WASHINGTON UTC UTILITIES AND TRANSPORTATION COMMISSION

Investigation Report

Greenwood Natural Gas Pipeline Explosion - March 9, 2016

Docket PG-160924

Alan Rathbun, Director, Pipeline Safety
Dave Cullom, Utilities Engineer

September 20, 2016

I. PURPOSE, SCOPE, AND AUTHORITY

A. Purpose and Scope

The purpose of this investigation was to analyze causal factors of the March 9, 2016 natural gas explosion in the Greenwood neighborhood of Seattle, Wash. Another purpose was to determine whether the pipeline's owner and operator, Puget Sound Energy (PSE or company), violated any commission laws or regulations.

B. Authority

Utilities and Transportation Commission staff undertook this investigation pursuant to Revised Code of Washington (RCW) 80.01.040, RCW 81.04.070, RCW 81.88.065, and RCW 81.88.090. PSE is a "public service company" and a "gas company" as those terms are defined in RCW 81.04.010.

The commission has been certified by the federal Pipeline and Hazardous Materials Safety Administration (PHMSA) to enforce the minimum pipeline safety regulations set forth in 49 C.F.R. § 192 with respect to intrastate facilities that are subject to the commission's jurisdiction.

The commission has adopted 49 C.F.R. § 192 by reference, Washington Administrative Code (WAC) 480-93-999.

II. SUMMARY

A. Natural Gas Leak and Explosion

At 1:04 a.m. on March 9, 2016, the Seattle Fire Department (SFD) received a call about a natural gas leak in the 8400 block of Greenwood Avenue North. Upon arrival, firefighters smelled a natural gas odor. The 911 caller led firefighters to an alley behind the buildings on the west side of Greenwood Avenue North. The caller then directed firefighters to a narrow space between the 8411 (Mr. Gyros) and 8415 (Neptune Coffee) buildings of Greenwood Avenue North. There, firefighters determined that gas was escaping from a threaded coupling along the above-ground portion of a steel service line attached to the north-facing wall of the Mr. Gyros structure. The leaking gas ignited at 1:43 a.m. The explosion injured nine firefighters and caused extensive property damage. PSE deactivated the service line at 7:28 a.m.

A. Findings

Staff finds that the immediate structural cause of the natural gas leak and explosion was external damage to a threaded coupling in the above-ground portion of the service line

attached to the north-facing wall of the Mr. Gyros structure. The damage allowed natural gas to escape and to migrate into or under the Mr. Gyros structure, where it subsequently ignited.

Damage to the threaded coupling was likely caused by human activity. Post-incident interviews revealed that individuals used the narrow space between the Mr. Gyros and Neptune Coffee structures to store personal property. Interviewees acknowledged that they sometimes tripped on or bumped the service line. Staff did not determine whether the damage in this case was intentional.

Staff finds that the leak and explosion would not have occurred but for PSE's improper abandonment of the service line in September 2004. Staff's investigation revealed that the service line had not been "cut and capped" as documented by PSE's contractor on Sept. 1, 2004. As a result of PSE's improper abandonment, the service line remained operationally active until it was shut off after the explosion.

Staff finds that PSE violated the following pipeline safety regulations:

1. **49 C.F.R. § 192.727.** PSE failed to abandon the service line in accordance with federal standards (one violation, maximum $200,000 penalty).
2. **WAC 480-93-180 and 49 C.F.R. § 192.13(c).** PSE failed to follow its internal pipeline deactivation plan (one violation, maximum $200,000 penalty).
3. **WAC 480-93-188.** PSE failed to perform annual leak surveys of the active service line (11 violations, maximum $2,000,000 penalty).
4. **49 C.F.R. § 192.481.** PSE failed to perform atmospheric corrosion tests of the active service line at least once every three years (three violations, maximum $600,000 penalty).
5. **49 C.F.R. § 192.** PSE failed to perform external corrosion tests of the active service line at least once every 10 years (one violation, maximum $200,000 penalty).

B. Penalty Recommendation

As discussed in more detail below, staff recommends that the commission issue a formal complaint against PSE and, in accordance with WAC 480-93-223, assess a penalty of up to $200,000 for each violation (maximum $2 million penalty for each category of violation). PSE will face a maximum penalty of $3,200,000.

Staff further recommends that the commission require PSE to implement a compliance program under which the company will identify and mitigate any other improperly abandoned pipelines that may exist within the company's system.

III. BACKGROUND

A. PSE's Washington Operations

PSE is an energy utility providing electrical power and natural gas primarily in the Puget Sound region of the northwest United States. The utility serves natural gas to customers in King, Kittitas, Lewis, Pierce, Snohomish, and Thurston counties.

B. PHMSA Advisory Bulletin – Aug. 16, 2016

On Aug. 16, 2016, PHMSA issued an advisory bulletin that addressed, among other topics, "regulatory requirements operators must follow for the abandonment of pipelines." PHMSA, Pipeline Safety: Clarification of Terms Relating to Pipeline Operational Status, 81 Fed. Reg. at 54512 (Aug. 16, 2016) (Advisory Bulletin ADB-2016-05).

The advisory bulletin stated:

> PHMSA regulations do not recognize an "idle" status for hazardous liquid or gas pipelines. The regulations consider pipelines to be either active and fully subject to all relevant parts of the safety regulations or abandoned. . . . Owners and operators have a responsibility to assure facilities for which they are responsible do not present a hazard to people, property, or the environment.

IV. STAFF INVESTIGATION

A. Evidence

On March 9, 2016, at 1:04 a.m., the Seattle Fire Department (SFD) received a 911 call reporting a natural gas leak in the 8400 block of Greenwood Avenu North. SFD firefighters smelled a natural gas odor upon arrival.

The 911 caller led firefighters to an alley behind the buildings on the west side of Greenwood Avenue North. The caller then directed firefighters to a narrow space between the 8411 (Mr. Gyros) and 8415 (Neptune Coffee) buildings of Greenwood Avenue North. There, firefighters determined that gas was escaping from a threaded coupling along the above-ground portion of a steel service line attached to the north-facing wall of the Mr. Gyros structure.

