Comments to the Pilot Test Report Boeing Field Chevron, June 15, 2024, prepared by G-Logics.

Comments on Pilot Test Implementation.

As requested in Ecology's previous comments, a Deviations from Pilot Test Workplan (Workplan) discussion was added as Section 5.1 to the Pilot Study Report. The most significant deviation from the Workplan was that total liquids extraction events were not performed from the Upper Saturated Zone (USZ) (e.g., from well IP-4 or other wells).

Per a Regenesis product sheet for RegenOx PetroCleanze™ included in the Workplan,

> "*The primary function of RegenOx PetroCleanze is to increase the desorption rates of hydrocarbons bound in saturated soil and make them available for more efficient and rapid treatment using enhanced recovery technologies.*"

And from the PetroCleanze™ Technical Description in the Workplan (underlining for emphasis)

> *"PetroCleanze is a patented alkaline surface catalyst system that is applied with RegenOx® oxidizer complex (RegenOx Part A). Like RegenOx, PetroCleanze stimulates the rapid chemical oxidation of contaminants in situ. A further benefit is the generation of surfactants from the partial oxidation of hydrocarbons. Surfactants are formed upon alkaline oxidation of linear or branched hydrocarbons contaminants, which assist in the desorption of more contaminants from soil. <u>This process enhances the ability to physically remove hydrocarbons from the contaminated subsurface by extraction or other methods</u>."*

As described in the Pilot Test Report, three injection events were performed in the vicinity of USZ well IP-4. Injections targeted this area because, as stated in Section 4.0 of the report, the "high concentrations of GRO, DRO, and benzene in the groundwater at monitoring well IP-4 suggested the presence of LNAPL or anomalously high levels of residual petroleum entrained in soil near that well." Given the primary function of PetroCleanze™ is to increase desorption of hydrocarbons for physical removal of contaminant mass, a pilot test with injections of PetroCleanze™ would likely include extraction events from the same saturated zone (e.g., USZ) and area of the site as the injections were performed (near or from IP-4).

In general accordance with the Workplan, the total liquids extraction events were performed several weeks (one was 4 weeks late) to months after each round of injections (three injection events and three extraction events total). **However, the total liquids extractions were only conducted at a Lower Saturated Zone (LSZ) well, IP-7, located more than 32 feet from the nearest injection point from each injection event.**

Section 5.1 of the Pilot Test Report states

> *"Fluid extraction events were not performed at well IP-4 as presented in the Pilot Test Workplan because LNAPL did not accumulate in the well during the pilot test. Total fluids extraction was scoped in the Pilot Test Workplan for points where LNAPL was observed."*

These sentences are only true for wells other than IP-4. According to the Workplan (Section 4.2), total liquid extractions were to be performed at IP-4 for a given time or volume recovered; and at any well in which LNAPL was measured, with the volume being limited to that required to remove the LNAPL from the well. Excerpts from Section 4.2 of the Workplan:

Section 4.2 Total Liquids Extraction of the Workplan (underlining for emphasis):
First paragraph:

> *"As part of each extraction event, water and LNAPL accumulated in well IP-4 and in other wells in which LNAPL is observed will be removed using a truck-mounted vacuum or pump unit. Water and LNAPL levels will be evaluated at each well in the pilot test monitoring program prior to initiation of total liquids extraction during each of the three planned events. If LNAPL is observed accumulated in other wells at the site, then additional total liquids extraction will be performed at those wells."*

Second paragraph:

> *"Total liquids will be removed from well IP-4 for a period of approximately 2 hours, or until 450 gallons of liquid are removed from the well, whichever occurs first."*

Third paragraph:

> *"For wells other than well IP-4 in which LNAPL is observed during each total liquids extraction event, total liquids will be removed using a vacuum or pump truck using a similar procedure as described for well IP-4 above. Note that total liquid volumes removed from these wells will be limited to the volume needed to complete removal of the accumulated LNAPL."*

Wells other than IP-4: LNAPL was measured in well IP-7 during the baseline monitoring event prior to the injections, and in gauging events throughout the pilot test, including the extraction events at the well. The presence of LNAPL in well IP-7 did not appear to be influenced by the injections of PetroCleanze™. LNAPL did not accumulate in a measurable thickness in any of the other wells included in the pilot test monitoring well network. Therefore, no total liquids extractions were performed from other wells.

