All's Well that Ends Well

Implementing an Emergency Water Well Program

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EUGENE WATER & ELECTRIC BOARD

EWEB

GSI Water Solutions, Inc.

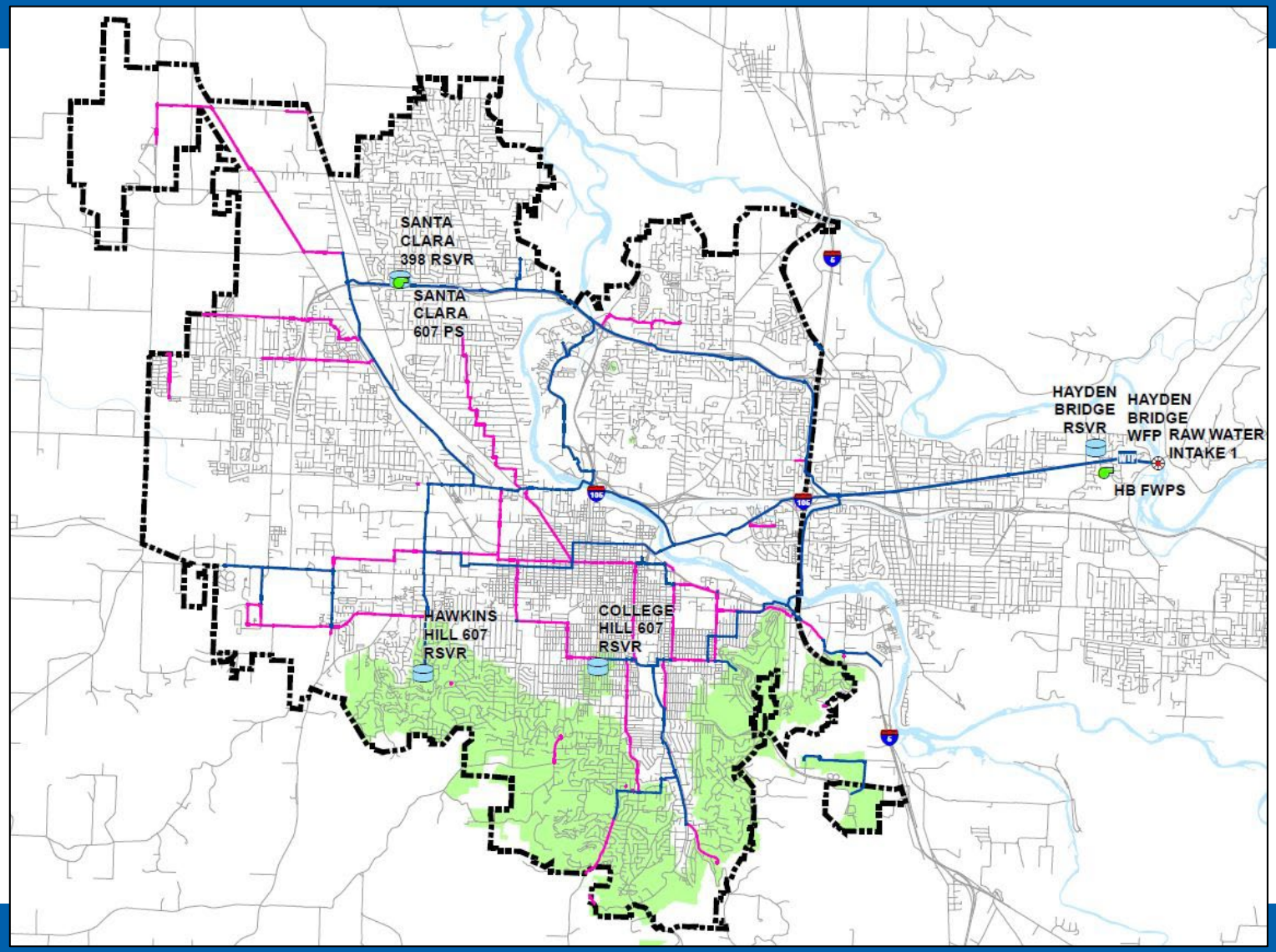
02/23/2023

Presentation Outline

- **Summarize - EWEB's Water System**
- **Background - Emergency Water Program**
- **Discuss – Mobile Distribution and Treatment Systems**
- **Discuss – Emergency Water Supply Wells**
  - **Design and Implementation**
- **Next Steps**
- **Questions**

EWEB's Water System

- **Founded in 1911**
- **Serves a population of ~185,000.**
- **19 storage reservoirs**
- **34 pump stations**
- **Over 800 miles of distribution pipelines**



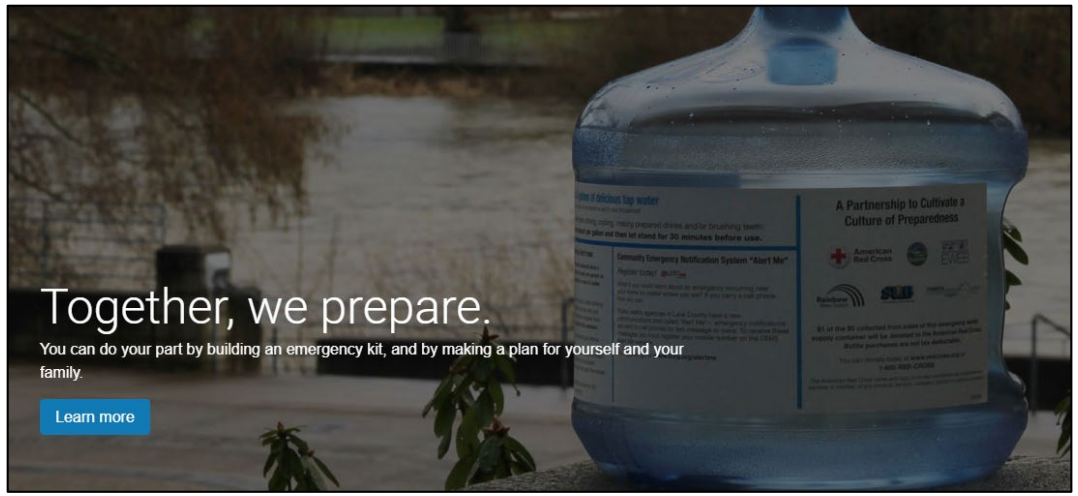
Background – Emergency Water

EWEB realized a reliable supply of clean water is vital and the lack of a second source is a significant risk to public health, the community, and our economy.

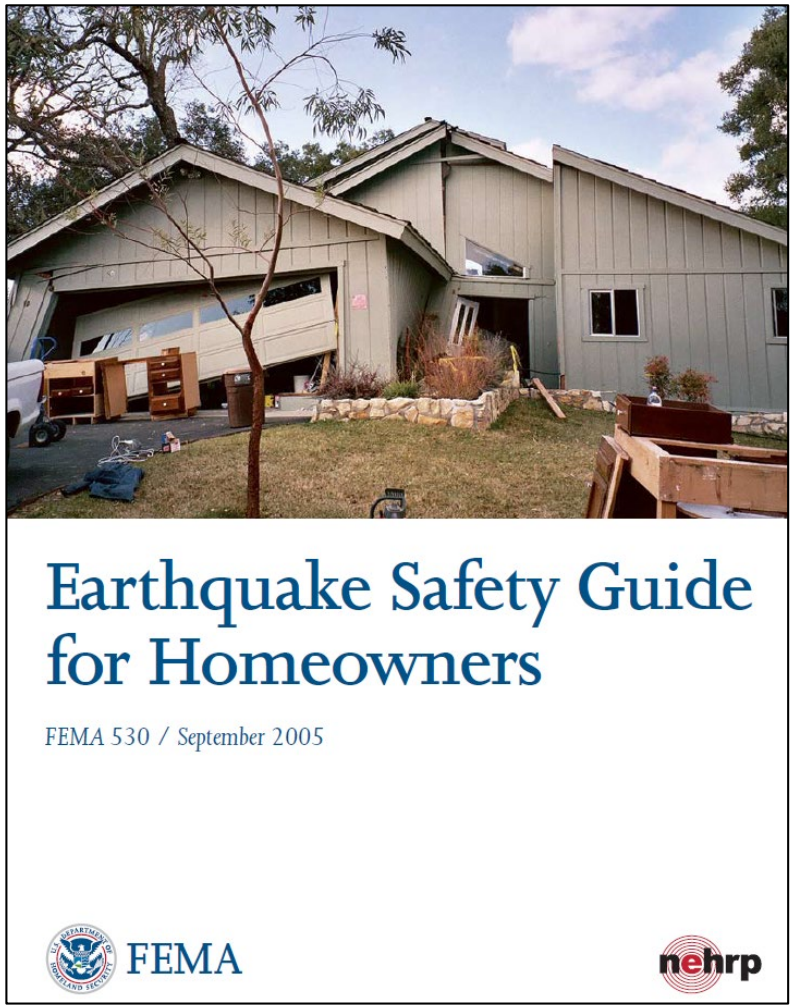
Background – Emergency Water

EWEB launched the EWS program in 2012.

- **Primary Goal - Distribute 2 gallons per person per day**



Cascadia subduction zone earthquake awareness helped the cause.



