
Kenneth S. Dybalski
Vice President, Energy Planning & Technical Compliance

____
Joseph R. Hawkinson
Vice President, Field Operations

I&E Statement No. 1-SR
Witness: Terri Cooper Smith

PENNSYLVANIA PUBLIC UTILITY COMMISSION,
BUREAU OF INVESTIGATION AND ENFORCEMENT

v.

PHILADELPHIA GAS WORKS

Docket No. C-2024-3052277

Surrebuttal Testimony

of

Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

on behalf of the

Bureau of Investigation and Enforcement

Q: Have you reviewed the rebuttal testimony of PGW's witnesses Joseph Hawkinson and Joseph Leva?

A: Yes.

Q: What is the purpose of your surrebuttal testimony in this proceeding?

A: My surrebuttal testimony will respond to the testimony of Joseph Hawkinson and Joseph Leva. My responses will provide necessary clarification and context to the testimony of Mr. Hawkinson and Mr. Leva.

Q: Do you still believe that the three One Call tickets for two sewer system failures, excavations, and repairs at 815 and 813 Jackson Street should have raised concerns for PGW as to the safety of their facilities?

A: Yes. The One Call tickets identified the extent of the excavation (8-feet deep) and that the excavation was being done because the sewer failed and was in need of repair. In conjunction with PGW's knowledge of five (5) other cast iron main breaks on the 800 block of Jackson Street in the preceding 12 years, PGW should have been concerned for the safety of their cast iron facility that was more than 125 years old.

Mr. Hawkinson testifies that PGW serves approximately 31,600 blocks in Philadelphia and responds to approximately 70,000 One Call notices per year to justify his statement that the notion that two sewer related excavations is a concentrated number is not empirically supported. PGW St. 1-R at 37. However, a closer analysis of these numbers does not support Mr. Hawkinson's statement.

Quick math shows that 70,000 One Call notices per year divided by 31,600 blocks equals 2.215 One Call notices per block per year. This average was arrived at without accounting for One Call Notices that do not involve PGW facilities, do not pose a risk to PGW facilities, do not pose a substantial risk to PGW facilities, such as sewer and water main excavations, and do not involve exceptionally vulnerable facilities, like cast iron that can "break without warning and without any apparent cause." PGW St. 1-R at 29. As stated by Mr. Hawkinson, the 800 block of Jackson Street had 4 One Call notices in 2021, which almost doubled the average of 2.215, without accounting for the aforementioned factors.

In light of these numbers, PGW should have been concerned by two adjacent excavations to repair sewer failures that were in the immediate vicinity of a cast iron main. As previously described, cast iron is susceptible to cracking, especially in areas where sewer failures have occurred. Sewer excavations and sewer leaks pose an increased risk to gas facilities due to the known likelihood of soil instability caused by water saturation, erosion, and the removal of compacted soil around and beneath gas facilities.

Q: How do you view the five (5) other cast iron main breaks on the 800 block of Jackson Street in the preceding 12 years?

A: I believe that the history of cast iron main breaks for the 800 block of Jackson Street is an important factor in determining risk assessments to the cast iron facilities in that area. I view five breaks on one block in a 12-year time period as being a concerning number of breaks and should have raised concerns for PGW that there were graphitization issues with the cast iron in that area, lack of support for the mains in that area, or other issues threatening the safety of their cast iron facilities. I am surprised by PGW's dismissiveness of the prior cast iron breaks and their position that the northside main "*only* experienced three (3) breaks since 2009." PGW St. 1-R at 27 (emphasis added). I&E hopes that due to the risk cast iron mains represent to public safety, that PGW takes seriously the threat of cast iron main breaks and uses cast iron main break history to assess and mitigate risks to their facilities. Every main break is a close call and a race against time to mitigate the risks associated with gas migration.

Q: Do you agree with PGW's position that the cause of the cast iron main break is unknown?

A: No. Mr. Hawkinson attempts to suggest the cause of the cast iron break could be something other than the excavation to repair the sewer system failure by implying that "age and graphitization of the cast iron pipe" could be the cause or that "[c]ast iron can also break without warning and without apparent cause." PGW St. 1-R at 29.

However, the metallurgical evaluation from Affiliated Engineering Laboratories, Inc. ("AEL") makes the cause of the break evident. The metallurgical evaluation finds that "[e]xternal stresses applied to a graphitized gas main induced a circumferential crack," "the fracture occurred as a one-time overload condition," and the pipe "experienced an external bending force acting upon it where a through wall- crack initiated and propagated near its bottom." See

I&E Exhibit 9 at 4, 28-29. The metallurgical evaluation continues on to explain that:

> Circumferential cracking is a common mode of failure for cast iron piping, when subjected to bending forces. Due to the inherent brittle nature of gray cast iron, the pipe will not plastically deform under bending loads but rather fracture. A crack initiates at the highest stressed region, whether it be at a thinned wall due to corrosion, large-sized casting flaw, or some other stress riser, and propagates rapidly along the pipe's circumference to alleviate the stresses induced by the bending forces. ***Such bending forces can occur as a result of frost upheaval during freeze/thaw cycles, poor bedding, loss of soil support or external force from soil disturbances near the buried pipe or undermining.***

I&E Exhibit 9 at 29 (emphasis added).

AEL identifies three causes for the bending forces: (1) frost upheaval during freeze/thaw cycles; (2) poor bedding; and (3) loss of soil support or external force from soil disturbances near the buried pipe or undermining. AEL obtained and analyzed weather data from the National Oceanic & Atmospheric Administration ("NOAA") concluding that it is "unlikely that the ground froze during the month of November 2021," ruling out frost upheaval as a cause of the external bending forces. Pipeline bedding can be affected by sewer failures and excavations, like what was present in this case. The loss of or compromise of pipeline bedding leads to the loss of support for a pipeline. The disturbed pipeline bedding and external bending forces due to "loss of soil support or external force from soil disturbances near the buried pipe or undermining" contributed to and caused this cast iron main break.

Q: Do you have a response to Mr. Hawkinson's testimony that PGW would have to hire an "exorbitant number of employees," costing PGW's ratepayers an estimated "$17.7 million/year," to monitor every One Call notice it receives?

A: Yes. I&E has not requested, nor suggested, that PGW must monitor each and every One Call Notice it receives. Mr. Hawkinson testifies that PGW would need to hire 24 or more employees to "monitor all 'Frequent' and 'Concentrated' emergency One Call requests" and 184 employees to "monitor all non-emergency One Call requests," costing PGW ratepayers "no less than $17.7 million/year." PGW St. 1-R at 44-46. It appears that PGW's calculation fails to account for One Call Notices that do not involve PGW facilities, do not pose a risk to PGW facilities, do not pose a substantial risk to PGW facilities, and do not involve exceptionally vulnerable facilities, like cast iron that can "break without warning and without any apparent cause." PGW St. 1-R at 29. Failure to account for these factors, overinflates the estimated cost. A risk-based approach that considers excavation tickets, excavation types, gas pipe type, age and leak history, would provide a more accurate accounting of the number of employees and costs.

It is concerning that PGW has given little to no consideration or concern for the benefit to public health and safety that would result from additional monitoring of third-party excavations when calculating these costs. Calculations concerning the integrity of PGW's facilities, especially in geographic regions where sewer leaks have been known to occur, should always consider the benefit to public safety and not just focus on the company's cost.

Q: Do you agree with Mr. Hawkinson and Mr. Leva's application of PGW Bulletins #312, 54, and 313 to the facts of this underlying matter?

A: No, I do not agree with their application of PGW Bulletins #312, 54, and 313. I believe that important points in all three of those bulletins were missed in their testimony.

Q: How should Bulletin #312 be interpreted and understood in light of the underlying facts?

A: I believe that Section III(B) of Bulletin #312 needs to be more thoroughly discussed. Section III(B) states the following:

> ***Upon receipt of notice of water or sewer system failures***, or surface conditions, such as cavities or cave-ins which may be caused by such failures, the location of gas pipeline facilities shall be determined. ***Where pipeline facilities may be affected***, appropriate personnel shall be dispatched promptly to determine the effect of the failure on pipeline facilities. Inspection and necessary follow-up action shall be in accordance with the "Protection of PGW Facilities from Underground Street Troubles" procedure.

I&E Exhibit 11 (emphasis added). There are two very important parts to this directive. The first is "Upon receipt of notice of water or sewer system failures." Here, PGW received three separate notices of sewer system failures, in the form of the PA One Call notices. Both of the PA One Call notices for 815 Jackson Street indicated that type of work was "Repl Curb Trap Lateral" or replace curb trap lateral. See I&E Exhibits 6-7. The PA One Call notice for 813 Jackson Street indicated that the type of work was "Repair Curb Trap." See I&E Exhibit 8. The need to replace or repair a sewer curb trap arises when the curb trap, which is part of the sewer system, breaks or fails. Thus, PGW received three notices of sewer system failures at 815 and 813 Jackson Street.

The second important part in Section III(B) is the direction "Where pipeline facilities may be affected, appropriate personnel shall be dispatched promptly to determine the effect of the failure on pipeline facilities." As more thoroughly discussed above and in my direct testimony, PGW was aware of the prior history of five (5) cast iron main breaks on the 800-block in the preceding 12 years. PGW was also aware, per the One Call notices, that the excavation at 815 Jackson Street would include an 8 feet deep by 4 feet wide by 4 feet long excavation in the sidewalk in front of 815 Jackson Street. Coupling the knowledge of the size and location of excavation with the location of the cast iron main, 7.5 feet from the front foundation wall of 815 Jackson Street, PGW knew that the excavation would occur at or immediately adjacent to their facility. The notice of the sewer system failure, the extent and location of the excavation, and the cast iron main break history for the 800-block of Jackson Street, clearly indicate that PGW's "pipeline facilities may be affected." In this case, PGW failed to dispatch appropriate personnel to determine the effect of the failure on their pipeline facility.

Any inspection or necessary follow-up would be taken in accordance with PGW Bulletin #54 "Protection of PGW Facilities from Underground Street Troubles."

Additionally, Section III(A) of Bulletin #312 directs that:

> ***Wherever pipeline facilities are or may be endangered***, the appropriate supervisor shall be promptly informed. The supervisor shall, after consulting with his/her superiors,

> institute necessary actions such as patrolling, supporting, replacing, relocating or removing from service the affected gas facilities.

I&E Exhibit 11 (emphasis added). As established above, PGW's facility at 815 Jackson Street was endangered; however, there is no evidence that a PGW supervisor was promptly informed or that PGW instituted necessary action to protect their facilities as required by Section III(A).

Q: Do you agree with Mr. Hawkinson and Mr. Leva's application of PGW Bulletin #54 to the facts of this underlying matter?

A: No, I do not agree with their application of Bulletin #54.

I believe that Bulletin #54 needs to be more thoroughly discussed. Section III states the following:

> Underground troubles are usually ***brought to PGW's attention*** due to a condition observed on the street surface; or as a result of a pre-existing condition encountered in the performance of PGW work but not caused by PGW activity. Some underground troubles are:
>
> - Water Leaks
> - Washouts
> - ***Sewer System Failure*** – Signs of a sewer system failure are as follows: cavity, cave-in, or paving faults such as a surface crack, settlement, or depression in the street or curb area.
> - Paving depressions – These may be caused by settlement in "area" fill or settlement caused by poor backfill.

See I&E Exhibit 13 (emphasis added). This section clearly identifies that sewer system failures are considered an underground street trouble by PGW. As discussed above, in relation to Bulletin #312, a sewer system failure had occurred, as noticed by the need to replace and repair the sewer traps and laterals at 815 and 813 Jackson Street. Section III further indicates that underground street troubles can be brought to PGW's attention in the performance of PGW work but not caused by PGW activity. It is quite clearly within the scope of PGW's work to receive and respond to PA One Call notices, therefore the PA One Call Notices for 815 and 813 Jackson Street brought the sewer system failure to PGW's attention.

Section IV(A)(1) further illustrates the point that the notice of an underground street trouble, such as a sewer failure, can originate from a PA One Call System ("POCS") notice. Section IV(A)(1) provides that:

> 1. Origin of the Notice
>
> a) POCS Notice – These notices can be handled by an Inspector during normal working hours. The Dispatcher will generate an Underground Street Trouble order in AIMS. The Inspector will also notify the Dispatcher if the situation warrants an immediate visit of a Distribution crew and/or supervisor. If the Inspector can determine at the time that PGW is not involved due to the distance of our structures from the UST and the containment of the UST problem, the job may be finaled at this point.

See I&E Exhibit 13.

As discussed in my direct testimony and admitted by PGW, PGW did not generate any underground street trouble orders after receiving notice from the PA One Call System. By failing to recognize the underground street trouble and generate a work order PGW was unable to conduct an investigation of the sewer system repairs and ascertain PGW facility involvement, distance of the issue to

PGW facilities, if any undermining had occurred, or determining the status of the underground street trouble repair.

Q: How is Bulletin #313 applicable to this matter?

A: Bulletin #313 provides direction to PGW Damage Prevention Inspectors regarding their various duties. These duties include inspecting "third party construction activities for the main purpose of protecting PGW underground structures and facilities," revisiting ongoing without watchman, particularly any jobs in which PGW facilities will be undermined, and "visit any underground street trouble encountered and report the same to Distribution Dispatching and supervisor." See I&E Exhibit 12.

Further Mr. Hawkinson, testifies that Bulletin #313, Section III(E) Pipeline Patrols, "requires the Damage Prevention Inspector to be alert for and report adverse conditions." PGW St. 1-R at 41. In particular, Mr. Hawkinson cites to the following section:

> When performing a pipeline patrol, the inspector should be looking for any activity or changes in the environment ***that could affect the safety of the pipeline.*** An activity or changes found must be reported to the Supervisor immediately and documented in the corresponding AIMS order. . . The following is a sampling of items the inspector should always report or act upon:
>
> - Any excavations (including backfilled openings that are not familiar to the inspectors), grading, demolition, or other construction activity ***which could result in*** damage to a pipeline, loss of support due to settlement or shifting of soil around a pipeline, undermining or damage to a pipeline support, or loss of cover or excess fill.

See I&E Exhibit 12 (emphasis added).

PGW's Damage Prevention Inspectors that performed the One Call mark outs in response to the three One Call notices at 815 and 813 Jackson Street, would have been provided with the One Call notices that were attached to my direct testimony as I&E Exhibits 6-8. As thoroughly discussed above, the PA One Call notices informed PGW and its Damage Prevention Inspectors that there was an extensive excavation (8 feet deep by 4 feet wide by 4 feet long) being performed at or immediately adjacent to a cast iron main and that the excavation was being undertaken to repair and replace a sewer system failure. Both Bulletins #312 and #54 identify sewer system failures as an underground street trouble and a threat to PGW facilities.

With this information in mind, the PGW Damage Prevention Inspectors had an obligation to inspect the excavation to protect PGW facilities, revisit the site as there was a threat for undermining to PGW's facility due to the sewer system failure and extent and location of the excavation, and visit and report the underground street trouble that was identified in the PA One Call notice.

The Damage Prevention Inspectors should have been alert for and reported the adverse conditions. The sewer system failure and the extensive excavation at or immediately adjacent to a cast iron facility was an activity or change in the environment that ***could*** affect the safety of the cast iron pipeline and should have been reported to a supervisor immediately. Additionally, the Damage Prevention Inspector should have reported and acted upon the excavation at 815 Jackson Street because the planned excavation to repair and replace a sewer system failure was an excavation "which ***could*** result in damage to a pipeline, loss of support due to settlement or shifting of soil around a pipeline, [or] undermining or damage to a pipeline support."

I believe the job description for a Damage Prevention Inspector, as provided by Mr. Leva at PGW Exhibit JCL-1, should also be noted. Among other responsibilities, a Damage Prevention Inspector is responsible for the following:

- Must follow all PGW damage prevention procedures.
- Upon notification by the Pennsylvania One Call System or some other means of communication visits construction sites of work in progress by other utilities or contractors to insure that all PGW structures are protected and undisturbed by such work.
- Must be familiar with safe construction methods and practices and recognize unsafe practices that may affect the safety of PGW structures.

See PGW Exhibit JCL-1.

Q: Can you clarify the requirements of 49 CFR § 192.605 and 49 CFR § 192.614 as discussed by Mr. Hawkinson at page 42 of his rebuttal testimony?

A: 49 CFR § 192.605(a) requires that: "Each operator shall prepare and ***follow*** for each pipeline, a manual of written procedures for conducting operations and maintenance activities and for emergency response." (emphasis added).

49 CFR § 192.614 is similar, requiring that "each operator of a buried pipeline must ***carry out***, in accordance with this section, a written program to prevent damage to that pipeline from excavation activities…" (emphasis added). I&E's alleged violations of section 192.605, as stated in I&E's Formal Complaint, are not that PGW failed to have procedures, as framed by Mr. Hawkinson, but that

PGW failed to *follow* or *carry out* the procedures that were already in place, specifically Bulletins 54, 312, and 313.

Q: Can you clarify I&E's position on 49 CFR § 192.755?

A: Section 192.755 requires that operators protect cast iron pipelines that:

> When an operator has knowledge that the support for a segment of a buried cast-iron pipeline is disturbed:
>
> (a) That segment of the pipeline must be protected, as necessary, against damage during the disturbance by:
>
> (1) Vibrations from heavy construction equipment, trains, trucks, buses, or blasting;
>
> (2) Impact forces by vehicles;
>
> (3) Earth movement;
>
> (4) Apparent future excavations near the pipeline; or
>
> (5) Other foreseeable outside forces which may subject that segment of the pipeline to bending stress.
>
> (b) As soon as feasible, appropriate steps must be taken to provide permanent protection for the disturbed segment from damage that might result from external loads, including compliance with applicable requirements of §§ 192.317(a), 192.319, and 192.361(b)-(d).

Mr. Hawkinson frames the situation as if PGW had no knowledge that the support of their CI main on the 800 Block of Jackson Street would be disturbed. However, as discussed above, PGW knew that there were repairs for two separate sewer system failures occurring on the 800-block of Jackson Street, knew that water and sewer leaks and excavations can lead to loss of support for gas facilities, knew that the excavations were occurring next door to each other, knew that the excavation would be at or immediately adjacent to their cast iron facility, knew that the excavation would be extensive and go significantly deeper than their cast iron facility, and knew that area had a significant history of cast iron main breaks. PGW had the knowledge in their possession to understand that the support for their buried cast iron main would be or had been disturbed.

Q: Are you familiar with the settlement at PUC v. PGW, Docket No. C-2022-3033834, ("8th Street Settlement") that addressed a December 19, 2019 natural gas explosion?

A: Yes, I am familiar with that explosion and the settlement in that matter.

Q: Can you provide context regarding the 8th Street Settlement?

A: On December 19, 2019, a natural gas explosion occurred at 1435 South 8th Street, Philadelphia, PA, resulting in two fatalities and extensive property damage. Leading up to the explosion, the 1400-block of South 8th Street was the subject of multiple excavation activities. Eight (8) locate requests related to water and/or sewer repair work were submitted to the Pennsylvania One Call System, Inc. ("Pennsylvania One Call") between March 28, 2018 and October 23, 2019. Six (6) of these locate requests occurred between September 13, 2019 and October 23, 2019. PGW responded to each of these requests and properly marked its facilities. Between October 7, 2019 and October 23, 2019, private contractors completed various sewer repairs at 1428 South 8th Street, 1430 South 8th Street, 1431 South 8th Street, and 1433 South 8th Street. Two of the private contractors observed underground voids near the sewer lines of the Philadelphia Water Department. After the explosion, PGW excavated over the broken cast iron main. When the roadway was opened to start the excavation, there were signs of potential under-street disturbance in proximity to the excavation. Once the main was excavated and exposed, a circumferential crack on the cast iron pipe became visible. A metallurgical evaluation of the cracked cast iron pipe concluded that external stresses applied to a graphitized gas main induced a circumferential crack whereby gas could escape.

Q: Do you agree with Mr. Hawkinson that the 8th Street Settlement involved a similar set of circumstances to the instant matter and that the 8th Street Settlement largely addresses the corrective action sought in this Complaint?

A: Yes, I agree with Mr. Hawkinson that the circumstances between the two events are incredibly similar and the corrective actions in the 8th Street Settlement go towards addressing the issues in this matter.

However, it is the similarity in circumstances between the 8th Street Settlement and this matter that causes concern.

Q: Why does the similarity in circumstances cause you concern?

A: In the two years between the 8th Street explosion (December 19, 2019) and the explosion at 815 Jackson Street (November 30, 2021), PGW did not take the necessary action or make necessary changes to their policy and procedures to reduce risk and prevent reoccurrence of events. It took a formal complaint by I&E and the 8th Street Settlement for PGW to take measures to address the risk of excavations at and near their cast iron mains to repair water and sewer system failures.

Q: Does PGW have an obligation to learn from prior events and improve their procedures to reduce risk and prevent reoccurrence?

A: 49 CFR §§ 192.1001-1015 requires that PGW maintain a Distribution Integrity Management Plan ("DIMP") that requires that they continually improve and measure the effectiveness of their efforts to reduce risk and prevent reoccurrence of events and explosions.

DIMP is a performance based regulatory program applicable to gas distribution operators driven by risk management. The federal Pipeline and Hazardous Materials Safety Administration ("PHMSA") created the DIMP regulations to reduce the number of Department of Transportation ("DOT") reportable incidents. DIMP requires a natural gas distribution utility to:

1. Demonstrate knowledge of the gas distribution system;
2. Identify the threats to its facilities;
3. Evaluate and rank the risks of threats to the facilities;
4. Identify and implement measures to reduce risk;
5. Measure performance, monitor the results, and evaluate effectiveness;
6. Periodically evaluate and make improvements to the program; and
7. Report the results.

See 49 CFR § 192.1007. DIMP regulations mandate PGW to identify the risks to its pipeline facilities and create a plan to mitigate and reduce these risks. PGW determines pipeline replacements by risk ranking the various pipeline types and then replacing the pipe based on the highest risk. DIMP compliance is not optional.

Mr. Hawkinson states that PGW is on target to replace all cast iron in their system within 35 years. However, the mere existence of cast iron piping in their system continues to be their highest risk, even as they are replacing it. During the replacement period, DIMP is still in effect and mitigation efforts and accelerated actions must still be implemented to remain in compliance with the federal code. In short, the replacement program, by itself, does not satisfy its obligation to protect its facilities. Continual monitoring coupled with accelerated actions are required until the risk associated with cast iron mains is eliminated.

PGW should have proactively monitored excavations to repair water and sewer system failure near their cast iron mains. This doesn't necessarily mean they have to be on site at each excavation, but PGW needed an accelerated action to reduce the risk posed by these types of excavations. Had PGW established more effective measures for prioritizing underground sewer excavations in their DIMP Plan, PGW may have averted this event.

Q: Do you agree with PGW's "position that it cannot be held accountable when third-party excavators perform work unrelated to PGW's utility infrastructure but fail to inform PGW of potentially hazardous situations they observe which may impact PGW's facilities," as advanced by Mr. Hawkinson at PGW St. 1-R at 47-48?

A: I do not agree with that position. As I have discussed in my Direct Testimony and this Surrebuttal, PGW has a duty and responsibility to protect its cast iron facilities as required by its procedures (Bulletins # 312, 313, and 54), DIMP, 49 CFR §§ 192.703 and 755, 52 Pa. Code § 59.33, and 66 Pa.C.S. § 1501.

PGW's position that it is the sole responsibility of 3rd party excavators to be on the look out for threats to PGW facilities and that PGW does not actively need to be identifying and mitigating threats, runs counter to the regulatory framework. This is especially true when PGW is in possession of information and data that indicate there is a threat to its cast iron facility but does not act on this information. To take such a position, as advocated by PGW, would be to encourage utilities to take a passive role in the protection of their own facilities, instead of using information in their possession to actively identify threats to their facilities.

Q: Did you review PGW's charts and data regarding hazardous leaks on cast iron mains and cast iron main replacement provided by Mr. Hawkinson's testimony?

A: Yes, I did review it.

Q: Do you have anything to add to PGW's charts and data?

A: Yes. On April 17, 2025, PGW filed its Quarterly Leak Report at Docket No. P-2012- 2337737 and Quarterly Report on Mains and Training at Docket No. P-2015-2501500.

Using that filing, I compared PGW's 1st quarter of 2025 cast iron main breaks on 10" or smaller diameter pipelines. The data is as follows:

2022: 468

2023: 344

2024: 370

1st quarter of 2025: 568

Although PGW is replacing approximately 30 miles of cast iron mains every year, the number of cast iron main breaks, in this category, continues to increase. During this time period, PGW has maintained that cast iron is their highest risk asset, but has not accounted for the increased risk based on the increase of breaks over the last 3 years. This data clearly shows that replacement, alone, does not mitigate the existing risk with the cast iron that remains in service.

Q: To your knowledge, can a civil penalty be imposed upon PGW for violations of violation of the Public Utility Code, Commission regulations, and/or Code of Federal Regulations?

A: Yes, I am advised by counsel that a civil penalty can be assessed in this matter.