SFD notified PSE at 1:11 a.m. While waiting for PSE to arrive, firefighters attempted to locate a shut-off valve. When these attempts failed, the firefighters retreated to a retaining wall in the alley behind the buildings on the west side of Greenwood Avenue North.

The leaking gas ignited at 1:43 a.m. The explosion injured nine firefighters and caused extensive property damage.

The commission was notified of the incident at 4:07 a.m. Three pipeline safety inspectors were dispatched to the scene and initiated an investigation.

Natural gas continued to leak for nearly six hours after the explosion. PSE finally deactivated the service line at 7:28 a.m.

According to SFD firefighter Nathan Buck, the leak occurred in the narrow space between the Mr. Gyros (8411) and Neptune Coffee (8415) buildings, at a union connecting two threaded pipe sections attached to the north-facing wall of the Mr. Gyros structure. The exposed, threaded connection was situated one to two feet above the ground. Mr. Buck recalled seeing a plastic bag rippling on the ground, indicating to him that the gas was shooting downward toward the Mr. Gyros foundation.

The evidence suggests that the immediate structural cause of the leak and explosion was external damage to the service line caused by human activity.

PSE hired Tim Riddle, Riddle & Associates, Inc., to conduct post-incident witness interviews. Interviewees acknowledged that they used the narrow space between the Mr. Gyros and Neptune Coffee buildings to store personal property, including bags, backpacks, bicycles, and bicycle parts. Interviewees also acknowledged that they sometimes tripped on or bumped the service line.

PSE also hired Ron Liem, P.E., Investigative Sciences, to conduct laboratory analyses of specimens recovered from the scene. Mr. Liem concluded that the service line recovered from the narrow space between the Mr. Gyros and Neptune Coffee buildings failed at a threaded connection due to applied external force.

PSE's records indicate that the service line involved in the March 2016 explosion was retired and abandoned in 2004, as part of a plan to relocate certain gas services fed from the main under Greenwood Avenue North to the alley behind the Mr. Gyros and Neptune Coffee buildings. A Gas Service Order (D-4 card) dated Sept. 1, 2004, states that PSE's contractor "cut and capped" (i.e., deactivated) the service line on that date.

During its investigation, staff located the below-ground portion of the service line by excavating sections of the sidewalk and southbound lane of Greenwood Avenue North. Contrary to PSE's D-4 card, the line had not been cut and capped. Staff did, however, locate a steel pipe of unknown origin approximately 15 inches above the service line. This pipe appeared to have been cut with a wheel tool used for cutting pipe.

PSE last performed an atmospheric corrosion test for the service line on July 22, 2004.

B. Cause Analysis

Staff finds that the immediate structural cause of the natural gas leak and explosion was external damage to a threaded connection along the above-ground portion of the line serving 8411 (Mr. Gyros) and 8415 (Neptune Coffee) Greenwood Avenue North.[1] The damage was likely caused by human activity.

Staff finds that another cause of the leak and explosion was PSE's failure to properly abandon the line, as intended in 2004. Contrary to PSE's construction record (D-4 card), the line had not been "cut and capped." Staff finds that the leak and explosion would not have occurred but for PSE's failure to properly disconnect and seal the line.

IV. VIOLATIONS

1. 49 C.F.R. § 192.727(b) – Improper deactivation of a pipeline (one violation)

The version of 49 C.F.R. § 192.727(b) in effect on Sept. 1, 2004, provided in relevant part:

> Each pipeline abandoned in place must be disconnected from all sources and supplies of gas; purged of gas; in the case of offshore pipelines, filled with water or inert materials; and sealed at the ends. However, the pipeline need not be purged when the volume of gas is so small that there is no potential hazard.

PSE's attempted service line abandonment did not conform to 49 C.F.R. § 192.727(b). The service line remained operationally active until after the March 2016 explosion.

Staff alleges one violation of 49 C.F.R. § 192.727(b).

2. WAC 480-93-180 – Failure to follow internal procedures (one violation)

The version of WAC 480-93-180 in effect on Sept. 1, 2004, provided in relevant part:

> [E]very gas company shall develop appropriate operating, maintenance, safety, and inspection plans and procedures and an emergency policy.

Wash. St. Reg. 01-20-061.

PSE has adopted a Gas Operating Standards manual in accordance with WAC 480-93-180(1). Effective March 1, 2004, Gas Operating Standard 2525.3600, section 3.1, provided in relevant part:

[1] The line also served 8409 Greenwood Avenue North.

> Each facility abandoned in place or each line not subject to gas pressure, shall be disconnected from all sources and supplies of gas, purged of gas in accordance with Operating Standard 2525.3400, "Purging," and sealed at the ends with expansive foam.

PSE's attempted service line abandonment did not conform to Gas Operating Standard 2525.3600. The service line remained operationally active, unpurged, and unsealed until shortly after the March 2016 explosion.

Staff alleges one violation of WAC 480-93-180.

3. WAC 480-93-188 – Failure to perform gas leak surveys (11 violations)

The version of WAC 480-93-188 in effect on Sept. 1, 2004, provided in relevant part:

> (1) . . . Every gas company shall have a leak control program, which shall be determined by the nature of the gas company's system and by existing physical and operating conditions, and which must meet the following minimum requirements. During a gas leak survey, a gas detection instrument shall be conducted over all mains and services, including the testing of the atmosphere in gas, electric, telephone, sewer, water, and other underground structures; at cracks in paving, and in wall-to-wall paved areas, the cracks in sidewalks; at building walls; and at other opportune locations for discovering gas leaks.
> . . .
> (3) Frequency of surveys in designated areas. Gas leakage surveys shall be conducted according to the following specified frequencies: (a) Business areas - at intervals not exceeding fifteen months, but at least once each calendar year;

Wash. St. Reg. 92-16-100.