Background – Emergency Water

- **Multiple sources of supply:**

Surface Waters

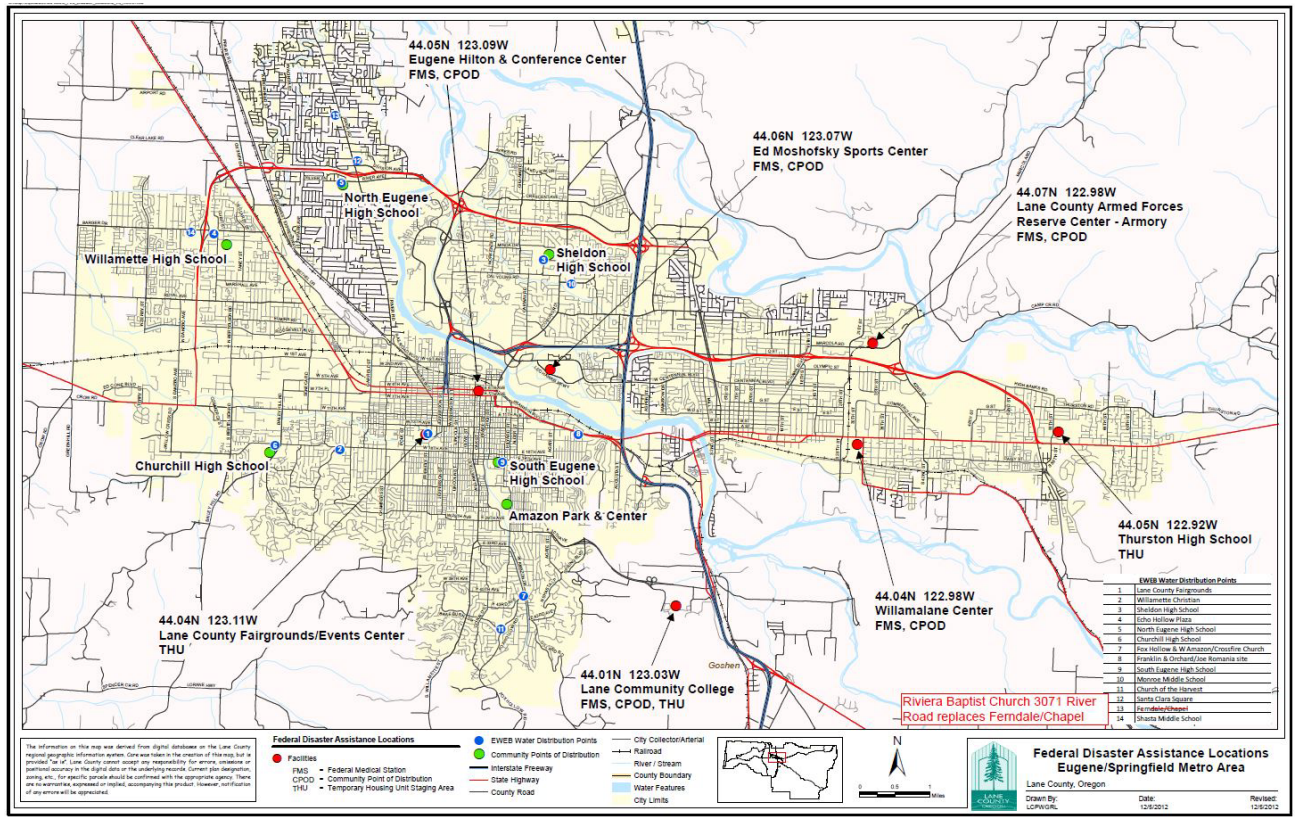
Neighboring Utility Interties

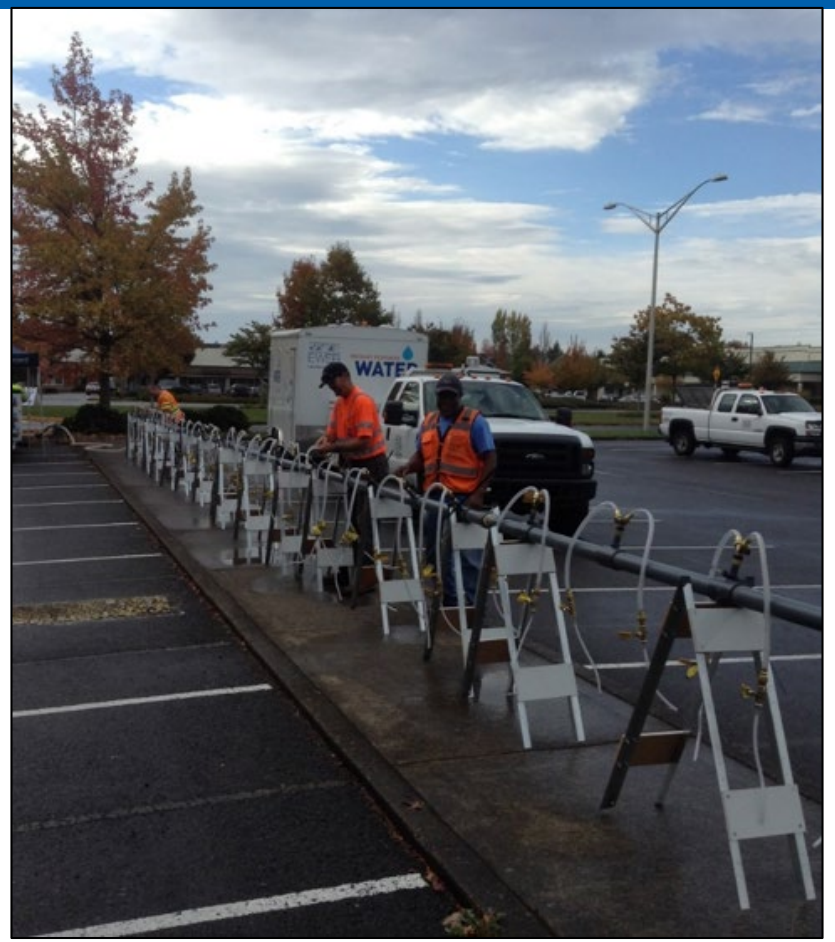
Hardened Reservoirs

Groundwater Wells

Background – Emergency Water

- **Multiple distribution locations (fourteen):**





Distribution station example

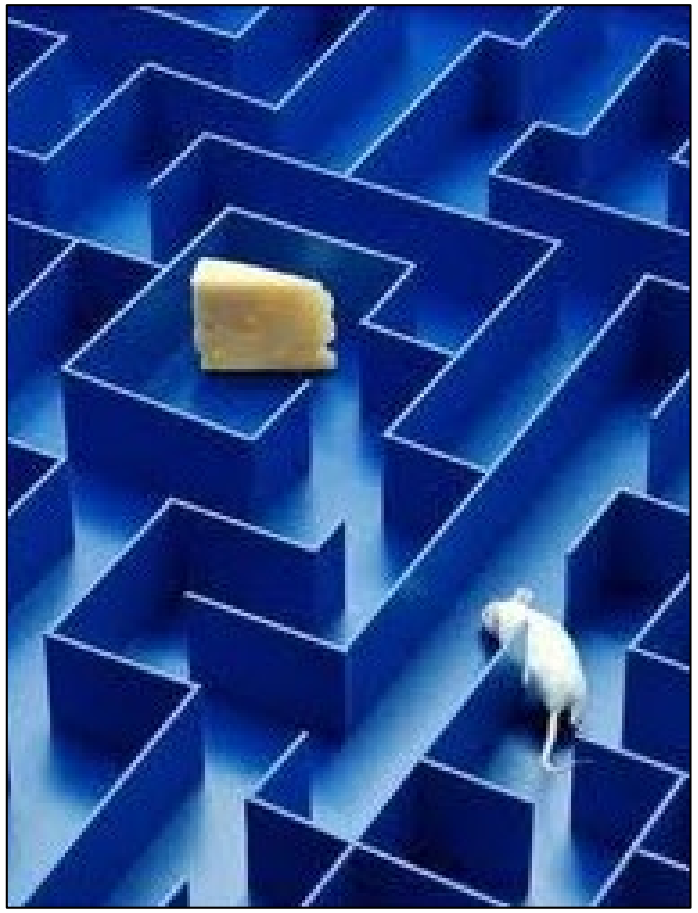
Background – Emergency Water

Initially, the Logistics were daunting:

How to…

- **Provide over 300,000 gallons per day;**
- **Mobilize sites while fixing existing water system;**
- **provide resources and staffing?**

- **EWEB proceeded forward…**



Mobile Distribution

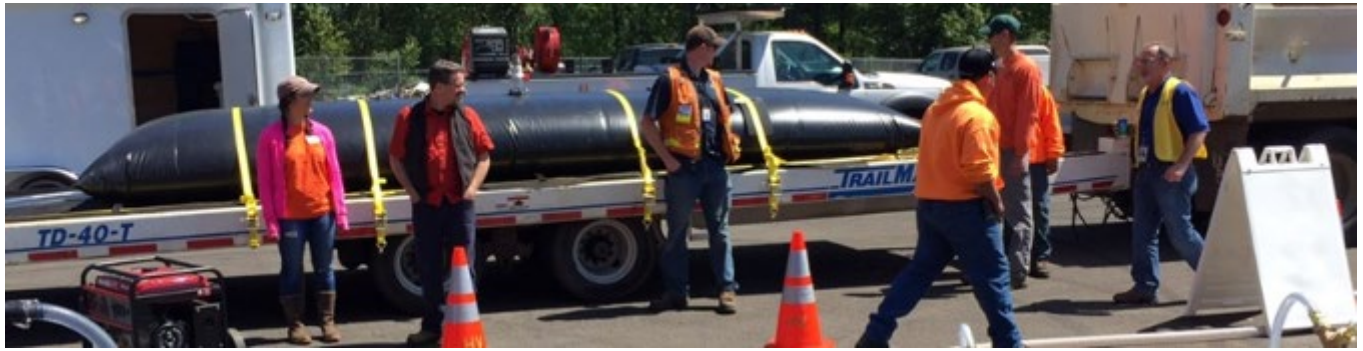
Distribution Trailers:

- **Towable**
- **Supply from pressurized or non-pressurized source**
- **Self contained -**
  - ❑ Piping
  - ❑ Spigots
  - ❑ Pumps
  - ❑ Generator
  - ❑ Restroom

Mobile Distribution

Distribution Trailer FAQ:

- **Distribute water from blivet, hardened reservoir, or well, etc.**
- **Three distribution trailers constructed (~$40k/ Ea.)**
- **Grundfos MQ 3-45, shallow well pumps, (79-gpm)**



Blivet

Mobile Treatment

Treatment Trailer:

- **Towable**
- **Treat most surface waters**
- **100-gpm capacity (5-NTU)**
- **60-gpm capacity (10-NTU)**
- **Requires chlorine residual**
- **Self contained -**
  - ❑ Generator
  - ❑ Treatment system and equipment
  - ❑ Raw water pump
  - ❑ Intake screen

Mobile Treatment

Treatment Trailer:

- **Water Quality Parameters -**
  - **2 log (99%) Cryptosporidium inactivation.**
  - **3 log (99.9%) Giardia inactivation.**
  - **4 log (99.99%) virus inactivation.**
- **Following OHA WQ guidelines**
- **Using EPA planning guidelines.**

Oregon Health Authority

Alternative Treatment Technology Units Meeting Challenge Study Criteria
CARTRIDGE & BAG FILTERS: Oregon Administrative Rule 333-061-0050(4)(c)(J)
Oregon Health Authority, Drinking Water Services (DWS)

