

TECHNICAL MEMORANDUM

Groundwater Study in Support of a Large Capacity Septic System, Cascade RV Co-Op, McKenzie Bridge, Lane County, Oregon

То:	Shawn McFadden / Oregon Cascade RV Co-Op
From:	Matt Kohlbecker, RG / GSI Water Solutions, Inc.
	Jesse Hall, GIT / GSI Water Solutions, Inc.
Cc:	Tim Gross, PE / Civil West Engineering, Inc.
	Michael Faught / Oregon Cascade RV Co-Op
Date:	July 28, 2023



1. Background

Oregon Cascade RV Co-op (Oregon Cascade), located on Highway 126 in McKenzie Bridge, Oregon, manages sanitary and residential waste streams with a septic system. The septic system serves 52 full hookup RV spaces, 11 mobile home spaces, a coin operated laundry facility, and a shower facility.

Oregon Cascade is planning to replace its septic system. DEQ regulations¹ require a written assessment of the impact of the proposed system on the quality of groundwater (called a "groundwater study" in this scope of work). This technical memorandum (TM) documents a groundwater study using the Large Onsite Septic System (LOSS) model, which was developed by the Washington State Department of Ecology and simulates nitrate attenuation due to mixing in groundwater. Specifically, wastewater is mixed with groundwater in the aquifer, groundwater entering the aquifer from upgradient, and infiltrating precipitation. Inputs to the LOSS model include certain characteristics of the wastewater, physical dimensions of the site, and subsurface soil properties. Output from the LOSS model is the nitrate concentration in groundwater some distance from the septic drainfield.

2. Model Input Parameters

Model input parameters are summarized in Table 1. The following subsections describe the methods that were used to develop the model input parameters and the value of the model input parameters used in the LOSS model. Model input parameters were developed based on scientific literature, default values in the LOSS model developed by the Washington Department of Ecology, septic system designs provided by Civil West Engineering, property maps, and water well driller records from the Oregon Department of Water Resources.

¹ OAR 340-071-0520(6)

Model Input Parameter	Symbol	Value	Units	Subsection in the Text
Nitrate Concentration in Precipitation	N _R	0.24	mg/L	Subsection 2.1
Total Nitrogen Concentration in Wastewater	Nw	24.0	mg/L	Subsection 2.2
Soil Denitrification	d	0.10	percent	Subsection 2.3
Aquifer Thickness	b	20	feet	Subsection 2.4
Drainfield Area	A _D	20,000	ft²	Subsection 2.5
Distance from Drainfield to Property Boundary	D_{pb}	782	feet	Subsection 2.6
Aquifer Width	WA	220	feet	Subsection 2.7
Aquifer Hydraulic Conductivity	K	1,000	feet/day	Subsection 2.8
Hydraulic Gradient	i	0.01	feet/feet	Subsection 2.9
Recharge	R	28	inches/year	Subsection 2.10
Nitrate Concentration of Upgradient Groundwater	Nв	0.24	mg/L	Subsection 2.11
Wastewater Volume	V_W	7,000	gpd	Subsection 2.12

mg/L = milligrams per liter

gpd = gallons per day

ft² = square feet

2.1 Nitrate Concentration in Precipitation (*N_R*)

Precipitation contains a small amount of nitrate from anthropogenic and natural sources. The default value for N_R of 0.24 milligrams per liter (mg/L) from DOH (2021) was used in the LOSS model.

2.2 Total Nitrogen Concentration in Wastewater (*N_W*)

The total nitrogen concentration in wastewater (N_W) used in the LOSS model is 24 mg/L. This value reflects the DOH (2021) default value for residential strength nitrogen concentration in wastewater (60 mg/L)² reduced 60 percent by treatment. Oregon Cascade plans to achieve the 60 percent reduction by using a single stage AdvanTex system.

2.3 Soil Denitrification (*d*)

After discharge from the septic drainfield, denitrification in soil reduces the nitrate concentration that reaches groundwater. The default value for *d* of 10 percent from DOH (2021) was used in the LOSS model.

2.4 Aquifer Thickness (b)

The alluvial aquifer in McKenzie Bridge, Oregon, is characterized by a saturated thickness of over 75 feet (see well log LANE 70704, located at the Upper McKenzie Rural Fire Protection District Facility adjacent to the Oregon Cascade property, and included in Attachment A). However, the DOH (2021) guidance requires that the maximum aquifer thickness that can be used for modeling purposes is 20 feet. Therefore, a value for *b* of 20 feet was used in the LOSS model.