Measurable LNAPL thicknesses were observed in well IP-7 during each extraction event. Per the Pilot Test Report, the total liquid extractions from IP-7 during each event ranged from 500 to 550 gallons, which is higher than the 450 gallons of liquids to be removed (per the Workplan) from well IP-4 after each injection event. According to the fifth bullet of Section 5.0 in the report, a hand-bailer was used to remove LNAPL from well IP-7 prior to sampling groundwater from the well. Why 500 to 550 gallons of liquids had to be extracted from well IP-7 to remove the LNAPL in the well during the extraction events is not clear. Additionally, high volume recovery (500+ gallons/event) from IP-7 in the LSZ versus recovery from IP-4 in the USZ, potentially spread out the injected materials that had reached the LSZ (based on IP-3 and IP-5 field data), reducing the effectiveness of the injected materials near IP-4 in the USZ, which was the target area of the pilot test.

Related to the question of which wells were extracted from, the comment in the first bullet of Section 7.0 that "*extracting groundwater at well IP-4 in the absence of LNAPL would have generated large volumes of groundwater containing high concentrations of dissolved-phase hydrocarbons and would unnecessarily increase disposal costs*" is odd, as the primary function of PetroCleanze™ is to increase desorption of contaminant mass for the purpose of physically removing groundwater containing high concentrations of hydrocarbons. Also, the total liquids extracted from well IP-7 likely contained LNAPL and high dissolved phase concentrations.

Comments on Field Water Quality Observations.

Several sections in the Pilot Test Report include discussions of water quality field measured parameters (e.g., pH and conductivity in Section 6.4) and visual observations (purge water color in Section 6.6) which may have indicated that PetroCleanze™-related reactions were occurring in the saturated zone around specific wells.

See attached table for a summary of water quality measurements; GRO, DRO, and Benzene concentrations; purge water color and indications of hydrocarbons observations; and distances the wells were from the closest injection points prepared from data presented in Pilot Study Report Tables and Appendices. Cells are shaded in the table to indicate qualitative or semi-quantitative indications of changes that could be due to PetroCleanze™-related reactions.

From Section 6.4 Groundwater Field Parameters

- *"As shown in Chart D-8, the highest pH measurements for the pilot test target wells occurred during the February 2023 progress groundwater monitoring event, almost 3 months after the last injection event in December 2022. In February 2023, some of the highest pH readings were measured at Upper Saturated Zone wells TW-1, TW-4, TW-5, and Lower Saturated Zone wells IP-3 and IP-5. This condition could suggest the presence of the injectate at those wells, which could cause the degradation or mobilize petroleum hydrocarbons. However, statistically, concentrations of GRO, DRO, and benzene at Upper Saturated Zone well TW-5 and Lower Saturated Zone wells IP-3 and IP-5 remained stable over time. In contrast, concentrations of GRO are shrinking over time at well IP-4 even though pH readings are relatively stable with time compared to pH readings at wells TW-4 and TW-5. Since wells IP-4, TW-4, and TW-5 are similar in distance from the injection points, pH in this instance does not appear to be a solid indicator for the presence of the injectate."*
    - Please make correction in text that the February 2022 event was 2 months after the last injection event in December 2023, not 3 months.
- *"Changes in pH during the life cycle of the pilot test appear to be affected more by the changes in groundwater elevations than by the introduction of the injectate into the Upper Saturated Zone. Furthermore, the magnitude, direction, and permanence of the pH changes are dependent on several factors, such as the buffering capacity of the aquifer material, the amount and type of contaminant oxidized, and the mass of the oxidant. These factors are variable throughout a saturated zone. In consultation with Regenesis, introducing the injectate into the groundwater should have increased the pH into the alkaline range (i.e., 10 to 12) compared to baseline conditions. Regenesis suggested that the absence of alkaline conditions in the groundwater may indicate that the oxidant component of injectate was spent by the time the progress groundwater monitoring event was performed or the oxidant demand of petroleum hydrocarbons overwhelmed the injectate, limiting its effectiveness."*
- *"As shown in Chart D-9, the highest electrical conductivity readings for pilot test target wells, except for Upper Saturated Zone wells IP-4, TW-4, and AS-1, occurred during February and April 2023 progress groundwater sampling events. The increases occurred 2 to 4 months after the last injection event on December 2022. The high conductivity readings that occurred in February and April 2023 at Upper Saturated Zone well TW-5 and Lower Saturated Zone wells IP-3 and IP-5 may suggest the presence of the injectate at those wells. This condition could cause the degradation or mobilization of petroleum hydrocarbons. However, since concentrations of GRO, DRO, and benzene at wells TW-5, IP-3, and IP-5*