As amended effective June 2, 2005, WAC 480-93-188 provided in relevant part:

> (1) Operators must perform gas leak surveys using a gas detection instrument covering the following areas: (a) Over all mains, services, and transmission lines including the testing of the atmosphere near other utility (gas, electric, telephone, sewer, or water) boxes or manholes, and other underground structures;
> . . .
> (3) Gas leak surveys must be conducted according to the following minimum frequencies: (a) Business districts - at least once annually, but not to exceed fifteen months between surveys. All mains in the right of way adjoining a business district must be included in the survey[.]

Wash. St. Reg. 05-10-055.

As amended effective June 30, 2008, WAC 480-93-188 provided in relevant part:

> (1) Each gas pipeline company must perform gas leak surveys using a gas detection instrument covering the following areas and circumstances: (a) Over all mains, services, and transmission lines including the testing of the atmosphere near other utility (gas, electric, telephone, sewer, or water) boxes or manholes, and other underground structures;
> . . .
> (3) Each gas pipeline company must conduct gas leak surveys according to the following minimum frequencies: (a) Business districts - At least once annually, but not to exceed fifteen months between surveys. All mains in the right of way adjoining a business district must be included in the survey[.]

Wash. St. Reg. 08-12-046.

PSE performed no annual gas leak surveys with respect to the improperly abandoned (active) service line from Sept. 1, 2004, at the latest, until March 9, 2016. PSE failed to perform a minimum of 11 surveys.[2]

Staff alleges 11 violations of WAC 480-93-188.

4. 49 C.F.R. § 192.481(a) – Failure to perform atmospheric corrosion tests (three violations)

The version of 49 C.F.R. § 192.481(a) in effect on Sept. 1, 2004, provided in relevant part:

> Each operator must inspect each pipeline or portion of pipeline that is exposed to the atmosphere for evidence of atmospheric corrosion, as follows:
> [For onshore pipelines:] At least once every 3 calendar years, but with intervals not exceeding 39 months[.]

PSE performed no atmospheric corrosion tests with respect to the improperly abandoned (active) service line from July 22, 2004, until March 9, 2016. PSE failed to perform a minimum of three tests.[3]

Staff alleges three violations of 49 C.F.R. § 192.481(a).

5. 49 C.F.R. § 192.465(a) – Failure to perform external corrosion tests (one violation)

The version of 49 C.F.R. § 192.465(a) in effect on Sept. 1, 2004, provided in relevant part:

[2] At a minimum, PSE should have performed gas leak surveys in 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, and 2015.
[3] At a minimum, PSE should have performed atmospheric corrosion tests in 2007, 2010, and 2013.

> Each pipeline that is under cathodic protection must be tested at least once each calendar year, but with intervals not exceeding 15 months, to determine whether the cathodic protection meets the requirements of § 192.463. However, if tests at those intervals are impractical for separately protected short sections of mains or transmission lines, not in excess of 100 feet (30 meters), or separately protected service lines, these pipelines may be surveyed on a sampling basis. At least 10 percent of these protected structures, distributed over the entire system must be surveyed each calendar year, with a different 10 percent checked each subsequent year, so that the entire system is tested in each 10-year period.

The improperly abandoned service line was a "separately protected service line" within the meaning of this provision.

PSE performed no external corrosion tests with respect to the improperly abandoned (active) service line from Sept. 1, 2004, at the latest, until March 9, 2016. PSE failed to perform a minimum of one test.[4]

Staff alleges one violation of 49 C.F.R. § 192.465(a).

V. PENALTY RECOMMENDATION

A. Commission's Enforcement Policy

In 2013, the commission adopted a policy statement identifying 11 factors the commission may consider when deciding whether to bring an enforcement action and, if an action will be brought, the appropriate penalty amount.[5]

1. **How serious or harmful the violation is to the public.**
   PSE's violations are very serious. The company's improper abandonment of the service line and subsequent failure to maintain and monitor the operationally active line were a contributing cause of the March 2016 Greenwood explosion. The explosion injured nine firefighters, destroyed two buildings, and damaged multiple nearby structures.

2. **Whether the violation is intentional.**
   Staff does not contend that PSE intentionally violated the law.

3. **Whether the company self-reported the violation.**
   PSE did not self-report the violations.

4. **Whether the company was cooperative and responsive.**

[4] At a minimum, PSE should have performed an external corrosion test in 2014.
[5] *Enforcement Policy of the Washington Utilities and Transportation Commission*, Docket A-120061 (Jan. 7, 2013).

PSE has been cooperative and responsive throughout staff's investigation.

5. **Whether the company promptly corrected the violations and remedied the impacts.**
   PSE failed to identify and correct the violations prior to the March 2016 explosion.

6. **The number of violations.**
   Staff alleges five distinct categories of violations.

7. **The number of customers affected.**
   The March 2016 explosion damaged or destroyed numerous buildings served by PSE.

8. **The likelihood of recurrence.**
   Staff recommends that PSE implement a compliance program designed to identify and mitigate any other improperly deactivated service lines that may exist within the company's system.

9. **The company's past performance regarding compliance, violations, and penalties.**
   PSE or has been the subject of ten commission enforcement actions related to pipeline safety since 1992.[6]

10. **The company's existing compliance program.**
    Staff is not aware of any voluntary compliance program other than the pipeline replacement plan approved by the commission in Docket PG-160294.

11. **The size of the company.**
    PSE serves more than 750,000 Washington natural gas customers.

B. Monetary Penalty Recommendation

WAC 480-93-223 provides, "Any gas pipeline company that violates any pipeline safety provision of any commission order . . . is subject to a civil penalty not to exceed $200,000 for each violation for each day that the violation persists. The maximum civil penalty under this subsection for a related series of violations is $2 million."

Pursuant to WAC 480-93-223, after giving consideration to the enforcement factors discussed above, staff recommends that the commission impose the following penalties:

1. **49 C.F.R. § 192.727(b) – Abandonment or deactivation of facilities:** Up to $200,000 for one violation.
2. **WAC 480-93-180 – Plans and procedures.** Up to $200,000 for one violation.
3. **WAC 480-93-188 – Gas leak surveys.** Up to $2,000,000 for 11 violations.