2.5 Drainfield Area (A_D)

The available area for the drainfield is 26,136 square feet (ft²), as shown on the site plan provided by Civil West (see orange-hatched area in Attachment B). A drainfield area of 20,000 ft² was used in the LOSS

² For systems that do not have advanced treatment and are not treating high strength waste.

model based on a 10 foot spacing between laterals, and a lateral length of 45 linear feet per 150 gallons per day capacity (Civil West, 2023a).

2.6 Distance from Drainfield to Downgradient Property Boundary (*D*_{pb})

Groundwater at Oregon Cascade flows north, towards the McKenzie River. The distance from the septic drainfield to the downgradient (northern) property boundary (see Figure 1) was measured based on the site plan provided in Attachment B. A distance of 782 feet for *D*_{pb} was used in the LOSS model.

2.7 Aquifer Width (*W_A*)

Groundwater at Oregon Cascade flows north, towards the McKenzie River. As shown in Figure 1, the aquifer width, which is equivalent to the width of the drainfield perpendicular to the groundwater flow direction, was estimated to be 220 feet based on the site plan provided in Attachment B.

2.8 Aquifer Hydraulic Conductivity (*K*)

Hydraulic conductivity is a property of porous materials that describes how easily fluid moves through the pore space, and is correlated with soil type in the aquifer (e.g., clay, silt, sand, or gravel). According to well log LANE 70704, located at the Upper McKenzie Rural Fire Protection District Facility adjacent to the Oregon Cascade property (Attachment A), the aquifer consists of gravels and coarse sand. A well test at this well indicated that the aquifer is characterized by a high hydraulic conductivity (i.e., the well produces groundwater at a rate of 200 gallons per minute).

A hydraulic conductivity of 1,000 feet per day was used in the LOSS model, which is the median hydraulic conductivity for a gravel in Table 3.3 of Anderson and Woessner (1992).

2.9 Hydraulic Gradient (*i*)

The hydraulic gradient (*i*) is the slope of the water table. The default value of 0.01 for hydraulic gradient from DOH (2021) was used because no groundwater elevation contour maps or groundwater elevation measurements were available to determine a site-specific hydraulic gradient.

2.10 Recharge (R)

Recharge is the amount of precipitation that infiltrates into the aquifer. USGS (2005) indicates that recharge in the study area is in the range of 26 to 30 inches per year. A value of 28 inches per year (the midrange value) was used in the LOSS model.

2.11 Nitrate Concentration of Upgradient Ground Water (N_B)

Groundwater at Oregon Cascade flows north, towards the McKenzie River. The area upgradient (i.e., south) of Oregon Cascade is undeveloped. No nitrate concentration data are available upgradient of Oregon Cascade. Therefore, we conservatively assumed that the upgradient concentration of nitrate in groundwater was equal to the nitrate concentration in rainwater recharging the aquifer (i.e., 0.24 mg/L).

2.12 Wastewater Volume (*V_w*)

Civil West developed a wastewater volume estimate for Oregon Cascade (Civil West, 2023b), and staff from the Oregon Department of Environmental Quality provided feedback about the volume estimate (DEQ, 2023). The wastewater volume estimate is 7,000 gallons per day.

3. Model Output (N_{GW ALT})

Output from the LOSS model is provided in Attachment C. The output of the LOSS model is the nitrate concentration in groundwater at the downgradient property boundary (called " N_{GWALT} " in Attachment C). The

nitrate concentration in groundwater at the downgradient property boundary calculated by the LOSS model is 0.67 mg/L.

4. Conclusions

While the 0.67mg/L potentially represents an increase above background nitrate concentrations (recall that the upgradient nitrate concentration is *assumed* to be 0.24 mg/L), it should be noted that the increase is minimal. The existing septic system at Oregon Cascade RV is a standard system that offers little nitrate reduction. The new system should significantly reduce current impacts to groundwater.

5. References

Anderson, M. P. and W. W. Woessner. 1992. Applied Groundwater Modeling: Simulaton of Flow and Advective Transport. Academic Press, San Diego, California, 381 pp.