remain statistically stable over the life cycle of the pilot test, injectate appears to have had no substantial impact on petroleum hydrocarbon at those wells. In contrast, Upper Saturated Zone well IP-4 showed little change in conductivity readings, but GRO and benzene concentrations statically shrank during the pilot test. The increase in conductivity at Lower Saturated Zone wells IP-3 and IP-5 may also result from an influx of salt water from the Duwamish River in the Lower Saturated Zone at the time of sampling. There was an extremely high tide event (9 to 10 feet of change) at the time of sampling at wells IP-3 and IP-5. In consultation with Regenesis, they suggested an increase in electrical conductivity compared to baseline measurements may indicate the presence of salts released from the injectate but does not necessarily indicate the oxidant in the injectate is reacting in the groundwater to degrade petroleum hydrocarbons."

Comments – the February 22-23, 2023 event was approximately 2 months after the December 20, 2022 injection event. As shown in the attached summary of pilot test field and laboratory data, the pH measurements in wells TW-1, TW-4, TW-5, IP-3, and IP-5 in February 2023 ranged from 9.31 (TW-1) to 10.38 (IP-5). Comparing these values to baseline measurements in August 2022 ranging from pH 5.89 (IP-5) to 6.73 (TW-4), there was a significant change from slightly acidic (pH < 7) to alkaline (pH > 7) conditions, with one value above pH 10. As shown in the table, pH values for 140 measurements reported in the RI Report (Table 7) ranged from pH 5.88 to 7.09, with an average of pH 6.46; the baseline pH data agrees with this data. As noted in a Regenesis PetroCleanze™ "White Paper" [1], PetroCleanze reactions in the saturated zone result in temporary alkaline conditions. Field measurements are consistent with that, as measured pH in the wells decreased after the February 2023 event.

Electrical conductivity values also spiked between the August 2022 baseline event and the February 2023 event, in wells AS-1, TW-4, TW-5, IP-3, and IP-5. Most notable changes were in USZ well TW-5 (829 to 7,786 µS/cm) and LSZ well IP-5 (222.8 to 4,682 µS/cm). Conductivity values reported in the RI Report ranged from 166 to 1,295 µS/cm with an average of 520 µS/cm. Whether or not the change in tidal conditions during the February 2023 sampling event for IP-3 and IP-5 could have resulted in an influx of salt water and increased conductivities in the LSZ wells, that would not explain the similar increases in the USZ wells, nor why the elevated electrical conductivities were sustained in the LSZ wells through July 2023.