Mr. Hawkinson suggests that "the Commission has previously agreed that that (sic) no fine is appropriate for PGW which has no shareholders and is regulated on a "cash flow" basis." PGW St. 1-R at 51. Counsel advises me that in the Commission's Order in *Public Utility Commission, Bureau of Investigation and Enforcement v. Philadelphia Gas Works*, Docket No. C-2022-3033834 (January 8, 2025) the Commission reasoned that the pecuniary concessions agreed to by PGW, including a $800,000 Residential Methane Detector Pilot Program, were a more useful expenditure to advance public safety than a civil penalty and were sufficient to deter future violations. *PUC v. PGW*, Docket No. C-2022-3033834, at 56. Additionally, I am advised by counsel that in an earlier case in which the Commission assessed a $400,000 civil penalty against PGW, the Commission stated that "PGW's status as a municipally-owned utility does not negate the Commission's authority to impose a penalty on PGW when appropriate." *Public Utility Commission v. Philadelphia Gas Works*, Docket No. C-2011-2278312 at 27 (Order entered July 16, 2013).[1]

Q: Having reviewed the rebuttal testimony of Joseph Hawkinson and Joseph Leva, has your opinion regarding PGW's inactions to safeguard its cast iron main changed?

A: No, my opinion has not changed. I still believe PGW did not follow its procedures and failed to take appropriate measures to safeguard its facilities while having knowledge of third party excavation activities to repair sewer system failures.

Q: Have all your answers and responses today been based upon your personal knowledge or professional expertise?

A: Yes.

Q: Does this conclude your surrebuttal testimony?

A: Yes. However, I reserve the right to supplement my testimony as additional issues and facts arise during the course of the proceeding.

[1] The legal arguments regarding the applicability of a civil penalty will be addressed by I&E's legal counsel in I&E's brief.

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Pennsylvania Public Utility Commission, Bureau of Investigation and Enforcement, Complainant	:	
v.	:	Docket No. C-2024-3052277
Philadelphia Gas Works, Respondent	:	

VERIFICATION

I, Terri C. Cooper Smith, Fixed Utility Valuation Engineer Supervisor, hereby state that the facts above set forth are true and correct to the best of my knowledge, information, and belief and that I expect to be able to prove the same at a hearing held in this matter. I understand that the statements herein are made subject to the penalties of 18 Pa.C.S. § 4904 relating to unsworn falsification to authorities.

Terri Cooper Smith
Supervisor, Pipeline Safety Division
Bureau of Investigation and Enforcement
Pennsylvania Public Utility Commission
Commonwealth Keystone Building
400 North Street
Harrisburg, PA 17120

Date: September 15, 2025

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

REBUTTAL TESTIMONY OF

JOSEPH HAWKINSON

ON BEHALF OF
PHILADELPHIA GAS WORKS

Docket No. C-2024-3052277

Formal Complaint of Bureau of
Investigation and Enforcement

TOPICS:

Responding to the Direct Testimony of
BI&E Witness Cooper Smith

August 15, 2025

PUBLIC VERSION

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1 To be provided under separate cover and incompliance with the appropriate designated requirements.

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND POSITION WITH THE COMPANY.

A. My name is Joseph Hawkinson. I am the Vice President, Field Operations for Philadelphia Gas Works ("PGW").

Q. HOW LONG HAVE YOU HELD THIS POSITION?

A. Over seven years since January of 2018.

Q. AS IT PERTAINS TO GAS SAFETY, WHAT ARE YOUR JOB RESPONSIBILITIES?

A. In my present position, I am responsible for the Distribution and Field Service Departments.

Q. PLEASE SUMMARIZE YOUR BACKGROUND AND EXPERIENCE.

A. I have been employed with PGW for 21 years since February 17th, 2004. I have been Vice President of Field Operations since 2018. Prior to that I was Director of Engineering Design, Construction, & Planning from 2017 to 2018. I held the position of Director of Field Services & Maintenance from 2014 to 2017. I held the position of Superintendent of Construction from 2011 to 2014. Prior to 2011 I held various positions as an Engineer in the Field Operations department. I received my Bachelor of Science degree in Mechanical Engineering from Pennsylvania State University in 2002.

Q. HAVE YOU PREVIOUSLY PROVIDED TESTIMONY BEFORE THIS COMMISSION?

A. Yes, at Commission Docket No. C-2022-3033834. The situation in that case involved a complaint by the Pennsylvania Public Utility Commission's ("PUC") Bureau of Investigation and Enforcement ("BI&E") about an explosion on Eighth Street in Philadelphia, PA, the facts of which are relevant here and which was resolved by settlement of the parties and approved by the Commission, as I will explain later in my testimony.

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY IN THIS PROCEEDING?

A. My testimony will discuss the numerous efforts PGW makes to provide safe and reliable service and the timeline of events that happened at 815 Jackson Street in Philadelphia, PA on November 30, 2021. I will also respond to the testimony of the BI&E witnesses.

Q. PLEASE IDENTIFY THE EXHIBITS THAT ACCOMPANY YOUR REBUTTAL TESTIMONY.

A. The exhibits that accompany my rebuttal testimony are:

Exhibit JH-1	BI&E's Responses to PGW Set I and Set II
CONFIDENTIAL Exhibit JH-2	BI&E's Investigative Report (Redacted)
CONFIDENTIAL SECURITY INFORMATION Exhibit JH-3	Map of the 800 Block of Jackson Street on or before November 31, 2021[2]

Q. WERE THOSE EXHIBITS PREPARED BY YOU OR UNDER YOUR DIRECTION AND SUPERVISION?

A. Yes.

Q. PLEASE DESCRIBE EXHIBIT JH-1.

A. **Exhibit JH-1** is a copy of all BI&E's Responses to PGW's Interrogatories Sets I and II that are referred to in the PGW witnesses' testimony. I have included these documents as a single exhibit for ease of reference since the responses are used throughout PGW's rebuttal testimony statements.

Q. PLEASE DESCRIBE CONFIDENTIAL EXHIBIT JH-2.

A. **CONFIDENTIAL** Exhibit JH-2 is the internal BI&E Investigative Report of the incident at 815 Jackson Street as provided by BI&E to PGW in response to a discovery request.

[2] To be provided under separate cover and incompliance with the appropriate designated requirements.

This is a separate exhibit for ease of reference. I note that consistent with my testimony, PGW does not support, adopt, or otherwise accept any findings or conclusions in the Investigative Report, and I have included the document only for the reasons discussed herein.

II. SUMMARY OF COMPLAINT AND OVERALL RESPONSE.

Q. PLEASE SUMMARIZE THE PROCEDURAL EVENTS LEADING UP TO YOUR TESTIMONY IN THIS MATTER.

A. A natural gas explosion occurred at 815 Jackson Street in Philadelphia, PA on November 30, 2021, resulting in an estimated $55,000 of property damage. No injuries or loss of life occurred.

About three years later, on November 25, 2024, BI&E filed a complaint seeking a finding that PGW violated 49 CFR Part 192, the Public Utility Code, the Commission's regulations, and PGW's internal procedures. PGW filed its answer on January 29, 2025, denying each of the allegations contained in the complaint. BI&E then pre-filed its direct testimony of a single witness, Ms. Terri Cooper Smith, Supervisor and Fixed Utility Valuation Engineer in the Pipeline Safety Section of BI&E.

Q. ON WHAT BASIS DOES BI&E ASSERT THAT PGW VIOLATED THESE PROVISIONS?

A. First, I want to note that BI&E, after investigation, has not found any deficiency with PGW's main maintenance programs, the manner in which PGW responded to the One Call marking requests, or PGW's emergency response to the explosion. BI&E's basic assertion is that, because there were two PA One Call *sewer* line excavations in the area

(815 and 813 Jackson St.)[3] approximately three (3) months prior to the explosion in September 2021, PGW should have known somehow that the underground support of its distribution main in front of 815 Jackson St. *might* be compromised (i.e., a void under the pipeline) and, therefore, the main at that location was at risk of cracking at some later date. BI&E's premise is that, because PGW did not dispatch crews to monitor this third-party excavation work on third-party (sewer) facilities at the time of excavation, PGW failed its duty to safeguard its facilities.

Q. IS THIS "SHOULD HAVE KNOWN" AND SUBSEQUENT MONITORING OF THE SEWER EXCAVATION, A REASONABLE POSITION TO TAKE?

A. No, BI&E's position suffers from several fundamental errors.

First, the position misreads the regulations and PGW's procedures. PGW's safety bulletins and federal rules regarding "safeguarding" against another party's excavation near our gas mains is triggered by *actual* knowledge of an unsafe conditions affecting PGW's facilities. In other words, there must be an Underground Street Trouble ("UST") noticed by PGW employees or a third-party report of a UST to trigger third party excavation monitoring. *Neither of those exist here.* Nevertheless, BI&E then asserts that actual knowledge is not required; rather that PGW *should have* known solely because of the One Call tickets themselves. PGW strongly disagrees with BI&E's version of the facts, interpretation of PGW's safety procedures, and the law.

Second, there was nothing unusual or conspicuous about the One Call marking requests by the sewer excavators on Jackson Street in 2021 that could have triggered any concern by PGW. Nothing in the One Call tickets discussed by BI&E indicate anything to deem it

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[3] Water/sewer customers in Philadelphia own and are required to maintain the service lines that connect to the Philadelphia Water Division's mains. Thus, the homeowners hire plumbers to excavate and repair their service lines in the street.

"necessary" for PGW to continue to be present at the site after its facilities were appropriately marked and visually evaluated. The PGW Damage Prevention Inspectors that undertook the street marking are trained to recognize surface indications of underground street trouble. For example, depressions in the street surface may indicate underground voids. If observed, PGW employees follow procedures for reporting and follow up investigation. PGW was unaware of any UST in the 800 block of Jackson Street associated with the work by any third-party excavator in 2021.

Third, there was no concentration of PA One Call tickets on the 800 block of Jackson Street. The existence of two excavations on a city street in Philadelphia is a routine matter. PGW serves approximately 31,600 city blocks in the City and receives approximately 70,000 One Calls each year. The notion that two excavations (three One Call tickets) is a concentrated number in a City of Philadelphia block is not empirically supported or rational. Further, for the year 2021 prior to the event, only four tickets (three excavations) in total were received in the area near 815 and 813 Jackson Street (i.e., 1 ticket unrelated to the sewer excavations raised by BI&E), which is not at all unusual in the City of Philadelphia. To provide clarity, on average, approximately 50% of the tickets filed with PA One Call occur on the same block in the same year.

Fourth, there were no third-party reports of underground subsidence in the 800 block of Jackson St. Neither of the two excavators working on the sewer reported adverse conditions (such as voids) during their work at or proximate to 815 Jackson St. to any entity (e.g., PGW, the City Water Department, or PA One Call). Indeed, "I&E is not aware of any individual or entity that knew of the void prior to November 30, 2021 [the date of the explosion]." Exhibit JH-1, BI&E Response to PGW Set I, No. 8.c.

Fifth, imposing such an obligation on PGW (either retroactively or going forward) is unrealistic and without regulatory support. There is no question that PGW's existing workforce compliment is not sufficient to undertake the surveillance of all third-party water and sewer excavations occurring in clusters of two or more (time period not specific) across the City (which is what BI&E's position would require). Rewriting the regulations and procedures (retroactively or going forward) to require PGW to continuously monitor third-party excavations where there are two or more One Call marking tickets during the year on the same block sets a unrealistically low threshold that, conservatively, would cost PGW ratepayers approximately $17.7 million/year in additional employee and support costs to implement based on estimates that I discuss below. This is neither feasible nor reasonable.

Q. WHAT WAS THE CAUSE OF THE ACCIDENT AND HAS BI&E INVESTIGATED THE SEWER EXCAVATORS?

A. I do not know the cause of the main break and BI&E never discussed the matter with the sewer excavators to determine what they observed and their excavation/backfill techniques.

The BI&E witness states that underground subsidence caused by sewer failures and *excavations to repair sewer laterals* at 815 Jackson St. caused the crack. I disagree with this conclusion – there is no evidence to support BI&E's hypothesis. If the excavators observed a void or failed to properly backfill at that location, the excavator had a duty to report an adverse condition to PGW as the facility owner. No such report was ever filed. In order to support its hypothesis, BI&E should have some actual facts. However, BI&E has not investigated or even contacted the excavators to determine the manner in which they excavated and backfilled their excavations on the 800 block of Jackson St. Instead, BI&E solely investigated PGW and filed a complaint arguing that it was up to PGW to watch over the City of Philadelphia's sewer excavators, and up to PGW ratepayers to pay for such monitoring.

Q. HAS BI&E EXPLAINED WHY THE EXCAVATORS WERE NOT ALSO INVESTIGATED?

A. No. The failure to investigate the excavators is not mentioned in the BI&E testimony. However, the internal BI&E investigative report states:

[**BEGIN CONFIDENTIAL**]

[**END CONFIDENTIAL**]

CONFIDENTIAL Exhibit JH-2 at 2.

Q. HAS ANY OTHER GAS DISTRIBUTION COMPANY BEEN REQUIRED TO MONITOR THIRD-PARTY EXCAVATION OF THIRD-PARTY FACILITIES IN THE ABSENCE OF A KNOWN REASON TO DO SO?

A. No, not to my knowledge. PGW is not required to and no other gas distribution company in Pennsylvania, of which I am aware, does so.

Q. HAS BI&E PREVIOUSLY PROSECUTED PGW UNDER THE THEORY THAT MONITORING IS REQUIRED ON THE BASIS OF THE NUMBER OF ONE CALL TICKETS?

A. Yes. BI&E filed a complaint against PGW on July 15, 2022 at Docket No. C-2022-3033834 alleging similar violations of State and Federal regulations as were presented in an incident on 8th St. in Philadelphia. BI&E's complaint theory in that case was the same as it is here – a strict liability standard requiring that PGW be held responsible for any explosion regardless of cause even where PGW was unaware of the underground conditions and had no reason to monitor the street. The matter was settled as discussed later in my testimony. The parties, as part of that settlement, however, agreed to establish observable trigger points for the investigation of underground troubles, which did not include the number of One Call tickets.

Q. DO YOU HAVE ANYTHING ELSE TO SAY IN TERMS OF OVERVIEW?

A. It is well known that PGW has a substantial amount of cast iron mains in its distribution system as detailed in BI&E's and PGW's testimonies. PGW and the Commission have set an aggressive schedule to replace all cast iron mains with the resources available, money and personnel included. This schedule has been approved by the Commission in many proceedings. PGW's regulatory and statutory obligations should not be any greater or lesser than other gas utilities that have less cast iron or other at risk main in their system.

III. <u>PGW BACKGROUND AND DISCUSSION OF CAST IRON MAIN REPLACEMENT PROGRAMS.</u>

Q. PLEASE PROVIDE A GENERAL DESCRIPTION OF PGW'S GAS DISTRIBUTION SYSTEM.

A. PGW is the nation's largest municipally owned gas distribution company. PGW's gas distribution system serves approximately 512,000 customers in the County and City of Philadelphia, operating approximately 3,049 miles of natural gas mains ("Mains") and some 472,656 service lines ("Services").[4] At the end of calendar year 2024 PGW's mains were comprised of approximately 37% cast iron, 43% PE plastic and protected coated steel, and 19% unprotected coated steel and ductile iron. The Company's Services are made up of 84% plastic and protected coated steel, 12% bare steel and 3% unprotected coated steel.

[4] PGW owns and operates all of the service lines from the mains to the inlet side of the meters. There are no customer-owned service lines in the PGW service territory.

Q. CAN YOU DESCRIBE PGW'S EFFORTS TO REDUCE THE AMOUNT OF CAST IRON MAINS IN ITS DISTRIBUTION SYSTEM?

A. In the last ten plus years, with the help of the Commission, PGW has made tremendous strides in reducing the amount of cast iron main in its system and replacing these mains with modern materials such as protected steel and plastic. In 2010, PGW was annually replacing approximately 18 miles of "at risk" pipe, mostly cast iron main. In contrast, currently PGW is replacing cast iron mains at a rate of over 30 miles per year. In each Long-Term Infrastructure Improvement Plan ("LTIIP") filing with the Commission, PGW has consistently reduced the projected date of complete cast iron main replacement. The current projected completion of replacing all cast iron main inventory is approximately 35 years. PGW also applied for and has been awarded $125 million[5] in federal grant funds through PHMSA to replace an additional 66 miles of cast iron main over the next five years, which will accelerate PGW's cast iron removal program by approximately 2 years.

Q. WHAT ARE THE IMPEDIMENTS TO MORE RAPID REPLACEMENT OF CAST IRON MAINS?

A. Financial limitations are the primary impediment to more rapid replacement of cast iron mains. PGW finances replacement in four ways: 1) Funds made available from its current base rates; 2) Debt financing; 3) PGW's distribution system improvement charges ("DSIC"), currently set at 7.5% of PGW's distribution revenues; and 4) Third party grants.

This funding combination allowed PGW to successfully complete its first LTIIP in FY 2017, removing approximately 3% more cast iron main than originally planned. PGW's

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[5] PGW was awarded $10 million for the 2022 grant year, $75 million for the 2023 grant year, and $40 million for the 2024 grant year.

second LTIIP, ending with FY 2022, also had strong results. While PGW's replacements were impacted during FY 2020 as a direct result of the COVID-19 Pandemic, PGW made up the FY 2020 shortfall in FY 2021 and exceeded its second LTIIP replacement goals from FY 2018 - 2022, replacing 164.7 miles, or 4% more cast iron main replaced than planned. PGW's third LTIIP was approved by the Commission in 2022 and will account for another 155.04 miles of cast iron main replacement. PGW's third LTIIP continues the acceleration of its cast iron main replacement program and reflects the current DSIC cap of 7.5%, which is currently ~$38.7 million annually.

Q. WHY IS PGW FOCUSED ON CAST IRON MAIN REPLACEMENT?

A. Cast iron becomes brittle (a process known as graphitization) over time and is susceptible to breaking with very limited or any prior notice. PGW concentrates on cast iron main replacement because the amount of cast iron main replacement is positively correlated with the following:

1. The reduction of leaks and the associated risk of serious incidents from those leaks;
2. The reduction of breakage repairs and future breakage repair costs;
3. A reduction in leak maintenance and repair on the facilities being removed from service; and
4. An improvement in pressure, and lower levels of unaccounted-for gas, which should produce greater rate stability for PGW's customers and result in a more adequate, efficient, safe, reliable and reasonable natural gas distribution service.

PGW has a large amount of installed cast iron mains compared to other natural gas distribution companies, and much of it is of relatively older vintage.

Q. IS THE PRESENCE OF CAST IRON SOMETHING NEW THAT THE COMMISSION AND BI&E WERE NOT AWARE OF PREVIOUSLY?

A. No. The presence of cast iron in PGW's distribution system is well known to the Commission and BI&E. The Commission and BI&E have worked extensively with PGW to reduce the amount of cast iron in our distribution system.

The Commission, including BI&E, and PGW have a long history of shared concern with the aging status of PGW's pipeline and have worked closely to create effective solutions. PGW's first DSIC filing to accelerate investment in cast iron main replacement was made in 2013, which the Commission approved in 2014.

Then, in 2015, a multi-Bureau Commission Staff task force, which included BI&E, was formed that produced in an extensive report discussing ways to accelerate PGW's "at-risk" pipeline replacement, explaining that "[d]espite the fact that PGW accelerated its replacement efforts in 2014, Staff believes this replacement rate is not aggressive enough, given the risk this pipe poses to PGW's system and its customers."[6] The Staff Report noted that PGW's then-current cast iron main replacement program would not be completed for eighty years.

The 2015 Staff Report identified the same risks of cast iron pipe that I have explained above:

> Although pre-1971 unprotected steel pipe mains and services are at risk, cast iron is more risky. Cast iron has low beam strength and is subject to graphitization, which makes it more brittle and susceptible to complete and partial main breaks with large volumes of gas exiting the main, with little to no warning.[7]

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[6] Pennsylvania Public Utility Commission Staff Report: Inquiry into Philadelphia Gas Works' Pipeline Replacement Program, April 21, 2015 at 4 ("2015 Staff Report"). https://www.puc.pa.gov/press-release/2015/puc-publishes-staff-report-on-pgw-pipeline-replacement-program.

[7] 2015 Staff Report at 15.

In response, PGW filed to further accelerate its pipeline replacement program timeline from eighty-six years to forty-eight years.[8] Upon PGW's petition, the PUC agreed to increase the DSIC recovery percentage to 7.5%, resulting in an additional $11 million annually for main replacement at the time.[9] Accordingly, it is fair to say that PGW's present cast iron main replacement effort is supported by the Commission and BI&E.

Q. HOW DOES PGW DETERMINE WHICH CAST IRON MAINS TO REPLACE?

A. PGW has developed a prioritization process that incorporates a risk ranking strategy in its Distribution Integrity Management Program ("DIMP"), consistent with the U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration's ("PHMSA") standards. The DIMP establishes relative risk rankings and an updated benchmarking / prioritization study to identify the poorest performing main segments, so that these mains can be targeted to be replaced at the earliest feasible times. BI&E has reviewed PGW's DIMP every year since 2018.

PGW's sophisticated predictive model, the Main Replacement Prioritization Model ("MRP"), is used to identity which "at risk" mains to replace to maximize safety. The process is consistent with federal regulations and has been reviewed by BI&E.

Q. IS THERE ANY EVIDENCE THAT THE ACCELERATED PIPELINE REPLACEMENT PROGRAM HAS IMPROVED SAFETY?

A. Yes. PGW continues to make significant strides towards reducing the number of hazardous leaks encountered on the distribution system. The graph below depicts

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8 *Petition of Philadelphia Gas Works for Waiver of Provisions of Act 11 to Increase the Distribution System Improvement Charge CAP and to Permit Levelization of DSIC Charges*, Docket No. P-2015-2501500, Opinion and Order entered January 28, 2016.

9 *Petition of Philadelphia Gas Works for Waiver of Provisions of Act 11 to Increase the Distribution System Improvement Charge CAP and to Permit Levelization of DSIC Charges; Office of Consumer Advocate v. Philadelphia Gas Works*, Docket Nos. P-2015-2501500 and C-2015-2504092 (Order entered January 28, 2016).

hazardous leaks repaired on distribution mains from FY 2014 through FY 2024, showing a downward trend.

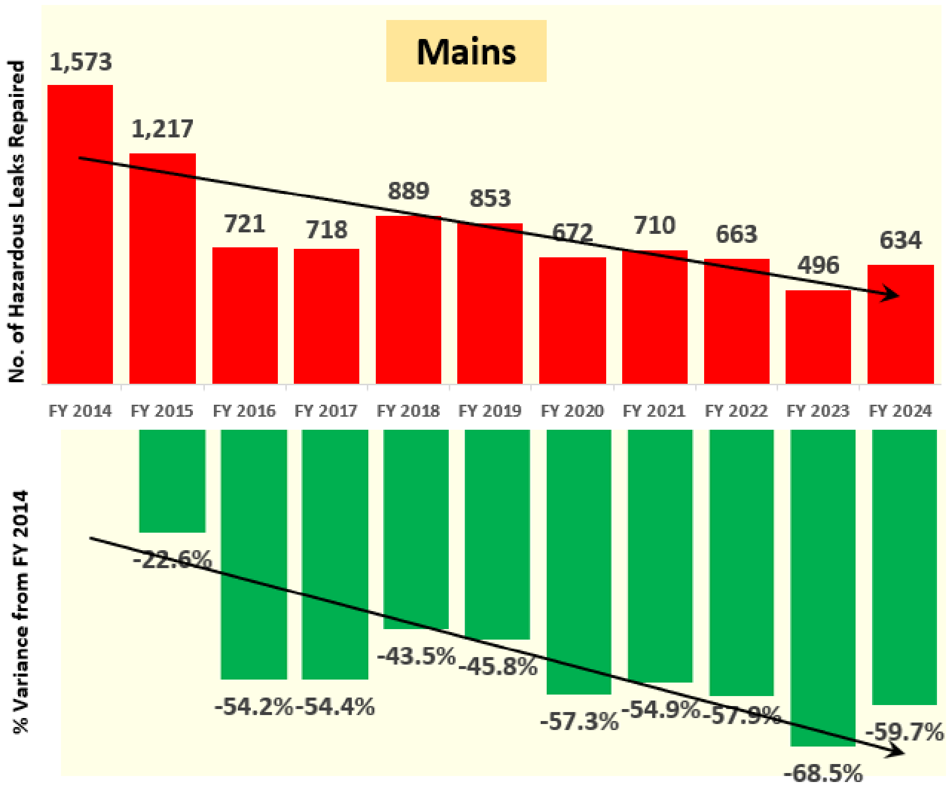

Figure 1 – Hazardous Leaks Repaired on Mains Fiscal Years 2014 – 2024

This continued downward trend is attributed to prioritized main selection, the accelerated pace of PGW's main replacement program, and recent warmer than average winter seasons.

PGW has also made substantial gains in the reduction of hazardous leaks repaired on Services. The number of hazardous leaks on Services has continually declined since FY 2014 by approximately 58%.