Log_{10} Removal Credit		
Crypto.	*Giardia*	Virus

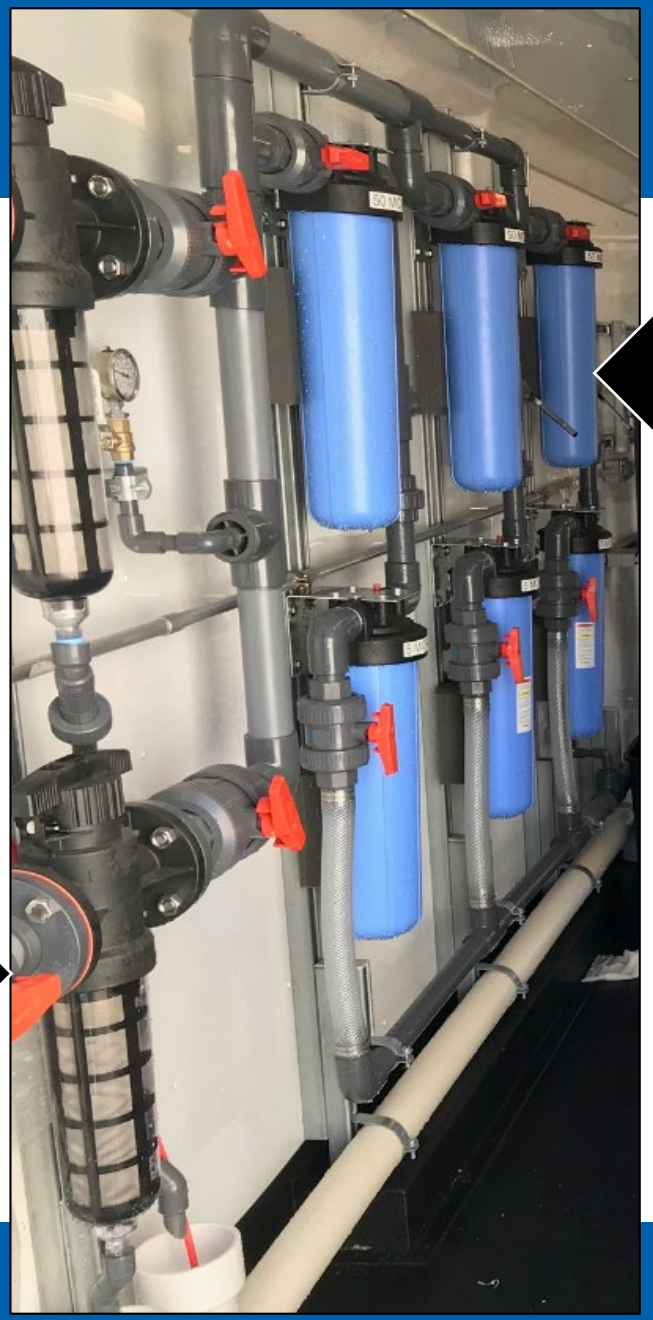
EPA United States Environmental Protection Agency

Planning for an Emergency Drinking Water Supply

Mobile Treatment

Treatment Trailer Technology:

- **Pre-filtration Treatment -**
  - **Two (2) twist to clean strainers, interchanging to allow for 250-, 150-, 104- and 75-Micron mesh.**
  - **150-50 Micron dual gradient cartridge filter.**
  - **50-5 Micron dual gradient cartridge filter.**



Replacement Required

Mobile Treatment

Treatment Trailer Technology:

- **LT2 Filtration *Harmsco Hurricane (HC/170-LT2)***
  - **3.6 log Cryptosporidium inactivation.**
  - **3.6 log Giardia inactivation.**
- *Can bypass if UV system has a transmittance (UVT) above 95%.*

Mobile Treatment

Treatment Trailer Technology:

- **UV Disinfection (Viqua Sterilight) -**
  - **4 log Cryptosporidium inactivation.**
  - **4 log Giardia inactivation.**
  - 4 log virus inactivation (exception of Adenovirus).
- Provides 40 mJ/cm^2 @ 95% transmittance.
- Can bypass if HC/170-LT2 are in service.

Replaceable lamps

Mobile Treatment

Treatment Trailer Technology:

- **Chlorine Disinfection -**
  - **4 log virus inactivation.**
- 10-minutes contact time @ 1mg/L.
- 5-minutes contact time @ 2mg/L.
- Protects water after it leaves treatment trailer.

Measure Flow

Distribute to water delivery system

Mobile Treatment

Treatment Trailer FAQ:

- One treatment trailers constructed
  - Trailer – $14k
  - Plumbing – $50k
  - Materials – $20k
  - Not including Design & Overhead
- Do other options exist?
  - FirstWater
  - RWL
  - WesTech
- Primary Variables (cost vs. flow rate)

Emergency Water Supply Wells

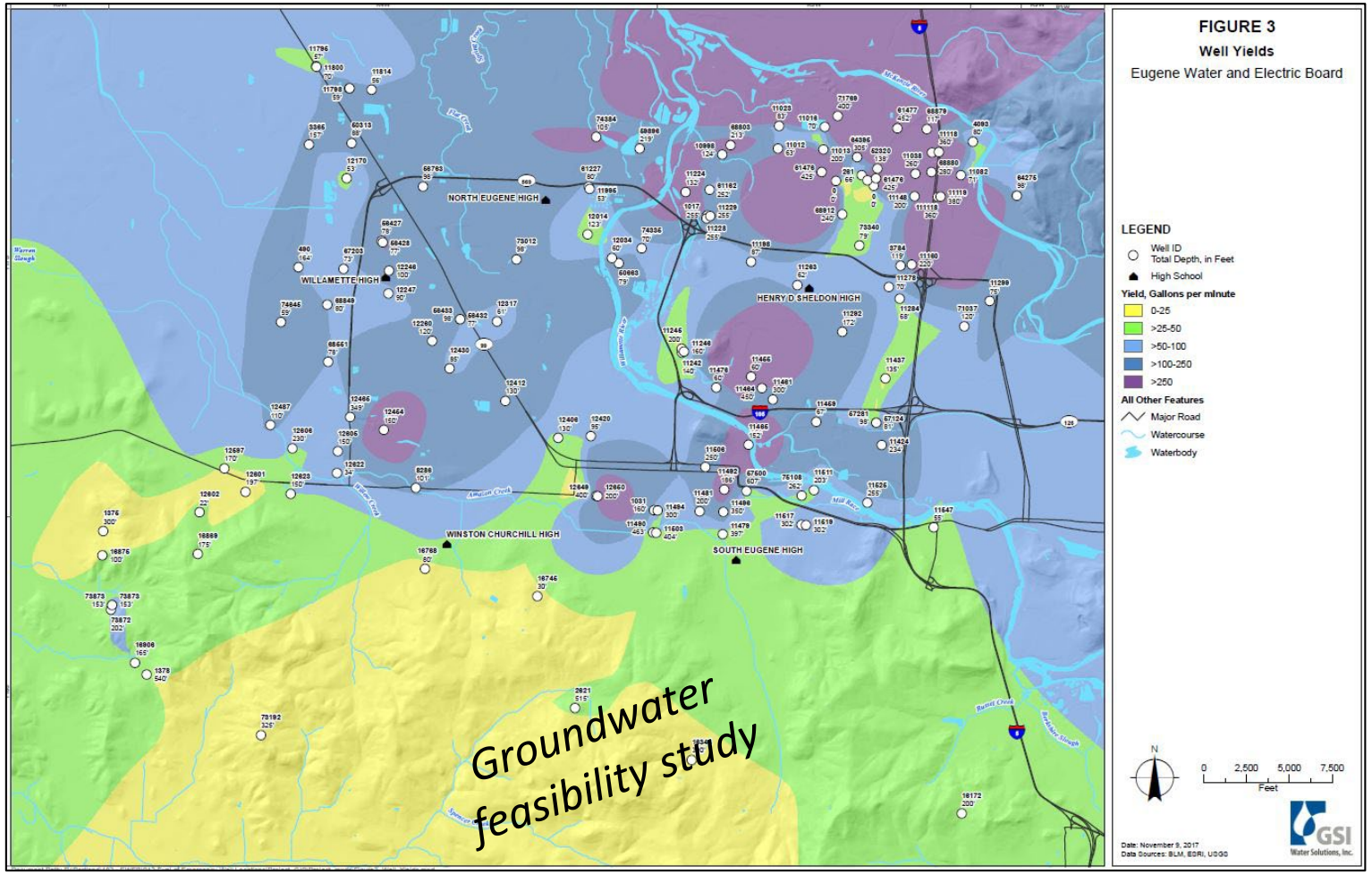
Change in Direction:

- **In 2017, EWEB decided to expand.**
- **Establishing permanent sites utilizing groundwater.**
- **The change was based on staffing concerns while repairing the existing water system.**

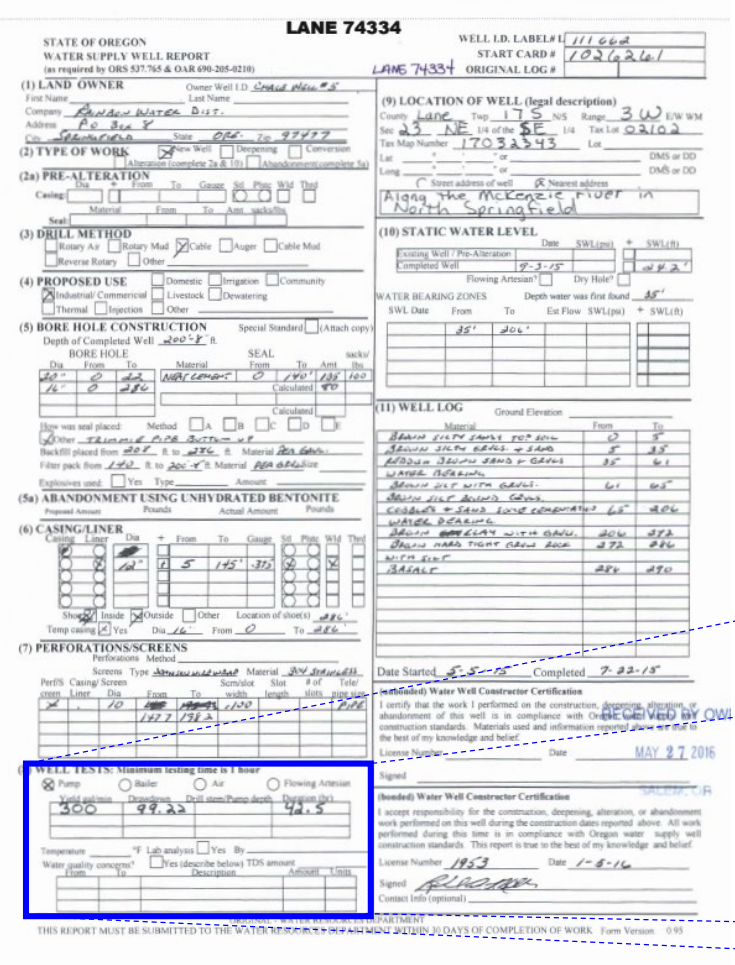
Emergency Water Supply Wells

Groundwater yield feasibility study and drilling:

- **Phase I – Desktop Study**
- **Phase II – Design/Implementation**
- **Phase III – Specs/Contracting**
- **Phase IV—Drilling and Testing**



Desktop Study to Estimate Well Yield



LANE 74334

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765 & OAR 690-205-0210)

WELL I.D. LABEL# L 111662
START CARD # 102626.1
ORIGINAL LOG # LANE 74334

(1) LAND OWNER — Company: RAINBOW WATER DIST. — Address: PO BOX X — City: SPRINGFIELD — State: ORE. — Zip: 97477

(2) TYPE OF WORK — New Well

(2a) PRE-ALTERATION

(3) DRILL METHOD — Cable

(4) PROPOSED USE — Industrial/ Commercial

(5) BORE HOLE CONSTRUCTION — Depth of Completed Well 200'-8" ft.