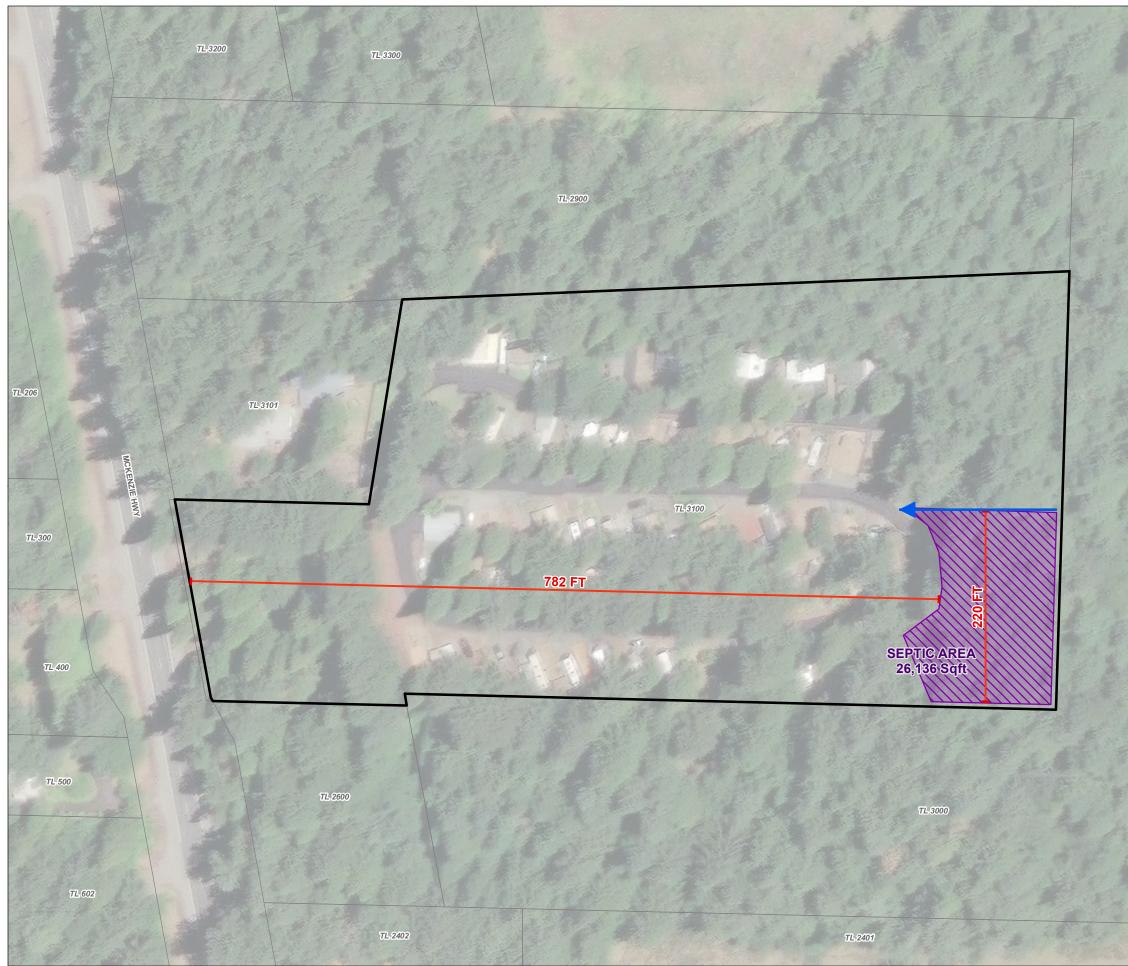
Civil West. 2023a. RE: Oregon Cascade Coop – 56640 McKenzie Hwy Drainfield Replacement. Email from Tim Gross (Civil West) to Matt Kohlbecker (GSI Water Solutions) and Shawn McFadden (Oregon Cascade). May 30.

Civil West. 2023b. RE: Oregon Cascade Coop – 56640 McKenzie Hwy Drainfield Replacement. Email from Tim Gross (Civil West) to Daniel Wiltse (Oregon Department of Environmental Quality). January 11.

DEQ. 2023. RE: Oregon Cascade Coop – 56640 McKenzie Hwy Drainfield Replacement. Email from Dan Wiltse (Oregon Department of Environmental Quality) to Tim Gross (Civil West). January 18.