Discussion of the concentration trends for GRO, DRO, and benzene, including statistical trend analysis with the Mann-Kendall tests, as presented do not seem to reflect the results. The data indicate that there are significant decreases or increases in concentrations for one or more analytes and wells, however, in several cases stable trends were reported, potentially because of the small data sets (up to five sampling results). In well TW-5, GRO decreased from 214,000 ug/L in August 2022 to 150,000 ug/L in April and July 2023, and DRO decreased from 8,850 in August 2022 to 3,400 µg/L by July 2023, yet a stable trend is reported for both constituents. In well IP-3, between August 2022 and February 2023, GRO increased from 4,450 ug/L to 29,000 ug/L, DRO increased from 306 to 2,100 µg/L, and benzene increased from 1,080 to 3,100 µg/L, yet all three were reported as stable trends. The decrease in concentrations at TW-5 for some constituents could indicate effectiveness of the ISCO reactions to treat GRO and DRO impacts, while the increases in well IP-3 (and in IP-5) could be a sign that more contaminant mass was made available by the

[1] https://regenesis.com/en/techinfo/petrocleanze-white-paper/

detergent-like effect of PetroCleanze™, but insufficient oxidant was available to treat the contaminants.

Note – some of the Mann-Kendall statistical outputs are missing from the Pilot Test Report appendices – please include these in the final report.

From Section 6.6 Field Observations

- *"At the start of purging, the color of the water discharged from Upper Saturated Zone wells TW-1, TW-4, TW-5, and AS-1 and from Lower Saturated Zone wells IP-3 and IP-5 was sometimes described as amber or brown. In consultation with Regenesis, the amber and brown colors may represent an emulsion of surfactant and fine petroleum hydrocarbon droplets or the formation of precipitates (e.g., metal oxyhydroxides). An emulsifier acts like a detergent, dissolving the oil into the water. Instead of an oil layer on top of the water, there are dissolved oil and fine immiscible oil droplets in the water. The surfactant dissolves the oil and disperses it throughout the water column rather than allowing it to float on the surface (ITRC 2024a). The color of the water may also indicate the presence of non-petroleum precipitates in the water created from the presence of oxidant and salts from the injectate."*

Comments – Continuing from previous comments, Ecology agrees that the observations of highest pH occurred in February 2023 and electrical conductivity in February and April 2023 in USZ wells TW-1, TW-4, TW-5, and LSZ wells IP-3 and IP-5. The electrical conductivity in well AS-1 was highest in the September 2022 and April 2023 events. Purge water color observations in these wells also included shades of orange, amber, red rust, and/or brown during these sampling events, providing another line of evidence that the changes in pH, conductivity, and water color point to injectate related reactions. The September 2022 observations in AS-1 that included changes in water color are of note as that event was 20 days after the first injection event, with an injection point approximately 7.6 feet from the well. A response was not observed in September 2022 in well TW-4, which was located approximately 8.4 feet from an injection point. However, a water color response was observed at TW-4 in February 2023, with the nearest point from the third injection approximately 5.3 feet away.

LSZ wells IP-3 and IP-5 were located even closer to first round injection points, approximately 4.7 and 5.3 feet respectively. However, these wells were not scheduled for groundwater sample collection until later in the program, in accordance with the Workplan.

The injection volume per location (per Section 5.0 of the Pilot Test Report) ranged 360 to 375 gallons. Over a 3-foot vertical injection interval and assuming 10% effective porosity, the injection fluids could have traveled approximately 7.15 to 7.3 feet in a homogeneous horizontal/vertical distribution. Under injection pressures and/or preferential flow paths, the injectate may have traveled further (e.g., reaching well AS-1 at 7.6 feet, but not to TW-4 at 8.4 feet).

The closest injection to well IP-4 was during the second injection event at 8.6 feet. During the third injection event, the closest point was 10 feet away. In contrast, wells TW-4 and TW-5 were 5.3 and 6.0 feet, respectively, from the nearest injection point during the third event. It appears that IP-4 was too far from the injection points for the PetroCleanze™ injectate and associated reactions to be observed in the well, and/or the oxidant was consumed prior to reaching the well. The lack of pH, electrical conductivity, or water color changes in one well (IP-4) does not discredit the responses seen in 5 other wells. Given the statements in Section 6.6 that the detergent-like effects would

result in dissolved-phase hydrocarbons, not a free phase oil layer on top of the water, it is not unexpected that LNAPL did not accumulate in the well.

