

Gas / Electric Arcing Interactions



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Gas System Integrity

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Puget Sound Energy (PSE)

PSE is Washington state's oldest local energy company, serving 1.1 million electric customers and 770,000 natural gas customers in 10 counties.



-  Combined electric and natural gas service
-  Electric service
-  Natural gas service



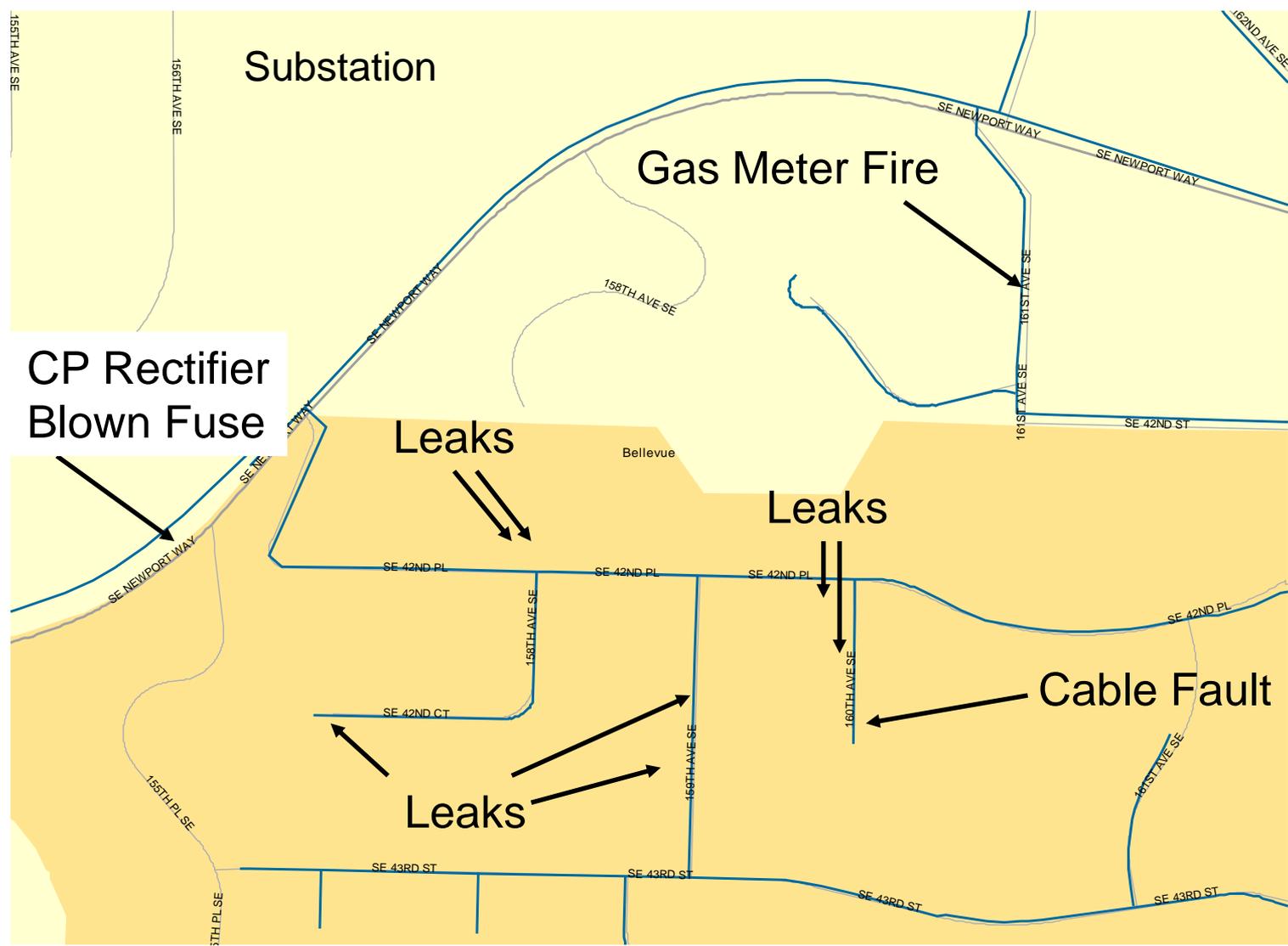
Ground Faults

- What Started PSE Down the Path?
- The Event that Caught PSE's Attention
- How does Arcing Happen?
- How is Arcing Recognized?
- How does PSE Respond?





