PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Bull Run TREATMENT PROJECTS

Technical Memorandum

Subject:	Effect of Raw Water Pipeline and Tunnels on the Local Water Wells – Summary
Date:	August 3, 2023

To: Dan Hogan, Project Manager
Portland Water Bureau

From: Laura Miles, PE / Delve Underground

Prepared by: Kim Elliott, CEG, / Delve Underground
Farid Sariosseiri, PE / Delve Underground

Reviewed by: Mark Havekost, PE / Delve Underground

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1.0 Introduction

This summary technical memorandum (TM) evaluates the impact of construction of the Filtration Pipelines Project (Project) – Raw Water Pipeline (RWP) on nearby wells.

2.0 Project Description

As a part of the Bull Run Treatment Projects, the new RWP will intersect the existing conduits from the Bull Run Watershed and redirect flow to the new Filtration Facility. The primary elements of the RWP alignment include:

- A connection with existing conduits on SE Lusted Rd.
- Two Lusted Raw Water Pipelines (LRWP) with trenchless crossings
- Two raw water tunnels and a tunnel shaft system (Raw Water Tunnels)

The project location and elements are shown in attached Figure 2-1.

3.0 Site Description

Land uses adjacent to the alignment include general agricultural, commercial nurseries, and rural residential home sites.

3.1 Subsurface Conditions

The RWP alignment is located near the eastern margin of the Portland Basin, a topographic and structural depression formed by the tectonic folding and faulting of middle Miocene age lava flows of the Columbia River Basalt Group (CRBG), a 12- to 15-million-year-old sequence of basalt flow-rock that is up to about 1,000 feet thick. The Portland Basin is filled by a thick section of late Tertiary to Quaternary terrestrial sediment that lies upon the CRBG base. Locally, in and near the RWP project site, the sediment section was intruded by several volcanic eruptions of basaltic lava that flowed out onto the ground surface and were then buried by additional layers of alluvial sediment.

In the RWP project area, the Portland Basin fill consists of the following geologic units from oldest to youngest: (1) Sandy River mudstone, (2) Troutdale Formation, (3) Boring Lava, (4) Springwater Formation, and (5) terraced alluvial deposits of the Gresham Formation in the Sandy River canyon. A generalized geologic cross-section that illustrates the relationships between the geologic units in the RWP project area is shown in Figure 3-1.

The Sandy River mudstone lies deep below the Project site. It was not reached in explorations and will not be encountered in RWP construction. Most of the Raw Water Tunnel will be driven through the overlying Troutdale Formation. The tunnel shaft will rise above the tunnel through a thin section of

Troutdale Formation and a ±50-foot-thick Boring Lava flow lying upon the Troutdale Formation surface, and then through about 250 feet of the Springwater Formation to the ground surface. The sediments making up the Springwater Formation were deposited at the western foot of the Cascade Range as a broad, west-to-northwest sloping piedmont plain. The formation was deposited prior to incision of the Sandy River into its present canyon.

Following the establishment of the Sandy River canyon, two periods of flooding and aggradation occurred on the Sandy River. Probably caused by volcanic eruptions on Mount Hood, these floods filled much of the canyon with mudflow deposits that consisted of clay, sand, coarse gravel, cobbles, and scattered boulders. After each flood event, the river eroded through the flood deposits and reestablished its canyon but left behind some of the mudflow deposits terraced against the canyon walls. The materials composing the highest terrace have been named the Gresham Formation. The first approximately 1,000 feet of the RWP project, from the existing conduits connection to the Raw Water Tunnels portal and about 300 feet of the tunnels, will be constructed in clay and gravel of the Gresham Formation.

3.2 Existing Water Wells Observations

Well logs from private water wells located near the RWP alignment listed in the OWRD registry were reviewed for water levels and well depth to understand depth of the aquifer supplying the water. For locations of these existing water wells, see attached Figure 2-1.