BORE HOLE: 30" 0 42; 16" 0 286
SEAL: NEAT CEMENT 0 140' 135 sacks/ 100 lbs

(5a) ABANDONMENT USING UNHYDRATED BENTONITE

(6) CASING/LINER: 16" Dia, 5 From, 145' To, .375 Gauge, Steel, Welded — Shoe: Inside, Outside — Location of shoe(s) 286' — Temp casing: Yes — Dia 16" From 0 To 286'

(7) PERFORATIONS/SCREENS — Perforations Method — Screens Type STAINLESS WIRE WRAP — Material 304 STAINLESS

Perf/S cover	Casing/ Screen Liner	Dia	From	To	Scrn/slot width	Slot length	# of slots	Tele/ pipe size
	X	10	1477	1582	.150			PIPE

(8) WELL TESTS: Minimum testing time is 1 hour — Pump — Bailer — Air — Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)
300	99.22		42.5

Temperature ____ °F Lab analysis Yes By ____

Water quality concerns? Yes (describe below) TDS amount ____

From	To	Description	Amount	Units

(9) LOCATION OF WELL (legal description) — County Lane — Twp 17S N/S — Range 3W E/W WM — Sec 23 NE 1/4 of the SE 1/4 — Tax Lot 02102 — Tax Map Number 17032343 — Lot — Lat ° ' " or DMS or DD — Long ° ' " or DMS or DD — Street address of well — Nearest address: Along the McKenzie River in North Springfield

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Pre-Alteration				
Completed Well	9-3-15			40 ft.

Flowing Artesian? Dry Hole?

WATER BEARING ZONES — Depth water was first found 35'

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
	35'	206'				

(11) WELL LOG — Ground Elevation

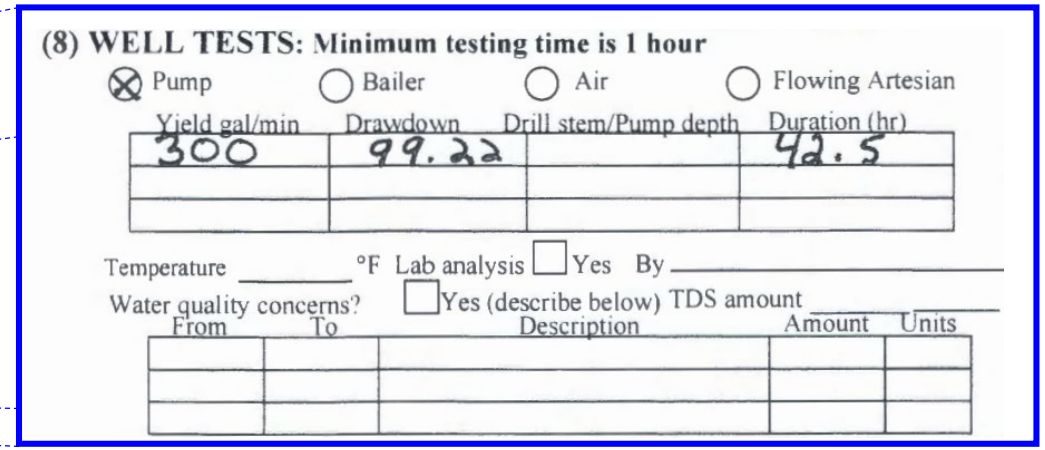
Material	From	To
BROWN SILTY SAND TOPSOIL	0	5
BROWN SILTY GRAVEL + SAND	5	35
MEDIUM BROWN SAND + GRAVEL	35	61
WATER BEARING		
BROWN SILT WITH GRAVEL	61	65
BROWN SILT AROUND GRAVEL		
COBBLES + SAND, SOME CEMENTATION	65	206
WATER BEARING		
BROWN CLAY WITH GRAVEL	206	272
BROWN HARD TIGHT GRAVEL ROCK	272	286
WITH SILT		
BASALT	286	490

Date Started 5-5-15 Completed 7-22-15

(unbonded) Water Well Constructor Certification — I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief. License Number ____ Date MAY 27 2016 — Signed ____

(bonded) Water Well Constructor Certification — I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief. License Number 1953 Date 1-6-16 — Signed — Contact Info (optional)

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK. Form Version 0.95



(8) WELL TESTS: Minimum testing time is 1 hour

Pump — Bailer — Air — Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)
300	99.22		42.5

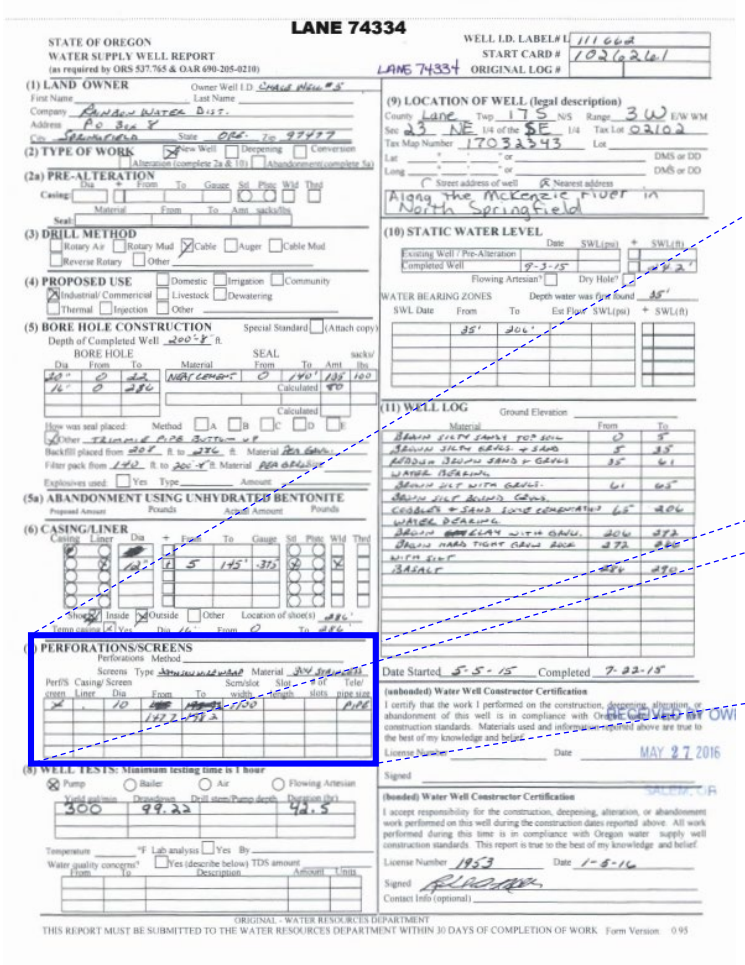
Temperature ____ °F Lab analysis Yes By ____

Water quality concerns? Yes (describe below) TDS amount ____

From	To	Description	Amount	Units

CAUTION: CONSIDER THE TESTING METHOD

Desktop Study to Estimate Well Yield



LANE 74334

STATE OF OREGON
WATER SUPPLY WELL REPORT
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WELL I.D. LABEL# L 111662
START CARD # 1026261
LANE 74334 ORIGINAL LOG #

(1) LAND OWNER — Company RAINBOW WATER DIST. — Address PO BOX X — City SPRINGFIELD — State ORE. — Zip 97477

(2) TYPE OF WORK — New Well

(2a) PRE-ALTERATION

(3) DRILL METHOD — Rotary Air, Rotary Mud, Cable

(4) PROPOSED USE — Industrial/ Commercial

(5) BORE HOLE CONSTRUCTION — Depth of Completed Well 200'

(5a) ABANDONMENT USING UNHYDRATED BENTONITE

(6) CASING/LINER

(7) PERFORATIONS/SCREENS — Perforations Method — Screens Type JOHNSON WIREWRAP Material 304 STAINLESS

(8) WELL TESTS: Minimum testing time is 1 hour — Pump — Bailer — Air — Flowing Artesian — 300 — 99.22 — 42.5

(9) LOCATION OF WELL (legal description) — County Lane Twp 17S N/S Range 3W E/W WM — Sec 23 NE 1/4 of the SE 1/4 Tax Lot 02102 — Tax Map Number 17032343 Lot — Along the McKenzie River in North Springfield

(10) STATIC WATER LEVEL — Existing Well / Pre-Alteration — Completed Well 9-3-15 — WATER BEARING ZONES — SWL Date — From 35' — To 206'

(11) WELL LOG — Ground Elevation — Material — From — To

BROWN SILTY SAND TOPSOIL 0 5
BROWN SILTY GRAVEL + SAND 5 35
BROWN SAND + GRAVEL 35 61
WATER BEARING
BROWN SILT WITH GRAVEL 61 65
BROWN SILT ROUND GRAVEL
COBBLES + SAND SOME CEMENTATION 65 206
WATER BEARING
BROWN CLAY WITH GRAVEL 206 272
BROWN HARD TIGHT GRAVEL ROCK 272 280
WITH SILT
BASALT 280 290

Date Started 5-5-15 Completed 7-22-15

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Contact Info (optional)

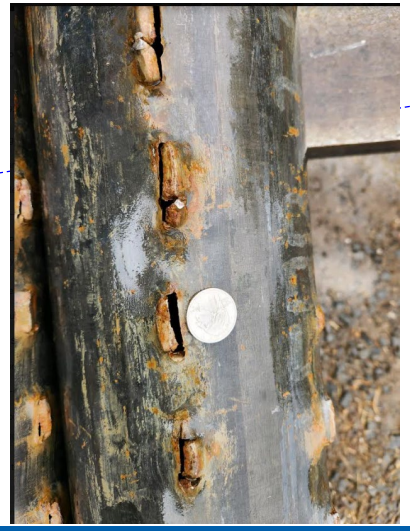
ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK Form Version 0.95

(7) PERFORATIONS/SCREENS

Perforations Method

Screens Type JOHNSON WIREWRAP Material 304 STAINLESS

Perf/Screen	Casing/Liner	Screen Dia	From	To	Scrn/slot width	Slot length	# of slots	Tele/pipe size
X	.	10	[illegible]	[illegible]	.100			PIPE
			147.7	198.2				