Bellevue 2002





Bare Concentric Neutral Cables



Fault Location



Leak on Service





...and then in 2011





How does a Ground Fault Happen

- Overhead Conductors
 - Conductor falls to ground
 - Grounded object contacts conductor
- Underground Conductors
 - Insulation breaks down
 - Neutral Corrosion





Intended Return Paths

- Ground Fault Current will usually travel through the earth and use the electrical system grounds to complete the circuit (return to source).
- Grounds – ground plates, ground rods, or ground grids are placed on distribution overhead and underground circuits and equipment
- Neutrals – connect grounds with substation



Why is a Ground Fault a Problem





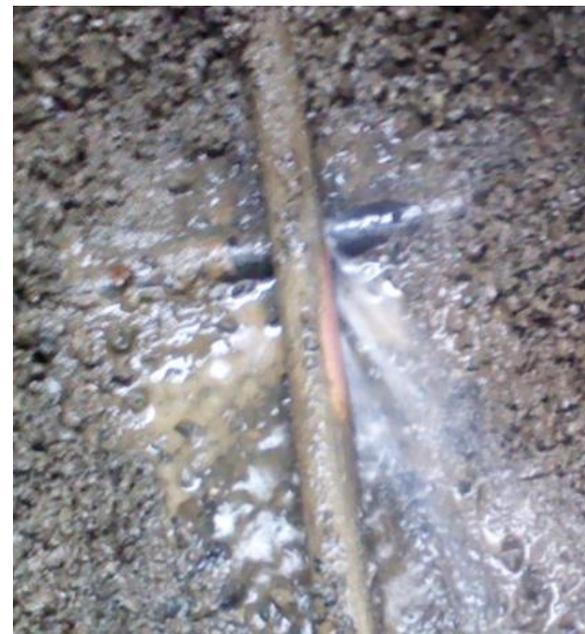
What is the Risk of a Gas System Failure?

- Electrical events resulting in ground fault current are frequent
- The probability of a ground fault affecting the gas system is low, however the consequence is high
- The following may put the gas system at risk during a ground fault event:
 - The intended return path may not be continuous;
 - The return path may be in close proximity to or in contact with another conductive parallel path as it returns to its source



Close Proximity

- Other conductive objects may provide a path to complete the circuit:
 - Water
 - Gas
 - Underground tanks
 - Sewer
 - Cable TV
 - Telephone





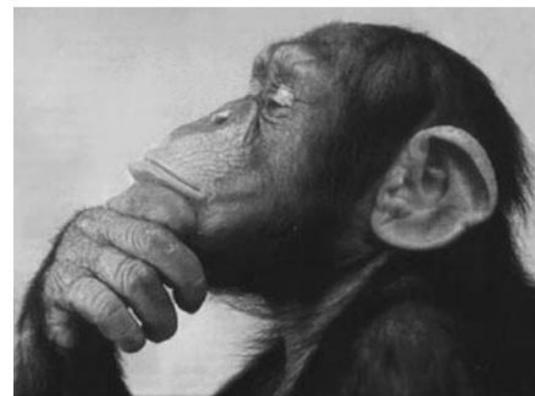
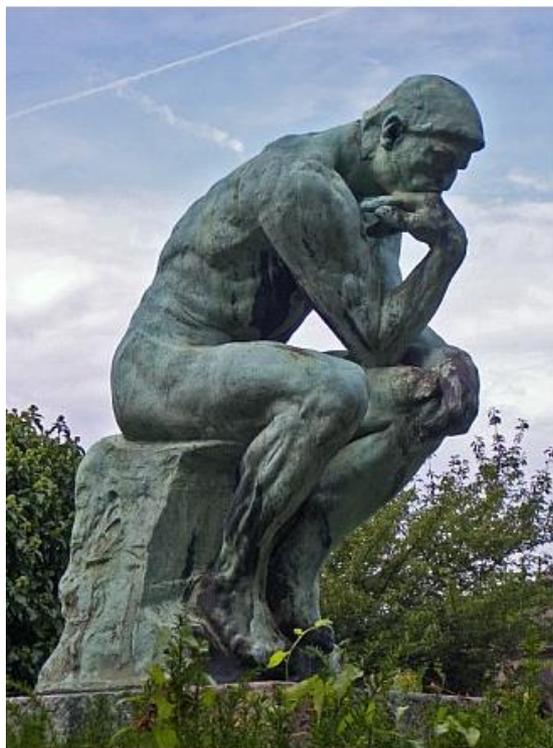
When gas piping becomes part of the return path

- Coating gets damaged
- Equipment gets damaged (RTU's, rectifiers, bond wires)
- Extreme heating can weaken or rupture pipeline
- Gas may ignite
- Personnel may get injured





How do we Know Electricity is Involved?