3.2.1 Gresham Formation Terrace

The first section of RWP, from the existing conduits connection on SE Lusted Rd. to the Raw Water Tunnels portal, will be constructed by open-cut trenching methods primarily in the Gresham Formation. Alluvial gravel deposits of Gresham Formation are remnants of a former floodplain of the Sandy River, which now lies terraced between 300 and 400 feet above the Sandy River and about 200 feet or more below the Springwater Formation surface (Trimble 1963).

Three water well logs were found on the Gresham terrace near the RWP alignment: one (MULT 044) about 300 feet east of the RWP alignment (and RWP-MI-BH01), one (MULT 763) about 170 feet north of RWP-BH02, and another (MULT 2595) about 350 feet north of the Raw Water Tunnels portal (and RWP-BH04).

First water was encountered in the eastern well (MULT 044) at elevation (El.) 360 feet. A pumping test was performed between El. 360 and 330, which yielded 12 gpm with 40 feet of drawdown from the static level at El. 378 feet after 1 hour. According to the well log, an "air test" was performed on (MULT 2595), which yielded 15 gpm for 1 hour. No drawdown was recorded on the well log. The static water level was reported at El. 395 feet.

Well MULT 763 was listed as having the bottom of the well at El. 240 feet. The well log does not indicate where groundwater was first encountered, but the static water level is reported as being about El. 329 feet. A “bailer” test yielded 5 gpm with 84 feet of drawdown from the static level after 2 hours.

3.2.2 Springwater Formation

The Raw Water shaft will be constructed mostly in the Springwater Formation. The Springwater Formation typically consists of about 30 feet of stratified fine-grained soil overlying approximately 165 feet of massive sand and gravel with scattered boulders. Near-surface stratification, which is due both to upward fining of the sediment deposition and to weathering and decomposition of the soil, is assumed to dip northwestward, which would be generally parallel to the slope of the Springwater surface and consistent with the piedmont origin of the deposit. Surface streams that begin with small springs west of and at lower elevations than the Project site also flow northwestward across the Springwater Formation surface.

The fine-grained soils include red clay, silt, and sensitive saprolitic silts that retain relic textures of thoroughly decomposed gravel clasts. Where underlain by clay layers, the saprolites can form small, perched aquifers. In general, available water from these aquifers is thought to be minor. However, a flow rate of 120 gpm was estimated from dewatering pumping rates over several hours in one test pit excavation that was approximately 3,900 feet northwest of the tunnel shaft (Bednarz 2022).

The confining clay layers that form the perched aquifers are localized and are not continuous over large areas. The exploration boring LRWP-BH08, drilled at the tunnel shaft site (surface El. 715 feet), for example, penetrated a 19-foot-thick layer of sensitive saprolite between El. 683 and 702 feet, but confining layers and associated groundwater bodies were not present. Groundwater was first encountered in the shaft boring in poorly graded gravel with silt and sand near El. 600 feet. A VWP was installed at El. 589 feet to measure variations in the groundwater surface. Between February 2022 and February 2023, the groundwater surface varied between approximately El. 597 and 601 feet.

For comparison, boring WTP-B-02 (Rhino One 2020b), which is located approximately 216 feet northeast of the tunnel shaft, penetrated 18 feet of sensitive saprolite between El. 683 and 701 feet. A 1-inch diameter PVC monitoring well was installed in this boring with a screened[1] interval between El. 687 and 697 feet and a VWP installed at El. 628 feet. On dates between February 2019 and February

[1] The depth where the screened portion of the well begins – below where the steel well casing ends is the depth of the well where the water enters.

2023, groundwater levels in the monitoring well that were measured with an electronic water level meter have ranged between El. 697 and 708 feet. The VWP recorded groundwater levels fluctuating between El. 655 and 659 feet.

Groundwater monitoring instrumentation installed in boring LRWP-BH08, completed at the Raw Water Tunnels shaft location, indicates a perched aquifer approximately located between El. 589 and 600 feet in the Springwater Formation. Static levels fell steadily for 3 months after monitoring began, then stabilized around El. 600 feet with 2-to-3-foot fluctuations following periods of significant precipitation.