[6] *See* Commission Dockets UG-920487, PG-000576, PG-001116, PG-030080 & PG-030128, PG-041209, PG-041624, PG-040210, PG-050516 & PG-050331, PG-060215, and PG-111723.

4. **49 C.F.R. § 192.481(a) – Atmospheric corrosion control: Monitoring.** Up to $600,000 for three violations.
5. **49 C.F.R. § 192.465(a) – External corrosion control: Monitoring.** Up to $200,000 for one violation.

Staff concludes that each of the above causes of action is a distinct "related series of violations" for purposes of WAC 480-93-223.

Staff recommends that the commission impose a maximum penalty of $3,200,000.

VI. CONCLUSION

Staff recommends that the commission issue a formal complaint against PSE and impose a penalty of up to $3,200,000. Staff further recommends that the commission require PSE to implement a compliance program designed to identify and mitigate any other failed deactivations that may exist within the company's system.

APPENDIX A

Images

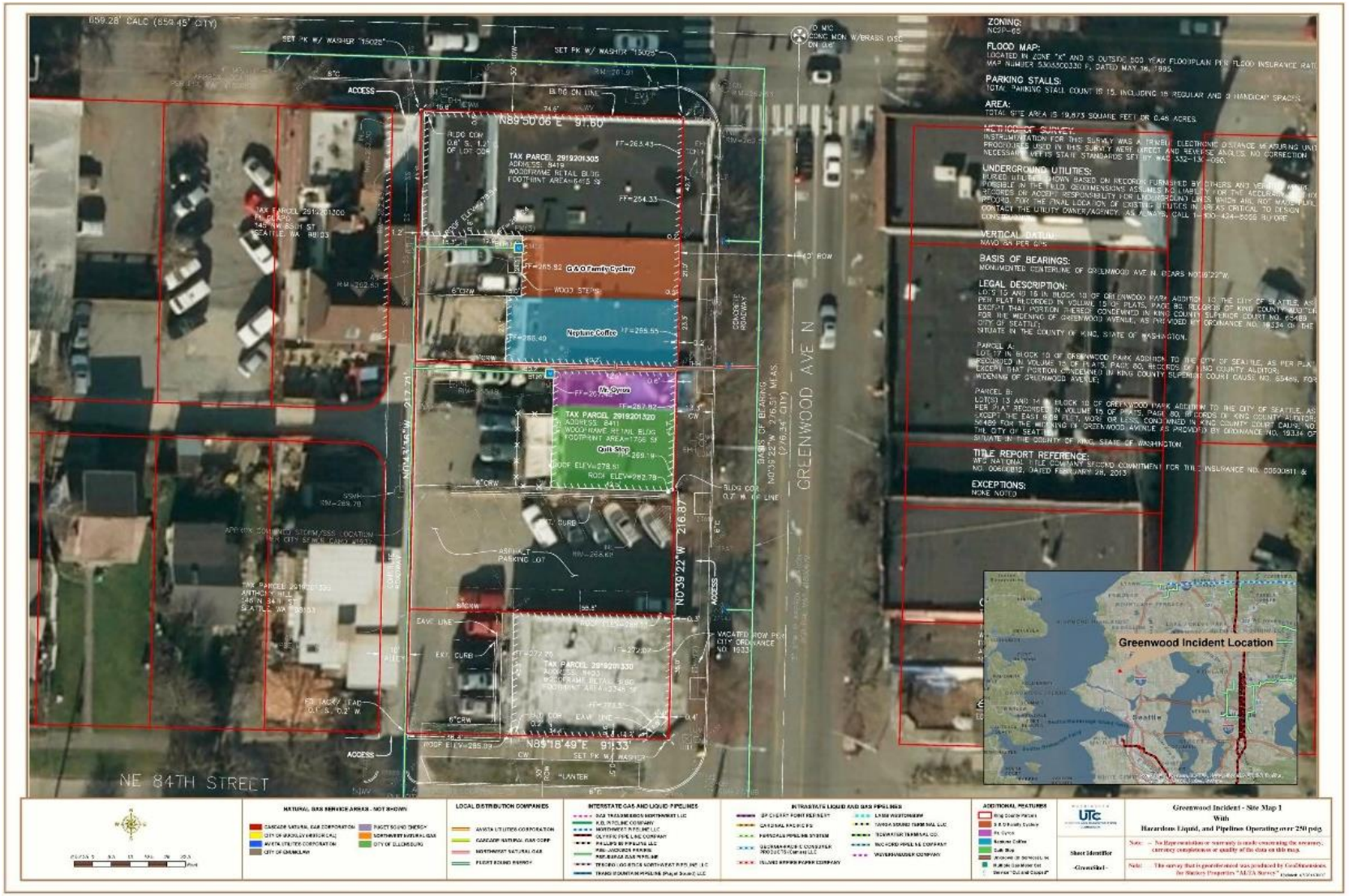


Image 1. Site overview.