Comments on Pilot Test Outcome.

As discussed above, PetroCleanze™ is designed to enhance physical recovery of contaminant mass. The physical recovery of liquid from the saturated zone in which PetroCleanze™ was injected (USZ) did not occur, indicating that the pilot test was not conducted in accordance with the Workplan. Therefore, the pilot test also did not fully test the potential for PetroCleanze™ to act as a surfactant to enhance physical recovery of contaminant mass from the USZ, and thereby reduce remaining residual impacts. Any conclusions in the text (e.g., Section 10.0) regarding the effectiveness of PetroCleanze™ as a surfactant or for its inclusion in the remediation strategy for the site are not fully substantiated based on the information provided from the pilot test.

Sections 6.4 and 6.6 indicate that Regenesis was consulted for interpretation of field water quality observations from the pilot test. Was Regenesis also consulted for opinion(s) on what effect(s) not conducting total liquids extractions from the USZ near the PetroCleanze™ injections had on the pilot test outcome? Please include in the revised Pilot Test Report.

However, the pilot test did inadvertently test whether ISCO alone would be effective for treating the contaminant mass around well IP-4. As noted from the Technical Description, the PetroCleanze™ mode of action includes in situ chemical oxidation (ISCO) reactions based on the Regenesis RegenOx oxidizer complex, which, through partial oxidation of contaminants creates the surfactants which assist in desorption of more contaminants. These reactions, including chemical oxidation and potentially destruction of some of the petroleum hydrocarbon contaminant mass, would have occurred with or without the physical extraction events. Whether the desorbed contaminants would eventually resorb to saturated soil or be potentially transported outside of the initial impact area, is currently unknown pending future monitoring.

As discussed in the Pilot Test Report, the contaminant mass present before the injections plus any additional mass resulting from the PetroCleanze™ desorption reactions, may have overwhelmed the oxidative properties of the injected oxidant. This is not surprising, given the high concentrations of GRO, DRO, and benzene in well IP-4 and other USZ wells. Elevated contaminant mass was a stated reason in the second bullet of Section 3.0 Pilot Test Approach for not injecting PetroCleanze™ into the LSZ:

> *"Pilot test injection into [the LSZ] was not expected to provide meaningful results because the larger contaminant mass within the Lower Saturated Zone was too large and stoichiometrically incompatible with even a full-scale ISCO injection program."*

Since extractions were not conducted in the USZ, it is unknown whether conducting three injection-extraction events per recommendations provided by Regenesis (in the Workplan appendix) would have removed some of the initial higher contaminant mass desorbed from soil to result in decreases in residual hydrocarbons and sustained dissolved phase concentrations in the USZ wells.

Additionally, recovery from the LSZ well IP-7 may have limited the effectiveness of the injected materials in the USZ by spreading them out beyond the intended pilot test area and saturated zone. With that being said, the implementation of this pilot test was not conducted in a way that leads to sufficient certainty of the effectiveness of the PetroCleanze™ injected materials at this site.

Groundwater Concentration and Pilot Test Field Parameter Data
Boeing Field Chevron