Troutdale Formation

Most of the Raw Water Tunnel will be driven through the Troutdale Formation. In the RWP project area, the Troutdale Formation is predominantly sandstone; it is basaltic in composition, poorly graded, and occurs in a matrix of volcanic glass or clay alteration products. In the project area, the formation is commonly well indurated; cement consists mainly of clay minerals. Coarse, well-rounded gravel and cobbles were commonly present at the top of the Troutdale section near the contact with the overlying Boring Lava.

The log of water well CLAC 76359, located along the bluff at the eastern edge of the Springwater surface and near the tunnel shaft was reviewed. This well was drilled to about El. 260 feet. A pumping test was performed from a point below El. 400 feet. Yields returned 20 gpm for 2 hours. The well log indicates the static groundwater level is at El. 350.

4.0 Evaluations and Design Considerations

As discussed in previous sections, a portion of the alignment between the existing conduit connection and the Tunnel portal, including the trenchless crossings, will be within the lower Gresham Formation, which primarily consists of coarse-grained material in a clayey matrix. The minimum pipe invert in this section of the alignment is at El. 475 feet (i.e., approx. 20-25 feet below ground surface) approximately 6 feet above the highest groundwater level, measured over the past 2 years by the nearest piezometer [note nearby wells do not draw water from this geologic unit or depth, see next paragraph].

The nearby wells[2] are screened in the deeper Troutdale Formation, which lies between lower Gresham Formation and Sandy River mudstone more than 80 feet below the pipe installation trenches. The clayey sandstone of the Troutdale Formation acts as an aquitard, limiting flow of water between the Gresham Formation and Sandy River mudstone. Although this section of the alignment is above groundwater level, the design includes trench cutoff walls at approximately 500-foot intervals to intercept groundwater flow paths that might develop within the trench backfill, minimizing the effect of construction on near-surface groundwater.

The tunnel portal and approximately 300 feet of the tunnels will be within the Lower Gresham Formation. The pipe invert in this section is at EL. 478 feet, approximately 20 feet below the groundwater level measured by the nearest piezometer. . As discussed in the previous paragraph, water wells near this section of the alignment pump water from the Troutdale Formation at elevations well below the pipe invert.

Piezometers installed along the tunnels within the Troutdale Formation do not record any ground water pressure, indicating groundwater levels well below the tunnel's invert. The nearby wells [3] supply water from the Troutdale Formation, more than 80 feet below the tunnel and pipeline invert. The annulus space between the pipe and the tunnel support system will be backfilled with cellular concrete, to prevent open flow paths around the pipe. In addition, shunt flow barriers at intervals along the tunnel will be installed to prevent open flow paths between the tunnel's support system and the native ground. Concrete or grout materials used to fill the annular spaces around the tunnel pipes and support systems will be contained by the tunnel ground support systems and are too thick to permeate and flow through the surrounding soils.

The Tunnel Shaft extends approximately 235 feet below the ground surface, with the bottom elevation of 480 feet (485 feet for pipe invert). The shaft will be constructed through the following geological units:

- Springwater Formation from El. 715.2 to El. 552
- Residual Soil of Boring Lava from El. 552 to El. 533
- Boring Lava from El. 533 to El.498

[2] MULT 044 and MULT 763

[3] CLAC 923 and MULT 2595

- Troutdale Formation below El. 498

Three piezometers were installed in the boring nearest to the shaft. The piezometer installed within the Troutdale Formation indicated that groundwater is below the tunnel invert within the Troutdale Formation. The piezometer within the Boring Lava did not indicate the presence of groundwater in the Boring Lava. The piezometer installed within the Springwater Formation indicated that the groundwater level fluctuated between El. 601 and 596 feet.