Indicators of a Ground Fault

- Overhead electric wire down and energized
- Wire down on a metallic item inserted into the earth (chain link fence, sign post)
- Electric system outage (lights out in the neighborhood)
- Evidence of charring or burning at a building near the gas meter





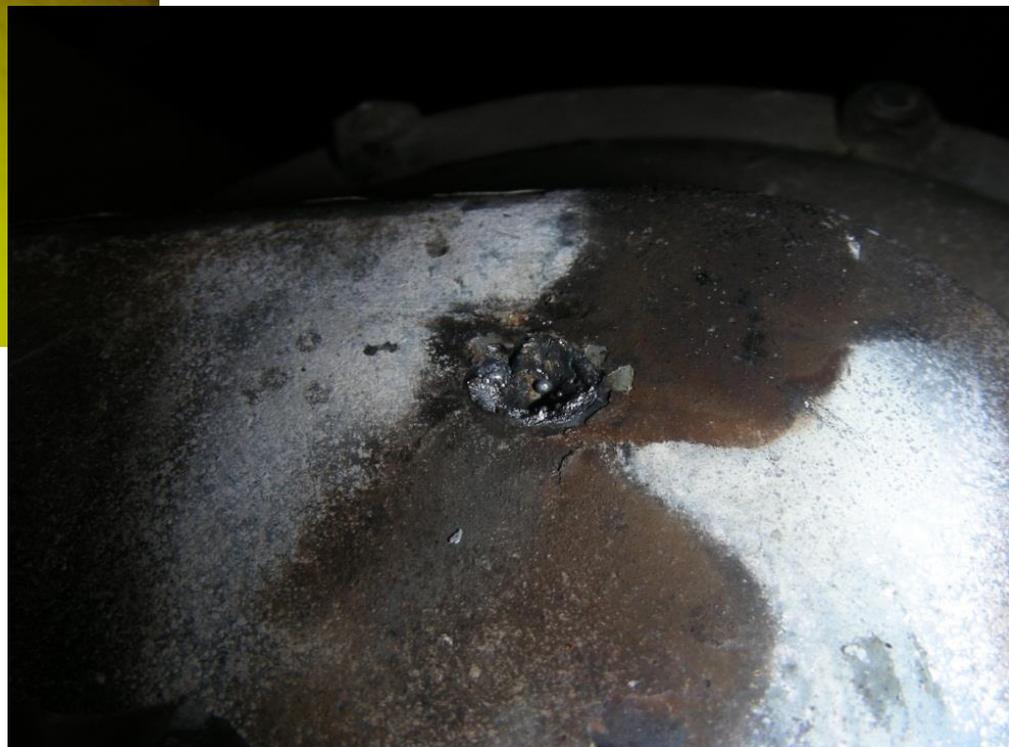
How is a Ground Fault Recognized?

- Damage to facility or pipe
 - A shiny cone shaped hole melted in a metal pipe similar in shape to a pit
- A leak at a contact with an electrical conductor
- Splatter from metal heating and cooling quickly
- Melted PE





What alerts us to this type of situation?





What alerts us to this type of situation?

- Fire at a meter set; and
- meter set and fuel line in close contact.





Close up of Metal Loss at the Regulator





What Alerts Us to this Type of Damage

- Energy transfer at a water line and gas service contact:
 - Coating damaged;
 - Copper plating on gas pipe.





What Alerts Us to this Type of Damage

- Insulated Coupling
- PE pipe





Initial Response

- If there is one leak – there may be others:
 - Metal loss occurs both when current leaves or enters the pipe;
- Confirm leak is Caused by Electricity
- Mobilize Leak Investigation Team
- Request Corrosion Control Assistance
- Establish Leak Investigation Boundary



Mobilize Leak Investigation Team

- Mobile and walking leak investigators;
- Notify Fire Department if assistance needed:
 - Evacuations;
 - Accompanying leak investigators;
- Initiate leak investigation:
 - Start in the neighborhood; and
 - Electrically continuous metal pipe;
- Expand leak investigation boundary:
 - As additional leaks are found;
 - To include circuit back to substation.





Leak Investigation Boundary

- Look for;
 - Down power lines;
 - Burned electric meters;
 - Electric utility vehicles and workers;
 - Water company vehicles and workers;
 - Electric outages in the area;
- Center the leak investigation at the largest hole and increase area as more holes are found;
- Conduct follow-up leak investigations
 - Leaks could be from initial fault or subsequent attempts to restore power.