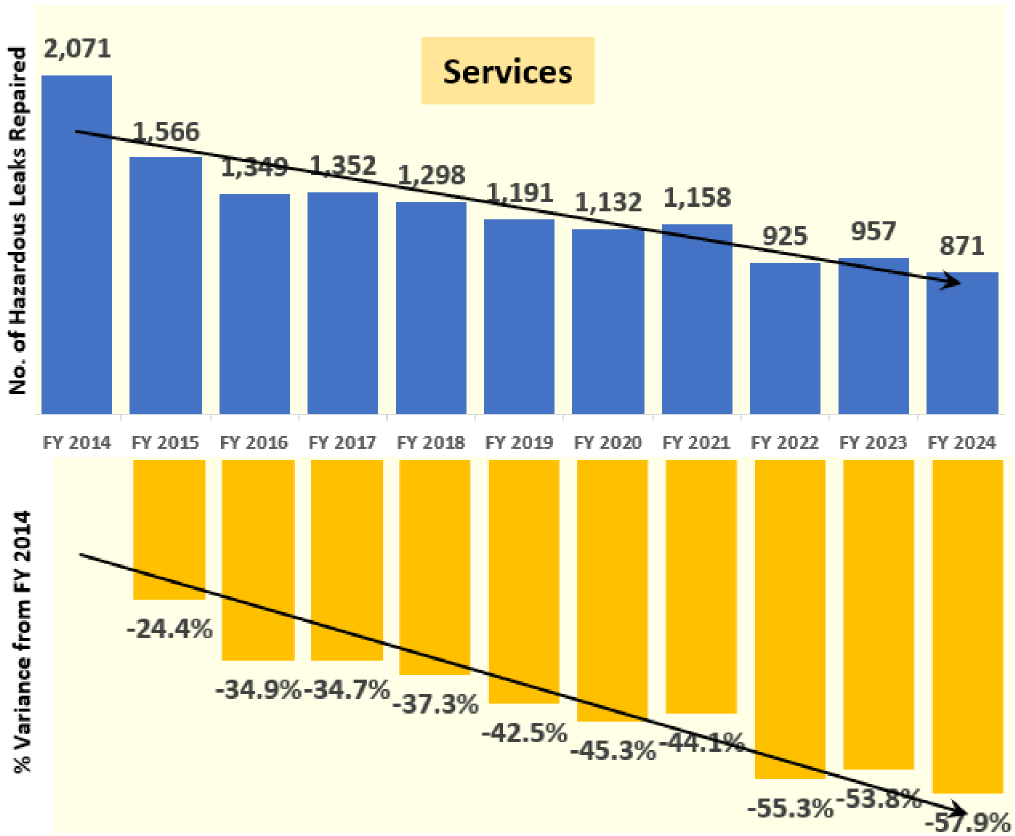

Figure 2 – Hazardous Leaks Repaired on Services FY 2014 – FY 2024

It is PGW's practice to replace all bare steel services encountered on main replacement projects regardless of condition. This proactive replacement of aging bare steel services has aided PGW in continuously reducing the number of hazardous leaks caused by corrosion on service lines.

Q. PLEASE DESCRIBE THE EFFORTS PGW HAS MADE IN RECENT YEARS AND SINCE ITS LAST RATE INCREASE IN FY 2023 TO MODERNIZE ITS NATURAL GAS DISTRIBUTION SYSTEM.

A. PGW has continued to make tremendous strides in reducing the amount of cast iron main in its system and replacing it with modern materials, such as cathodically protected, coated steel and plastic. In the past twelve (12) fiscal years, PGW has successfully removed 373.59 miles of this "at-risk" pipe from inventory. The following graphic shows this.

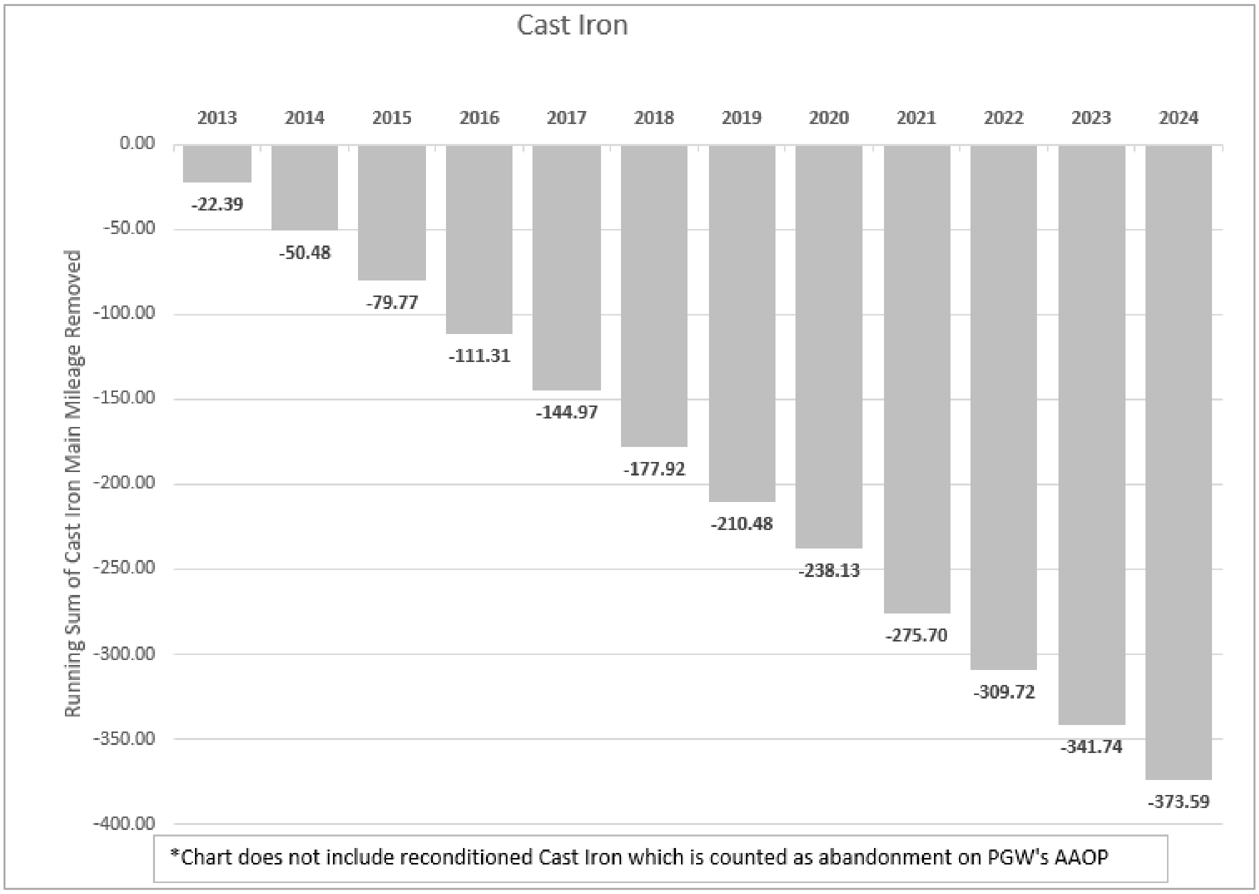

Figure 3 – Cumulative Cast Iron Main Removed from Inventory Fiscal Years 2013 – 2024

The installation of modern materials and subsequent elimination of "at-risk" pipe has been financed with PGW's base rates and the DSIC mechanism. This funding combination has allowed PGW to successfully complete its first LTIIP in FY 2017, removing approximately 3% more cast iron main than planned. PGW's second LTIIP, ending with FY 2022, also had strong results. While PGW's replacements were impacted during FY 2020 as a direct result of the COVID-19 Pandemic, PGW made up the FY 2020 shortfall in FY 2021 and exceeded its second LTIIP replacement goals from FY 2018 – FY 2022, replacing 164.7 miles, or 4% more cast iron main replaced than planned. Through the first two years of PGW's third LTIIP, PGW has replaced 63.9 miles, or 5% more cast iron main than planned.

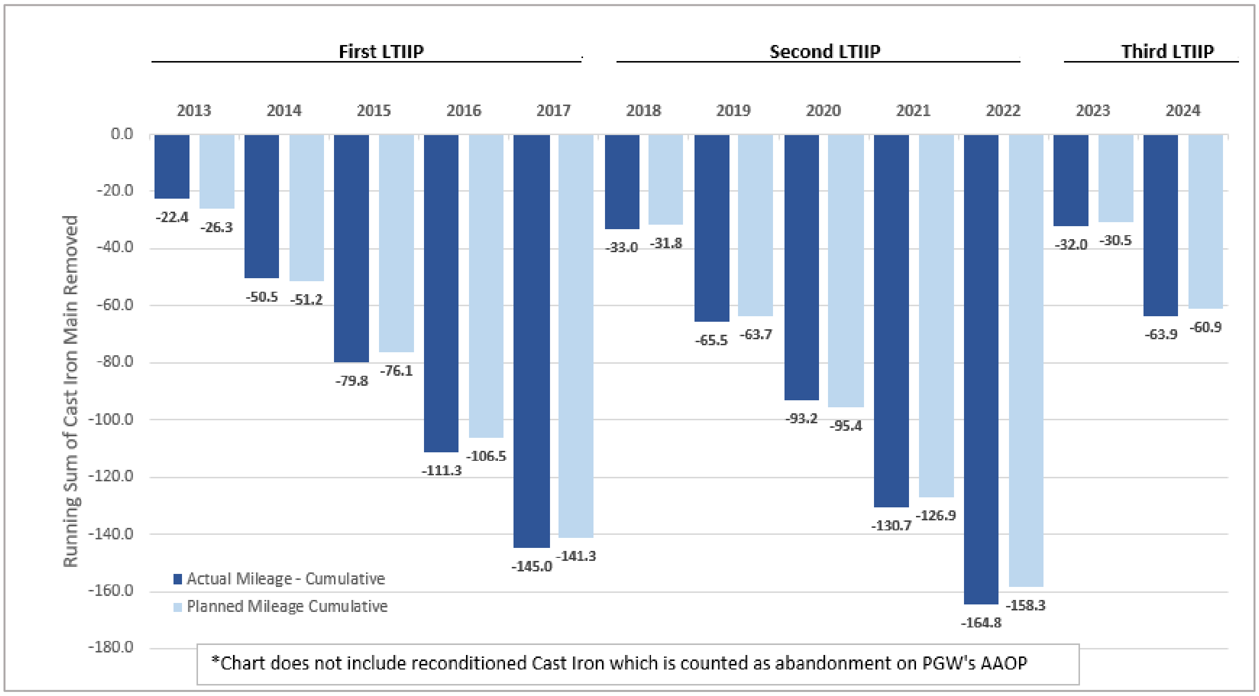

Figure 4 – LTIIP Cast Iron Main Removal Cumulative Results Fiscal Years 2013 - 2024

Q. PLEASE DESCRIBE PGW'S PROPOSED FUTURE EFFORTS TO MODERNIZE ITS NATURAL GAS DISTRIBUTION SYSTEM.

A. In PGW's third LTIIP, which covers FY 2023 – FY 2027, PGW will eliminate approximately 65 miles of cast iron main over the life of the program, which will be done concurrently with PGW's baseline main replacement program which removes 18 miles of cast iron main per year and is funded by current base rates. In addition to PGW's current LTIIP, PGW plans to replace an additional 66 miles of cast iron through the PHMSA Natural Gas Distribution Infrastructure Safety and Modernization Grant Program ("NGDISM") during FY 2025 – FY 2030. Approximately 120.9 miles of cast iron main are planned for replacement in FY 2025 – FY 2027 which includes replacement funded through base rates, the DSIC mechanism, and PHMSA NGDISM grant funding.

Q. WHAT OTHER FUTURE EFFORTS HAS PGW PLANNED TO MODERNIZE ITS SYSTEM?

A. Starting in FY 2026, PGW plans to begin implementing Advanced Metering Infrastructure ("AMI") using Smart Metering technology. The AMI initiative, which is expected to span ten years, will seamlessly integrate with PGW's existing meter replacement program, allowing PGW to minimize both costs and operational resources required for the meter replacements. Over the course of the AMI initiative, approximately 277,000 of PGW's residential meters will reach the end of their operational lifespan, creating an opportunity to replace the outdated meters with state-of-the-art AMI smart meters. Meters that have not yet reached the PUC's mandated replacement timeline will be upgraded to AMI smart meters in the later phases of the ten-year program ensuring enhanced safety and functionality for all residential customer meters.

AMI is an integrated system that combines smart meters, communication networks, and data management platforms, enabling two-way communication between the utility and customer meters. By integrating AMI with smart gas meters, traditional gas meters are transformed into advanced, automated safety devices.

AMI smart meters are equipped with automated shut-off valves, which can enhance safety during an emergency.

IV. PUBLIC OUTREACH

Q. WHAT INTERNAL STEPS DOES PGW TAKE TO MAXIMIZE SAFETY?

A. PGW has a multi-pronged set of programs that include formal statements of procedure and employee training on these topics. For example:

1. PGW utilizes in-house trained employees to perform Pennsylvania One Call mark outs. Their title is Damage Prevention Inspectors, as will be further explained by Mr. Leva in his testimony.

2. PGW staffs dedicated in-house trained crews/technicians for maintenance and emergency response on a 24/7 basis.
3. PGW's leak survey goes beyond code requirements by performing an annual City of Philadelphia-wide mobile survey.

V. STREET TROUBLE IDENTIFICATION AND REMEDIATION

Q. WHAT ARE UNDERGROUND STREET TROUBLES (USTS) AND HOW ARE THEY IDENTIFIED BY PGW?

A. USTs are failures of underground structures that could reduce or eliminate support for PGW pipelines or otherwise compromise them. Underground street troubles are usually brought to PGW's attention due to a condition observed on the street surface either by us or a third party.

PGW Damage Prevention Inspectors and Foreman are thoroughly trained that when they are working on a job, they must look for paving depressions, cavities, cave-ins, paving faults such as surface cracks, or settlement that are in proximity to PGW facilities and which could reduce or eliminate support of PGW pipe. When these circumstances are identified, an Underground Street Trouble investigation is triggered.

Q. DOES PGW HAVE AN OBLIGATION TO INVESTIGATE UNDERGROUND STREET TROUBLES?

A. Yes, and it undertakes this obligation seriously. When an UST is identified by a PGW trained employee or by an outside source – such as another utility, a City department, an excavator, member of the public or others – a UST work order is created in PGW's work management system ("AIMS") and assigned to a crew to investigate. If the location of the UST is not in proximity to PGW structures, bar holes will be drilled through the pavement to determine the solidity of the foundation under PGW structures. If the UST is in proximity to PGW structures, then the Foreman may make an exploratory opening. If needed, the affected gas mains may be blocked up or beamed temporarily if PGW facilities require support. If the UST is extensive, the gas main may need to be cut out or temporarily abandoned until the underlying issues are repaired.

Q. WHAT PROCEDURES DOES PGW HAVE IN PLACE THAT ADDRESS UNDERGROUND STREET TROUBLES?

A. My and Mr. Leva's testimony addresses our protocols.

Q. IS PGW OBLIGATED TO BE ON SITE DURING A THIRD PARTY EXCAVATION WHERE IT HAS NO NOTICE OF AN UNDERGROUND STREET TROUBLE THAT WOULD AFFECT PGW FACILITIES?

A. No. PGW cannot possibly be present at all third-party street construction sites in the City of Philadelphia to supervise and observe all third-party excavators. PGW responds to approximately 70,000 PA One Calls each year. Once we have knowledge of an UST, however, PGW promptly dispatches the appropriate personnel. PGW relies on the experience and expertise of excavators and other utilities (facility owners) and the requirements of PA One Call Act 287 as amended "to protect the public health and safety by preventing excavation or demolition work from damaging underground lines."

VI. <u>INCIDENT OF NOVEMBER 30, 2021</u>

Q. WAS THERE A NATURAL GAS EXPLOSION ON NOVEMBER 30, 2021 IN PGW'S SERVICE TERRITORY?

A. Yes. A natural gas explosion occurred at 815 Jackson Street in Philadelphia, PA on November 30, 2021. This explosion resulted in property damage.

Q. WHAT WAS THE PROXIMATE CAUSE OF THE EXPLOSION?

A. Based upon our investigation, we have concluded that the explosion occurred after natural gas was released from a circumferential crack on PGW's 4-inch cast iron main located in front of 815 Jackson Street, Philadelphia, PA.

Q. HAVE YOU REVIEWED THE COMPANY'S RESPONSE TO THE INCIDENT?

A. Yes. The actions taken in response to the emergency by all first responders, including PGW personnel, was heroic and protected the public by taking control of the incident area and limiting the potential for any further damage to the community. It showed how public safety is a first priority in all that we do. No injuries or loss of life occurred.

Q. WHAT PGW FACILITIES ARE LOCATED ON THE 800 BLOCK OF JACKSON STREET?

A. The gas distribution system on Jackson Street consists of three mains: a north side, 4-inch low pressure main 7.5 feet from the curb, a south side, 4-inch low pressure main, and a 16-inch steel high pressure main located in the street itself.

Q. WHAT PGW FACILITIES SERVED 815 JACKSON STREET?

A. The north side, 4-inch low pressure cast iron main located approximately 7 feet from the foundation wall and 7.5 feet from the curb, was installed in pre-1899 and connects to the service line for 815 Jackson Street.

Q. CAN YOU PROVIDE A DIAGRAM OF THE FACILITIES IN THE 800 BLOCK OF JACKSON STREET?

A. Yes. PGW prepared a map showing the location of gas and water/sewer facilities and PGW's distribution system on the 800 Block of Jackson Street. See **CONFIDENTIAL SECURITY INFORMATION Exhibit JH-3.**

Q. PRIOR TO THE INCIDENT, DID PGW UNDERTAKE LEAK DETECTION IN THE AREA?

A. Yes. We undertake a leak survey of our system and have done so annually in the 800 block of Jackson Street. **CONFIDENTIAL** Exhibit JH-2 at 11. To add more details to BI&E's report, PGW conducts annual leak surveys on the 800 block of Jackson Street (and the rest of the natural gas distribution system in Philadelphia); also, every three years it conducts a walking survey of the mains in the 800 block of Jackson Street as part of PGW's ongoing, leak survey program.

Q. PLEASE DESCRIBE THE COMPANY'S POST-INCIDENT INVESTIGATION ON THE 800 BLOCK OF JACKSON STREET.

A. PGW undertook a post-incident investigation, assessing events and its facilities including:

- The day of the incident PGW completed a thorough leak investigation per PGW procedures and took the necessary steps to isolate the broken cast iron main;
- PGW removed a section of the cast iron main for evidence and testing;
- PGW sent the cast iron main to a third-party laboratory for metallurgical testing;[10]
- PGW utilized a third-party investigator to perform a root cause analysis;
- PGW replaced the cast iron main on the 800 block of Jackson St.

Q. PLEASE DESCRIBE PGW'S FOLLOW UP IN THE AREA POST-INCIDENT.

A. Following the incident on November 30, 2021, PGW performed regular leak surveys in the area to help verify safety conditions and assuage concerns from local residents. PGW continued performing regular leak surveys until all cast iron main in the area was replaced. PGW designed and replaced the cast iron main on the 800 block of Jackson St by January 27, 2022 and approximately 795' of cast iron was abandoned, 1,548' of pipe was installed at an approximate cost of $557,000.

Q. WHAT WAS THE PROPERTY DAMAGE CAUSED BY THE EXPLOSION?

A. Ms. Cooper Smith states that the "estimated property damage was $104,269.92." BI&E

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[10] PGW contracted with Affiliated Engineering Laboratories, Inc. to perform a metallurgical evaluation of the aforementioned pipe. A copy of this report was attached to BI&E's testimony, BI&E Exhibit 9. The evaluation concluded that a combination of the graphitic corrosion, the brittle nature of gray cast iron pipe, and an external bending force caused the circumferential cracking of the cast iron piping.

St. 1 at 8. A total “cost” of $104,269.92 is accurate but the breakdown is not. Damage to property (buildings and cars) was estimated to be $55,000 with the remaining costs being incurred by PGW for site restoration and lab testing.[11]

Ms. Cooper Smith addresses the federal PHMSA requirement of filing information in the instance of a “reportable incidence” but agrees that the incident on Jackson Street “was not a reportable incident.” Exhibit JH-1, BI&E Response to PGW Set II, No. 15.

VII. <u>SPECIFIC REBUTTAL TO BI&E TESTIMONY</u>

Q. WERE YOU INVOLVED IN BI&E’S INVESTIGATION? AND, IF SO, CAN YOU DESCRIBE YOUR INVOLVEMENT?

A. Yes. I was a full participant, responding to BI&E’s written questions of PGW. PGW responded to numerous data requests, performed the necessary field work, and arranged the lab and root cause analyses. To my knowledge, BI&E investigators did not interview any PGW Damage Prevention Inspectors undertaking the One Call line marking and the written questions did not address anything regarding PGW’s Inspectors.

BI&E investigators did not interview the plumbing excavators Clements Brothers or Lepore Plumbing either. As stated in response to PGW discovery:

> I&E did not conduct any investigation into excavator conduct …I&E did not interview anyone for Clements or Lepore.

Exhibit JH-1 (BI&E response to PGW Interrogatory Set I No. 8). When asked whether BI&E reviewed “any pre- or post-work plans or otherwise know what work was done by Clements or Lepore” BI&E stated that they only reviewed the One Call tickets submitted by Clements Brothers and Lepore Plumbing and the plumbing permit issued by the City. Exhibit JH-2 (BI&E response to PGW Interrogatory Set I No. 9). In other words, BI&E’s

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[11] See **CONFIDENTIAL** Exhibit JH-2 at page 15.

sole investigation of the excavation and backfill work by the plumbers relied on a review of some of the paperwork without speaking with the parties responsible for the excavation. Regardless of the obvious third-party concerns in this explosion, BI&E's investigation focused exclusively on PGW.

Q. WAS MS. COOPER SMITH INVOLVED IN THE INVESTIGATION?

A. Not to our knowledge. We never observed her on site or during any of the follow-up by BI&E. In fact, she agreed in discovery that she was never on site at the scene of the incident. BI&E Response to PGW Interrogatories Set II, No. 3. The active investigators were Pipeline Safety Inspectors Scott Orr and Vladimir Shteyn, neither of whom has been called by BI&E as witnesses to describe their firsthand observations and conclusions. In discovery, Ms. Cooper Smith described her role as assigning two investigators and "instructed them to fully investigate the cause of the incident and report all findings to her." BI&E Response to PGW Interrogatories Set II, Nos. 1 and 2. Her testimony appears to be based on secondhand information obtained from the actual investigators or other sources. The description of the investigation by "I&E Safety" or "I&E Pipeline Safety" contained in her testimony is not about things she personally observed firsthand.

Q. IF MS. COOPER SMITH WAS NOT DIRECTLY INVOLVED IN THE INVESTIGATION, DO YOU HAVE AN UNDERSTANDING OF WHAT FORMED THE BASIS FOR HER TESTIMONY?

A. Based on the discovery responses, Ms. Cooper Smith's testimony relied on secondhand materials, in particular, the BI&E "Investigative Report" prepared by the active investigators involved entitled "Investigation of Injury 815 Jackson Street, Philadelphia, PA, November 30, 2021." A copy of the report is provided as **CONFIDENTIAL** Exhibit JH-2.

Q. DID BI&E EVER REACH OUT TO PGW SUBSEQUENTLY TO DISCUSS

THEIR FINDING AND POTENTIAL REMEDIAL ACTION?

A. No. There was no follow-up discussion of the conclusions reached by the BI&E investigators and they sought no input from PGW on how they came to their conclusions. BI&E's conclusions were reached without the benefit of PGW's subject matter expertise. PGW was not aware of BI&E's conclusions concerning this incident until the Complaint was received almost three years after the incident.

Q. HAVE YOU REVIEWED THE TESTIMONY OF BI&E WITNESS COOPER SMITH?

A. Yes. Overall, her conclusions are based on a misunderstanding and misinterpretation of the facts and applicable procedures and regulations, which do not warrant assignment of any fault or responsibility to PGW. Ms. Cooper Smith has misapplied the PGW Bulletins that BI&E has previously reviewed and approved. PHMSA regulations are only selectively quoted.

Fundamentally, BI&E is asserting that PGW should be some sort of "street sheriff" or excavation regulator in the City of Philadelphia, and be required to change its protocols to require monitoring of all third-party excavations involving third party facilities at or near its natural gas facilities. This would involve almost all underground street excavation in the City of Philadelphia.

In effect, BI&E proposes that PGW should be penalized for not adopting unprecedented and costly third-party oversight procedures not required by any regulation or law. BI&E's position would lead to fines and otherwise penalize PGW for any explosion. I have been advised by counsel that, by attempting to hold PGW liable for *any* damage caused by *any* gas leak regardless of cause, BI&E is seeking to implement a strict standard of liability, which has never been applied previously anywhere in the industry in so far as PGW is aware.

In summary, the testimony misinterprets and misapplies PGW's safety bulletins and the PHMSA rules to require PGW to undertake remedial action even where it has no notice and is not otherwise aware that an UST has occurred.

Q. CAN YOU BRIEFLY SUMMARIZE BI&E'S TESTIMONY?

A. Yes. The basic assertion of BI&E is that excavation work on sewer service lines in the area months prior to the incident may have (eventually) disturbed PGW's gas main or the underground support in front of 815 Jackson Street, and created a crack in the gas main, causing the explosion. At the same time, the BI&E witness concedes in discovery that PGW was not made aware of any safety concerns and that nothing was brought to PGW's attention regarding that gas main:

> **Interrogatory:** [Please identify w]hether any persons for Clements or Lepore reported to any entity whatsoever any adverse conditions (such as voids) during their work at or proximate to 815 Jackson St as identified in Paragraphs 30-37 [of the Complaint.]
>
> **Response:** I&E is not aware of any reports of adverse conditions (such as voids) during their work at or proximate to 815 Jackson Street.

Exhibit JH-1, BI&E Response to PGW Set I, No. 8. In another response to an interrogatory, she agrees that:

> I&E is not aware of any individual or entity that knew of the void prior to November 30, 2021.