Appendix A -- Images

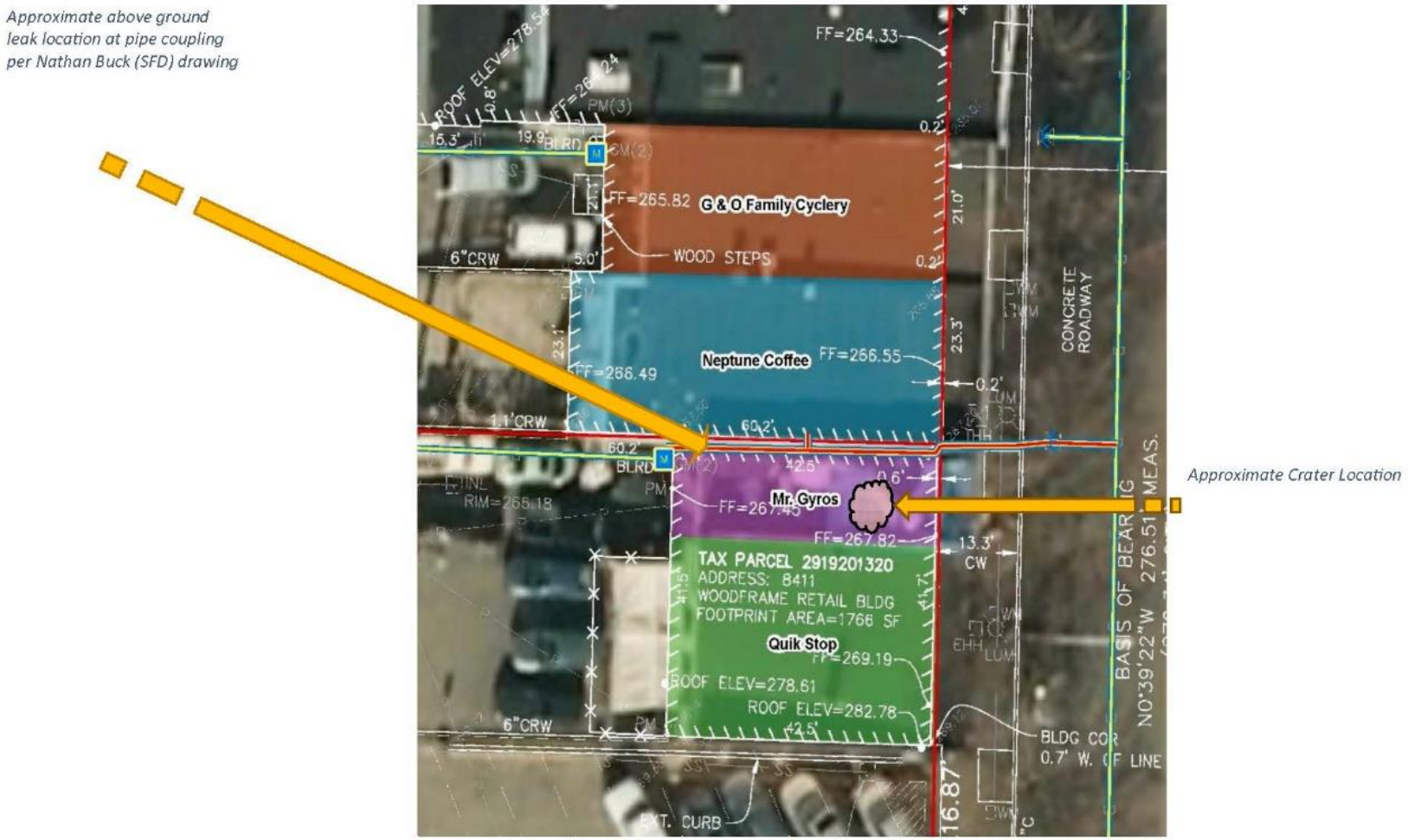


Image 2. Approximate leak and crater locations.

Image 3. Debris spread facing west from Greenwood Avenue North.

Appendix A -- Images

Image 4. Debris spread facing northwest from Greenwood Avenue North.

Image 5. Debris spread facing north from Greenwood Avenue North.

Image 6. Debris spread facing north from Greenwood Avenue North.

Image 7. Debris spread facing northeast from Greenwood Avenue North.

Image 8. Panoramic image facing west from Greenwood Avenue North.

Image 9. Location of narrow space between Mr. Gyros and Neptune Coffee buildings where leak occurred.

Image 10. PSE plat map.

Appendix A -- Images

Image 11. Curb valve recovered post-incident.