DOH. 2021. Level 1 Nitrate Balance Instructions for Large On-Site Sewage Systems.

USGS. 2005. Groundwater Hydrology of the Willamette Basin, Oregon. Scientific Investigations Report 2005-5168. 95 pp.



Document Path: Y:\2055_Oregon_Cascade_RV\Source_Figures\Figure1_Site_Overview.mxd, wkimmon



-ATTACHMENT A----

Upper McKenzie Rural Fire Protection District Well Log (LANE 70704)

LANE 70704

Lane 70704

STATE OF OREGON WATER SUPPLY WELL REPORT

(as required by ORS 537.765)

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WELL I.D. # L 100545

START CARD # 206451

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LANE 70704

STATE OF OREGON WATER SUPPLY WELL REPORT

(as required by ORS 537.765)

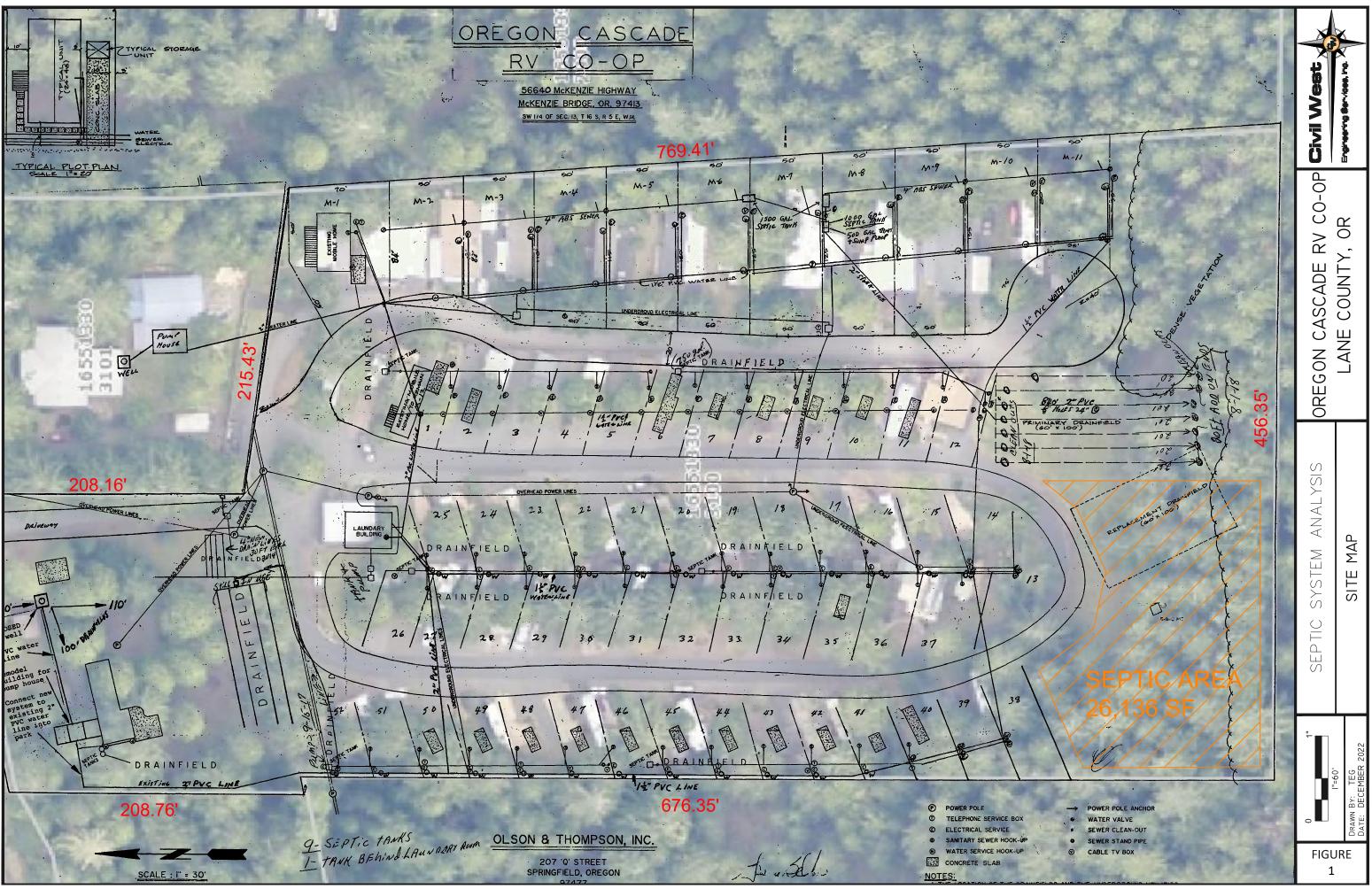
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	FORATIC forations	DNS/SCF	REENS Method	tool								
					Mat	terial						
	CCIIS		Type <u>s</u>		Ivia			Date Started 8-17-1	0Co	mpleted 8-	31- <u>10</u>	
From	To		Number	Diameter		e Casing	Liner	(unbonded) Water	Well Constructor (ertification		
65'	72'	Size	35	8"	size			I certify that the	work I performed or	the construct		
72'	98'		130	8"	pipesize			abandonment of this				
98'	102'		20	8"	pipesize			construction standard the best of my knowl		nd informatio	on reported ab	ove are true to
						□		the best of my know	euge and bener.			
								WWC Number		Date		
(8) WEL	L TESTS	: Minim	um testi	ng time i	s 1 hour							
🗌 🔽 Pur	np 🗌	Bailer	🗆 Ai		☐ Flowin	g Artesian		Signed				
Yield	gal/min	Drawd	lown	Drill st	em at	Time	, ^s	(bonded) Water We	Il Constructor Cer	tification		
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well ou		may fluc			CEIV	FD		supply well construct				
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	ORIG	INAL – W	ATER RE	SOURCE	S DEPART	MENT	FIRS	COPY - CONSTRUC	CTOR SEC	OND COPY	- CUSTOME	R 06/16/2004