CAUTION: CONSIDER THE WELL COMPLETION

OWRD Well Drilling Setbacks

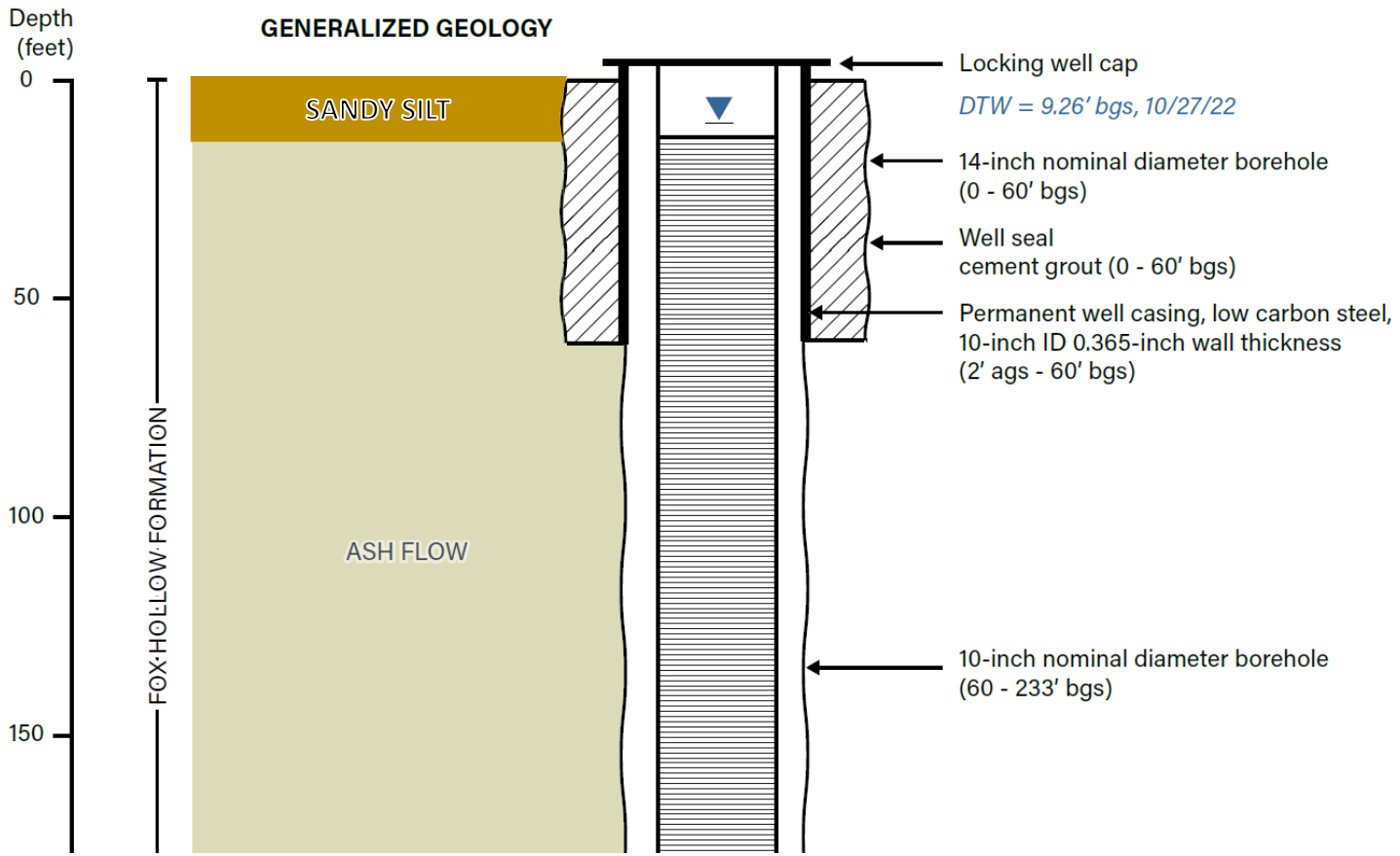
Meeting Setbacks:

- **Existing storm and sewer (50 feet)**
- **Septic (100 feet)**
- **Petroleum storage tanks (25 or 50 feet)**
- **Property owner preferences**

Well Construction

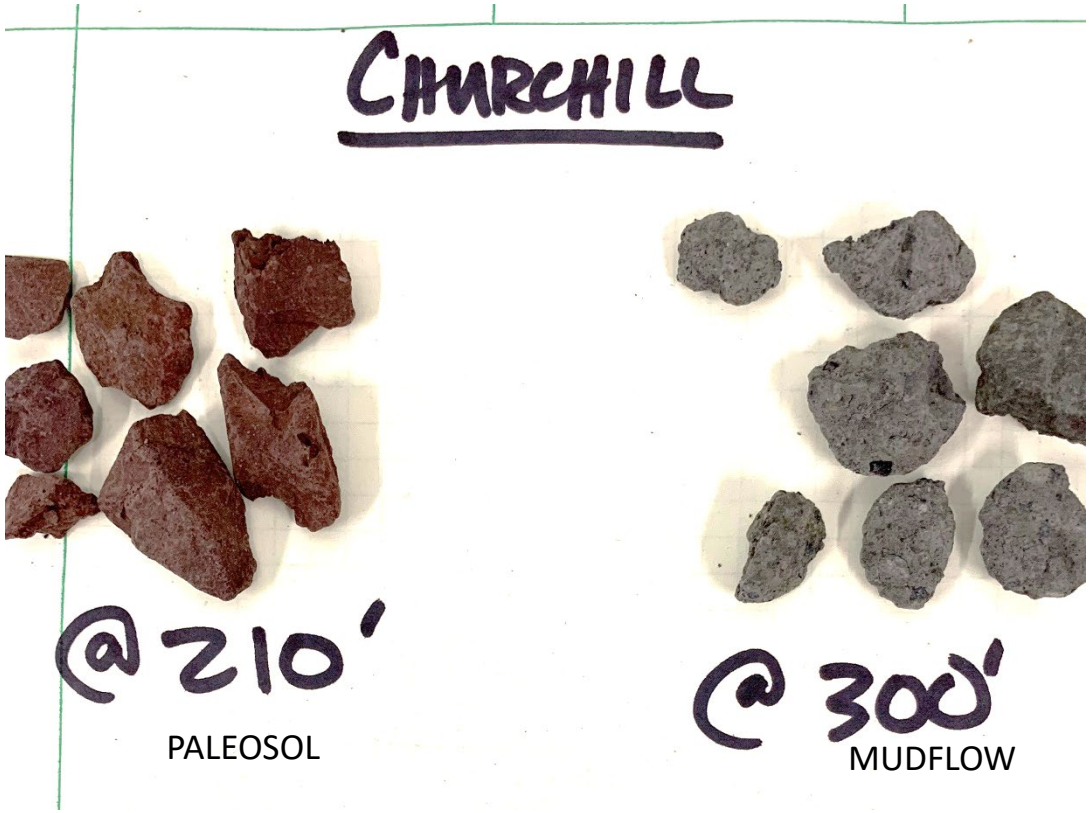
Well Design:

- **Increase casing wall thickness**
- **Key casing deeper into bedrock than state minimum**
- **Heavier screen construction (if applicable)**



Drilling in Different Geologic Environments

ALLUVIAL WELL
(Sheldon, Howard)



BEDROCK WELL
(Amazon, Churchill)

Emergency Water Supply Wells

Partnerships were critical!

- Developed IGA's with four separate local entities
- Coordinated training events with first responder organizations

EUGENE OR DISASTER RELIEF TRIALS 2014

CERT COMMUNITY EMERGENCY RESPONSE TEAM

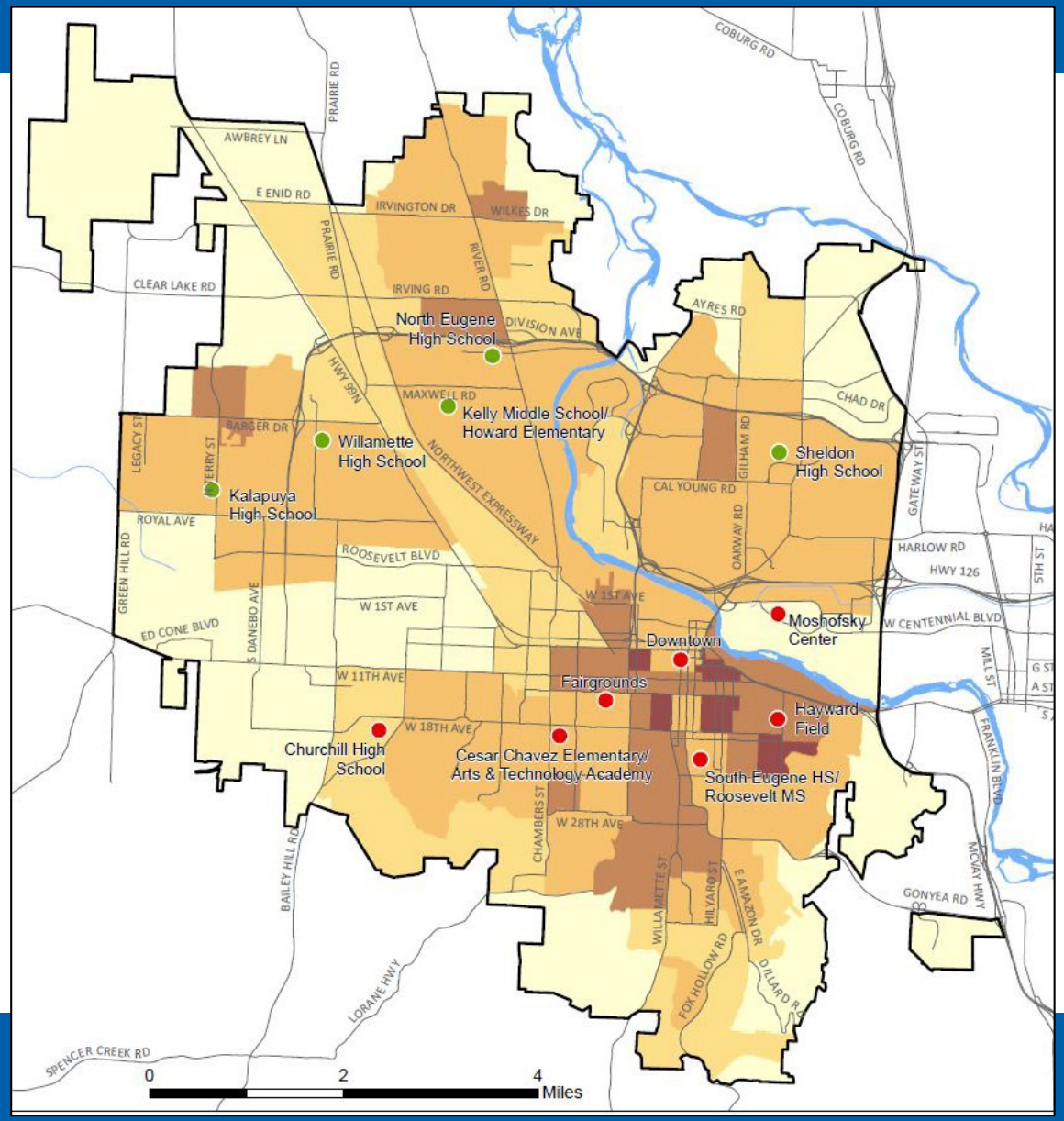
INTERGOVERMENTAL AGREEMENT BETWEEN
EUGENE WATER & ELECTRIC BOARD
AND THECITY OF EUGENE
FOR COMMUNITY EMERGENCY WATER DISTRIBUTION SITES

Emergency Water Supply Wells

Emergency water stations:

- **Establish well sites based on sufficient area and public accessibility.**
- **Demand (2-gal/person-day) calculations based on a population density map.**