Check Cathodic Protection System

- Damaged rectifiers;
- Shorted insulating fittings;
- Burned bond wires;
- Perform post event surveys.



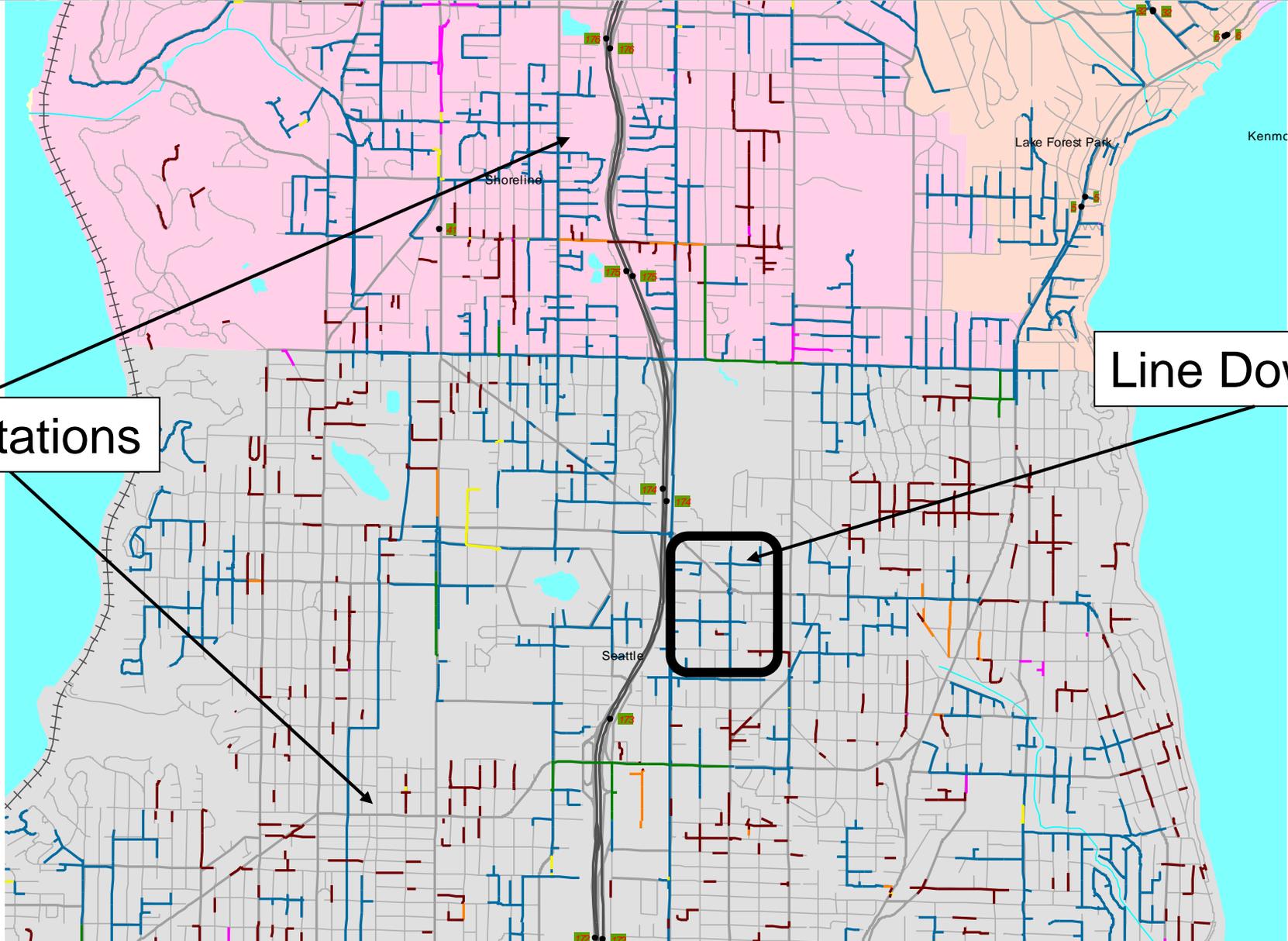


Be Prepared

- Underground cable failures occur more often in summer;
- Down overhead electric lines occur more often in winter;
- Know your local power company, establish contacts;
- Public awareness:
 - Mobilize communication team to inform residents and respond to news media;
 - What did people see - overhead line on the ground arcing?
- Develop job aids for first responders.