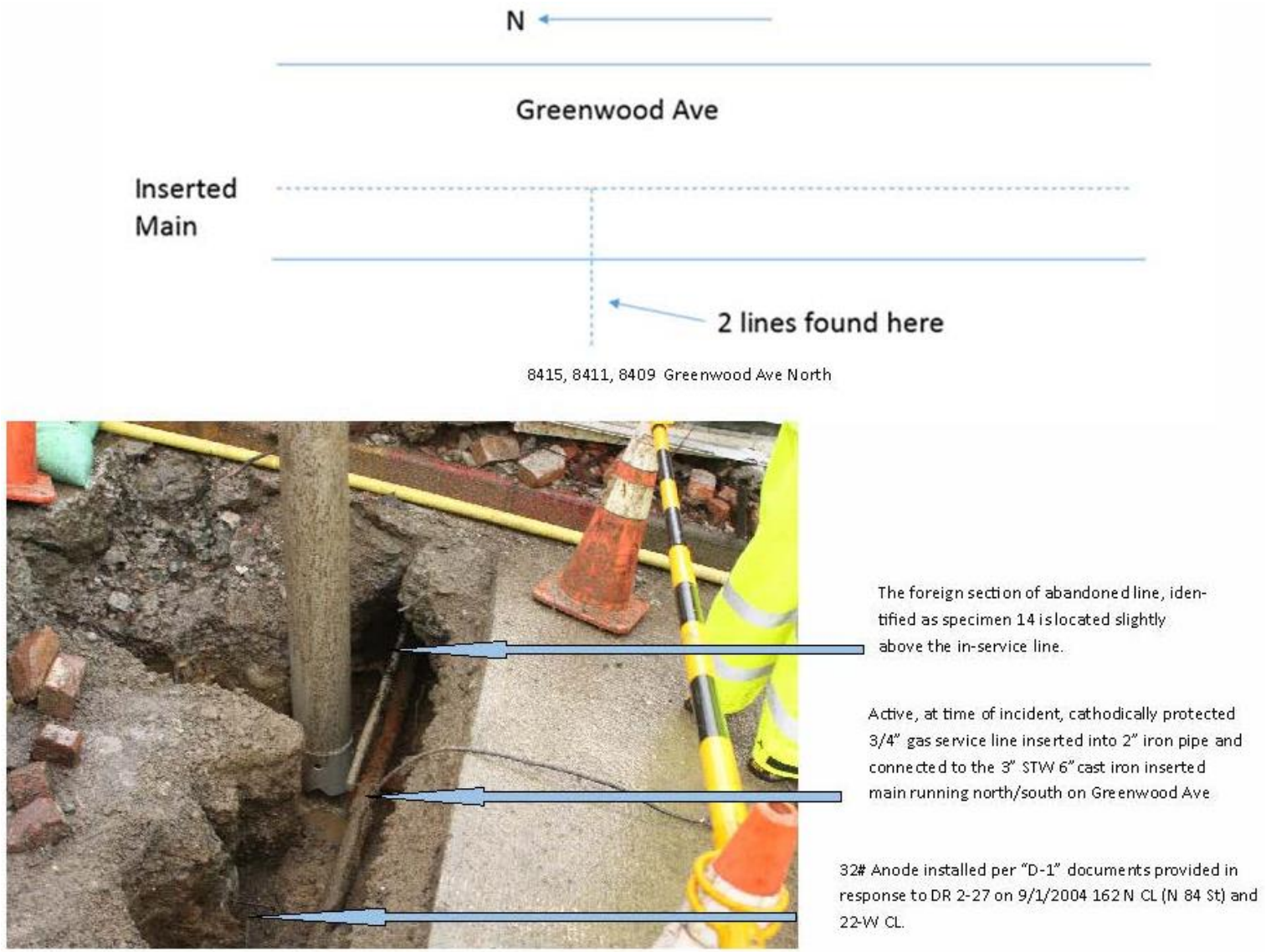


Image 12. Illustration and image depicting excavation of service line and foreign line post-incident.

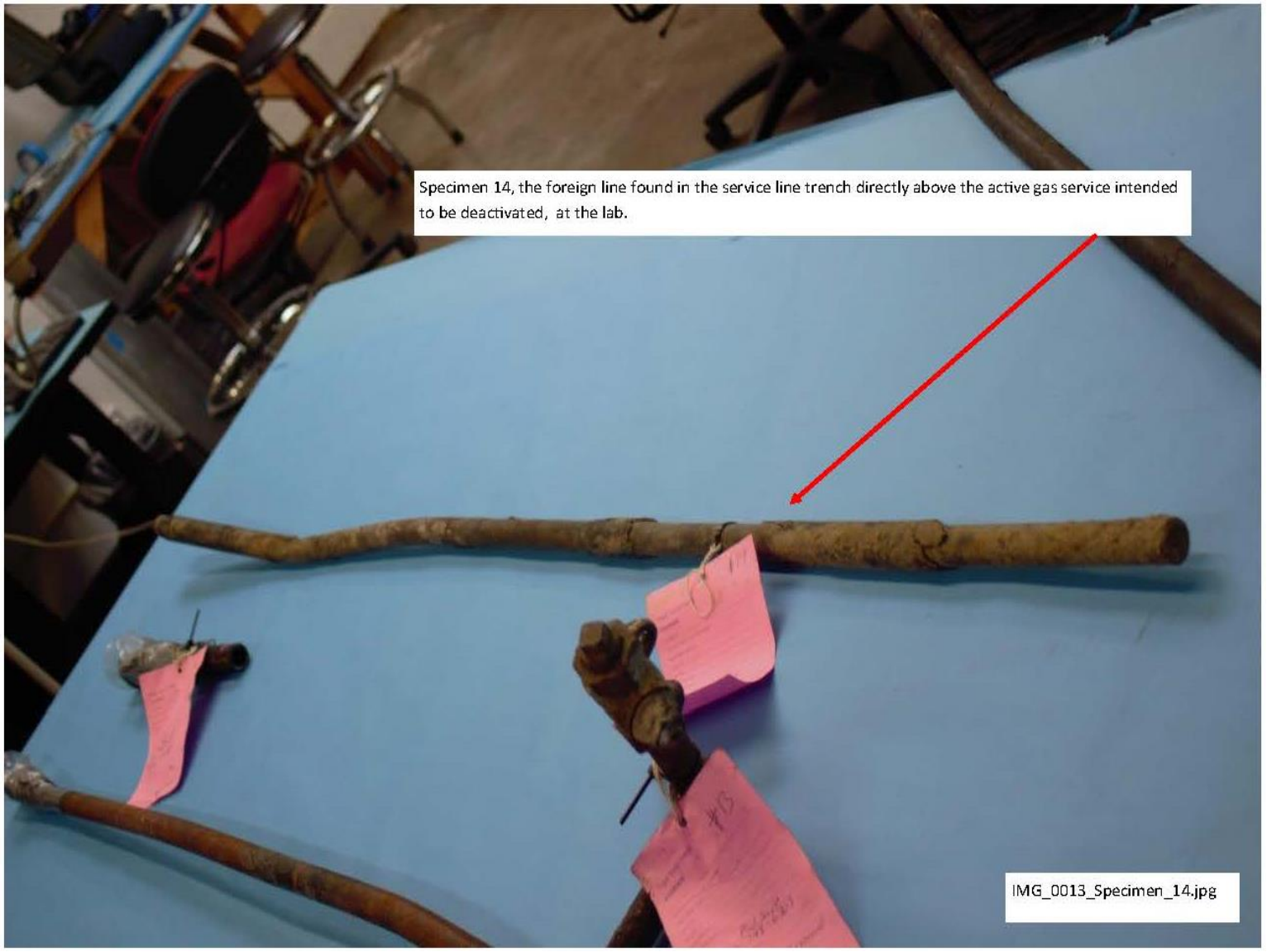


Image 13. Lab photo.

Appendix A -- Images

Image 14. Lab photo.