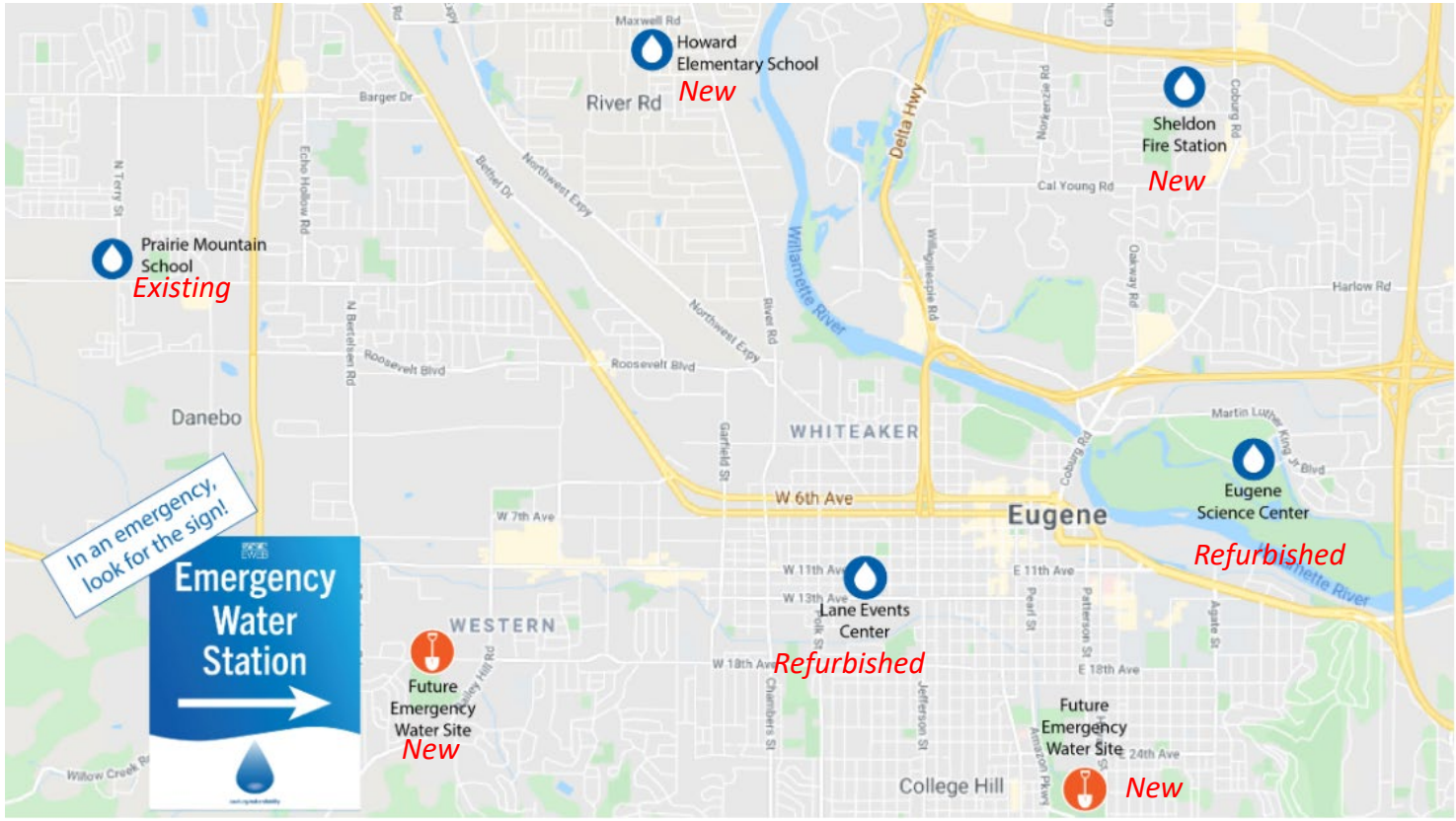
	GPM (24 Hr)	GPM (10 Hr)
Sheldon High School	40	100
Howard Elementary School	20	50
Kalapuya High School	30	60
South Eugene/Roosevelt Middle School	30	60
Fairgrounds (Lane Event Center)	20	40
Moshofsky Center (Science Center)	20	50



Emergency Water Supply Wells

Current Emergency water station well sites:

- One existing
- Two refurbished (improved)
- Four new (drilled)



Emergency Water Supply Wells

Emergency water station well improvements -

BEFORE

DURING

AFTER

Emergency Water Supply Wells

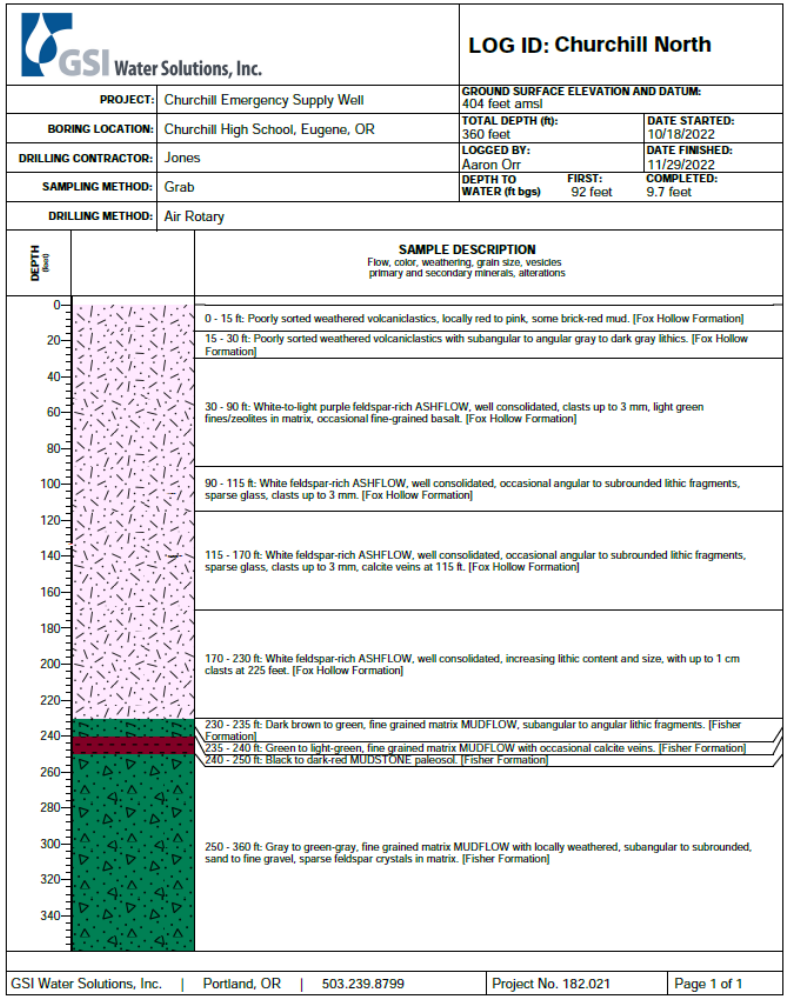
Emergency water station well drilling -

Drilling

Liner/Screen Install

Flow test

Bridging at Churchill



GSI Water Solutions, Inc.

LOG ID: Churchill North

PROJECT:	Churchill Emergency Supply Well	GROUND SURFACE ELEVATION AND DATUM: 404 feet amsl	
BORING LOCATION:	Churchill High School, Eugene, OR	TOTAL DEPTH (ft): 360 feet	DATE STARTED: 10/18/2022
DRILLING CONTRACTOR:	Jones	LOGGED BY: Aaron Orr	DATE FINISHED: 11/29/2022
SAMPLING METHOD:	Grab	DEPTH TO WATER (ft bgs) FIRST: 92 feet	COMPLETED: 9.7 feet
DRILLING METHOD:	Air Rotary		

DEPTH (feet)	SAMPLE DESCRIPTION (Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations)
0	0 - 15 ft: Poorly sorted weathered volcaniclastics, locally red to pink, some brick-red mud. [Fox Hollow Formation]
20	15 - 30 ft: Poorly sorted weathered volcaniclastics with subangular to angular gray to dark gray lithics. [Fox Hollow Formation]
40	
60	30 - 90 ft: White-to-light purple feldspar-rich ASHFLOW, well consolidated, clasts up to 3 mm, light green fines/zeolites in matrix, occasional fine-grained basalt. [Fox Hollow Formation]
80	
100	90 - 115 ft: White feldspar-rich ASHFLOW, well consolidated, occasional angular to subrounded lithic fragments, sparse glass, clasts up to 3 mm. [Fox Hollow Formation]
120	
140	115 - 170 ft: White feldspar-rich ASHFLOW, well consolidated, occasional angular to subrounded lithic fragments, sparse glass, clasts up to 3 mm, calcite veins at 115 ft. [Fox Hollow Formation]
160	
180	170 - 230 ft: White feldspar-rich ASHFLOW, well consolidated, increasing lithic content and size, with up to 1 cm clasts at 225 feet. [Fox Hollow Formation]
200	
220	
240	230 - 235 ft: Dark brown to green, fine grained matrix MUDFLOW, subangular to angular lithic fragments. [Fisher Formation]
	235 - 240 ft: Green to light-green, fine grained matrix MUDFLOW with occasional calcite veins. [Fisher Formation]
	240 - 250 ft: Black to dark-red MUDSTONE paleosol. [Fisher Formation]
260	
280	250 - 360 ft: Gray to green-gray, fine grained matrix MUDFLOW with locally weathered, subangular to subrounded, sand to fine gravel, sparse feldspar crystals in matrix. [Fisher Formation]
300	
320	
340	

GSI Water Solutions, Inc. | Portland, OR | 503.239.8799 | Project No. 182.021 | Page 1 of 1

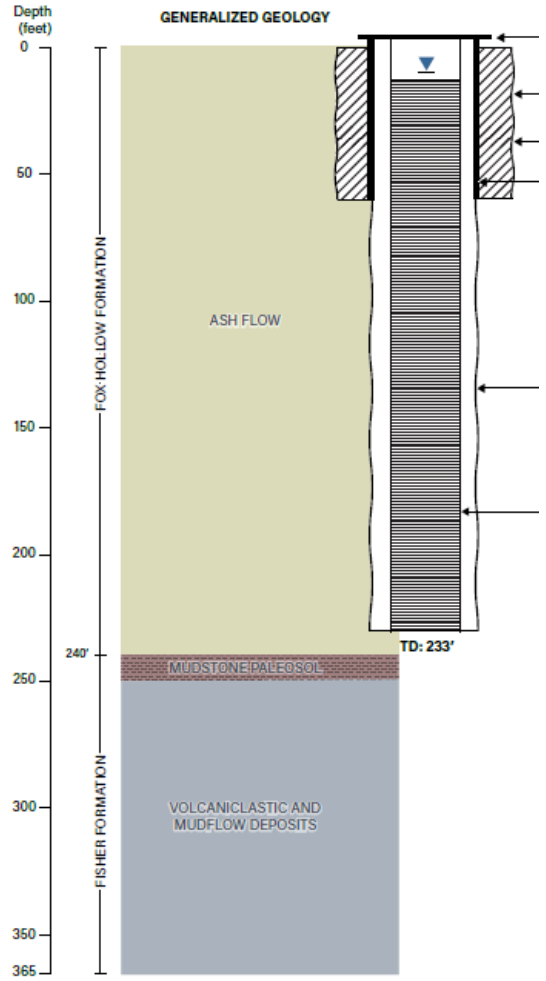
Sequence of Events--

- **August 26 – Churchill South reaches TD, driller demobs to await liner delivery (supply chain issues)**
- **September 27 – Attempt to install liner and could not reach TD due to formation of a bridge at ~233 feet**

Flow measurements:

- 2 gpm @ 135 feet bgs
- 5 gpm @ 275 feet bgs
- 15 gpm @ 280 feet bgs
- 30 gpm @ 355 feet bgs