Well	Date	pH	Conductivity (µS/cm)	Temp (deg C)	ORP (mV)	DO (mg/L)	GRO (µg/L)	DRO (µg/L)	Benzene (µg/L)	Initial Purge Water Color Observation	Petroleum Observation	Distance to Most Recent / Closest Injection Point (feet)	Distance to Injection Points by Event 1, 2, 3 (feet)
Upper Saturated Zone Wells													
AS-1	4/17/2019	6.49	589	13.1	71.1	0.4	4,150	270	702	*Results shown for comparison to Aug 2022*		--	--
AS-1	8/15/2022	6.6	900	17.1	-0.9	0.54	474	617	5.98	clear	--	--	--
AS-1	9/27/2022	7.67	3,254	17.5	-240.4	0.1	5,960	3,990	109	opague orange/red rust color	--	Inj 1 - 7.6	7.6 ft
AS-1	2/23/2023	7.85	2,679	10	-258.9	8.09	9,200	4,400	43	grayish brown	organic odor	Inj 3 - 7.3	5.9, 7.3 ft
AS-1	4/25/2023	7.01	3,343	12.2	-73.3	0.68	3,000	< 450	16	very dark brown then reddish-brown	petro odor	Inj 3 - 7.3	--
AS-1	7/20/2023	7.23	2,554	16.5	520.9	0.41	2,900	720	25	grey cloudy	odor	Inj 3 - 7.3	--
IP-4	8/15/2022	6.53	992	16.6	-115.5	0.32	126,000	9,500	54.6	clear	odors present	--	--
IP-4	9/27/2022	6.66	1,100	17.3	-134.7	0.16	114,000	17,300	47.2	opaque	--	Inj 1 - 8.7	8.7
IP-4	2/23/2023	7.34	1,071	8.5	-98.5	8.06	63,000	3,300	27	clear	petro odor	Inj 3 - 10	8.6, 10
IP-4	4/25/2023	6.77	1,838	12.5	-56.1	0.43	57,000	< 4,500	26	clear	petro odor	Inj 3 - 10	--
IP-4	7/20/2023	6.7	1,000	16.4	368.4	0.7	66,000	6,300	41	clear	petro odor sheen	Inj 3 - 10	--
TW-1	2/22/2023	9.31	1,259	8.9	37.7	7.2	<100	130	< 0.20	brown cloudy	no odor	Inj 3 - 7.0	13.3, 14.8, 7.0
TW-1	4/24/2023	8.39	1,510	11.5	80.1	3.08	<100	< 210	< 0.20	orangey brown cloudy	no odor, no sheen	Inj 3 - 7.0	--
TW-1	7/19/2023	8.13	1,593	18.5	450.6	0.69	<100	230	0.33	brown cloudy	no odor	Inj 3 - 7.0	--
TW-2	2/22/2023	7.82	1,517	8.3	89.7	16.09	100	110	0.24	cloudy then clear	--	Inj 3 - 18.2	24.4, 25.4, 18.2
TW-2	4/24/2023	7.05	1,667	11.3	106.9	6.56	330	< 210	< 0.40	clear	no odor, no sheen	Inj 3 - 18.2	--
TW-2	7/19/2023	6.9	1,428	20.2	497.3	1.72	7,400	170	1.3	clear went dry	--	Inj 3 - 18.2	--
TW-3	2/22/2023	6.82	954	9.8	-134.1	8.25	14,000	4,800	2800	clear	petro odor	Inj 3 - 33.2	31.7, 28.8, 33.2
TW-3	4/24/2023	6.52	1,364	12.1	-86.2	0.6	13,000	< 3,700	2400	clear	no odor, no sheen	Inj 3 - 33.2	--
TW-3	7/19/2023	6.75	1,318	20.7	325.5	0.59	NS	NS	NS	clear went dry	no odor	Inj 3 - 33.2	--
TW-4	8/15/2022	6.73	864	18.2	-54.9	0.6	139	561	< 0.44	clear	--	--	--
TW-4	9/27/2022	6.73	734	18	-88.1	0.26	133	381	< 0.44	clear	--	Inj 1 - 8.4	8.4
TW-4	2/22/2023	9.52	1,441	10	-7.3	9.17	< 100	< 120	< 0.20	slightly cloudy and cloudy, brown	--	Inj 3 - 5.3	10.3, 5.3
TW-4	4/24/2023	7.84	1,406	12.4	-35.2	7.34	< 100	< 230	< 0.40	very brown cloudy	petro odor	Inj 3 - 5.3	--
TW-4	7/19/2023	7.5	1,640	19.6	299.2	0.47	< 100	120	< 0.20	brown cloudy	no odor	Inj 3 - 5.3	--