Water wells[4] in the vicinity of the shaft draw water from the Troutdale Formation more than 130 feet below the bottom of the shaft. Considering the distance between the bottom of the shaft and the depth of water wells, shaft construction is not expected to impact nearby water wells. The design includes construction of seepage barriers along the shaft to mitigate the risk of connecting confined and semi-confined aquifers within the Springwater Formation through the shaft backfill. The design also includes shunt flow barriers at vertical intervals along the shaft to intercept vertical perched groundwater flow path between the shaft support system and native ground. Concrete or grout materials used to form the seepage and shunt flow barriers will be contained by the shaft ground support systems and are too thick to permeate and flow through the surrounding soils.

The section of the alignment between the shaft and the connection point to the Filtration Facility will be within the residual soil of Springwater Formation, which primarily consists of fine-grained soils (i.e., silt and clay). This section is approximately 400 feet long and the minimum pipe invert is at El. 702 feet.

The nearby wells[5] supply water from the Troutdale Formation at more than 350 feet below the pipe invert. Therefore, construction of this section of the alignment is not expected to impact nearby wells. In addition, the design includes construction of trench cutoff walls to intercept groundwater flow paths that might develop within the backfill, minimizing the effect of construction on near-surface groundwater.

Three wells are within 300’ horizontal distance of either the tunnel, or pipe installation centerlines[6], these are CLAC 76359 (approximately 225 feet horizontal distance from tunnels centerline), MULT 763

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[4] CLAC 57250 and CLAC 76359

[5] CLAC 57250 and CLAC 76359

[6] As indicated by OWRD records and selected surveying.

(approximately 180 feet horizontal distance from trenchless pipe installation centerline) and MULT 044 (approximately 150 feet horizontal distance from centerline), for locations see figure 2-1.

As noted above, the private wells are offset from the construction work and the screened intervals are a minimum of approximately 80 to 130 feet below the invert of the to be constructed pipelines. Construction vibrations are not expected to impact the performance of private wells because the distances and depth of the wells is too far from the construction work areas to result in damage. The predicted vibrations at the wells from the tunneling and shaft construction are less than 0.05 inches per second. For comparison, the typical threshold for blasting vibrations to protect sensitive structures with lathe and plaster walls is 0.5 inches per second, approximately 10 times greater than what is predicted at the closest wells. Furthermore, the wells are constructed with well steel casing, a material that is tolerant to vibration without damage.

4.1 Conclusion

Based on the above discussions and measures considered in the design, construction of the RWP is not anticipated to impact nearby water wells since the construction of all the RWP facilities is between 80 and 350 feet above the nearby well water level and intake zone and expected construction vibration levels are well below published structural damage levels.

5.0 References

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Trimble, D.E. 1963. “Geologic Map and Diagrammatic Section of Portland, Oregon, and Adjacent Areas.” U.S. Geological Survey Bulletin, 1119.