-ATTACHMENT B----

Oregon Cascade RV LOSS Site Plan



-ATTACHMENT C-----

LOSS Model Results





Project name: Cascade RV Address, city and county: McKenzie Bridge, Lane County, Oregon Completed by (name and title): M. Kohlbecker (Principal Hydrogeologist) 5/26/2023 Date:

Input Values	Factor	Units	Values	Instructions	Information Source
Nitrate concentration in precipitation	N _R	mg/l as N	0.24	Default	Default from DOH (2021)
Total nitrogen concentration in wastewater	Nw	mg/l	24.0	Default - residential strength	Default from DOH (2021) (60 mg/L) reduced by 60% by Orenco AdvanTex
Soil denitrification	d	unitless	0.1	Default	Default used
Aquifer thickness	b	ft	20	Default or aquifer thickness if known	Default used, max allowable is 20 feet per guidance. Saturated thickness of
Drainfield area	AD	ft ²	20,000	Primary drainfield area	From site plan (see Attachment B), 10 foot spacing between laterals, and la
Distance from drainfield to property boundary	D_{pb}	ft	782	Measure in direction of GW flow	From Google Earth/site plan
Aquifer width	WA	ft	220	Perpendicular to GW flow	From site plan
Aquifer hydraulic conductivity	κ	ft/day	1,000	Measured or literature value	Slightly less than the median for a gravel (Anderson and Woessner, pg. 40,
Hydraulic gradient	i	ft/ft	0.010	lf unknown, use 0.01	Default from DOH (2021)
Recharge	R	in/yr	28.00	Recharge will be a % of ppt	From USGS groundwater hydrology report (Figure 12, https://pubs.usgs.gov midrange of the 26 to 30 inches per year range)
Nitrate concentration of upgradient ground water	N _B	mg/l	0.24	Prefer sampling data	No development to south of site. 0.24 used (nitrate concentration in precip)
Wastewater volume	v _w	gpd	7,000	Design flows or measured volume	System Design

Output Values		
Groundwater nitrate value	N _{GW} mg/l as N	0.68 Point of Compliance (POC)
Groundwater nitrate value	N _{GW ALT} mg/I as N	0.67 Alternative POC

DOH 337-070

Revised: May 2021

Large On-Site Sewage System (LOSS) LEVEL 1 NITRATE BALANCE

s of aquifer is over 75 feet (see Attachment A) l lateral length of 45 feet per 150 gpd

40, Table 3.3, 1992)

gov/sir/2005/5168/pdf/sir2005-5168.pdf,

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