TW-5	8/15/2022	6.62	829	16.6	-87.9	1.18	214,000	8,850	351	clear	slight odor	--	--
TW-5	9/27/2022	6.42	812	17.2	-147.9	0.25	178,000	8,520	258	clear	--	Inj 1 - 9.9	9.9
TW-5	2/22/2023	9.78	7,786	10.3	-428.6	5.47	140,000	9,200	220	cloudy brownish-red then dark amber color	petro odor	Inj 3 - 6.0	7.0, 6.0
TW-5	4/24/2023	8.74	7,506	12.8	-383.6	0.25	150,000	< 4,400	220	dark brown cloudy	petro odor	Inj 3 - 6.0	--
TW-5	7/19/2023	8.87	3,958	16.8	-246.3	0.26	150,000	3,400	340	slightly brown cloudy	slight odor sheen	Inj 3 - 6.0	--
Lower Saturated Zone Wells													
IP-3	8/15/2022	6.35	400	15.9	-37.1	0.24	4,540	306	1,080	clear	--	--	--
IP-3	2/23/2023	9.39	3,353	10.4	-319.4	13.05	29,000	2,100	3,100	grayish brown	strong petro odor	Inj 3 - 2.5	4.7, 4.4, 2.5
IP-3	4/25/2023	7.75	3,526	13.6	-133.5	0.35	21,000	< 930	2,100	clear	petro odor	Inj 3 - 2.5	--
IP-3	7/20/2023	7.44	3,342	15.4	237.2	0.55	20,000	1,600	1,100	clear	petro odor	Inj 3 - 2.5	--
IP-5	8/15/2022	5.89	222.8	15.5	31	0.34	13,200	625	1,940	clear	--	--	--
IP-5	2/22/2023	10.38	4,682	11.8	-147.9	7.2	21,000	3,400	3,000	grey, cloudy then amber	petro odor sheen	Inj 3 - 4.1	5.3, 7.9, 4.1
IP-5	4/24/2023	9.06	3,037	14.4	-307.1	0.29	14,000	< 2,000	1,700	slightly reddish brown cloudy	petro odor	Inj 3 - 4.1	--
IP-5	7/19/2023	7.62	2,975	16.8	268.9	0.3	25,000	2,600	4,900	dark brown cloudy then slightly cloudy	petro odor	Inj 3 - 4.1	--
IP-7	8/15/2022	NM	NM	NM	NM	NM	111,000	49,300	1,040		LNAPL	--	--
IP-7	2/23/2023	6.58	501	11.4	-103.9	14.14	82,000	16,000	850	clear	LNAPL, strong odor	Inj 3 - 32.5	37.6, 39, 32.5
IP-7	4/25/2023	6.32	679	13.3	-15.5	0.45	53,000	< 2,200	450	clear	petro odor sheen	Inj 3 - 32.5	--
IP-7	7/20/2023	6.52	574	17.3	398.6	0.54	54,000	4,000	840	clear	petro odor sheen	Inj 3 - 32.5	--

Statistic	pH	Cond
Minimum	5.88	166
Maximum	7.09	1295
Average	6.46	520

Values from Table 7 of RI Report (Oct 2020) - 140 pH and 143 conductivity measurements. 3 statistical outliers for pH removed.

Event	Date
Injection #1	9/7/2022
Injection #2	10/18/2022
Injection #3	12/20/2022

Extraction #1	10/7/2022
Extraction #2	12/16/2022
Extraction #3	1/20/2023

Indicates potential increase in pH or Conductivity; or slight decrease in GRO, DRO, or benzene concentration.

Indicates increase in pH or Conductivity; or decrease in GRO, DRO, or benzene concentration; or injection within approximately 7 to 8 feet of the well.

Indicates increase in GRO, DRO, or benzene concentration (light yellow for slight increase) or presence of sheen or LNAPL in a well.

Indicates observation of amber/orange/brownish colored water in well that may indicate presence of PetroCleanze related reactions.

Gray indicates hydrocarbons in the gasoline range (toluene-naphthalene) are present in the DRO sample results.