Exhibit JH-1, BI&E Response to PGW Set I, No. 20. Given the absence of knowledge of voids, BI&E argues that PGW was aware that sewer repair excavation was occurring in the 800 block of Jackson Street, which it conflates into knowledge of the "potential" for voids. Ms. Cooper Smith asserts that:

> …prior to the explosion PGW received various notifications/One Call requests for the 800-block of Jackson Street. The notifications identified sewer repairs as the reason for excavations and detailed the extent of excavations needed, therefore PGW had been aware of the construction/repair work in the area.

BI&E St. 2 at 20-21. As I have described above, PGW receives ~70,000 PA One Call requests per year. There was nothing unusual or conspicuous about these three requests that could have triggered any concern out of the ordinary by PGW.

The level of One Call activity in the area was routine. There were only three One Call requests involving two excavations associated with the work done by Clements Brothers Plumbing and Lepore Plumbing. To be clear, three (3) related locate requests were submitted to the One Call system between July 26, 2021 and September 3, 2021 near 815 Jackson Street and 813 Jackson Street. However, only two (2) unique requests were in fact received. The September 1, 2021 ticket was simply an update to the July 26, 2021 ticket for facility re-marking where the prior ticket's lawful start date had expired, and the excavator stated the reason as "work not started." The fact that this was a "work not started" situation by the plumber further indicates that the work was not an actual "emergency" since repairs were not started immediately by the plumber related to their ticket. Two (2) unique locate requests on a city block in a 39-day period is not uncommon within PGW's service territory.

Q. PLEASE CONTINUE.

A. BI&E's witness asserts that, because PGW should have been aware of the underground conditions of which they had no notice, PGW had an obligation to post employees to monitor the third-party excavation of third-party water/sewer facilities at each marked One Call location, apparently at the time of excavation and on a continuing basis.

However, PGW's safety bulletins and federal rules regarding "safeguarding" against another party's excavation near our gas mains is triggered by *actual* knowledge of unsafe conditions affecting PGW's facilities. However, BI&E asserts that actual knowledge is not required, rather that PGW *should have* known.

PGW strongly disagrees with BI&E's version of the facts, interpretation of our safety procedures, and requirements of the law.

Q. ON WHAT BASIS THEN DOES BI&E ASSERT THAT PGW SHOULD HAVE BEEN ON SITE DURING THE PLUMBERS' EXCAVATION?

A. The answer is encapsulated in an interrogatory response by BI&E as follows:

> PGW had knowledge that its cast iron mains on the 800 block of Jackson Street experienced 5 breaks since 2009. Additionally, PGW was aware of the type of work being performed, the location, the extent and depth of the excavations, and approximate time based on the three One Call Tickets that were submitted by Clements Brothers and Sister, Inc. and Lepore Plumbing. Based upon the available history of these breaks, coupled with the information from PA One Call that excavation was going to take place in the area of prior breaks, PGW should have proactively assessed and inspected the excavation to mitigate any risks to its facilities.

BI&E Response to PGW Interrogatories Set II, No. 10. I will discuss this position throughout my testimony.

Q. IS FIVE (5) BREAKS SINCE 2009 AN ACCURATE DESCRIPTION OF THE 800 BLOCK OF JACKSON STREET?

A. It is an accurate description as to the entire block, but there were two cast-iron mains along Jackson Street, one on the northside and one on the southside. The northside main was the main that experienced a break on November 30, 2021 and it only experienced three (3) breaks since 2009, that being on January 2, 2009, January 4, 2010, and January 25, 2016. Three (3) breaks on the north side 4-inch cast iron main over a 12+ year period is not out of the ordinary, is not indicative of any unique problem on the 800 block – it is just the reality of PGW's cast iron which PGW is continuing to accelerate the replacement of. Each of the northside breaks were timely repaired by PGW and such repairs addressed the breaks at issue. From this, PGW had no reason to believe that there was any continuing unsafe condition in the 800 block of Jackson Street.

Q. THE BI&E WITNESS ALSO RECITES SOME HISTORICAL FACTS REGARDING CAST IRON MAIN BREAKS. BI&E ST. 1 AT 3. DO YOU HAVE A RESPONSE?

A. Yes. As the Commission has recognized and I stated above, all parties are well aware of breaks associated with at-risk cast iron main, which is why the Commission heavily supports accelerated cast iron replacement and why PGW is pursuing every opportunity and funding to do so as accelerated as possible.

Q. WOULD YOU PLEASE SUMMARIZE PGW'S RESPONSE TO THE FACTUAL ASSERTIONS MADE AND CONCLUSIONS DRAWN BY THE BI&E WITNESS?

A. Yes. Ms. Cooper Smith's basic conclusion is that:

> Specifically, PGW did not follow its procedures relating to the protection of cast iron from disturbance because they did not safeguard their facilities, did not perform inspection and necessary follow-up actions upon receipt of notice of sewer system failures and repairs, and did not act on the multiple One Call notices detailing extensive excavation activities at and around its facilities.

BI&E St. 1 at 20. This conclusion is speculative and does not verify the timeline for when the field conditions developed.

PGW has numerous points of disagreement with the facts described by the witnesses and the conclusions drawn. I will address these in more detail, but summarized they are:

- The position that soil instability was the cause of the crack in the cast iron main in front of 815 Jackson Street is an unsupported conclusion and does not address the timeline of events.
- It is conclusory to state that the soil instability was caused by the water/sewer excavations. The witness presents no observations made about PGW facilities. Additionally, since BI&E did not interview the excavators, there are absolutely no facts presented regarding their activities and backfill practices.

- The photographs of street excavations occurred after the explosion and after the sewer repair work was undertaken and, importantly, after the street was marked by PGW employees.
- PGW had no prior knowledge of adverse underground street conditions at 815 Jackson Street after the excavations but prior to November 30, 2021.
- The underground conditions were not apparent from the surface inspection undertaken by the Damage Prevention Inspectors that marked the location of PGW's mains in response to One Call tickets.
- The One Call tickets for water/sewer service line repair were not all marked "emergency." Only one Lepore Plumbing ticket was marked "emergency." The classification of a ticket as "emergency" does not necessarily indicate a threat to PGW facilities.
- All of the sewer repairs and final paving were completed for a significant amount of time before the explosion. PGW had no way of knowing that some type of underground issue would eventually develop some time after all plumbing work was completed.

Q. LET'S START WITH THE TOPIC OF UNDERGROUND VOIDS. PLEASE EXPLAIN.

A. Ms. Cooper Smith states that:

> Water and sewer leaks can cause soil instability below gas pipelines due to water saturation and erosion. Additionally, repair of sewer laterals causes further soil instability due to the excavation removing compacted soil around and beneath gas facilities.

BI&E St. 1 at 3. These are correct statements of theoretical concerns, but BI&E has presented no evidence that they occurred here. There is no clear timeline or point of failure identified by the BI&E witness.

Most Philadelphia streets, including the street in front of 815 Jackson Street, are older and have been dug up many times by various entities. Clearly, there are alternative causes of underground failure (water or sewer) after the plumbers completed their excavation work, including the age and graphitization of the cast iron pipe. Cast iron can also break without warning and without any apparent cause.

Moreover, the testimony describes “newer sidewalk and pavement sections [and] signs of fresh pavement on the street in front of 815 Jackson Street…” that should have been observed by the PGW personnel undertaking the marking. BI&E St. at 11. She describes these as a result of the work undertaken by Clements Brothers or Lepore Plumbing: “The cast iron main cracked due to the instability of the soil due to sewer failures and excavations to repair sewer laterals in the vicinity of the main.” BI&E St. 1 at 25. The FCNA report also states that: “According to Mr. Zazula representing Clements Brothers, a backhoe was used for the excavation and a section of sidewalk, and the street surface had been replaced with a new asphalt surface.” See BI&E Exhibit 10 at 2. In other words, the repaving occurred as part of the excavation, which occurred some time after the One-Call marking.

The BI&E testimony does not recognize the obviously different time frames here – that these third party activities were undertaken *after* PGW personnel marked the PGW facilities and so could not have been observed by them.

Q. YOU MENTIONED PREVIOUSLY THAT PUBLIC PROTECTION UNDER ACT 287 (PA ONE CALL) IS A JOINT EFFORT BY EXCAVATORS AND FACILITIES OWNERS. WHAT ARE THE OBLIGATIONS OF THE EXCAVATORS?

A. If a water maintenance crew exposes a gas main while excavating, they should follow industry best practices and observe the notice requirements under the PA One Call Law related to notifications. Under Act 287 as amended, Sections 5(6)i and 5(6)ii, some of the responsibilities of the excavators are:

> 1) Plan the excavation or demolition work to avoid damage to or minimize interference with a facility owner's facilities in the construction area. Excavation or demolition work which requires temporary or permanent interruption of a facility owner's service shall be coordinated with the affected facility owner in all cases.

> 2) After consulting with a facility owner, provide such support and mechanical protection for known facility owner's lines at the construction work site during the excavation or demolition work, including during backfilling operations, as may be reasonably necessary for the protection of such lines.

Title 73 P.S. § 180(6). Importantly, if Clements Brothers or Lepore Plumbing noticed any threat to PGW's facilities, even if not caused by them, Clements Brothers and Lepore Plumbing were obligated:

> [t]o report immediately to the facility owner any break or leak on its lines, or any dent, gouge, groove or other damage to such lines or to their coating or cathodic protection, made or discovered in the course of the excavation or demolition work. The One Call System board of directors may adopt procedures to permit reporting under this clause through the One Call System.

Title 73 P.S. § 180(7)

The Common Ground Alliance[12] Best Practice at Section 5-24 provides:

> **Practice Statement:** An excavator discovering or causing damage to underground facilities notifies the facility owner/operator and the one call center. All breaks, leaks, nicks, dents, gouges, grooves, or other damages to facility lines, conduits, coatings, or cathodic protection are reported.
>
> **Practice Description:** A majority of states require notification for damage or substantial weakening of an underground facility (27 states). The possibility of facility failure or endangerment of the surrounding population dramatically increases when a facility has been damaged. Although the facility may not immediately fail, the underground facility owner/operator is provided the opportunity to inspect the damage and make appropriate repairs.

In other words, if the sewer excavation crews who excavated the street had encountered any voids and cavities under PGW facilities or damaged PGW facilities, they were obligated to notify the proper authorities including PGW.

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12 https://ams.pa1call.org/pa811/Public/Resource%20Center/Brochures/Public/POCS_Content/Links/Brochures.aspx?hkey=415b43c0-06bb-40c9-8959-804fea0078bc

BI&E cannot say whether Clements Brothers did or did not observe underground subsidence, because they narrowly defined their investigation to focus upon PGW exclusively.

Q. DID EITHER CLEMENTS BROTHERS OR LEPORE PLUMBING CONTACT PGW TO REPORT THAT ITS NATURAL GAS FACILITIES MIGHT BE AT RISK OR IN JEOPARDY?

A. We were never contacted by either of these excavators about their activities in the area or what they observed. As Chairperson of the Commission's Damage Prevention Committee, which oversees One Call violations in Pennsylvania, Ms. Cooper Smith would be acquainted with state statutes that place accountability on the excavator to protect structures, properly backfill, and notify facilities owners if their excavation goes beyond the scope of the One Call ticket.

I can testify as to what PGW does if an underground cavity/void is discovered. PGW would protect its structures and report the cavity/void to the City Streets Department. PGW would not backfill the cavity until the City or appropriate party made repairs to address the underlying cause of the cavity. PGW does not backfill water leaks or cavities unless the underlying issue is addressed. PGW would protect its structures and report water leaks to the PWD and a cavity/void to the City Streets Department. PGW would not backfill the water leak or cavity until the appropriate party made repairs to address the underlying cause of the cavity.

Q. TO THE BEST OF YOUR KNOWLEDGE DID BI&E FILE A COMPLAINT AGAINST EITHER OF THESE EXCAVATORS?

A. To the best of my knowledge, BI&E never investigated or took any action, formal or informal, involving these excavators. BI&E never interviewed the excavators to determine conditions on-site and the procedures they followed for excavation and backfilling. Counsel advises me that excavators have been prosecuted by BI&E on prior occasions.

Q. SHOULD PGW HAVE BEEN ON SITE FOR THE SEWER REPAIRS?

A. No. PGW did not need to be, nor was it required to be on location for the work undertaken by Clements Brothers and Lepore Plumbing. PGW had no reason to suspect any underground street trouble which could potentially cause the cast iron main to break on November 30, 2021, almost 2 months after the One Call tickets and all plumbing repairs were completed. As previously noted, no information about these circumstances was reported to PGW contemporaneously.

Q. DOES PGW KNOW THE REASON THAT THE CAST IRON MAIN IN FRONT OF 815 JACKON STREET CRACKED?

A. No, we do not know with any certainty why the main cracked.

Q. WHAT DID THE METALLURGICAL EVALUATION CONCLUDE?

A. The metallurgical evaluation prepared by Affiliated Engineering Laboratories dated July 15, 2022, undertaking a metallurgical analysis states:

> …there was no evidence of a pre-existing leaking condition prior to the reported incident…. The fracture occurred as a one-time overload condition … Circumferential cracking is a common mode of failure for cast iron piping, when subjected to bending forces.…Such bending forces can occur as a result of frost upheaval during freeze/thaw cycles, poor bedding, loss of soil support or external force from soil disturbances near the buried pipe or undermining.

BI&E Exhibit 9 at 28-29.

Q. WAS THERE ALSO AN EVALUATION OF THE CAUSAL (“ROOT CAUSE”) FACTORS OF THE EXPLOSION AND FIRE UNDERTAKEN?

A. Yes. A study was also undertaken by FCNA Partners, a forensic consulting group. The report is dated February 4, 2021. The conclusions of the report are not definitive but explore possibilities:

> *The potential exists* that work performed by Clements Brothers Plumbing on September 7, 2021, while excavating underground soil for a lateral curb trap replacement, compromised the natural gas piping that was later found to be damaged.
>
> ***
>
> Excavation, backfilling, replacement of soil and asphalt surfaces by Clements Brothers Plumbing, while completing a lateral curb trap, *most likely contributed* to the damage/cracking of the underground natural gas pipe and subsequent escape and migration of gas vapors that entered the subject residence of 815 Jackson Street.

BI&E Exhibit 10 at 4 (Emphasis added).

Yet the BI&E testimony is definitive in arguing that the cause lies with the excavators:

> The cast iron main cracked *due* to the instability of the soil due to sewer failures and *excavations to repair sewer laterals in the vicinity* of the main. Undermining in the area caused sufficient softening or removal of material supporting the cast iron main which led to the material failure.

BI&E St. 1 at 25 (Emphasis added).

Q. WHAT IS YOUR RESPONSE TO BI&E'S CONCLUSION ABOUT THE CAUSE OF THE GAS MAIN BREAK?

A. I think that the BI&E conclusion that the excavators caused the loss of underlying support for the gas main is a possibility but certainly not the only possibility. This is especially true where the 3 One Call tickets did <u>not</u> indicate that the excavators would be undermining PGW's main, and at most were to only work on a sewer curb trap in the street and a small 4x4 section of sidewalk that was over 3 feet from PGW's main. See I&E Exhibits 6-8. Based on the images I've reviewed, PGW's main was not exposed (or should not have been exposed) by the excavations, and the new sections of sidewalk were not above PGW's main. See I&E Exhibit 1. Mains can break from several causes. But, even if accurate, BI&E's conclusions were based on several glaring investigative omissions. As part of a thorough investigation, BI&E should have investigated the excavators to determine:

1. What they observed about the underlying soil support of the gas mains;

2. Whether poor trenching and/or backfilling was, in fact, the actual cause; and

3. If caused by the excavators or not properly remedied by them when the trench was open (or notification not given to PGW as required), whether they should be the subject of enforcement action and not PGW.

Simply stated, BI&E did not fully investigate the incident at 815 Jackson Street and has no basis to now prosecute PGW simply because they own the gas mains.

Q. DID PGW HAVE ANY PRIOR KNOWLEDGE OF THESE UNDERGROUND VOIDS REFERRED TO BY THE BI&E WITNESSES?

No. First, I want to emphasize that these voids are underground and only directly observable by excavation.

PGW is not going to randomly dig up the streets of Philadelphia to spot check for voids if it is unaware of any UST. Instead, we train our employees to use surface indications of UST, as I previously described. In my experience, this is the standard industry approach. PGW responds to indications of subsurface issues that we observe either directly or by inference or that are reported to us. The experienced PGW Damage Prevention Inspectors responding to the One Call tickets of Clements Brothers and Lepore Plumbing who marked the PGW facilities looked for indications of underground street troubles as they are trained to do and saw none.

The three One Call locate requests pointed to by BI&E are typical "routine" and "emergency" locates, as I have explained previously. They provide no evidence that "notice of water or sewer system failures, or surface conditions, such as cavities or cave-ins" was ever provided to PGW. To the contrary, BI&E agrees that PGW was never notified or otherwise aware of an exposed facility warranting PGW to return to support, replace, relocate, or remove from service gas pipeline facilities that are or may be endangered. BI&E further concedes that the plumber/excavators did not contact PGW, let alone indicate that an additional site visit was required once excavation began.

Q. WITHOUT ADVANCE KNOWLEDGE OF EVEN A POSSIBILITY OF ANY SUBSURFACE SUBSIDENCE, AS YOU DESCRIBE ABOVE, WHAT CAN PGW DO TO PROTECT ITS FACILITIES FROM THE LACK OF SUPPORT?

A. Without knowledge of an underground street condition to which we can respond, the best preventative action that we can undertake is continuing to pursue our aggressive cast iron replacement program, train our employees to constantly be "on patrol" and undertake public safety education efforts to spot and report as will be explained by Mr. Leva.

Q. WITHOUT KNOWLEDGE OF UNDERGROUND EROSION, HOW CAN PGW BE HELD ACCOUNTABLE FOR NOT "SAFEGUARDING" ITS FACILITIES AND PREVENTING THE CRACKED CAST IRON MAIN?

A. It cannot. BI&E's claim is that PGW "should have known" that there was underground subsidence, by deducing, from the One Call marking requests made for two locations, one at 815 Jackson Street by Clements Brothers and the other next door at 813 Jackson Street by Lepore Plumbing.

These tickets were submitted to One Call **"**approximately 3 months prior to the explosion." BI&E St. 1 at 12. From these two repairs, Ms. Cooper Smith claims that PGW should have realized "the nature of the One Call tickets poses an elevated risk of impacting PGW's pipeline facilities." BI&E St. 1 at 13. There are many concerns with this claim.

The term "emergency," as used by water and sewer line excavators, does not necessarily indicate a true "emergency." Under Act 287, an emergency One Call ticket requires us to respond "as soon as practicable" whether there is a true emergency or not. In my experience, plumbers use this as a scheduling tool to keep their customer work as continuously scheduled as possible. In other words, it is simply not correct to suggest that the "emergency" designation on a One Call request suggests an "elevated risk" to PGW's structures.

Moreover, the notion that two sewer related excavations (three One Call tickets / two unique tickets) is a concentrated number in a Philadelphia block is not empirically supported or rational. Even looking at the entire year, the block only had four total tickets in one year on a block, which is routine in the City. PGW has approximately 31,600 city blocks in the City with gas structures. PGW responds to approximately 70,000 One Call marking requests in a year and over 17,000 of these are claimed to be of an "emergency" nature.

Finally, we are aware of no study or investigation anywhere that has demonstrated a positive correlation between the number of One Call marking requests and dangerous underground conditions. Nor has BI&E presented any such study as part of their direct case. It is certainly not a relationship that PGW has ever observed. Nor am I aware of any other natural gas distribution company that utilizes such a standard for initiating monitoring. Furthermore, PGW relies on its dedicated and highly trained damage prevention inspectors that perform One Call mark outs to identify potential underground street troubles in order to protect PGW structures, and none were observed with respect to the 800 block of Jackson Street. Thus, PGW does not rely on an arbitrary number of One Calls to determine if an emergency situation may be immanent.

Q. WHAT DOES THE BI&E WITNESS STATE WHAT SHE BELIEVES PGW SHOULD HAVE DONE UNDER THESE CIRCUMSTANCES?

A. Ms. Cooper Smith argues that PGW should have deployed employees to be present during all sewer line excavation undertaken by these two third parties.[13] By not doing so, Ms. Cooper Smith asserts that "the integrity of the cast iron main was compromised the weakening of the soil and/or undermining of the pipeline. Thus, PGW failed to reinforce and protect the integrity of the main." BI&E St. 1 at 22-23. This is the essence of the BI&E case – that based upon the One Call tickets alone, PGW "should have known" that there were underground street troubles.

It is a complete overstatement to state that "PGW failed to act on the known One Call notices…" BI&E St. 1 at 22. PGW accurately marked its facilities – with which BI&E raises no criticism. The purpose of the One Call ticket is to mark the locations of facilities and to observe any underground street trouble that might be observable from the surface.

Q. DO ONE CALL REQUESTS BY A THIRD PARTY EXCAVATOR RELATED TO WATER AND SEWER LINES TRIGGER AN OBLIGATION BY PGW TO BE PRESENT DURING THAT EXCAVATION TO "SAFEGUARD" ITS FACILITIES?

No. The simple fact of three One Call tickets (two instances of excavation) in an area in year 2021 does not "trigger an investigation." BI&E St. 1 at 24. As explained previously, there was no indication that PGW facilities were threatened by routine water/sewer line maintenance; nor was there any observed threat to those facilities.

Q. MS. COOPER SMITH ASSERTS THAT PGW VIOLATED ITS OWN RULES AS ESTABLISHED IN ITS EMPLOYEE SAFETY BULLETINS. BI&E ST. 1 AT 21-22. DO YOU AGREE WITH HER CONCLUSIONS?

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[13] The BI&E witness claims that: "PGW employees did not observe contractor activities or offer assistance to safeguard PGW facilities during construction, institute necessary actions such as patrolling, supporting, replacing, relocating or removing from service the affected gas facilities when those facilities are or may be endangered…" BI&E St. 1 at 22.

A. No, I totally disagree with Ms. Cooper Smith's assessment.

Bulletin 312. As to Bulletin 312, Ms. Cooper Smith claims that:

> PGW employees did not observe contractor activities or offer assistance to safeguard PGW facilities during construction, institute necessary actions such as patrolling, supporting, replacing, relocating or removing from service the affected gas facilities when those facilities are or may be endangered or promptly dispatch personnel to determine the effect of water or sewer system failures or surface conditions on PGW facilities in accordance with Bulletin #312 "Damage Prevention Program."

BI&E St. 1 at 21. This paraphrasing of Bulletin 312 to "safeguard PGW facilities during construction" is from a section of the "Mission Statement," which provides that part of the damage prevention's mission is "[t]o observe contractor activities when necessary and to offer assistance to safeguard PGW facilities during construction." This quote from the generalized "Mission Statement" is not an action item for PGW. In any event, PGW employees fulfilled the purpose of the mission statement by accurately marking the location of the gas main demonstrating a positive response and "assistance to safeguard PGW facilities." No further action was indicated as "necessary."

The actual language of Bulletin No. 312 is as follows:

> ***Upon receipt of notice*** of water or sewer system failures, or surface conditions, such as cavities or cave-ins which may be caused by such failures, the location of gas pipeline facilities shall be determined. Where pipeline facilities may be affected, appropriate personnel shall be dispatched promptly to determine the effect of the failure on pipeline facilities. Inspection and necessary follow-up action shall be in accordance with the "Protection of PGW Facilities from Underground Street Troubles" procedure.

Bulletin No. 312, Sec. III.B (emphasis added).

As to this specific directive of Bulletin 312, and as noted several times above, PGW had no notice of underground conditions and, therefore, was under no obligation to further observe excavation as such was not "necessary" or known to be "necessary" by PGW.

Bulletin 313. The BI&E witness also selectively misreads PGW's Bulletin 313, where she states:

> PGW employees did not inspect third-party construction activities for the main purpose of protecting PGW underground structures and facilities, visit the underground street trouble and report the same to Distribution Dispatching and supervisor, re-visit the on-going job without a watchman, in which PGW facilities will be undermined, in order to report and/or recommend replacement or protection, or report an undermined gas main as required by Bulletin #313 "Damage Prevention Inspectors."

BI&E St. 1 at 22.

The following is stated in the "Objectives" section of Bulletin 313:

> To inspect foreign construction activities for the main purpose of protecting PGW underground structures and facilities….

PGW Bulletin 313, Sec. III.A. (Objectives). As I have previously stated, there is no indication that PGW had notice that any of the excavator's activities would or did impact PGW's facilities. The locates requested through POC were typical "routine" and "emergency" locates. There is no documentation presented by BI&E where PGW would have been notified of a need to return to the Jackson Street location to investigate an exposed PGW facility that would warrant "protecting."

The operative directive of Bulletin 313 is this:

> When performing a pipeline patrol, ***the inspector should be looking*** for any activity or changes in the environment that could affect the safety of the pipeline. An activity or changes found ***must*** be reported to the Supervisor immediately and documented in the corresponding AIMS order.

The Bulletin continues:

> The following is a sampling of items the inspector should always report or act upon:
>
> Any excavations (including backfilled openings that are not familiar to the inspectors), grading, demolition, or other construction activity which could result in damage to a pipeline, loss of support due to settlement or shifting

of soil around a pipeline, undermining or damage to a pipeline support, or loss of cover or excess fill.

This requires the Damage Prevention Inspector to be alert for and report adverse conditions. Once again, there was no observation of "damage to a pipeline, loss of support due to settlement or shifting of soil around a pipeline, undermining or damage to a pipeline support, or loss of cover or excess fill." As stated above, without notice to PGW, there is no way for PGW to have known that undermining may occur.