Bridging at Churchill



Sequence of Events on October 20--

- **3:25 PM– Churchill North reaches TD, begin tripping out**
- **4:00 PM—Stabilizer appears to be stuck on bottom of casing, trip out stops**
- **4:05 PM—Stabilizer has been freed, resume tripping out**
- **4:12 PM—All tooling removed from hole**
- **4:20 PM—Being installing PVC liner, centralizers every 20'**
- **4:55 PM—Liner stops on bridge at 233 feet**

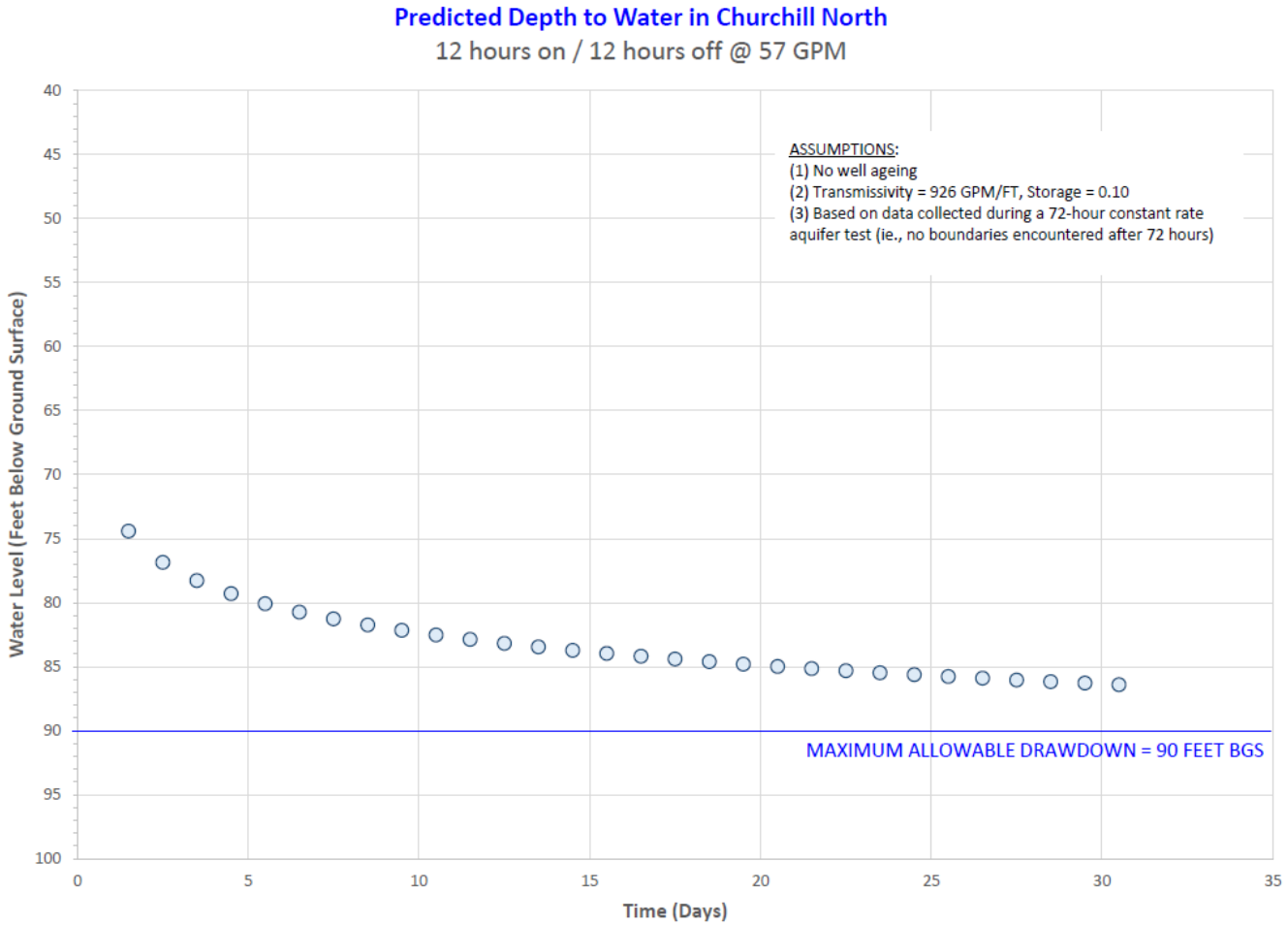
Flow measurements:

- 25 gpm @ 92 feet bgs
- 60 gpm @ 135 feet bgs
- 75 gpm @ 195 feet bgs
- 75 gpm @ 255 feet bgs
- 80 gpm @ 295 feet bgs

Well Drilling Constraints

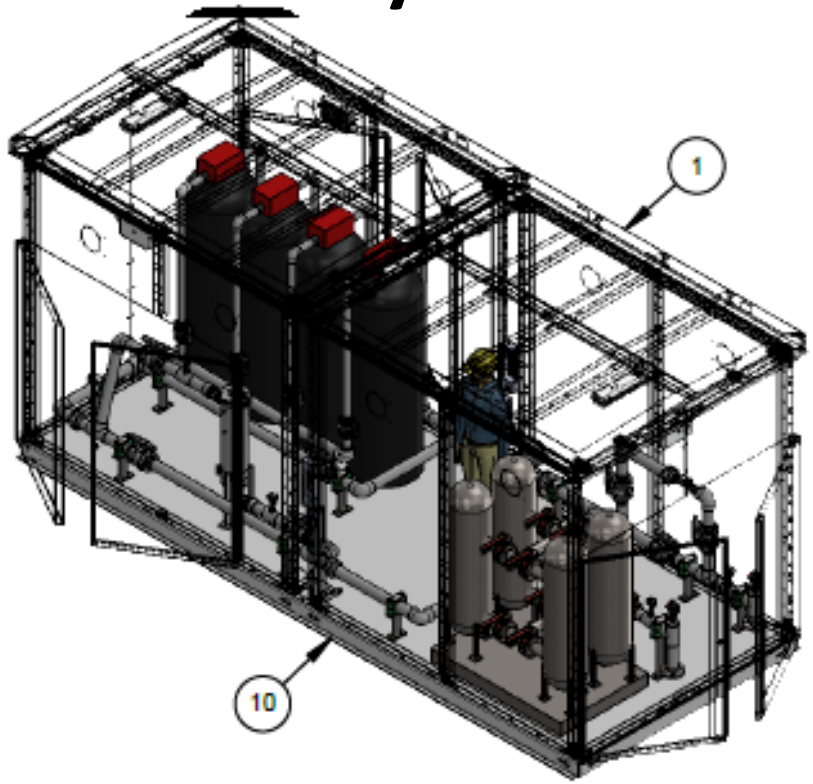
Emergency water station well drilling constraints–

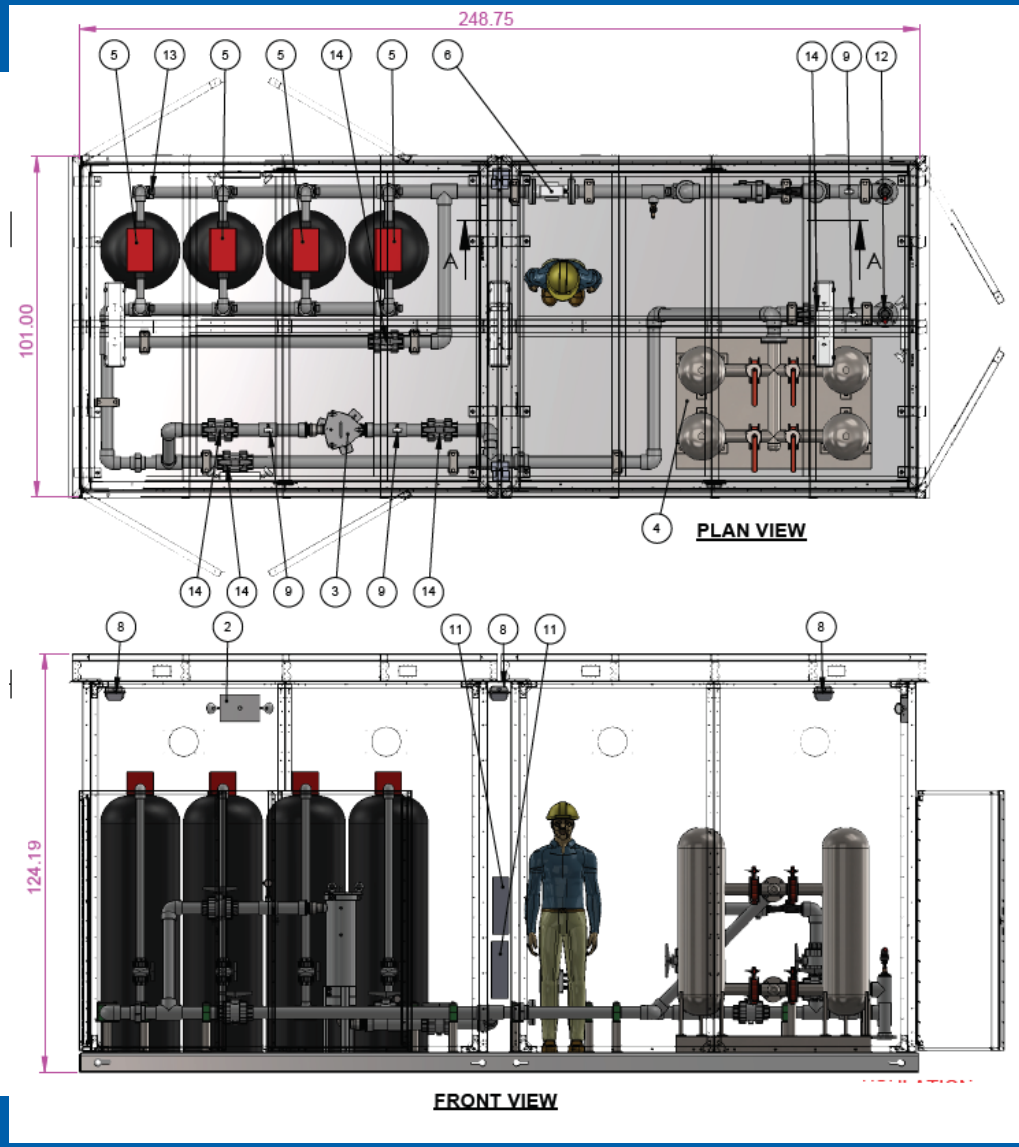
- **Maximum allowable yield**
- **Bridging at Churchill**



Emergency Water Supply Wells

Arsenic Treatment System.