Figures

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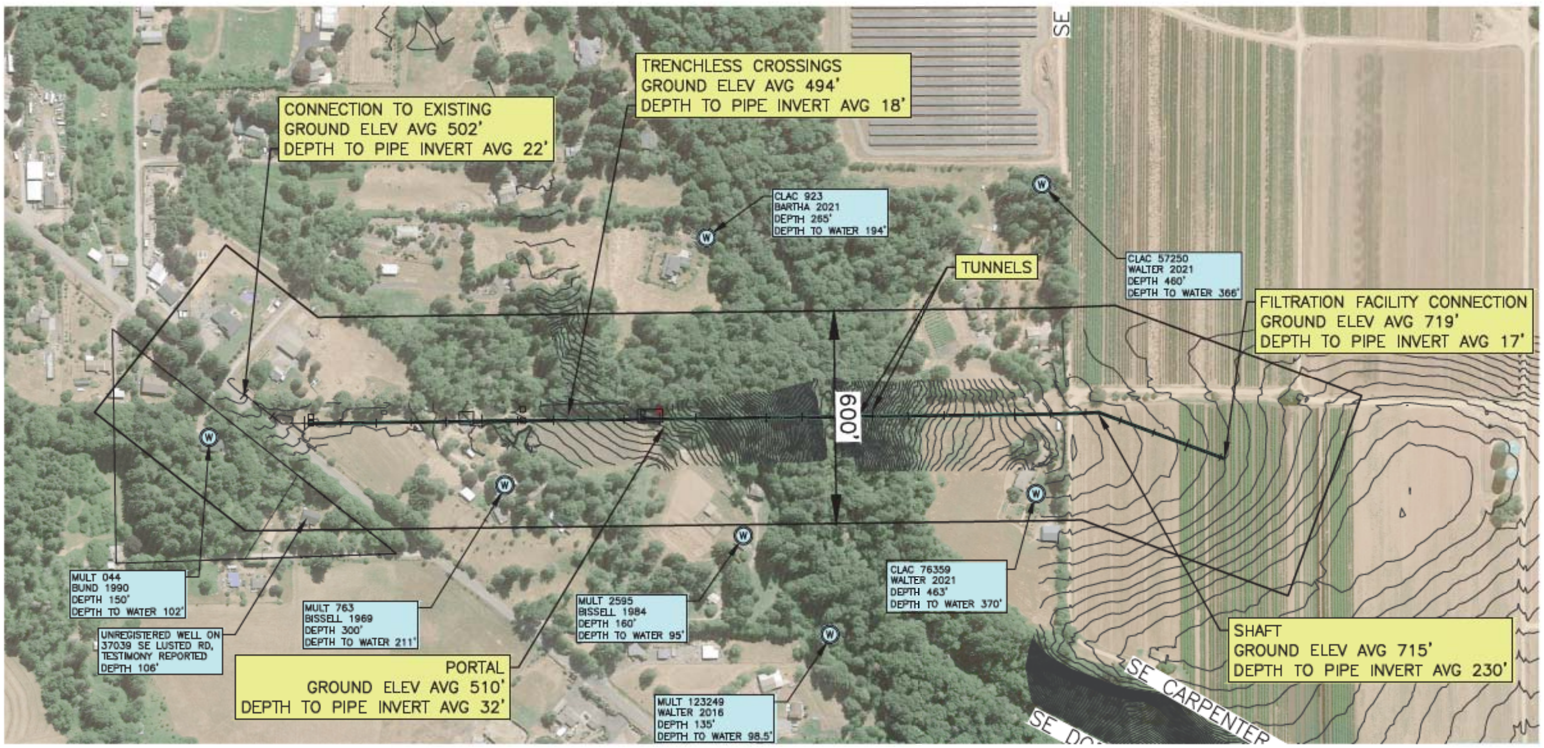

BORING AND SYMBOL KEY:

ALIGNMENT

MULT 2595 — PRIVATE WELL

EXPLORATION PLAN

SCALE: 1"=350' — 0" 350' 700'

NOTES:

1. ALL WELL LOCATIONS ARE APPROXIMATE.
2. MULT 133086 IS A GEOTECHNICAL MONITORING WELL

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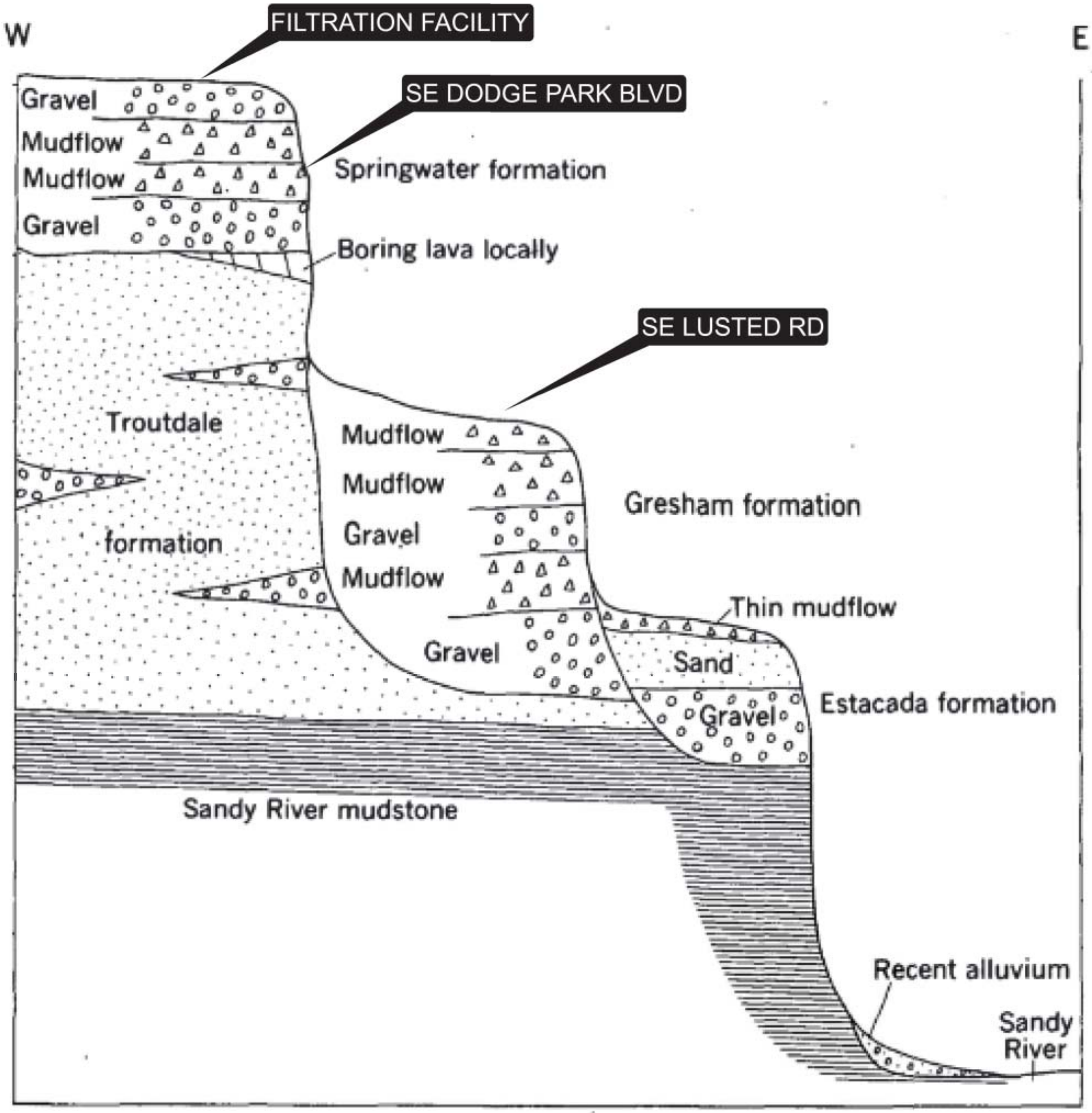
FILTRATION PIPELINES PROJECT - RAW WATER PIPELINE

EFFECT OF RWP ON THE LOCAL PRIVATE WELLS EVALUATION AND CONSIDERATIONS MEMORANDUM EXPLORATION PLAN

FIG.2-1

JULY 2023

Path: C:\Users\HughahMaddeleine\Box\Jobs\6218.0 PWB Filtration Pipelines Project FPP\CADD\03 Drawings_memo_FIG.2-2_plan_R2.dwg Plot date: Jul 25, 2023, CAD User: HughahMaddeleine



Generalized section through the west bank of the Sandy River near Dodge Park showing relations of the Springwater, Gresham, and Estacada formations and the bedrock. (Trimble 1963)

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FILTRATION PIPELINES PROJECT – RAW WATER PIPELINE

EFFECT OF RWP ON THE LOCAL PRIVATE WELLS – EVALUATION AND CONSIDERATIONS

FIG.3-1

JUNE 2023

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