Bulletin 54. Ms. Cooper Smith next claims that:

> PGW dispatchers did not generate a UST order in AIMS [Advanced Intelligent Mobile Solutions] upon receipt of a PA One Call System notice that a third party contractor would be performing excavations to repair the sewer system and PGW employees did not visit the location before, during, or after construction activities to perform inspection, investigation, or necessary follow-up actions in accordance with the "Protection of PGW Facilities 15 from Underground Street Troubles," Bulletin #54.

Once again this is a partial reading of the Bulletin, which provides that:

> Underground troubles are usually ***brought to PGW's attention*** due to a condition observed on the street surface; or as a result of a pre-existing condition encountered in the performance of PGW work but not caused by PGW activity. Some underground troubles are:
>
> - Water Leaks
> - Washouts
> - Sewer System Failure – Signs of a sewer system failure are as follows: cavity, cave-in, or paving faults such as a surface crack, settlement, or depression in the street or curb area.
> - Paving depressions – These may be caused by settlement in "area" fill or settlement caused by poor backfill.

Bulletin 54, Sec, III. PGW Bulletin No. 54 requires that the trouble be "brought to PGW's attention" as described in the above quote, before any action is directed on PGW's part.

PGW's Damage Prevention Inspectors are trained to look for potential underground street troubles and implement an UST investigation when one is identified. BI&E points to no pre-excavation indication a UST investigation was warranted. As Mr. Leva notes in his testimony, these employees did their job.

Q. ARE THERE ANY FEDERAL REQUIREMENTS TO MONITOR THIRD-PARTY EXCAVATION OF THIRD-PARTY SERVICE LINE FACILITIES?

A. Yes, but under circumstances that are not present here.[14] Ms. Cooper Smith refers to 49 CFR § 192.605 and 49 CFR § 192.614 as somehow having been violated by PGW. BI&E St. 1 at 24. In my review of these PHMSA regulations, neither apply to the present situation.

49 CFR § 192.605(a) simply requires that: "Each operator shall prepare and follow for each pipeline, a manual of written procedures for conducting operations and maintenance activities and for emergency response." 49 CFR Part 192.605(b)(1) requires that the manual include procedures related to: "(1) Operating, maintaining, and repairing the pipeline in accordance with each of the requirements of this subpart and subpart M of this part." The PGW Bulletins constitute PGW's written operating procedures. Thus, PGW is in compliance with 49 CFR Part 192.605 and the Jackson Street incident did not change that.

49 CFR § 192.614 is similar, requiring that "each operator of a buried pipeline must carry out, in accordance with this section, a written program to prevent damage to that pipeline from excavation activities…" Again, our Bulletins 54, 312, and 313 cover these topics.

[14] The best example would be excavation in the direct area of a high pressure natural gas transmission line, where PGW would certainly be on-site from excavation start to the conclusion of backfilling.

I can find nothing in these sections that would require PGW to be on site after marking to supervise excavation.

Q. ARE THERE ANY STATE REQUIREMENT IN THIS REGARD?

A. None that I am aware of. 52 Pa. Code § 59.33(a) cited in BI&E testimony (BI&E St. 1 at 24) is a general admonishment that: "Each public utility shall at all times use every reasonable effort to properly warn and protect the public from danger, and shall exercise reasonable care to reduce the hazards to which employees, customers and others may be subjected to by reason of its equipment and facilities." Again, this imposes no obligation upon PGW to supervise, inspect, investigate or monitor (BI&E St. 1 at 20) routine third party excavators working on third party utility facilities in the absence of a known reason to do so.

The Commission's regulation at 52 Pa. Code § 59.33(b) simply adopts the federal, United States Department of Transportation ("DOT") safety standards at 49 U.S.C. §§ 60101 - 60503 for gas transmission and distribution facilities. This is not an independent, standalone safety regulation by the Commission and any violations would be interpreted by reference to 49 USC. So, claiming a violation of 52 Pa. Code § 59.33(b) is the same as claiming a violation of federal safety standards.

Q. WHAT DO YOU CONCLUDE FROM THIS REVIEW OF THE ALLEGED VIOLATIONS SET FORTH IN BI&E'S TESTIMONY?

A. The BI&E testimony is composed of claims of violations of PHMSA and PA PUC regulations which cannot be substantiated upon a thorough review. BI&E has selectively chosen phrases and provisions from PGW's Bulletins and PHMSA regulation in an attempt to claim that PGW is culpable for not remaining onsite and monitoring the excavator's conduct for the duration of all street work. These repetitive allegations of "failure to protect" PGW's facilities from unknown and unreported threats, where none were evident are misleading and untrue.

The fact is that, absent observed or noticed conditions indicating underground street conditions, there are no regulations (or logic) that require PGW to be on-site during the subsequent excavation related to water and sewer repairs once the location of its low pressure distribution main has been marked pursuant to a One Call request. There is no reasonable basis on which to claim that PGW "should have known" that there was an issue at this site.

Q. BASED UPON YOUR EXPERIENCE WOULD PGW HAVE TO HIRE ADDITIONAL FIELD EMPLOYEES AND, IF SO, WOULD YOU PROVIDE AN ESTIMATED COST?

A. Yes. There is no question that our existing employee compliment is not sufficient to undertake the surveillance of all third-party excavations occurring in clusters of two or more across the City. Thus, PGW would have to hire an exorbitant number of employees to try and cover all excavator activities and for an indefinite time, at a direct cost to PGW ratepayers. This is not feasible and is unreasonable. BI&E appears to have ignored this.

Q. HAVE YOU ASSESSED HOW MANY EMPLOYEES PGW WOULD HAVE TO HIRE TO SURVEY THIRD-PARTY EXCAVATION ACROSS THE CITY AND WHAT THE COSTS MAY BE?

A. I have not fully assessed how many employees PGW would actually have to hire to survey "frequent" or "concentrated" third-party excavation activities in a given year. There are simply too many unknown variables to comply with BI&E's supervision request. However, based on the shear amount of One Call requests PGW receives, and due to the extent to which BI&E is proposing PGW monitor excavations for their duration, I believe that, in order to supervise street openings that are "frequent" or "concentrated" per BI&E's definition, PGW would need to hire no less than 208 employees. This is based on the following assumptions:

- PGW receives approximately 17,700 "Emergency" One Call requests/year.
  - This equates to approximately 48 requests/day.
  - For an "emergency" request, the line marker would remain onsite during work for the project to ensure safety of PGW's facilities.
  - The duration of an Emergency Project lasts 1 workday.
  - Assume that total requests/day is reduced by a factor of 2 to trigger BI&E's proposed third party monitoring and inspection schedule.
- PGW receives approximately 58,300 non-"Emergency" One Call requests/year.
  - This equates to approximately 160 requests/day.
  - For a non-emergency request, the line marker would not remain on site, as the line marking must be completed prior to excavation beginning, and excavation may not occur for days or weeks.
  - The duration of a non-emergency project lasts 2 workdays.
  - Assuming that total requests/day is reduced by a factor of 2 to trigger BI&E's proposed third party monitoring and inspection schedule.

Based on these assumptions, I estimate that PGW would need to hire an additional 24 or more employees to mark and subsequently monitor all "Frequent" and "Concentrated" emergency One Call requests. I also estimate that PGW would need to hire an additional 184 employees to monitor all non-emergency One Call requests and subsequent excavation which may take many days to complete.

Q. CAN YOU ESTIMATE HOW MUCH THIS WOULD COST PGW PER YEAR?

A. While most of the costs are unknown, assuming that each of the above 208 employees require a vehicle/work truck which I conservatively estimate to be approximately $5,000/year per vehicle with operating costs of $10,000/year per vehicle, and that each employee's salary and training will cost a conservative $70,000/employee (i.e. that each employee and equipment needed will total $85,000/year), I estimate that BI&E's request would cost PGW ratepayers no less than $17.7 million/year to implement. This assumes that PGW could even hire this number of employees in the current difficult employment market.

Q. DOES PGW HAVE THE INTERNAL CAPABILITY TO TRACK ONE CALL TICKETS AS SUGGESTED BY BI&E AND DEVELOP PATTERNS ABOUT FREQUENCY?

A. No. PGW does not track PA One Call tickets in this manner, which is why my above calculations are not tied to BI&E's suggested patterns or tracking. Assuming that there were clearly defined parameters of what we were supposed to be tracking, which there is not under any law or regulation, PGW would have to pay to develop the software programs to do so. I am not aware of any other gas company required to do this. To the best of my knowledge, as the first, PGW would be designing software from scratch. This would impose additional costs on our customers.

Q. SHOULD PGW BE REQUIRED TO DEVELOP A PROTOCOL OF ON-SITE MONITORING THIRD PARTY EXCAVATION UNRELATED TO PGW FACILITIES ONCE THE LOCATION OF PGW'S FACILITIES IS MARKED ACCORDING TO THE ONE CALL REQUEST?

A. No. PGW already trains employees to identify potential threats to the gas infrastructure and react accordingly. To overreact and require monitoring of all third-party excavations is a waste of resources and ratepayer dollars, because it does not solve any correlated risk.

There is no correlation in my opinion between hazardous leaks and One Call marking tickets. And BI&E has not presented any evidence to meet their burden to show that there is one. Such an effort would also be cost prohibitive for ratepayers with no real improvement in safety.

Q. YOU SAY THAT RATEPAYERS WOULD PAY. WHY SHOULDN'T THE SHAREHOLDERS OF THE COMPANY HAVE TO PAY FOR THESE MEASURES?

A. PGW has no shareholders and does not pay a dividend or a rate of return to its owners (instead it remits a statutorily fixed annual payment to the City of Philadelphia). Accordingly, all of the funds needed to run the Company come from ratepayers or from borrowing (the costs of which then must be paid by ratepayers). PGW's rates are set by determining the appropriate levels of cash and other financial metrics necessary to enable PGW to pay its bills and maintain access to the capital markets at reasonable rates. Accordingly, every extra dollar that PGW would have to expend to monitor and observe thousands of excavations would have to be paid for by ratepayers either through higher rates or increased borrowing costs. The same is true were a penalty to be imposed – it would be wholly paid for by ratepayers. Indeed, BI&E knows this, and it is a concern that civil penalties levied are by default passed on to customers. See **CONFIDENTIAL** Exhibit JH-2 at 23. This drives PGW to be very conscious of mandates that have cost consequences.

VIII. <u>SETTLEMENT AT DOCKET NO. C-2022-3033834</u>

Q. YOU MENTIONED PREVIOUSLY THAT IN A SIMILAR SET OF CIRCUMSTANCES PGW AND BI&E REACHED A SETTLEMENT WHICH IS RELEVANT HERE. CAN YOU EXPLAIN FURTHER?

A. Yes. A natural gas explosion occurred at 1435 South 8th Street, Philadelphia, PA on December 19, 2019. Excavation on water and sewer facilities on the 1400 block of South 8th Street, Philadelphia occurred in September and October 2019. PGW was unaware of, and no information was shared with PGW, about any voids under the water and sewer facilities or of any underground conditions that might adversely affect its facilities. It was, as it is now, PGW's consistent position that it cannot be held accountable when third-party excavators perform work unrelated to PGW's utility infrastructure but fail to inform PGW of potentially hazardous situations they observe which may impact PGW's facilities.

BI&E filed a complaint against PGW on July 15, 2022 at Docket No. C-2022-3033834 alleging similar violations of State and Federal regulations as are presented here. BI&E's theory of the case was the same as it is here – a strict liability standard requiring that PGW be held responsible for any explosion regardless of cause even where PGW was unaware of the underground conditions.[15] After filing direct and rebuttal testimony, the parties entered into a settlement a copy of which, along with supporting statements and the evidentiary record, is available on the Commission's docket.

In settlement, BI&E agreed that no fine should be applied. Rather the parties agreed, among other things, that PGW would undertake extensive educational efforts involving both the City Water Department and the excavators working on water and sewer service lines, as well as refine a set of "trigger points" requiring additional underground street trouble investigations near cast iron structures under certain conditions.

The terms of the settlement highlights are as follows:

1. **Coordination Efforts With The Excavator Community**
   The core issue in 8th Street complaint, in PGW's view, was a lack of communication from the excavators who completed work in September and October 2019 on the sewer lines on the 1400 block of South 8th Street. To address this and to increase awareness of the need for open channels of communication and the level of care needed when working around cast iron mains, the Parties created an outreach and education plan tailored to reduce the potential for similar incidents in the future. First, PGW agreed to implement automatic distribution of PGW's *Cast Iron Damage Prevention Brochure* to all Project Owners to continue until PGW's at-risk cast iron inventory is fully removed. Additionally, PGW agreed to provide targeted outreach, education, and training including two

[15] See Joint Petition for Settlement, Docket No. C-2022-3033834, Appendix C (BI&E's direct testimony) and Appendix D (PGW's rebuttal testimony). https://www.puc.pa.gov/pcdocs/1796544.pdf

training sessions per year regarding: 1) One Call requirements; and 2) the protection of underground utility infrastructure. This education and training will be made available to Philadelphia Water Department ("PWD") personnel, City of Philadelphia ("City") officials, other facility owners, and excavators and contractors who perform work in or around PGW's infrastructure. PGW will track the attendance of its training sessions for review by BI&E upon request.

2. **Cast Iron Main Replacement Commitments**
PGW committed to applying for the Natural Gas Distribution Infrastructure Safety and Modernization Grant Program administered by the federal Pipeline and Hazardous Materials Safety Administration each year it is offered and, subject to grant approval, to present a shortened timeframe for cast iron main replacement in its subsequent LTIIP filings.

3. **Residential Methane Detector Pilot Program**
BI&E had advanced in its direct testimony that PGW should implement a residential methane detector program. The parties agreed to a Pilot program which will create Pennsylvania's first natural gas utility-wide residential methane detector pilot in which audible style methane alarms will be made available to PGW residential customers with to a pilot cap of $800,000 to run for three years, or until the spending cap is reached.

4. **Amendments To Street Trouble Process, Procedures, And Training**
Lastly, the parties agreed that PGW will implement "trigger points" for requiring additional underground street trouble investigations near cast iron structures. While PGW believed then, as it does now, that its procedures and training which were in place at the time of the accident are sufficient and in compliance with all laws and regulations, PGW recognized that improving safety measures above minimum standards can lead to meaningful, cost-effective results. In this light, the Parties have agreed to additional instances in which PGW will investigate underground street troubles that might affect cast iron mains. The 8th Street settlement did not require that PGW oversee all excavations for their durations throughout the City, each and every day.

Q. HOW DO THE TERMS OF THE 8TH STREET SETTLEMENT ALIGN WITH THE RELIEF SOUGHT BY BI&E IN THIS CASE?

A. First, I would point out that the BI&E testimony here does not address at all the "corrective actions" set forth in the Complaint, while in the 8th Street case, BI&E witness Elena Bozhko, Fixed Utility Valuation Engineer, provided extensive detail regarding the "corrective actions" sought. Docket No. C-2022-3033834, I&E St. 1 at 26-30. Since BI&E has not supported or addressed these items in testimony here, we have not either.

But having said that, the terms of the 8th Street settlement largely satisfy the remedies set forth in the complaint here at paragraph 107 including the following:

a. Distribution of PGW's Cast Iron Damage Prevention Brochure to "Project Owners" (if known) as that term is defined in Act 50 or the excavator submitting the one call ticket. Once implemented, the email distribution of PGW's cast iron damage prevention brochure shall continue until PGW's at-risk cast iron inventory is fully removed.

b. Offer training sessions on One Call requirements and protection of underground utility infrastructure for PWD personnel, other City officials, other "Facility Owners" and "Excavators."

c. Continue to further accelerate the rate of infrastructure repair, distribution system improvement, or replacement of cast iron.

d. Implement trigger points for requiring Underground Street Troubles investigations near cast iron structures (using the same criteria as was set out in the 8th Street Settlement).

e. Pursuant to 49 CFR § 192.459, when PGW has direct knowledge through notice or observation that any portion of a buried pipeline is exposed, PGW shall examine the exposed pipeline facilities and determine if remedial action exists in the vicinity of the exposed portion.

f. PGW shall implement a 9-month pilot program for commercial, or smart, remote methane detectors ("SRMD") that can identify potential leaks, detect the presence of methane gas, and directly notify the gas operator and/or emergency official(s) through smart technology and communication networks.

With the exception of a smart methane detector pilot, these "corrective actions" have already been agreed to and are in place or in the process of being implemented making the relief sought by bring this new complaint moot and unnecessary.

Q. DID THE COMMISSION APPROVE THE 8TH STREET SETTLEMENT?

A. Yes, the Commission unanimously adopted the settlement without revision on January 8, 2025.

Q. WHAT IS THE STATUS OF IMPLEMENTING THE TERMS OF THE 8TH STREET SETTLEMENT?

A. The terms of the 8th Street Settlement have been implemented, including updates to PGW's Bulletins 313 and 45.

Q. DOES THE SETTLEMENT IN THE 8TH STREET COMPLAINT SATISFY BI&E'S CONCERNS EXPRESSED IN THIS CASE?

A. Yes, I believe that the settlement, although not addressed in Ms. Cooper Smith's testimony, addresses most if not all of BI&E's relief sought in this case. This is not to say that the settlement is expressly binding on this proceeding, but the relief requested itself is similar and, in some cases, identical. Further, the Commission has previously agreed that that no fine is appropriate for PGW which has no shareholders and is rate regulated on a "cash flow" basis. In that context, PGW does not believe that any of the relief requested is warranted.

IX. CONCLUSION

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes. This concludes my rebuttal testimony. I reserve the right to file additional responsive testimony. Thank you

VERIFICATION

I, Joseph Hawkinson, hereby state that: (1) I am Vice President, Field Operations for Philadelphia Gas Works ("PGW"); (2) the facts set forth in my testimony are true and correct (or are true and correct to the best of my knowledge, information and belief); and, (3) I expect to be able to prove the same at a hearing held in this matter. I understand that statements herein are made subject to the penalties of 18 Pa. C.S. § 4904 (relating to unsworn falsification to authorities).

Date: 8/15/2025

Joseph Hawkinson

Joseph Hawkinson
Vice President, Field Operations
Philadelphia Gas Works

PGW Exhibit JH-1

BI&E's Responses to PGW Set I and Set II

BI&E's Responses to PGW Set I

8. Regarding Paragraph No. 29 of the Complaint referencing "Three (3) locate requests… between July 26, 2021 and September 3, 2021," please identify:

a. Whether I&E investigated or reviewed any excavator conduct or otherwise contacted Clements Brothers and Sister, Inc. ("Clements") or Lepore Plumbing ("Lepore") regarding the work they completed at or proximate to 815 Jackson St as identified in Paragraphs 30-37;

b. The name of any persons for Clements or Lepore to whom I&E interviewed (if any);

c. Whether any persons for Clements or Lepore reported to any entity whatsoever any adverse conditions (such as voids) during their work at or proximate to 815 Jackson St as identified in Paragraphs 30-37;

d. Produce copies of any notes or reports I&E generated during its investigations of any excavators (if any) on the events as identified in Paragraphs 30-37; and

e. State any and all basis that PGW was made aware of any facts identified in a-d above prior to November 30, 2021.

ANSWER:

a. I&E did not conduct any investigation into excavator conduct further than what was alleged in the Formal Complaint or in this Answer.

b. I&E did not interview anyone for Clements or Lepore.

c. I&E is not aware of any reports of adverse conditions (such as voids) during their work at or proximate to 815 Jackson Street.

d. Objection. I&E formally objected to this request based upon attorney-client privilege and deliberative process privilege. *See Objections of the Bureau of Investigation and Enforcement to the Interrogatories of Philadelphia Gas Works- Set I*, dated March 3 2025. I&E does not have any other responsive non-privileged documents.

e. PGW was aware of the type of work being performed, the location, the extent and depth of the excavations, and approximate time based on the three One Call Tickets that were submitted by Clements Brothers and Sister, Inc. and Lepore Plumbing and PGW's responses to those One Call tickets. The One Call tickets and responses are in PGW's possession as they were attached to the Formal Complaint as I&E Exhibits 1, 2, and 3.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

9. Did I&E review any pre- or post-work plans or otherwise know what work was done by Clements or Lepore at or proximate to 815 Jackon Street as identified in Paragraphs 30-37? If so, produce such documents.

ANSWER:

I&E reviewed the three One Call Tickets that were submitted by Clements Brothers and Sister, Inc. and Lepore Plumbing and PGW's responses to those One Call tickets. The One Call tickets identified the work being performed, the location, the extent and depth of the excavations, and approximate time, prior to the beginning of excavation. The One Call tickets and responses are in PGW's possession as they were attached to the Formal Complaint as I&E Exhibits 1, 2, and 3.

I&E also obtained and reviewed the plumbing permit issued to Clements Brothers Inc. for the replacement of the existing curb trap at 815 Jackson Street. A copy of the plumbing permit is attached I&E Set I – Attachment 3.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

10. Regarding Paragraph 38 of the Complaint, please identify:

a. Any and all documents in I&E's possession that form the basis for the allegation of that "multiple sewer failures [occurred]… at and near 815 Jackson Street" before November 30, 2021;

b. Any and all documents in I&E's possession that form the basis for the allegation of that "sewer… leaks [occurred]… at and near 815 Jackson Street" before November 30, 2021; and

c. Any and all documents in I&E's possession that form the basis for the allegation of that "sewer… excavations [occurred]… at and near 815 Jackson Street" before November 30, 2021.

ANSWER:

a. The three One Call tickets and responses previously identified, the root cause report by Forensic Consultants of North America, LLC ("FCNA"), and the previously identified plumbing permit.

b. The three One Call tickets and responses previously identified and the root cause report by Forensic Consultants of North America, LLC ("FCNA"), and the previously identified plumbing permit.

c. The three One Call tickets and responses previously identified, the root cause report by Forensic Consultants of North America, LLC ("FCNA"), the previously identified plumbing permit, and photographs taken at 815 Jackson Street.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

11. Regarding Paragraph 39 of the Complaint, produce any documents or evidence that water and sewer leaks occurred at or near 815 Jackson Street before November 30, 2021.

ANSWER:

- **The three One Call tickets and responses, which are in PGW's possession as they were attached to the Formal Complaint as I&E Exhibits 1, 2, and 3.**

- **The root cause report by Forensic Consultants of North America, LLC ("FCNA"), which is in PGW's possession as it was provided to I&E by PGW.**

- **The plumbing permit issued to Clements Brothers Inc. for the replacement of the existing curb trap at 815 Jackson Street. A copy of the plumbing permit is attached I&E Set I – Attachment 3.**

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

PLUMBING PERMIT

PP-2021-016106

L&I District: SOUTH

OPA Account #: 393315700

815 JACKSON ST Philadelphia, PA 19148-3107

ISSUED 08/31/2021

L&I district SOUTH

Permit number PP-2021-016106

Permit type PLUMBING PERMIT (PLUMBING)

Type of work ALTERATIONS REPLACING EXISTING CURB TRAP FAI

Permit status COMPLETED

Date issued Aug. 31, 2021

Zoning documents No zoning documents

Contractor

CLEMENTS BROTHERS INC

CLEMENTS BROTHERS INC 2030 HARTEL STREET LEVITTOWN, PA 19057 USA

https://li.phila.gov/Property-History/search/Permit-Detail?address=815%20JACKSON%20ST&Id=PP-2021-016106

12. Regarding Paragraph 40 of the Complaint, produce any documents or evidence that sewer lateral failures occurred at or near 815 Jackson Street before November 30, 2021.

