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Project name:

2021 Foreshore Monitoring and
Sampling Program

Project Ref:

60653584

From:

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Date:

January 26, 2022

Memo

Subject: 2021 Foreshore Passive Treatment System Maintenance and Inspection Memo

1. Introduction

AECOM Canada Ltd. (AECOM) has prepared this memo for Parkland Refining (B.C.) Ltd. (Parkland) to summarize the maintenance (placement of rock material) of the Foreshore Passive Treatment System (FPTS) on September 27, 2021. The FPTS is located along the Foreshore area of Burrard Inlet down slope from the Eastern Impounding Basin (EIB), Area 2 of the Parkland Burnaby Refinery (hereafter referred to as the "Site"). This memo also provides a summary of the results from inspections of the FPTS on June 4, August 17, and October 15, 2021. The inspection completed on March 3, 2021 was reported in the Foreshore 2020 and 2021 Monitoring Report (January 2020 - March 2021) Below Area 2 – Eastern Impounding Basin, Parkland Burnaby Refinery, Burnaby BC (AECOM, 2021). A Site Plan is included as **Figure 1**.

This memo fulfills reporting requirements in accordance with the FPTS Monitoring and Maintenance Plan (MMP) (AECOM 2017a), and to meet condition 43 in Permit 16-180 issued by the Vancouver Fraser Port Authority (VFPA 2017). Condition 43 in Permit 16-180 states "*The applicant shall provide VFPA all future environmental monitoring data and reports that are related to the Project until such time that environmental monitoring at the Project site is completed. Monitoring data and reports shall include, at minimum, monitoring as detailed in "Section 8: Performance Verification Plan" of the Applicant's Foreshore Remedial Action Plan dated October 27, 2016, within 30 days of each monitoring period. The Application shall also make monitoring reports available to Aboriginal groups and the BC MoE*". On January 22, 2018, Spencer Chaisson of VFPA responded to Leslie Southern of AECOM and confirmed that Condition 43 of Permit 16-180 has been modified to only require reporting on an annual basis, within 90 business days of the last sampling event of the year.

2. Background

The FPTS was constructed between July 10 and October 30, 2017 and was designed to be the final remedial action to address any free-phase and dissolved phase hydrocarbon and sheens at the Site. The FPTS consists of permeable subsurface treatment cells for the mitigation of free-phase non-aqueous phase liquid (NAPL) and dissolved phase hydrocarbons in porewater and contains an oleophilic biobarrier (OBB) for the prevention of sheens. The FPTS construction followed the BC Ministry of Environment and Climate Change Strategy (ENV) supported Foreshore Remedial Action Plan (AECOM 2016) and in accordance with the Construction Environmental Management Plan (AECOM 2017b). In summary, the FPTS consists of a larger Eastern section (60 m) and a smaller Western section (20 m) and consists of the following components:

- A subsurface treatment cell with Aquagate+Organoclay;
- An adjacent, down slope subsurface treatment cell with Aquagate+Powdered Activated Carbon;
- Baffles in the treatment cells;
- Contingency delivery piping into the treatment cells;
- Monitoring wells;
- A polyethylene liner to direct groundwater into the treatment cells;
- An Oleophilic Bio-Barrier; and
- Cobbles and a boulder embankment to protect the wells and other components.

In total, 33 porewater wells, divided into four distinct types (Up Gradient Wells, Performance Wells, Sentry Wells and Compliance Wells), were installed at the Site in 2017 to assess the performance of the FPTS (AECOM 2017c).

Since construction of the FPTS was completed in 2017, AECOM has completed inspections to check the integrity of the FPTS on a monthly basis until April 2018, when the frequency of inspections was reduced to quarterly.

Inspections completed at the Site over 2020 and 2021 indicated the cobble mat at the contact point between the rip rap and cobble interface was thinning. This resulted in the exposure of portions of the geogrid and geotextile layers along the northern extent of both the Eastern and Western FPTS (AECOM, 2021). During the inspections completed in December 2020 and March 2021, the rip rap which had been placed around one of the Contingency Biodegradation Points (CBP-6) was observed to have shifted exposing the base of the concrete protector (AECOM, 2021).