Appendix A -- Images

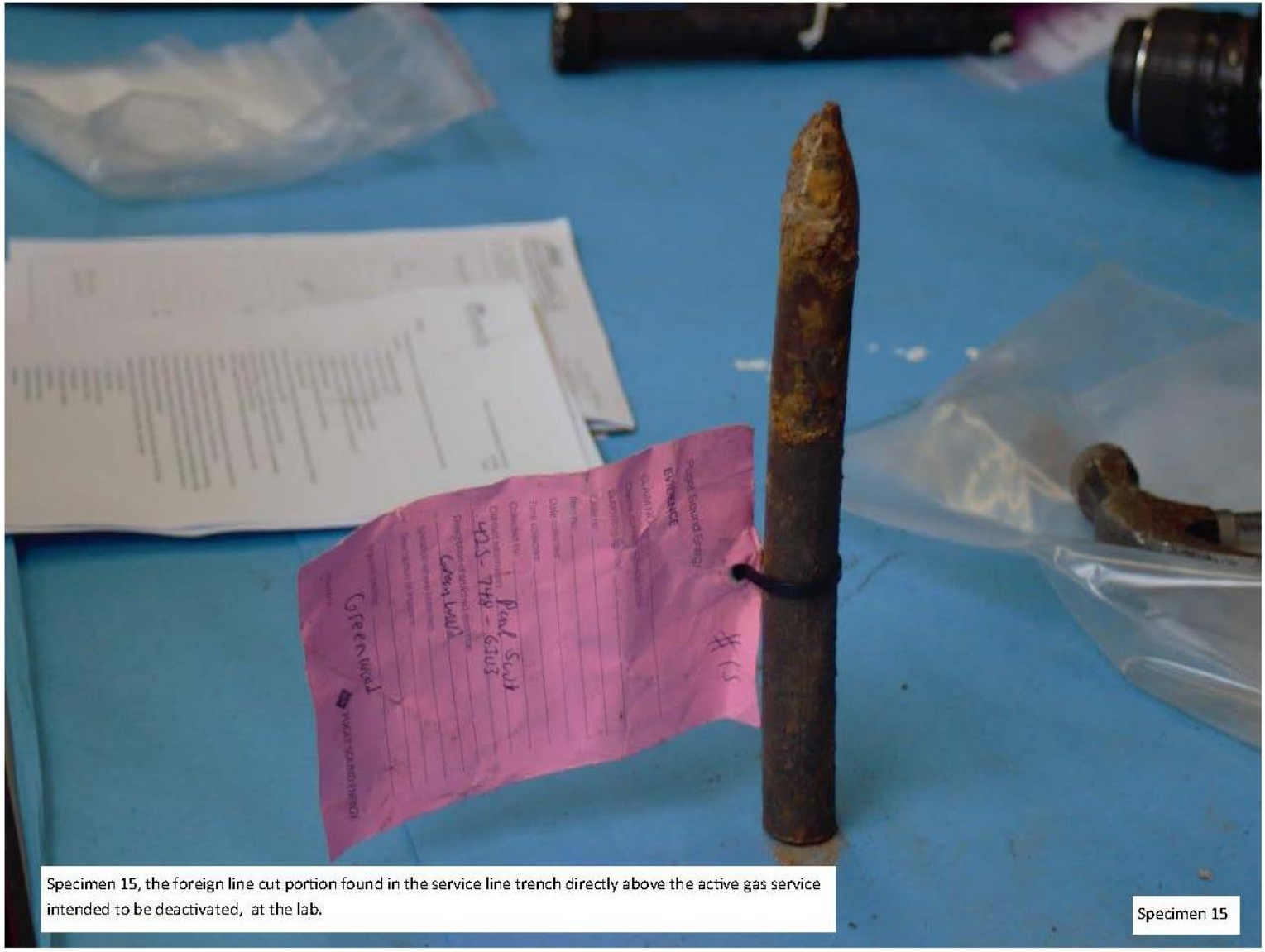


Image 15. Lab photo.

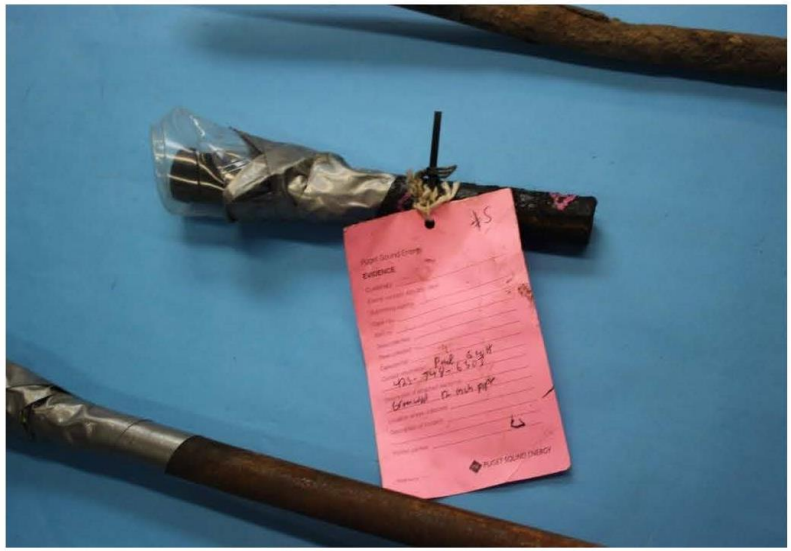
Appendix A -- Images

Image 16. Lab photo.

Appendix A -- Images

Specimen 13 fracture end at the laboratory in forefront

Specimen 13 opposite end at the laboratory



Specimen 5 fracture end at the laboratory

This image shows specimen 13 and 5 with orientation lines added

Image 17. Lab photo.

Appendix A -- Images

Image 18. Lab photo.

Appendix A -- Images

Image 19. Lab photo.

Appendix A -- Images

Image 20. Lab photo.

Appendix A -- Images

Image 21. Lab photo.