ANSWER:

- **The three One Call tickets and responses, which are in PGW's possession as they were attached to the Formal Complaint as I&E Exhibits 1, 2, and 3.**

- **The root cause report by Forensic Consultants of North America, LLC ("FCNA"), which is in PGW's possession as it was provided to I&E by PGW.**

- **The plumbing permit issued to Clements Brothers Inc. for the replacement of the existing curb trap at 815 Jackson Street. A copy of the plumbing permit is attached I&E Set I – Attachment 3.**

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

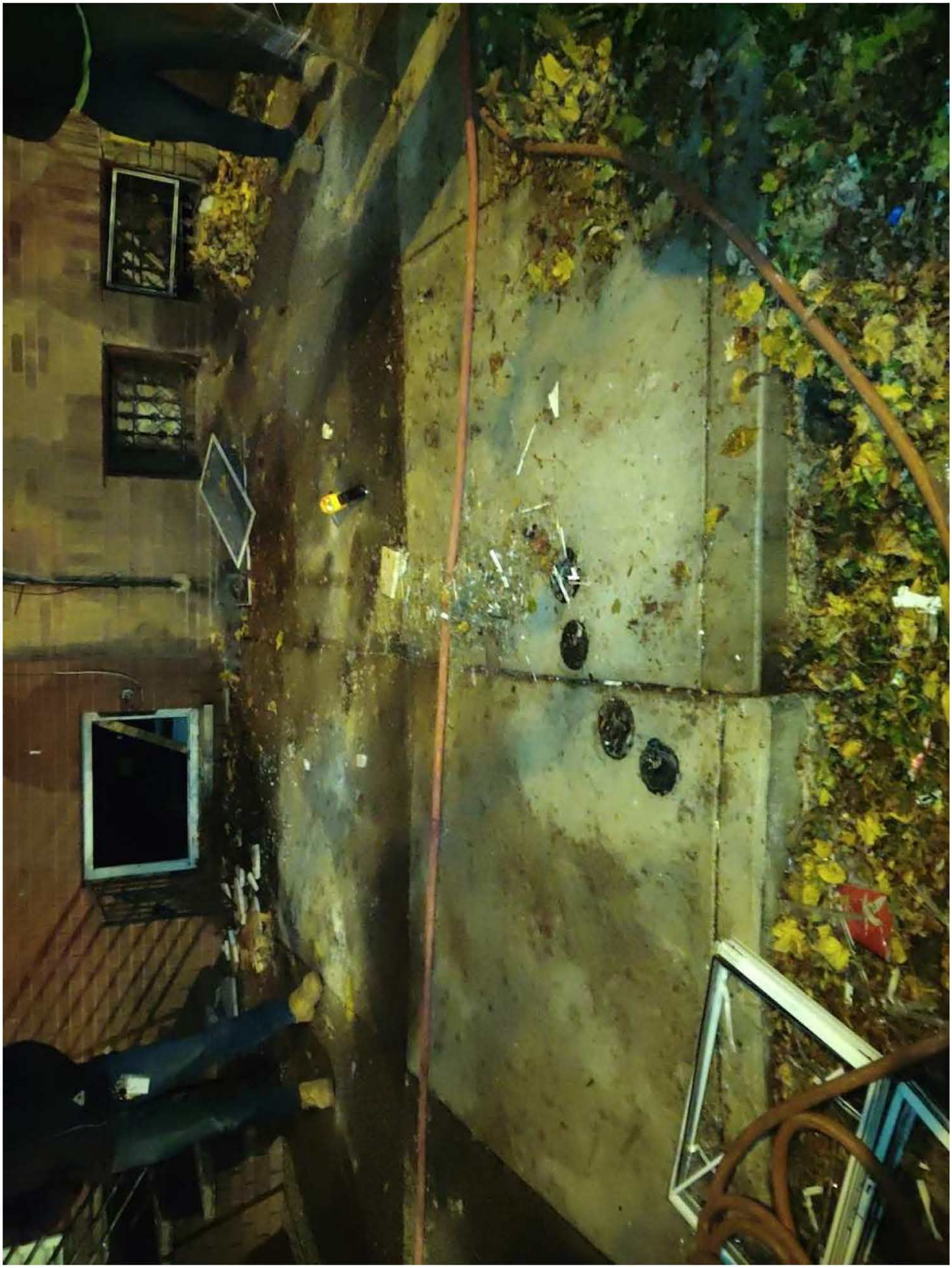
13. Regarding Paragraph 41 of the Complaint, produce any documents or evidence that sewer lateral repairs occurred at or near 815 Jackson Street before November 30, 2021.

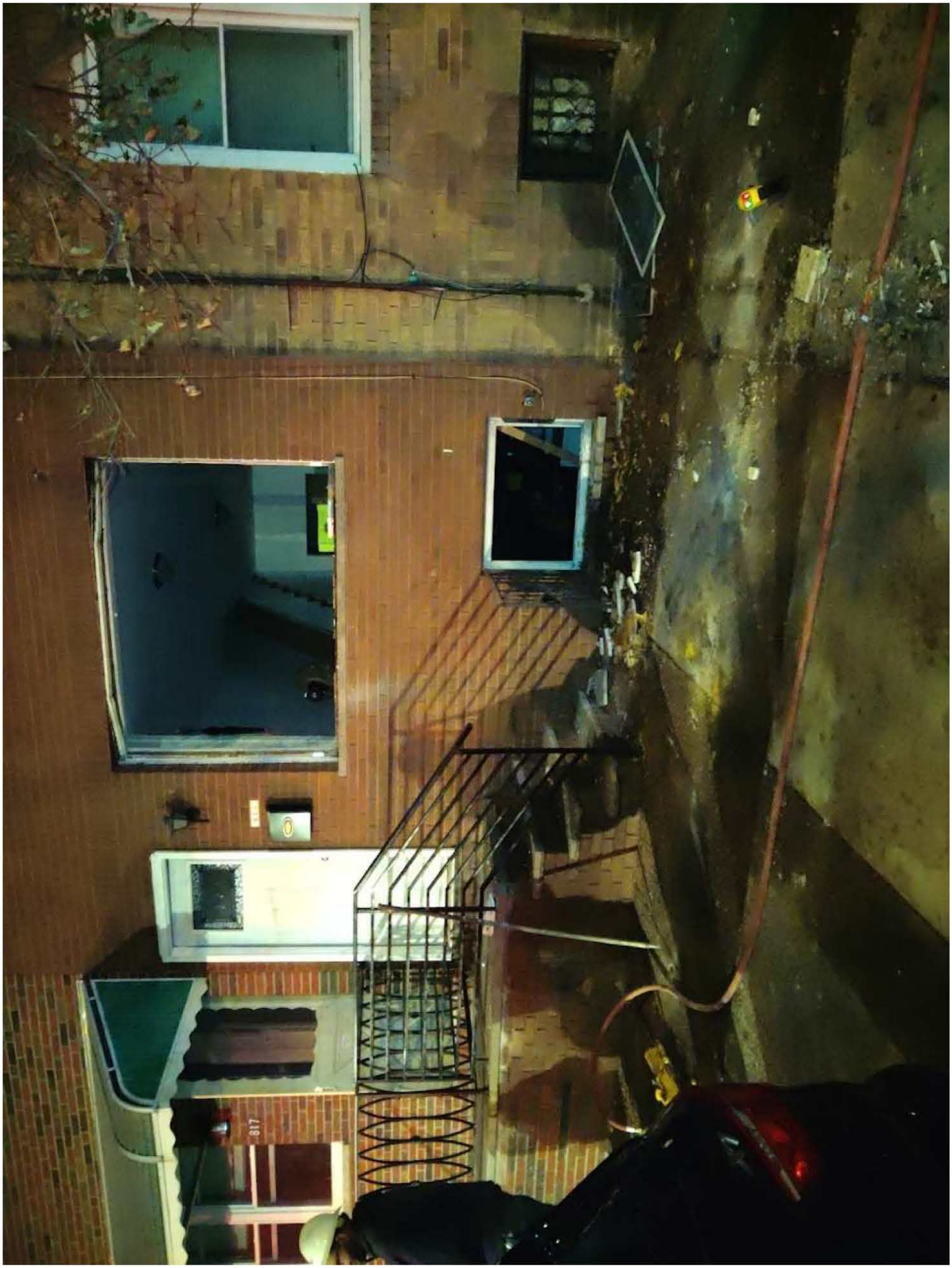
    a. Specifically, identify and produce any documents that support the allegation that any excavation before November 30, 2021 "remov[ed] compacted soil around and beneath gas facilities."

ANSWER:

- **The three One Call tickets and responses, which are in PGW's possession as they were attached to the Formal Complaint as I&E Exhibits 1, 2, and 3.**
- **The root cause report by Forensic Consultants of North America, LLC ("FCNA"), which is in PGW's possession as it was provided to I&E by PGW.**
- **Photographs taken at 815 Jackson Street. See I&E Set I – Attachment 4.**
- **Plumbing Permit issued to Clements Brothers Inc. for 815 Jackson Street. See I&E Set I – Attachment 3.**

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

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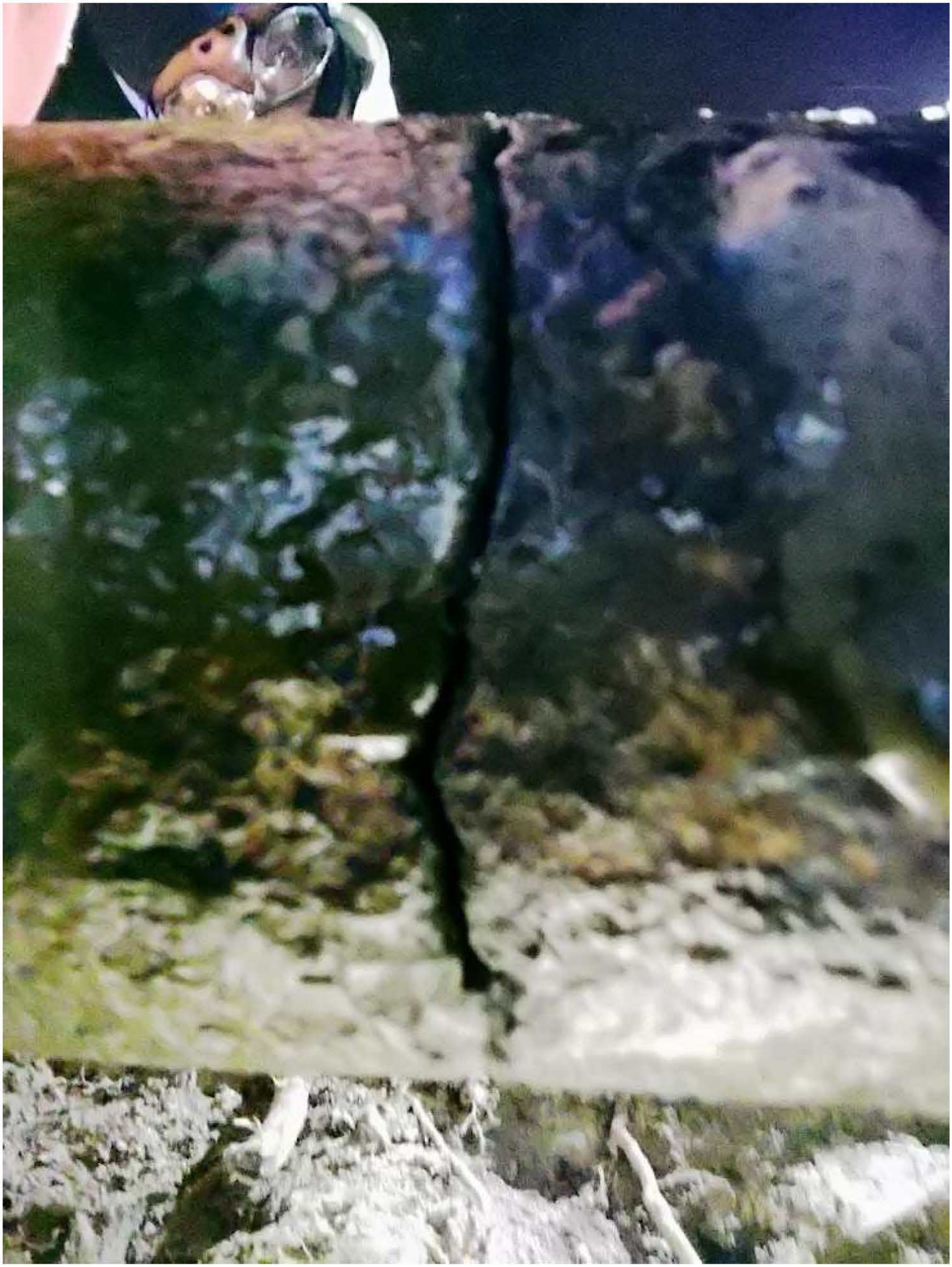

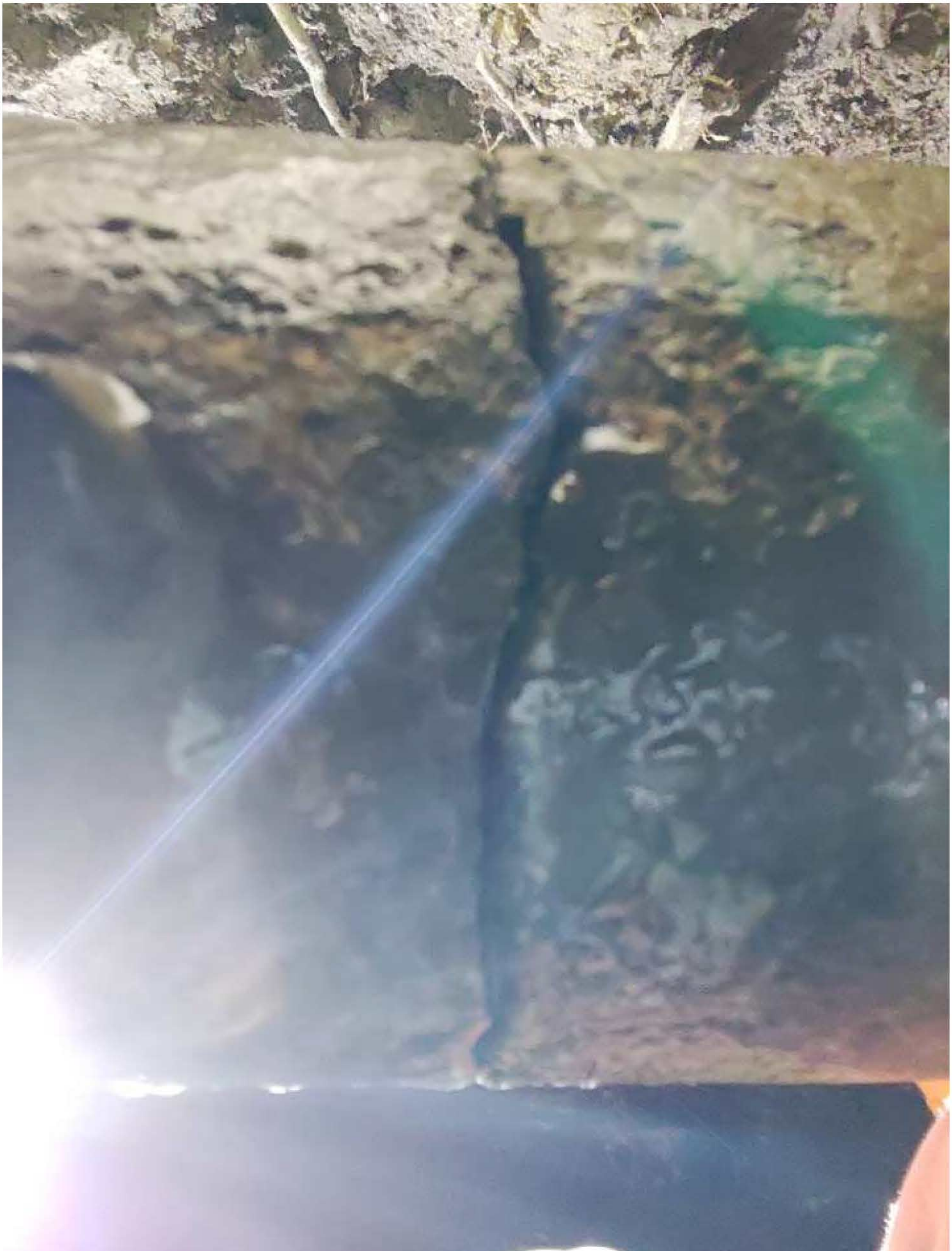


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Philadelphia PA 19148
United States
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W


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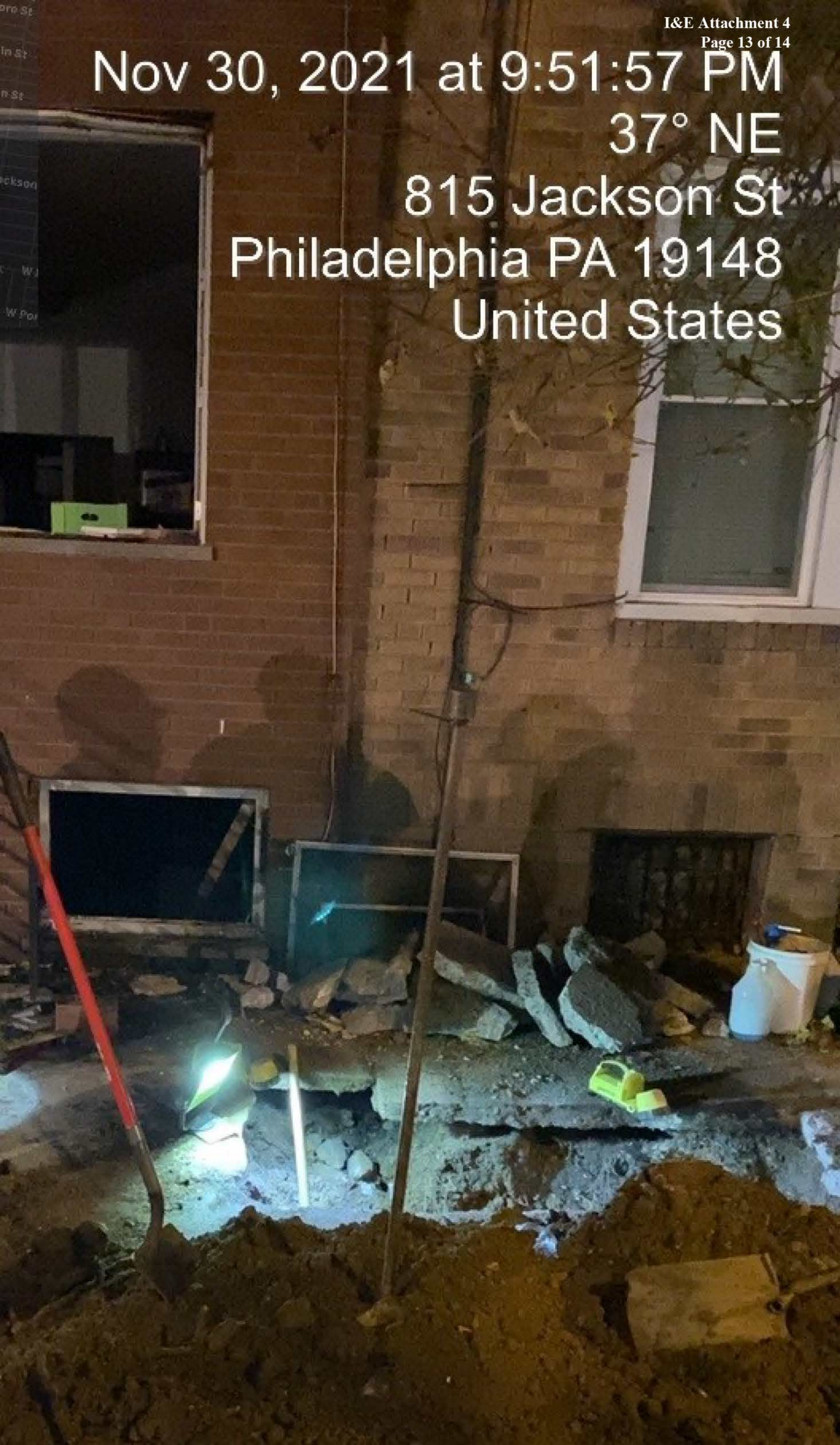
36° NE
815 Jackson St
Philadelphia PA 19148
United States
Maps
SOUTH PHILADELPHIA
EAST PASSYUNK
E Snyder Ave
Mifflin Square Park
N
E
S
W


Nov 30, 2021 at 9:51:57 PM
37° NE
815 Jackson St
Philadelphia PA 19148
United States


Nov 30, 2021 at 9:51:20 PM
43° NE
815 Jackson St
Philadelphia PA 19148
United States
NIGHTSTICK

14. Regarding Paragraph 42 of the Complaint, produce any documents or evidence that the Clements excavation “crossed,” “undermined,” and “exposed” PGW’s 4-in cast iron main at or near 815 Jackson Street before November 30, 2021.

a. State with specificity whether I&E is aware that Clements intention to or actual “crossing” “undermining” or “exposing” PGW’s 4-in cast iron main was communicated to PGW.

ANSWER:

- **The three One Call tickets and responses, which are in PGW’s possession as they were attached to the Formal Complaint as I&E Exhibits 1, 2, and 3.**
- **The root cause report by Forensic Consultants of North America, LLC (“FCNA”), which is in PGW’s possession as it was provided to I&E by PGW.**
- **Photographs taken at 815 Jackson Street. See I&E Set I – Attachment 4.**

a. The One Call tickets communicated to PGW the work and type of excavation being performed, the location, the extent and depth of the excavations, and approximate time, prior to the beginning of excavation.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

16. Regarding Paragraph 52 of the Complaint, produce any documents or evidence that the "excavation" by PGW began at approximately 9:32 PM.

ANSWER:

- **Document name is 2_Emergency Report – 815 Jackson Street.pdf and is in PGW's possession as it was provided to I&E by PGW in response to a Data Request.**

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

19. Regarding Paragraph 57 of the Complaint, produce any documents or evidence that support the claim that "when the excavation began, the roadway buckled downwards, indicating that the roadway lacked support and was caving in."

    a. Specifically, identify where in I&E exhibit 6 the "roadway" characteristics as alleged are shown.

ANSWER:

"Roadway" was used to generically refer to the area including both street and sidewalk, as both the street and sidewalk had been excavated and showed signs of being sunken or buckling, as shown in the FCNA report and I&E Set I - Attachment 4. To be clear, the photograph in I&E Exhibit 6 depicts the sidewalk buckling downwards into the void, indicating that the sidewalk lacked support. The photograph that was included in I&E's Formal Complaint as I&E Exhibit 6 is in PGW's possession.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

20. Regarding Paragraph 58 of the Complaint, state with specificity whether the void uncovered was known by any individual or entity whatsoever prior to excavation on November 30, 2021. If existence of the void was known, identify any communication that I&E is aware of relaying that information to PGW.

ANSWER:

I&E is not aware of any individual or entity that knew of the void prior to November 30, 2021.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

21. Regarding Paragraph No. 67 of the Complaint, please identify all documents that I&E Pipeline Safety Inspectors reviewed.

ANSWER:

- **PGW Bulletin #54, effective Date: 4/15/11, Protection of PGW facilities from underground street troubles**
- **PGW Bulletin #312, effective date 9/1/13, Summary of distribution department damage prevention program**
- **PGW Bulletin #313, effective date 8/2/16, Instructions for distribution department damage prevention inspectors**
- **PGW Bulletin # 212, effective date 10/12/21, Leak Response and Odor Investigation Procedure**
- **PGW Bulletin # 315, effective date 4/29/20, Reporting Requirements for Incidents, Accidents, Chemical Releases and News Worthy Events to PHMSA and PA PUC Gas Safety Division.**
- **Procedure Number #245, effective date 10/27/15, Procedure for Pipeline Incident Investigations.**
- **Power Point presentation used for locator training presented to I&E Pipeline Safety Inspectors by J. Durante (Manager of Training, PGW) on January 29, 2020 during a meeting with PGW**

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

BI&E's Responses to PGW Set 2

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Pennsylvania Public Utility Commission, Bureau of Investigation and Enforcement	:	
v.	:	Docket No. C-2024-3052277
Philadelphia Gas Works	:	

ANSWERS OF THE BUREAU OF INVESTIGATION AND ENFORCEMENT TO THE INTERROGATORIES OF PHILADELPHIA GAS WORKS- SET II

Pursuant to 52 Pa. Code § 5.342, the Bureau of Investigation and Enforcement ("I&E") of the Pennsylvania Public Utility Commission ("Commission"), by and through its prosecuting attorneys, files the within Answers to Interrogatories of Philadelphia Gas Works ("PGW")- Set II, directed to I&E, and in support thereof, avers as follows:

ANSWERS

1. Fully and completely describe any and all actions and assignments personally undertaken by Ms. Cooper Smith involving I&E's investigation of the incident of November 30, 2021 at 815 Jackson Street, Philadelphia.

ANSWER:

As Supervisor, Ms. Cooper Smith dispatched two engineers, Vladimir Shteyn and Scott Orr, to investigate the incident on November 30th. She instructed them to fully investigate the cause of the incident and report all findings to her.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer.

2. Identify all actions undertaken by Ms. Cooper Smith in response to the notification by PGW at approximately 8:31pm, November 30, 2021, of a gas explosion occurring at 815 Jackson Street, Philadelphia, PA.

ANSWER:

As Supervisor, Ms. Cooper Smith dispatched two engineers, Vladimir Shteyn and Scott Orr, to investigate the incident on November 30th. She instructed them to fully investigate the cause of the incident and report all findings to her.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer.

3. Identify any and all instances where Ms. Cooper Smith was on-site at 815 Jackson Street, Philadelphia, PA as part of the I&E investigation.

ANSWER:

Ms. Cooper Smith was not on site at 815 Jackson St as part of the I&E investigation.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer.

5. Refer to I&E St. No. 1 at 6. Confirm or Deny which of the "biggest threats" applied to the November 30, 2021 incident:

   a. The pipe at 815 Jackson St. was impacted by "earth movement"

   b. The pipe at 815 Jackson St. was impacted by "digging"

   c. The pipe at 815 Jackson St. was impacted by "seasonal frost heave"

   d. The pipe at 815 Jackon St. was impacted by "changes in ground water levels"

   For each (a-d) identified as "confirmed" fully explain and identify all information relied upon to form the basis of Ms. Cooper Smith's opinion.

ANSWER:

Earth movement was identified as "one of the biggest threats to cast iron pipe." Digging, seasonal frost heave, and changes in ground water levels can all cause earth movement.

In this instance, the earth movement caused by the digging of the excavation by the plumbers, with consideration for the ground water levels in the location at the time, allowed for a void under the sidewalk that led to the collapse of onto the cast iron main.

The three One Call tickets, evidence of recent excavations found at the explosion scene, the void that was uncovered during excavation of the broken main, the FCNA Report, and the metallurgical report all point towards earth movement primarily caused by digging as the cause of the cast iron main break. The cast iron main cracked due to the instability of the soil due to sewer failures and excavations to repair sewer laterals in the vicinity of the main. Undermining in the area caused sufficient softening or removal of material supporting the cast iron main which led to the material failure. Graphitization of the cast iron main coupled with lack of support and downward bending movements caused the crack and subsequent release of gas.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

6. Refer to I&E St. No. 1 at 6. Provide the sources, if any, for the definition provided for "undermining" as provided in lines 13-16.