Emergency Water Supply Wells

Lessons Learned:

- **Meeting OAR setbacks and property owner expectations led to increased construction.**
- **Exempt Use wells reduced the permitting timeline and cost.**
- **As expected, wells drilled into the consolidated rock required increased construction and implementation costs to resolve water quantity and quality concerns.**

Emergency Water Supply Wells

Emergency water station components -

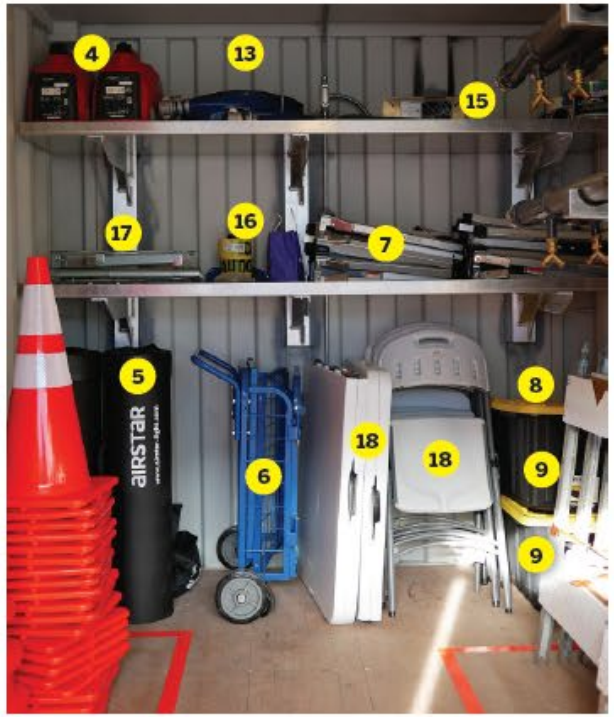
Pump House (Pump Control)

System Connection (Pipe Outlet)

Water Station (on-site storage)

Emergency Water Supply Wells

Emergency water station system components -



Water Station Equipment

Emergency Water Supply Wells

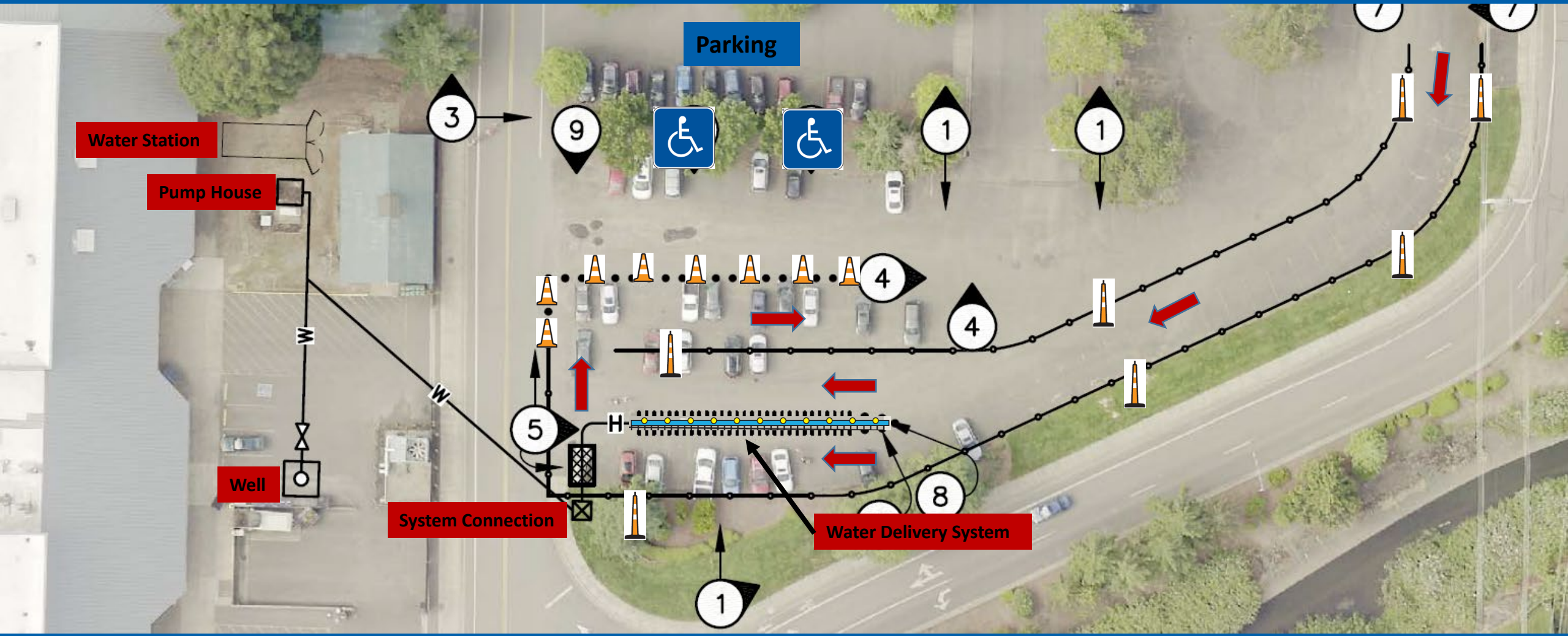
Emergency water station water delivery system -

Emergency Water Supply Wells

Emergency water station crowd control -

Continued…

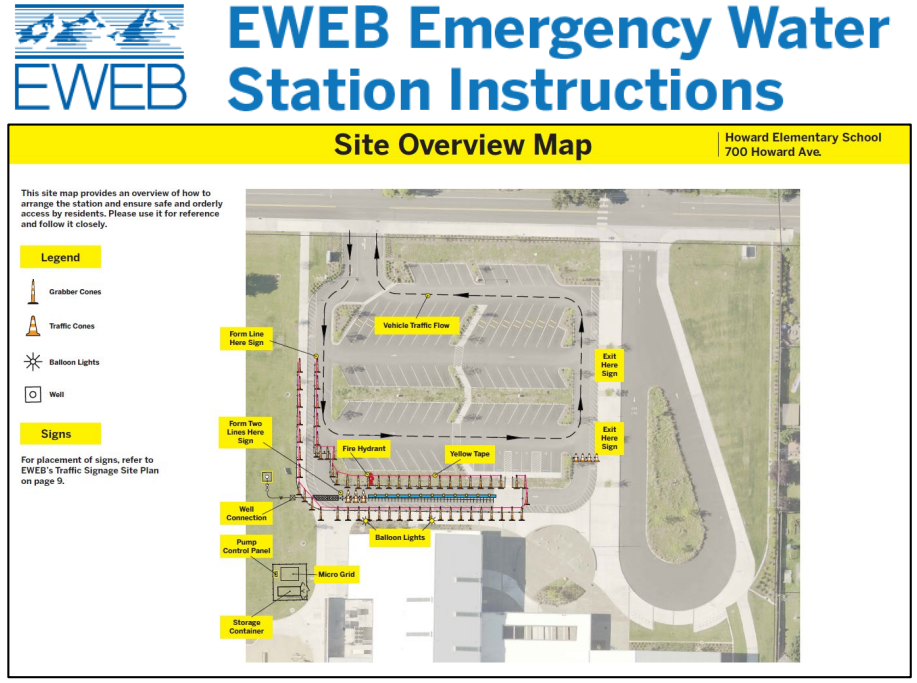
Emergency Water Supply Wells



Emergency Water Supply Wells

Emergency water station practice events with internal staff -

- **Each station includes EWEB tested assembly instructions.**



EWEB Emergency Water Station Instructions

Site Overview Map

Howard Elementary School
700 Howard Ave.

This site map provides an overview of how to arrange the station and ensure safe and orderly access by residents. Please use it for reference and follow it closely.

Legend

Grabber Cones

Traffic Cones

Balloon Lights

Well

Signs

For placement of signs, refer to EWEB's Traffic Signage Site Plan on page 9.

This Emergency Water Station set-up guide assumes: 1) That someone from EWEB or staff from the school let you in, and 2) that you are setting this up without technical assistance from EWEB.

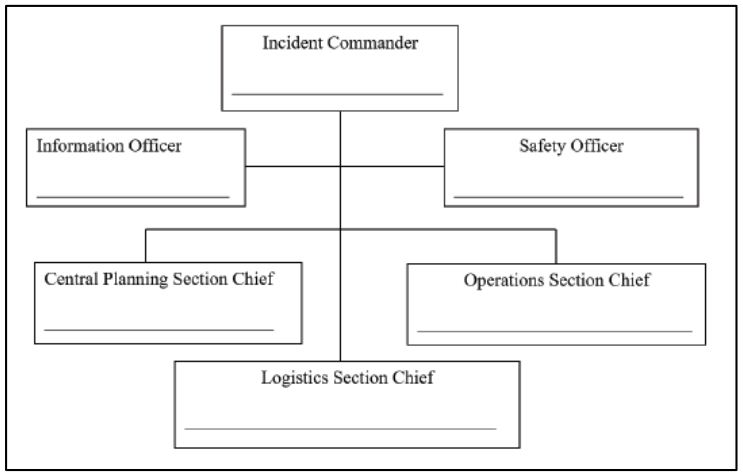
Emergency Water Supply Wells

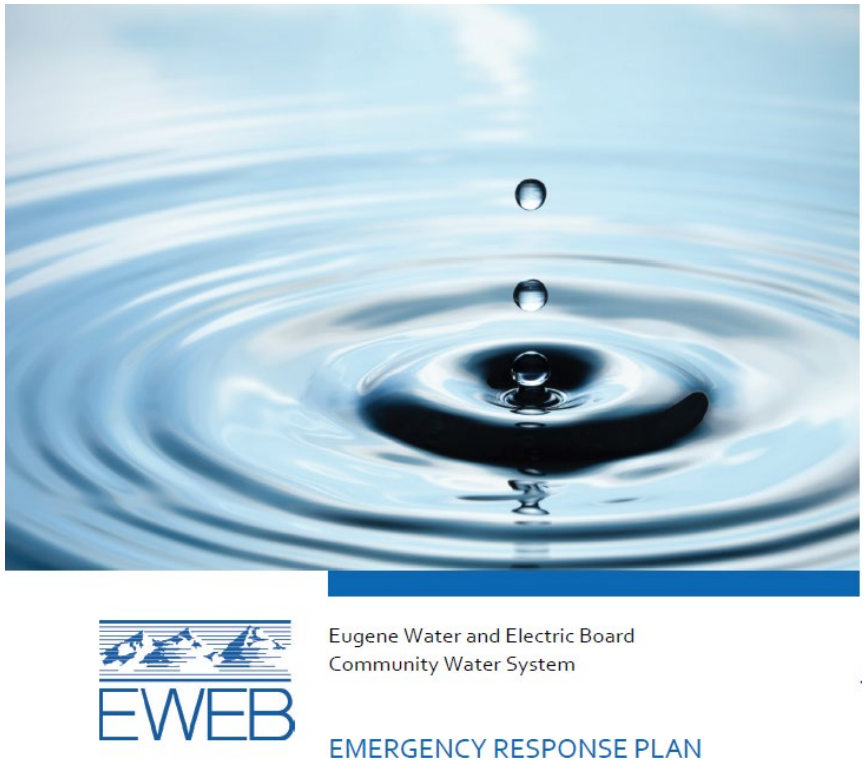
Emergency water station practice events and first responders-

Getting water from your tap is substantially different than walking down the street with a jug of water.

Next Steps

EWEB's Emergency Response Plan –





Tabletop Exercise

Questions

- EWEB's Water System
- Emergency Water Program
- Mobile Distribution and Treatment Systems
- Emergency Water Supply Wells
  - Design and Implementation
- Next Steps
- Questions