Appendix A -- Images

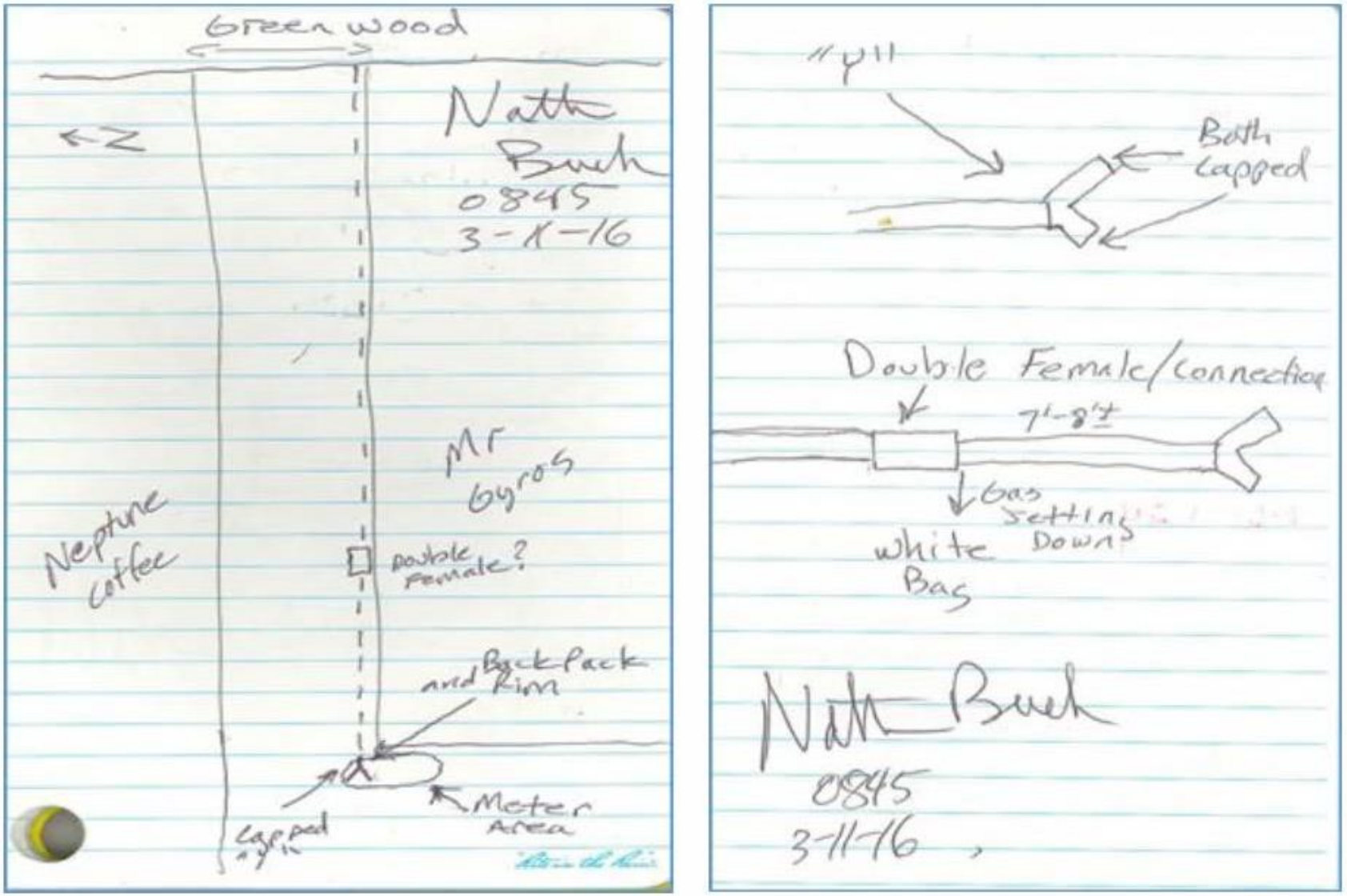


Image 22. Hand drawing by Seattle Fire Department firefighter Nathan Buck depicting scene upon initial SFD response.

Image 23. Photo depicting location of service line involved in explosion.

Image 24. Circled region of photo shows riser that fed 8409 and 8411 Greenwood Avenue North, with the dual “twin” service branching off to what is now 8415 Greenwood Avenue North.

APPENDIX B

PSE Gas Operating Standard 2525.3600
(Effective March 1, 2004)

Deactivation of Pipelines

GAS OPERATING STANDARDS
2525.3600

1. Scope

This Operating Standard establishes the requirements for deactivating pipelines.

Pipe that is to be deactivated and used as casing pipe is covered separately in Operating Standard 2525.2100, "Inserting New PE Mains and Services in Existing Facilities."

2. Responsibilities

2.1 The *Manager Contract Management* and the *Manager First Response* shall be responsible for ensuring the requirements of this Operating Standard are met.

2.2 The *Manager Municipal Land Planning* shall be responsible for providing specific municipal requirements regarding deactivation of pipelines.

3. General Requirements

(CFR 192.727)

3.1 Each facility abandoned in place or each line not subject to gas pressure, shall be disconnected from all sources and supplies of gas, purged of gas in accordance with Operating Standard 2525.3400, "Purging," and sealed at the ends with expansive foam. Refer to Operating Standard 2525.2100, "Inserting New PE Mains and Services in Existing Facilities," for specific cut and cap requirements.

3.1.1 Pipe temporarily out of service (such as for maintenance or uprating), is excluded from this provision.

3.1.2 When service to a customer is discontinued, refer to Operating Standard 2575.2200, "Locking and Unlocking Meters," for additional requirements.

3.1.3 When the volume of gas in the pipe is so small that there is no potential hazard, the pipe need not be purged.

3.1.3.1 Qualification under this exemption shall be in accordance with the following table:

Nominal Diameter	Maximum Length
2″ or less	400′
4″	100′
6″	50′
8″	25′

Pipe larger than 8″ nominal diameter must be purged.

3.2 The Municipal Land Planning Department shall be contacted to verify municipal requirements.

Deactivation of Pipelines

GAS OPERATING STANDARDS
2525.3600

3.3 Vaults

3.3.1 All components shall be removed from abandoned or inactivated vaults.

3.3.2 The interior of such vaults will be filled with a suitable compacted material.

PSE PUGET SOUND ENERGY