ANSWER:

"Undermining" is a generally understood term within the fields of utilities and pipeline safety. The definition and understanding of "undermining" has come from years of education and practice within the field.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

7. Refer to I&E St. No. 1 at 6-7. Is it Ms. Cooper Smith's opinion that "supporting or reinforcing the cast iron pipe" could have prevented any leakage at 815 Jackson St? If so, please explain how such remedy would be possible where a main is never exposed during a 3rd party excavation.

ANSWER:

Ms. Cooper Smith's opinion is that "supporting or reinforcing the cast iron pipe" could have minimized the possibility of the occurrence because any soil that may have been eroded away as support for the cast iron would not have affected the movement of the pipe.

PGW should have known that the cast iron pipe at 815 Jackson Street would need to be supported and reinforced based on inspection of excavation. Witnessing the extent and location of the excavation, the soil conditions, and the restoration practices employed by the excavator would have provided the necessary information to PGW to make a determination whether it would be necessary to support the surrounding structures.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

8. Refer to I&E St. No. 1 at 7. Ms. Cooper Smith identifies "some ways an operator can protect a cast iron pipe from damage." Does Ms. Cooper Smith agree that the Pennsylvania One Call Law also requires excavators, such as plumbers, to act with care to protect underground facilities when excavating near utility infrastructure?

ANSWER:

The PA One Call Law directs excavators "[t]o exercise due care and to take all reasonable steps necessary to avoid injury to or otherwise interfere with all lines where positions have been provided to the excavator by the facility owners pursuant to section 2(5)."

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

10. Refer to I&E St. No. 1 at 8. State with specificity how any of the cast iron breaks "in the twelve (12) years prior to this incident" are related to the November 30, 2021 incident.

ANSWER:

PGW had knowledge that its cast iron mains on the 800 block of Jackson Street experienced 5 breaks since 2009. Additionally, PGW was aware of the type of work being performed, the location, the extent and depth of the excavations, and approximate time based on the three One Call Tickets that were submitted by Clements Brothers and Sister, Inc. and Lepore Plumbing. Based upon the available history of these breaks, coupled with the information from PA One Call that excavation was going to take place in the area of prior breaks, PGW should have proactively assessed and inspected the excavation to mitigate any risks to its facilities.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

11. Refer to I&E St. No. 1 at 10. Provide any and all evidence known to I&E including measurements, reports, etc. which formed the basis of Ms. Cooper Smith's opinion that: "The newer sections were sunken down with a depression in the center." If relying on photographs provided in response to PGW Set I discovery or in I&E's exhibits, please:

a. Identify with specificity the photograph relied upon (by exhibit, page No.)

b. Explain in detail and/or annotate where Ms. Cooper Smith observes any visible depression in any identified photograph.

c. Identify, with specificity, the size (depth, width) of any visible depression. Provide estimates which formed the basis of Ms. Cooper Smith's opinions if exact measurements are not known.

ANSWER:

a. The photographs relied upon were provided in Attachment 1 of I&E's response to PGW Set 1 discovery and Exhibit 1 of I&E Statement 1. The photographs are on pages 2, 3, and 4 of both Attachment 1 and Exhibit 1.

b. The visible depression is located in center of the photographs on pages 2 and 3 and the bottom right corner on page 4. Specifically, the depression is at the four corners of the sidewalk segments, between the hose and methane detector. Water, glass, and other debris collected in that area.

c. Specific measurements of the visible depression were not collected. An accurate estimate has not been made without a measured point of reference.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

12. Refer to I&E St. No. 1 at 10, lines 9-10. Please state Ms. Cooper Smith's opinion on the cause of any void discovered "under the sidewalk."

ANSWER:

Water and sewer leaks weaken the surrounding soil which is the foundation for pavement and underground utilities such as water, gas, or sewer facilities. Sewers and sewer laterals are located well below gas facilities, making the probability of gas mains losing support high. The repair process to excavate sewer facilities will also loosen and weaken supporting soil due to the size of the excavation during the sewer repair process. The likelihood of further weakening of the soil surrounding the pipeline facilities is increased if there are multiple excavations in close proximity.

It is my opinion that the void was an after effect of continual water intrusion that caused the erosion of the loosen and weakened supporting soil underneath PGW's main and/or the lack of sufficient backfill processes. Once the soil eroded, undermining of PGW's main occurred and the cast iron main cracked due to lack of support.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

14. Confirm or Deny: I&E's investigation process for the November 30, 2021 incident includes a report(s) addressing the results of its investigation by either Ms. Cooper Smith or by an individual under her supervision. If your response is "Confirmed":

a. Identify the author and date of such investigative reports created by Ms. Cooper Smith or by an individual under her supervision during the investigation.

b. State whether Ms. Cooper Smith relied upon such report(s) in preparing her testimony.

c. If your answer to (b) above is affirmative, produce any and all such report(s).

ANSWER:

Confirmed.

a. I&E's investigation began on the day of the event with an incident inspection by Pipeline Safety Inspectors Scott Orr and Vladimir Shteyn. The initial incident inspection formed the basis of the Investigative Report. The Investigative Report was continually amended during the investigation process. The Investigative Report created by Scott Orr was finalized on March 14, 2024. The investigation and drafting of the Investigative Report were done under the supervision of Ms. Cooper Smith. Ms. Cooper Smith reviewed, edited, and approved the Investigative Report through the drafting process, prior to sending the report for legal review.

b. Yes.

c. I&E formally objected to producing this document based upon attorney-client privilege and deliberative process privilege. *See Objections of the Bureau of Investigation and Enforcement to the Interrogatories of Philadelphia Gas Works- Set II*, dated June 23, 2025.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

15. State whether in Ms. Cooper Smith's opinion the incident of November 30, 2021 at 815 Jackson Street, Philadelphia was a "reportable incident" under PHMSA regulations. If in the affirmative, fully and completely explain your response.

ANSWER:

This was not a reportable incident.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

16. Does Ms. Cooper Smith agree that the report prepared by Forensic Consultants of North America does not find that the Clements or Lapore excavations caused the cracking of the distribution pipe in question rather that "the potential exists" or "most likely" also noting that: "Mr. Guzinski [Affiliated Engineering] also opined that undermining of soil by any means can cause movement of piping or create stress on piping."?

ANSWER:

Agreed.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

17. Fully and completely explain the basis for alleging that PGW “did not recognize, react, or investigate and take the proper steps to mitigate the danger caused by the compromised soil conditions. ” I&E St. No. 1 at 23.

ANSWER:

PGW, by not utilizing all known information for the 800 block of Jackson St, did not pre-emptively take the necessary steps to protect their main on the 800 block of Jackson Street. PGW was aware of 5 previous cast iron breaks on this block. Additionally, PGW was aware of the type of work being performed, the location, the extent and depth of the excavations, and approximate time based on the three One Call Tickets that were submitted by Clements Brothers and Sister, Inc. and Lepore Plumbing. PGW did not utilize the information available to it to ensure an inspector was on site before or after the plumbing excavation to assess the conditions surrounding the main.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

18. Fully and completely explain the basis for alleging that PGW violated 49 CFR § 192.755 when it had no knowledge that the support for a segment of a buried cast-iron pipeline could be or was disturbed. Produce any legal authority that would apply to the facts of this case as described by Ms. Cooper Smith. See 52 Pa. Code § 5.342(c)(5).

ANSWER:

PGW was aware of the type of work being performed, the location, the extent and depth of the excavations, and approximate time based on the three One Call Tickets that were submitted by Clements Brothers and Sister, Inc. and Lepore Plumbing. PGW marked out the locations of its facilities in response to the One Call tickets. Additionally, PGW was aware that the cast iron mains on the 800 block of Jackson Street were susceptible to breaking, as evidenced by 5 cast iron main breaks on the 800 block since 2009.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

19. Ms. Cooper Smith claims that "the procedures for locators do not provide instructions to the locator on when to initiate an investigation for underground street trouble report." Please confirm that this also an allegation in I&E St. 1 submitted at Docket No. C-2022-3033834.

ANSWER:

Confirmed.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation Engineer

21. State whether “trigger points” contained in the Settlement at Docket No. C-2022-3033834 includes the frequency of excavation in an area.

ANSWER:

I&E formally objected to this interrogatory based upon relevance and being beyond the scope of direct testimony. *See Objections of the Bureau of Investigation and Enforcement to the Interrogatories of Philadelphia Gas Works- Set II*, dated June 23, 2025.

23. Regarding Ms. Cooper Smith's employment, I&E St. No. 1 at 2:

a. Does Ms. Cooper Smith participate in the Commission's Damage Prevention Committee? If so, in what capacity?

b. Confirm or Deny: the Commission's Damage Prevention Committee did not make any finding of violations under the Pennsylvania One Call Law regarding any ticket related to the 815 Jackson St. area in 2021 at issue in this complaint against any party whatsoever.

ANSWER:

a. Yes, as the non-voting Chairperson of the Committee.

b. Confirmed that the Damage Prevention Committee did not make any findings of violations. By way of further explanation, the Damage Prevention Committee does not control which cases are brought before it and must "[r]eview a report of an alleged violation of [the PA One Call Law] and damage prevention investigator findings concerning the basis or root cause of the alleged violation reported and recommendations proposed to address the alleged violation" as outlined by 73 P.S. § 182.8(b)(1). The PA One Call Law requires that excavators and facilities owners file alleged violation reports ("AVRs") when facilities are damaged by excavations or when a violation of the PA One Call Law may have occurred. The DPC relies on stakeholders, which include excavators, facilities owners, designers, and project owners, to file AVRs when violations of the PA One Call Law may have occurred. To date, no AVRs have been filed by any stakeholders, including PGW.

Answer provided by: Terri Cooper Smith, Supervisor, Fixed Utility Valuation

CONFIDENTIAL

PGW Exhibit JH-2

BI&E's Investigative Report (Redacted)

CONFIDENTIAL SECURITY INFORMATION

PGW Exhibit JH-3

Map of the 800 Block of Jackson Street on or before November 30, 2021

THIS INFORMATION IS SUBJECT TO PROTECTIONS UNDER THE PUBLIC UTILITY CONFIDENTIAL SECURITY INFORMATION DISCLOSURE PROTECTION ACT,
35 P.S. §§ 2141.1 – 2141.6. DISCLOSURE OF THIS INFORMATION WOULD COMPROMISE SECURITY AGAINST SABOTAGE OR CRIMINAL OR TERRORIST ACTS, AND NONDISCLOSURE
IS NECESSARY FOR THE PROTECTION OF LIFE, SAFETY, PUBLIC PROPERTY OR PUBLIC UTILITY FACILITIES.

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

REBUTTAL TESTIMONY OF

JOSEPH C. LEVA

ON BEHALF OF
PHILADELPHIA GAS WORKS

Docket No. C-2024-3052277

Formal Complaint of Bureau of
Investigation and Enforcement

TOPICS:

Responding to the Direct Testimony of
BI&E Witness Cooper Smith

August 15, 2025

TABLE OF EXHIBITS

Exhibit JCL-1	Distribution Inspector Job Description
Exhibit JCL-2	Cast Iron Damage Prevention Brochure

I. <u>INTRODUCTION</u>

Q. PLEASE STATE YOUR NAME AND POSITION WITH PHILADELPHIA GAS WORKS ("PGW" OR "COMPANY").

A. Joseph C. Leva, PGW, Superintendent, Operations and Maintenance.

Q. HOW LONG HAVE YOU HELD THIS POSITION?

A. Since May of 2017.

Q. WHAT ARE YOUR JOB RESPONSIBILITIES?

A. In my present position, I manage all construction activities performed by leak repair crews in the Distribution Department. I also oversee PGW's Damage Prevention, Leak Survey, Service Abandonment and Leak Inventory Management programs.

Q. PLEASE SUMMARIZE YOUR BACKGROUND AND EXPERIENCE.

A. I have been employed with PGW since 2002. I spent the first nine years leading a crew primarily involved with leak investigations and repairs. This included protecting underground PGW structures that were compromised by underground street troubles. From 2012 to 2017, I held various supervisory positions that also involved overseeing crews who repaired and protected PGW's underground facilities. I received my Bachelor's Degree from Temple University in 2015 and Master's Degree from Drexel University in 2025.

Q. HAVE YOU EVER PREVIOUSLY OFFERED TESTIMONY BEFORE THIS COMMISSION?

A. Yes, at Commission Docket No. C-2022-3033834.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING?

A. I am testifying on behalf of PGW regarding the formal complaint filed by the Bureau of Investigation and Enforcement ("BI&E").

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY IN THIS PROCEEDING?

A. My testimony will discuss the numerous efforts PGW makes to provide safe and reliable service in the context of the events that occurred at 815 Jackson Street in Philadelphia, PA before and after November 30, 2021. I will also address the testimony of the Bureau of Investigation and Enforcement ("BI&E") witnesses.

Q. PLEASE IDENTIFY THE EXHIBITS THAT ACCOMPANY YOUR REBUTTAL TESTIMONY.

A. The exhibits that accompany my testimony include:

Exhibit JCL-1	Distribution Inspector Job Description
Exhibit JCL-2	Cast Iron Damage Prevention brochure

Q. WERE THOSE EXHIBITS PREPARED BY YOU OR UNDER YOUR DIRECTION AND SUPERVISION?

A. Yes.

II. STREET MARKING

Q. PLEASE DESCRIBE THE PA ONE CALL SYSTEM FOR TICKETING RELATED TO FACILITIES MARKING.

A. The Pennsylvania One Call ("One Call") System is a statewide, statutory clearinghouse for identifying the location of underground facilities when excavation is going to occur. Such identification protects both the surrounding structures and the public, as well as the excavator. An excavator can place a variety of line locate requests based on the work they are planning, and the underground facility owner then has the legal obligation to mark the location of the line in a particular way, based on the type of ticket that was entered. "Ticket" is the term used in the industry for a One Call marking request.

Q. WHAT IS THE MEANING OF "EMERGENCY" AS APPLIED TO ONE CALL TICKETS?

A. Pennsylvania Act 287 as amended defines "emergency" as "a sudden or unforeseen occurrence involving a clear and immediate danger to life property or the environment, including, but not limited to serious breaks or defects in the facility owner's line." So, an emergency ticket involving a water service line, for example, means that the water service line is affected and work needs to be undertaken promptly. Under Act 287 as amended, an emergency designation requires facilities owners, like PGW, to make contact with the excavator and mark its facilities location "as soon as practicable" and "the response by the facility owner shall be consistent with the nature of the emergency information received by the facility owner." Without the emergency designation, marking is due within two days.

Q. FROM YOUR PROFESSIONAL EXPERIENCE DO ALL "EMERGENCY" ONE CALL REQUESTS MEET THE ABOVE CRITERIA?

A. No. The designation of "emergency" is defined by the excavator and automatically accepted and entered by the Pennsylvania One Call system. An "emergency" designation by an excavator which does not meet the criteria of an emergency can be utilized to expedite the utility response for the convenience of the excavator. The issue of overuse has been raised before the One Call Board, but curbing abuse is difficult to administer. Approximately twenty-five percent of the tickets processed by PGW (~17,000 per year) are excavator-designated "emergencies."

Q. DOES THE DESIGNATION OF AN "EMERGENCY" NECESSARILY MEAN THAT THERE IS A THREAT TO PUBLIC SAFETY INVOLVED?

A. No. An emergency could and frequently does mean that a home or business is without water or sewer service (or other utilities) but not necessarily that the condition of the subject facility poses a physical danger to anyone or anyone else's facilities.[1]

Q. WHO ARE THE PERSONNEL THAT RESPOND TO ONE CALL TICKETS AND MARK THE LOCATION OF PGW FACILITIES?

The term used by PGW for personnel who mark the location of our lines is "Damage Prevention Inspector." Many natural gas distribution companies hire external locator contractors to mark their structures. PGW utilizes in-house trained Damage Prevention Inspectors to not only locate PGW structures but also to ensure the safety of PGW's underground facilities from outside disturbances during their line marking duties.

I have attached the official PGW job description for Damage Prevention Inspector, which describes their prescribed duties. See **Exhibit JCL-1**. These responsibilities include making direct contact with excavators before, during, and after work is completed on larger, complex projects[2] where PGW may have moved structures that need to be put back once the excavator is finished, contacting other facility owners when failures of their system affect our facilities and being subject matter experts in One Call practices. We believe that arrangement best promotes public safety and PGW's interest.

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[1] See also PGW St. 1-R at 37.

[2] The 3 One Call tickets at issue in this proceeding were not part of a large, complex project.

Q. DO THE PROCEDURES THAT PGW HAS IN PLACE REQUIRE DAMAGE PREVENTION INSPECTORS TO ADDRESS UNDERGROUND STREET TROUBLES?

A. Yes. There are several internal procedures PGW has implemented, and on which employees are trained, that address underground street trouble identification and remediation. They are required to follow this training while in the field.

PGW Bulletin No. 312 dated May 2, 2025 (See **I&E Exhibit 11**), is a short directive that describes PGW's participation in One Call and notes PGW's obligation to mark facilities. The Bulletin states that: "Upon receipt of notice of water or sewer system failures, or surface conditions, such as cavities or cave-ins which may be caused by such failures, the location of gas pipeline facilities shall be determined." In such circumstances, "[W]herever pipeline facilities are or may be endangered, the appropriate supervisor shall be promptly informed."

PGW Bulletin No. 313 dated June 3, 2020 (See **I&E Exhibit 12**) is addressed to Damage Prevention Inspectors and marking activities: "To provide clear instructions for Distribution Department damage prevention inspectors regarding the various duties of their job." There are a variety of ongoing and constant "patrol" duties assigned to the Damage Prevention Inspectors, including to "always report or act upon":

- Any excavations (including backfilled openings that are not familiar to the inspectors), grading, demolition, or other construction activity which could result in damage to a pipeline, loss of support due to settlement or shifting of soil around a pipeline, undermining or damage to a pipeline support, or loss of cover or excess fill.
- Land subsidence, earth slippage, soil erosion, extensive tree root growth, flooding, climatic conditions, soil accumulation and other natural causes that can create additional external loading.
- Damage to pipeline markers, the need to replace them, or add additional pipeline markers. (Look to see that emergency contact information is clear and visible on all markers).

Bulletin No. 313 is a comprehensive list of the Damage Prevention Inspector duties that separate them from a routine locator that is more typical in the industry. In addition to locating PGW structures, Bulletin No. 313 outlines a list of physical cues that an Inspector is to be attentive to, and the follow up actions that are to be taken if the select condition is identified in the field.

PGW Bulletin No. 54 dated May 1, 2025 (See **I&E Exhibit 13**). This procedure addresses the "[d]ispatching and investigating failures of underground structures such as water and sewer mains that could reduce or eliminate support of PGW pipelines." The Bulletin notes that: "Underground troubles are usually brought to PGW's attention due to a condition observed on the street surface; or as a result of a pre-existing condition encountered in the performance of PGW work but not caused by PGW activity." The trigger for an investigation is "the result of a telephone message or an observation on the street." The Bulletin also states that: "It is important to emphasize that every complaint of underground street troubles must immediately be brought to the attention of the Dispatcher in the same manner as gas leaks." (Underlined in the Bulletin). The investigation procedures undertaken upon notice or discovery of underground street troubles is then detailed.

There is a One Call notice procedure for reporting underground street trouble by an excavator to a facilities owner. Section 5.6.ii of Act 287 as amended states that: "After consulting with a facility owner, provide such support and mechanical protection for known facility owner's lines at the construction work site during the excavation or demolition work, including during backfilling operations, as may be reasonably necessary for the protection of such lines."

It is important to note that, under all of these procedures, PGW must have prior notice, from either an internal or external source, to dispatch an underground street trouble order.

Q. DO YOU BELIEVE THAT PGW'S ACTIONS WERE IN COMPLIANCE WITH ITS BULLETINS NOS. 54, 312, AND 313 IN JULY-SEPTEMBER 2021?

A. Based on my review of the facts, PGW's employees all complied with Bulletins Nos. 54, 312, and 313 as written and as discussed in more detail in the testimony of PGW witness Joseph Hawkinson.

Q. HOW OFTEN ARE PGW FIELD PERSONNEL TRAINED ON THESE MATERIALS?

A. Theses safety measures are reviewed annually at the Distribution Annual School for Foreman and Damage Prevention Inspectors held in September every year.

Q. HAVE THE PROCEDURES YOU DESCRIBED PREVIOUSLY IN YOUR TESTIMONY BEEN REVIEWED BY BI&E?

A. Yes. We routinely submit our written procedures to BI&E for their review and comment. Most recently, PGW submitted numerous bulletins to BI&E on January 31, 2019, including Bulletins Nos. 54, 312 and 313, as part of an O&M Inspection that occurred February 28, 2019 and March 5, 2019. No deficiencies were noted by BI&E. Most recently on July 31, 2025, PGW's current bulletins were reviewed by BI&E, and, again, no deficiencies were noted.

Q. OUTSIDE OF THE COMPANY, DOES PGW OFFER EXCAVATOR EDUCATION AND TRAINING AS WELL?

A. Yes. We meet with Philadelphia Water Department ("PWD") and the excavators working on water and wastewater systems regularly. Since February 14, 2020, we began disseminating brochures to the excavators encouraging them to be cautious when excavating around PGW facilities. These brochures outline the safety concerns and protocols to take when excavating around cast iron mains. We distribute these brochures at meetings with City agencies, facilities owners and excavators, as more fully described below. We also provide copies to the City's Department of License and Inspection (“L&I”) who issue the street opening permits and ask them to distribute them to all permit applicants. See **Exhibit JCL-2**.

PGW also meets monthly with front line supervisors from PWD and L&I during the City’s monthly DITCH meetings. The purpose of these meetings is to discuss problematic and high-profile excavation locations. During those discussions, excavation safety is usually a routine topic.

In addition, the PGW maintenance team attends a City-sponsored semi-annual meeting at which all relevant City departments attend, alongside a liaison from PA One Call, at which presentations on various topics about City operations are conducted. Excavation safety is a key topic at these meetings. The meetings are also open to all contractors and excavators working on water and sewer facilities within the City of Philadelphia.

Q. PLEASE DESCRIBE PGW’S OUTREACH TO OTHER UNDERGROUND FACILITIES OWNERS, INCLUDING PWD.

A. PGW meets regularly with the majority of underground facility owners in the City of Philadelphia at the monthly DITCH meeting. Representatives include PWD’s water and sewer divisions, the Philadelphia Streets Department, the Southeast Pennsylvania Transportation Authority (“SEPTA”) and the Pennsylvania Department of Transportation (“PENNDOT”).

PGW’s planning and construction team also meets with the city facility owners during their planning and design meetings that are usually dedicated to discussing large construction projects within the City.

Q. DOES PGW ALSO OFFER PUBLIC/CUSTOMER EDUCATION?

Yes. PGW has a robust communication program to better explain the Company's investment in its infrastructure, expand communication of pipeline improvement efforts, improve public perception, build stronger, more collaborative external relationships, and help increase customer satisfaction.

III. <u>ACTIVITIES ON DAY OF INCIDENT</u>

Q. WERE YOU DEPLOYED TO THE SCENE AT 815 JACKSON STREET IN PHILADELPHIA, PA ON NOVEMBER 30, 2021?

A. Yes. I was given the job by Dispatch once it was called in by the Philadelphia Fire Department ("PFD") at 7:09pm. I was notified at 7:15pm and immediately reported to the field and arrived at the location at 8:08pm. I was the incident commander on the scene for PGW.

Q. DID PGW CONTACT BI&E ABOUT THE INCIDENT?

A. Yes. PGW contacted BI&E shortly after 8:19 pm.

Q. WHAT WAS THE CONDITION OF THE SCENE AT 815 JACKSON STREET WHEN YOU ARRIVED?

A. At the time of my arrival, there was no fire, but the windows appeared broken and there was some charring around the drywall and framing to the entryway doors and windows along with some minor damage to a vehicle parked in front and a small amount of debris outside. There were also front foundation wall gas readings taken at 815 and 813 Jackson Street that gave 100% gas readings in bar-holes over the 4" cast iron gas main in front of 815 Jackson.

Q. WHAT ACTIVITIES DID PGW UNDERTAKE THAT DAY?

A. PGW Area Supervisor Chris Mitchell, who was notified of the incident by Dispatch at 7:09pm, arrived on the scene at 7:10pm. Chris was the closest PGW personnel to the incident and just happened to be around the corner from the location of the explosion. Once the PGW crew arrived on location, Chris immediately instructed the crew to begin an excavation approximately 50’ in each direction away from 815 Jackson in order to cut and cap the 4” main in front of the property. Upon my arrival I noticed the relatively minimal damage to the building and spoke with the L&I Inspector on site, who determined that the structure was not at risk of collapse. At that time, and based on this information, I instructed the crew to stop the cut and cap work and begin the investigation to locate the source of the gas leak in front of the property. In total, PGW Distribution team responded with a Superintendent, two Field Supervisors, one grease truck, one Mobile Equipment, and two separate crews each consisting of three personnel. Our main task was to make conditions safe by finding and stopping the source of the gas leak. In addition to the above-mentioned Distribution team, PGW’s Field Services Department (FSD) team also responded to the scene of the incident with two Field Supervisors and three Field Service Technicians. Their primary responsibility was to assist with safety checks and help evacuate the affected residents on the block. Other activities that were undertaken by PGW on that day included: shutting off gas where PGW had access to the property, completing odorant checks and analysis by FSD as well as PGW’s Chemical Services Department. Philadelphia Electric Company (PECO) was on site to shut power off to houses on the block in order to eliminate potential ignition sources.