Seattle, Wa 2011



Substations

Line Down



Overhead Splice Failed

Chain link Fence

Abandoned water main

Branch Fell

Bonded Test Lead Wires & Valve Box Extension

Bonded Test Lead Wires

Water svc

NE 127th St

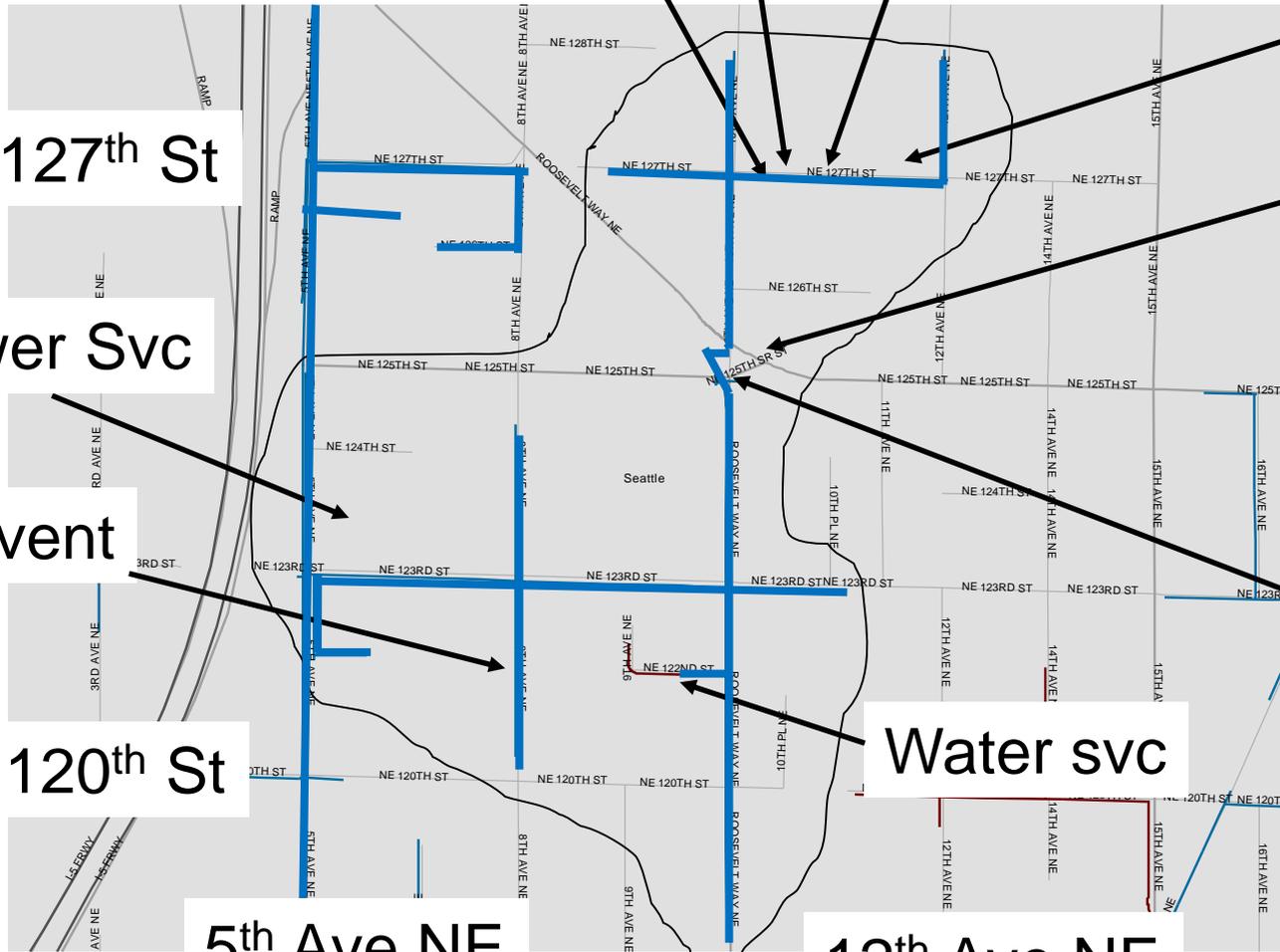
Sewer Svc

Oil vent

NE 120th St

5th Ave NE

12th Ave NE





Ground Fault Path

1016 NE 127th St (abandoned water svc)

1" by 0.6"



913 NE 122nd St (Water svc)

2,200 ft

0.48" by 0.4"





Ground Fault Path

12040 8th Ave NE (Oil tank vent)
2,700 ft, 0.3" by 0.2"



12312 5th Ave NE
(Sewer svc)
3,500 ft
Interior 0.125"
Exterior 0.25"



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