Q. WHAT CONCLUSIONS DO YOU DRAW FROM PGW’S RESPONSE TO THE INCIDENT?

A. As a whole, the response to the emergency by all PGW personnel on scene that day was above and beyond the call of duty and followed all procedures and protocols designed to protect life first then property from further damage. It was an excellent example of a real world, dangerous and life-threatening scenario that showcased the excellence and experience of PGW's field staff firsthand.

Q. WHAT WAS THE CONDITION OF THE SOIL SURROUNDING THE CRACKED MAIN WHEN IT WAS EXCAVATED?

A. Many photographs show the condition of the soil surrounding the cracked main during the excavation, both in BI&E's testimony exhibits and in PGW Exhibit JH-1. For the most part, during excavation a small cavity was found near PGW's 4-inch cast iron main. Given the age of the sidewalk above PGW's main (i.e., it was <u>not</u> disturbed by the prior plumber excavations in September 2021), there is no way of knowing when the voids may have formed and there was no indication from the surface of any underground street troubles near PGW's main. It is impossible to know what the surrounding condition was prior to the main breaking for certain.

IV. <u>REBUTTAL TO BI&E TESTIMONY.</u>

Q. WERE MARKING REQUESTS SUBMITTED TO PGW ON THE 800 BLOCK OF JACKSON STREET IN THE TWELVE MONTHS PRIOR TO NOVEMBER 30, 2021?

A. Yes. There were four One Call tickets submitted in 2021 on the 800 block of Jackson Street. Only three of the 2021 One Call tickets are relevant to this matter and were in the area near 815 Jackson Street and made by third party excavators on behalf of water/sewer customers in July – September 2021. One ticket was marked as "emergency." Two of the tickets were for the same address when the original ticket expired and work was not completed within the lawful dig period of 10 days. So, there were two instances/locations of excavation on the block. These requests were related to the repair/replacement of private water/sewer lines. Unlike natural gas, water/sewer customers own and are required to maintain the service lines that connect their properties to PWD's water/sewer mains.

Q. HAVE YOU REVIEWED THE MARKING ACTIVITIES OF PGW AS THEY RELATED TO THESE THREE TICKETS?

Yes. There were two PGW Damage Prevention Inspectors involved in these markings. I oversee both and have discussed the performance of their duties regarding those three tickets. These are experienced field personnel. They each have between seven and eleven years of experience with PGW and have been fully trained in marking procedures, including the responsibility to observe what they can regarding underground street conditions from the surface according to Distribution Bulletin Nos. 312, 313, and 54. The two Damage Prevention Inspectors undertaking these markings on the 800 block of Jackson Street were fully trained on Bulletin No. 54 and related protocols in Bulletin Nos. 312 and 313 at PGW's annual Distribution School, including in September 2020 and in September 2021 around the time of the events.

Q. WERE THE MARKINGS LAID OUT ACCURATELY AND IN COMPLIANCE WITH ALL PROCEDURES?

A. Yes. All markings were accurately laid out based on my discussions with the two trained Damaged Prevention Inspectors, and we are not aware of any reports to the contrary from the excavators or anyone else.

Q. DID YOU INVESTIGATE THE PROCEDURES THAT THEY FOLLOWED IN MARKING PGW FACILITIES AND OBSERVING ONSITE CONDITIONS?

A. Yes. The Damage Prevention Inspectors who performed marking of the three One Call tickets referenced by the BI&E witness did their job in full compliance with the published procedures of PGW in Bulletin Nos. 54, 312 and 313. In this instance, they looked for indications of underground street troubles when they marked the location of PGW facilities and they found none. These are substantial duties, and PGW personnel take them very seriously.

Q. DID BI&E WITNESSES INTERVIEW ANY OF THE THREE DAMAGE PREVENTION INSPECTORS INVOLVED AS PART OF THEIR INVESTIGATION?

A. No. There was no request by the BI&E inspectors to speak to the Damage Prevention Inspectors at any time during their investigation.

Q. HOW DO YOU RESPOND TO MS. COOPER SMITH'S CLAIM THAT "PGW EMPLOYEES BEFORE/WHILE/AFTER VISITING THE LOCATION DID NOT PERFORM INSPECTION AND NECESSARY FOLLOW-UP ACTIONS IN ACCORDANCE WITH BULLETIN #54" (BI&E ST. 1 AT 23)?

A. I totally disagree with BI&E's position. BI&E is misinterpreting, and then retroactively applying the PGW Bulletins, to require that PGW personnel be present at most, if not all, third party excavations on third party facilities when there has been no observation or notice of any signs of underground street trouble, which is not our procedure and never has been. What Ms. Cooper Smith appears to be saying is that, even though there was no reason for them to have been there after marking out the structures, the Damage Prevention Inspectors were not present during the excavation at the marked sites, and this is a "necessary follow-up action." BI&E St. 1 at 18.

As Mr. Hawkinson explains, supervision of third-party excavation on third party facilities – where there has been no notice of UST – is not required, is unnecessary and would be very expensive and impractical to implement. In addition to costing the ratepayers tens of millions of dollars, it would likely add many hours if not days to every single one of thousands of these excavations.

Q. WAS THERE ANY NOTICE GIVEN TO PGW PRIOR TO THE INCIDENT THAT THERE WERE UNDERGROUND STRUCTURAL ISSUES IN THE 800 BLOCK OF JACKSON STREET?

A. I am not aware of any notice being provided to PGW about underground structural issues prior to the incident. Nor does BI&E assert that PGW or anyone else was aware of any void in front of 815 Jackson Street.

V. CONCLUSION

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes. This concludes my rebuttal testimony. I reserve the right to file additional responsive testimony as necessary. Thank you.

VERIFICATION

I, Joseph C. Leva, hereby state that: (1) I am Superintendent, Operations and Maintenance for Philadelphia Gas Works ("PGW"); (2) the facts set forth in my testimony are true and correct (or are true and correct to the best of my knowledge, information and belief); and, (3) I expect to be able to prove the same at a hearing held in this matter. I understand that statements herein are made subject to the penalties of 18 Pa. C.S. § 4904 (relating to unsworn falsification to authorities).

Date: 8/15/2025

/

Joseph C. Leva
Superintendent, Operations and Maintenance
Philadelphia Gas Works

PGW Exhibit JCL-1

Distribution Inspector Job Description

JOB DESCRIPTION

JOB TITLE	JOB CODE	UNIT	WORK STATUS
Distribution Inspector	8LM12	Field Operations	X Shift Work ☐On-Call X Overtime
REPORTS TO	**JOB CODE**	**PAY SCALE**	**HR REVIEWER**
Distribution Supervisor	3A119	$1034.80-1316.60	

SUMMARY

Must work in inclement weather conditions, winter, summer and emergency work when necessary. Employee works ninety percent of the time indirectly supervised. May be required to work extensive overtime. This is a drug tested position. Performs all inspection functions as required in the Distribution Construction Maintenance areas including operating functions as follows:

ESSENTIAL FUNCTIONS

- <u>Contractors Performing PGW Construction Work</u>

  - Inspects contractors performing work on both energized and de-energized gas mains and service installations, regardless of pipe size, for adherence to Company specifications and construction methods. Responsible to ensure work performance by contractors is in accordance with the terms of the particular contract.
  - Inspects contractors performing service restoration work such as residential relights and rebuilds for adherence to Company and Departmental policies and procedures
  - Has authority to halt progress of work if needed to accomplish same. Within this work, specific duties included are:
    - Interprets and enforces contract specifications and construction methods of applicable gas main and service installations which requires knowledge of construction methods, drawings and sketches and repaving methods
    - Compiles records and reports of work in progress including measurement of any quantities completed using standard mathematical formulas for measurement.
    - Observes contractors' work in progress for any effects on other underground structures and assures compliance with safe construction practices to avoid damage to such structures.
    - Orders and returns materials for contractors performing contract work.
    - Determines need for "contingency" work required by unforeseen conditions.
    - Describes records and submits required forms for such extra work.
    - Visually inspects welding, fusion and corrosion control methods for adherence to required specifications. Seeks technical

assistance through supervision as needed.

- Advises contractors of the importance of minimizing adverse effects of contractors' work on customer relations and the general public.

- **Damage Prevention**

  - Must follow all PGW damage prevention procedures.
  - Upon notification by the Pennsylvania One Call System or some other means of communication visits construction sites of work in progress by other utilities or contractors to insure that all PGW structures are protected and undisturbed by such work.
  - Informs various utilities' and contractors' representatives of locations of gas structures and the necessary precautions to be taken.
  - Must be familiar with safe construction methods and practices and recognize unsafe practices that may affect the safety of PGW structures.
  - Must be able to read and interpret construction drawings including General Main Maps and Detail Main Maps.
  - Must have complete familiarity with PGW main and service records.
  - Must be able to recognize, evaluate and react according to Operator Qualification Requirements according to DOT Part 192.805 to prevent conditions which could result in hazards to natural gas structures.
  - Makes daily visits to jobsites that are assigned with a PGW Watchman to insure compliance with foreign construction responsibilities.

- **Walking (Footways) and Mobile (Roadways) Surveys, Flame Ionization Survey, Optical Methane Detection Survey and Curb Box Inspections**

  - Conducts walking or mobile survey throughout the City using various detection devices such as: Optical Methane Detectors, Flame Ionization Instruments, Gas Detection Instruments (GDI's), or any other gas detection instruments to conduct leak detection surveys and general safety monitoring. This work may require the assistance of a helper.
  - Must follow the existing leak Investigation Procedure when leaks are found on survey including taking necessary actions to protect people first and then property.
  - May be required to classify leaks, make leaks safe to hold in accordance with leak investigation procedure.

- May be required to inspect exposed mains on bridges and report on conditions found and necessary maintenance.
- Makes necessary adjustments to curb boxes as required or issues orders to rectify same.

- **Repaving of PGW Trenches**
  - Inspects repaving of PGW trenches by various contractors.
  - Determines and elucidates, in writing, reasons for paving requirements in excess of reported quantities by PGW forces.
  - Must be capable of handling customer complaints related to trenches, repaving of trenches or repaving methods.

- **Underground Metered Gas/House Piping Installations**
  - May be called upon to inspect underground gas lines being installed by contractors to insure compliance with PGW Underground House Piping Specifications.

- **Plastic Fusion Requirements**
  - Capable of butt fusion, saddle fusion or electro fusion in accordance with manufacturers' procedures and in compliance with DOT Parts 192.283, 192.285 and 192.287.
  - Makes templates for fusing various special shapes.
  - Fits and fuses specials such as bends, crosses, tees and drip pots.
  - Fits and fuses service connection on mains
  - May be required to fit and fuse in a trench.
  - Fuses on pipe or uses electro fusion fittings where required on high, intermediate or low pressure gas mains.
  - Must have the ability to lay out angles, calculate runs, establish tmvel lengths involving angles, rolls and sets for plastic pipe.
  - Uses various types of Plastic Fusion Equipment and performs Plastic Fusion Procedures in accordance with manufacturer's specifications to join plastic mains and services.

- **General Requirements**
  - Must maintain a valid driver's license.

- Performs as ventilating crew or backfilling crew leader when required.
- Must meet all requirements of PGW's Operator Qualification Plan.
- Operates various types of equipment such as Pipe Line Locators, Box Locators, etc.
- Must have thorough knowledge of and adhere to all requirements of the Pennsylvania One Call System. Must have thorough knowledge of safe excavation practices and trench protection systems such as shoring, sloping or shielding.
- Responsible for all tools, material and equipment issued and utilized.
- Immediately reports any unusual or unexpected condition encountered.
- Reacts appropriately to abnormal operating conditions.
- Writes complete and accurate reports of work completed in connection with assigned work, underground street troubles, injuries, accidents, incidents, etc.
- Makes intelligent and accurate reports which may be written, entered in a computer or reported by radio or telephone.
- Utilizes Computer technology to retrieve, enter and store data related to work assigned. Responsible for a clean, safe and properly secured jobsite.
- Responsible for enforcing and following established safety procedures.
- May be required to classify leaks, make leaks safe to hold in accordance with leak investigation procedure.
- This is a Drug tested position.
- Performs other related duties for which previously trained.

EDUCATION & EXPERIENCE QUALIFICATIONS

- HS Education
- Must have thorough knowledge of Distribution Department Detail Main Maps, construction drawings and various other utilities' plans
- Must have thorough knowledge of Engineering Department drawings and maps
- Must be willing to learn multiple software programs, internet programs
- Software:
    - TrueView
    - Design Review

- Adobe Professional
- Microsoft Office software
- PGW Programs:
  - Oracle, for purchase orders
  - PGW ftp, for file exchange with vendors for various departments
  - GIS Flex Map
- Internet Programs
  - City of Philadelphia ftp site
  - ERV, for retrieving PWD plans
  - AIMS, for responding to PA 1 Call tickets for outside vendors
  - PA-1-call.org, for entering PGW design one call tickets

ORGANIZATIONAL SCOPE	
REVIEWING SUPERVISOR Distribution Supervisor	
IMMEDIATE SUPERVISOR Distribution Supervisor	**OTHER DIRECT REPORTS OF SUPERVISOR**
THIS JOB	**POSITIONS REPORTING TO THIS POSITION** None

ADA PHYSICAL & MENTAL REQUIREMENTS

Following is a list of specific physical and mental requirements necessary to complete the Essential Functions of the job successfully. All requirements are subject to possible modification to reasonably accommodate individuals with disabilities. Individuals who pose a direct threat or significant risk to the health and safety of themselves or others in the workplace, because physical requirements cannot be eliminated or reduced by reasonable accommodation, will not be considered qualified for this position. The activities and metrics identified in this document represent what the Company anticipates are required under normal operating circumstances. However, due to the nature of PGW's work, normal circumstances may not always apply.

GENERAL WORK CLASSIFICATION: Check One Only

- ☐ **Sedentary work** - Exerting up to 10 pounds of force occasionally, and/or a negligible amount of force frequently or constantly to lift, carry, push, pull or otherwise move objects, including the human body. Sedentary work involves sitting most of the time. Jobs are sedentary if walking and standing are required only occasionally, and all other sedentary criteria are met.

- ☐ **Light work** - Exerting up to 20 pounds of force frequently, and/or a negligible amount of force constantly to move objects. If the use of arm and/or leg control requires exertion of forces greater than that of sedentary work and if the worker sits most of the time, the job is considered light work.

- ☒ **Medium work** - Exerting up to 50 pounds of force occasionally, and/or up to 20 pounds of force frequently, and/or up to 10 pounds of force constantly to move objects.

- ☐ **Heavy work** - Exerting up to 100 pounds of force occasionally, and/or up to 50 pounds or force frequently, and/or up to 20 pounds of force constantly to move objects.

- ☐ **Very heavy work** - Exerting in excess of 100 pounds of force occasionally, and/or in excess of 50 pounds of force constantly to move objects.

SPECIFIC WORK REQUIREMENTS:

Utilizing the "Key" below, check appropriate boxes for each requirement category as it pertains to performing the essential functions of the attached position.

Key: **C = Constantly 75% or more of an average workday**
F = Frequently 50% to 75% of an average workday
O = Occasionally 25% to 50% of an average workday
R = Rarely less than 25% of an average workday

C	F	O	R	WORKING ENVIRONMENT DESCRIPTIONS
		X		**Indoor Work:** Performs duties subject to inside environmental conditions protected from weather but not necessarily from temperature changes.
X				**Outdoor Work:** Performs duties subject to outside environmental conditions with no effective protection from weather.
X				**Extreme Temperatures:** Performs work activities at temperatures below 32 degrees or above 100 degrees for periods of more than one hour, this includes such factors as the affects of wind and humidity
X				**Noise:** There is sufficient noise to cause the worker to shout in order to be heard above the noise level and/or affect hearing ability.
		X		**Vibration:** There is sufficient exposure to oscillating movements of the extremities or whole body.
X				**Hazards:** Exposed to one or more hazards such as moving mechanical parts, moving vehicles, electrical current, high places, high heat, chemicals, etc.
	X			**Atmospheric Conditions:** Exposed to one or more conditions that affect the respiratory system such as fumes, odors, dusts, mists, gases, poor ventilation, etc

C	F	O	R	PHYSICAL REQUIREMENT DESCRIPTION
X				**Balancing:** Maintaining body equilibrium to prevent falling when walking, standing, or crouching on narrow, slippery, or erratically moving surfaces
X				**Bending and Stooping:** Bending body downward and forward by bending spine at the waist.
			X	**Climbing:** Ascending or descending ladders, scaffolding, ramps, poles, and other devises using feet and legs and/or hands and arms. Body agility is emphasized
			X	**Climbing Stairs:** Ascending or descending stairs to gain access to a building or to move from one floor to another
		X	X	**Crawling:** Moving about on hands and knees or hands and feet.
		X		**Light Carrying/Lifting:** Physically transporting items weighing less than 15 pounds from one location to another
		X		**Moderate Carrying/Lifting:** Items weighing 15 to 44 pounds
			X	**Heavy Carrying/Lifting:** Items weighing 45 pounds and over
		X		**Fingering:** Picking, pinching, typing, or otherwise working primarily with fingers rather than with the whole hand or arm
		X		**Grasping:** Applying pressure to an object with fingers (including thumb) and palm
		X		**Kneeling:** Bending legs at knees to come to rest on one or both knees
		X		**Light Lifting:** Raising objects under 15 pounds from a lower to a higher position or moving objects horizontally from one position to another
		X		**Moderate Lifting:** Objects 15 – 44 pounds
			X	**Heavy Lifting:** Objects 45 pounds and over
			X	**Pulling Hand over Hand:** Using upper extremities to exert force in order to draw, drag, haul, or tug objects in a sustained motion
			X	**Pushing:** Using upper extremities to press against something with steady force in order to thrust forward, downward, or upward
			X	**Reaching above shoulder:** Extending hand(s) and arm(s) in any direction
		X		**Repetitive motion:** Substantial movements of the wrists, hands, and/or fingers for sustained periods of time
	X			**Sitting:** Particularly for sustained periods of time
	X			**Standing:** Particularly for sustained periods of time
	X			**Walking:** Moving about on foot, particularly for long distances.
	X			**Hearing:** Utilizes hearing to perform one or more of the following: use communication equipment, detect specific noises, proper equipment operation, understand what clients are saying in normal conversation

C	F	O	R	VISUAL ACUITY REQUIREMENT DESCRIPTION (with or without corrective eyewear)
		X		**Typical Office Work:** Performs activities such as: preparing & analyzing data; transcribing; extensive reading; viewing PC screens, inspecting small parts; using measurement devices; operating machines
	X			**Typical Trade Work:** Performs activities utilizing mechanical equipment such as: lathes, drill presses, power saws, C screens; inspecting small parts; using measurement devices; operating machines
	X			**Typical Vehicle Work:** Performs activities which require visual acuity to operate motor vehicles or heavy equipment
	X			**Typical Service Work:** Performs activities determining the accuracy, neatness, and thoroughness of work assignment or general observations of facilities/structures (i.e. custodial, inspection, security guard, laborer)
C	**F**	**O**	**R**	**COMPREHENSION**
	X			Ability to understand, remember, and apply oral and/or written instructions or other information
	X			Ability to understand, remember, and communicate routine, factual information
		X		Ability to understand complex problems and to collaborate and explore alternative solutions
		X		Ability to understand opposing viewpoints highly complex issues and to negotiate/integrate different viewpoints
C	**F**	**O**	**R**	**ORGANIZATION**
	X			Ability to organize thoughts and ideas into understandable terminology
		X		Ability to organize and prioritize own work schedule on short-term basis (longer than one month)
			X	Ability to organize and prioritize work schedules of others on short-term basis
			X	Ability to organize and prioritize work schedules of others on long-term basis
C	**F**	**O**	**R**	**REASONING and DECISION MAKING**
	X			Ability to apply common sense in performing job
	X			Ability to make decisions which have moderate impact on immediate work unit
	X			Ability to make decisions of significant impact on the immediate work unit & moderate impact outside work unit
	X			Ability to make decisions which have significant impact on the department's credibility, operations, and services
C	**F**	**O**	**R**	**COMMUNICATION**
	X			Ability to understand and follow basic instructions and guidelines
	X			Ability to complete routine forms, use existing form letters and/or conduct routine oral communication
		X		Ability to compose letters, outlines, memos, basic reports and/or to orally communicate technical information
	X			Ability to communicate with individuals utilizing a telephone; requires ability to hear & speak effectively on phone
	X			Ability to express or exchange ideas by means of the spoken word, communicating orally with others accurately, loudly, and quickly
			X	Ability to make informal presentations speaking before groups inside and/or outside the organization
			X	Ability to compose materials such as detailed reports, work-related manuals, publications of limited scope or impact, etc., and/or to make presentations outside the immediate work area
			X	Ability to formulate complex and comprehensive materials such as legal documents, authoritative reports, official publications of major scope and impact, etc., and/or to make formal presentations

C	F	O	R	MATHEMATICS
		X		No mathematical ability is required
		X		Ability to count accurately
		X		Ability to add, subtract, multiply, divide and to record, balance, and check results for accuracy
			X	Ability to compute, analyze, and interpret numerical data for reporting purposes
			X	Ability to compute, analyze, and interpret complex statistical data and/or to develop forecasts and computer models

EQUIPMENT / DEVICE OPERATION: Check All that Apply

COMPUTER SOFTWARE	VEHICLES	HEAVY EQUIPMENT/TOOLS
× Microsoft Office × Outlook ☐ ADP × Oracle ☐ Visio ☐ BCCS × AIMS ☐ Goldmine ☐ Other, (describe below)	☐ Bicycle × Standard Passenger Vehicle (Coupe, Sedan, Light SUV, Minivan, etc.) ☐ Trucks/Vans (Pick-up, CDL, Cargo Van, etc.) ☐ Skilled Trade Vehicles (Excavator, Front End Loader, Crane, Towed Compressor, Forklift, etc.) ☐ Other, (describe below)	☐ Construction Equipment (Jackhammers, excavation hand tools, shovels, bars, rakes, levels, etc.) ☐ Welding Tools (AC/DC welders, Arc welders, Welding machines ☐ Drafting Tools (CAD, drafting machines, hand compass, dividers, protractors, etc.) ☐ Natural Gas Equipment (compressors, scrubbers, evaporators, refrigeration equipment, etc.) ☐ Other, (describe below)

APPROVALS:

Robert K. Smith, Director Employee relations, Development, and Support Services
PGW Department Director's Printed Name & Title

Robert Lucini Union Rep.
Union Representative Printed Name & Title

PGW Department Directors Signature — Date: 06/17/2016

Union Representative's Signature — Date: 6-30-16

John P. Rooney, Director Labor Relations
PGW Labor Director's Printed Name & Title

James Lennox Treasurer
Union Representative Printed Name & Title

PGW Labor Director's Signature — Date: 06/17/2016

Union Representative's Signature — Date: 6-30-16

PGW Exhibit JCL-2

Cast Iron Damage Prevention Brochure

Exhibit JCL-2

PHILADELPHIA GAS WORKS
800 West Montgomery Avenue, Philadelphia, PA 19122

Urgent Safety Notice!

Cast Iron gas pipe is susceptible to failure when it is disturbed or undermined.

Notify PGW immediately if the gas pipe is either undermined or disturbed. CALL **215-235-1212**

Potential conditions that can damage cast iron pipe by disturbing it or removing its support include the following:

- Water Main Breaks or Leaks
- Sewer line failures which cause **cavities**
- Improper support during excavation or backfill
- Poor backfill material or not compacted properly
- No protection of exposed facilities
- Settlement or Depressions
- Trenchless installations
- Vibrations from heavy construction equipment
- Trench or Shoring collapse
- Washouts, floods, unstable soil, landslides
- Blasting, boring, tunneling, the removal of aboveground structures by either explosive or mechanical means

Call 8-1-1 Before You Dig

Working on a project that requires digging? **Call 8-1-1.** This free service ensures underground utility lines are marked, preventing damage to service lines and keeping you and your property safe. Remember, **it's the law**.

Know what's below.
Call 811 before you dig.

PHILADELPHIA GAS WORKS
800 West Montgomery Avenue, Philadelphia, PA 19122

SMELL GAS?

CALL 215-235-1212

Natural gas smells bad on purpose. That “rotten egg” smell is the smell of natural gas. If you think you smell gas, **leave the area immediately** and then call PGW from a safe location.

IF YOU SMELL GAS:

- Do not use electrical devices including cell phones which may cause a spark and ignite the gas.
- Do not use an open flame, matches or lighters.
- Do not try to locate the source of the gas leak.
- Do not try to shut off any natural gas valves or gas appliances.
- Do not start vehicles.
- Do not re-enter the building or return to the area until a PGW employee or a qualified utility representative says it is safe to do so.
- Do not put out the flames if natural gas ignites.

Promptly report damage of gas facilities to PGW, securing the area, and standing by at a safe distance.

- ➢ Avoid any attempt to repair the damage or restrict the flow of gas. Leave the repairs to PGW.
- ➢ Allow the gas to vent to the atmosphere.
- ➢ Do not put out the flame if gas ignites, but let it burn. Burning gas will not explode.
- ➢ Do not cover the damaged pipe with dirt as a means of stopping the leak.
- ➢ Report coating damage, dents, and gouging. Surface damage that appears minor can lead to future failure and serious consequences.

Know what's below.
Call 811 before you dig.