In April 2020, GeoWest Engineering Ltd. (GeoWest) completed a geotechnical assessment to select appropriately sized rip rap and to suggest an approach for re-instating the material. The geotechnical assessment recommended a 250 kilogram (kg) class rip rap as defined in the BC Ministry of Transportation and Infrastructure (MoTI) "2016 Standard Specifications for Highway Construction", Section 205 be used for repairs to the toe of the rip rap embankment (GeoWest, 2021). Geowest also recommended the MoTI standard be used for sourcing the rip rap as it provides guidelines for selecting quarried rock with suitable nominal particle size, gradation and durability required.

3. Objectives

The objectives for the maintenance and inspections of the FPTS were as follows:

- Place additional rock material at the contact point between the rip rap and cobble interface of both the Western and Eastern FPTS to cover exposed portions of geogrid and geotextile materials;
- Place additional rock material to cover the exposed bases of concrete well protectors of monitoring wells and Contingency Biodegradation Points (CBP) associated with the Eastern and Western FPTS;
- Monitor for the presence of NAPL in 12 select monitoring wells at the Site; and,
- Maintain the integrity of the FPTS by checking the protective rip rap and cobbles of the FPTS and managing vegetation as required.

4. Scope of Work

AECOM's scope of work for maintenance and inspections of the FPTs included the following tasks:

- Application to VFPA for a permit prior to the FPTs maintenance.
- Direct Parkland's subcontractor, Fraser River Pile & Dredge Inc. (FRPD), on the placement of rock material within the FPTs as follows:
 - Place rip rap along the contact point between the rip rap and cobble interface of the Eastern and Western FPTs to cover exposed portions of geogrid and geotextile layers.
 - Place filter rock around the following concrete well protectors that were identified to have exposed bases:
 - PW17-1
 - CBP-2
 - PW17-6
 - CBP-6
 - PW17-31.
- Monitor turbidity of Burrard Inlet in the vicinity of the work area at the Site.
- Inspect components of the FPTs, including the protective rip rap, protective cobbles, monitoring wells and vegetation and make repairs as necessary.
- Inspect and gauge 12 select porewater monitoring wells during quarterly inspections at the Site to confirm presence/absence of NAPL using an oil/water interface probe along with the collection of combustible headspace vapours using a flame ionization detector (e.g. Eagle RKI).
- Prepare this memo summarizing the maintenance of the FPTs and inspections completed after March 2021.

4.1 Modifications to the Scope of Work

Modifications to the scope of work detailed above included:

- The work was scheduled to begin at 7:00 am on September 27, 2021. However, due to poor weather conditions on the evening of September 26, 2021, equipment was removed from the barge that night and reloaded the following morning, thus delaying the start of work to 9:00 am on September 27, 2021. As a result of the delayed start, the majority of rip rap, and the filter rock placed along the south of three Sentry wells of the Eastern FPTs was placed in the wet as the tide came in, at depths ranging between approximately 0.5 -1.0 m.
- Filter rock was placed around four additional concrete well protectors that were identified to have exposed bases by AECOM on September 27, 2021:
 - CBP-8
 - PW17-18
 - PW17-23
 - CBP-16
- Following the completion of the FPTs Maintenance, remaining filter rock was placed on the rip rap and cobble layers of the Western FPTs to fill voids between the rip rap and further fortify the bases of concrete well protectors.
- Filter rock was also placed along the southern side of three Sentry Wells (PW17-19, PW17-24, and PW17-29) associated with the Eastern FPTs.

5. Foreshore Passive Treatment System Maintenance

5.1 Preparation

On May 14, 2021, AECOM submitted an application on behalf of Parkland to the Vancouver Fraser Port Authority for a permit to complete maintenance of the FPTs. VFPA issued Project Permit 21-076 on May 17, 2021 included within **Appendix A**.

Prior to the FPTs maintenance, FRPD mobilized to Site to collect GPS coordinates of monitoring wells and the toe of the rip rap associated with the Eastern and Western FPTs.

5.2 Fieldwork

On September 27, 2021, FRPD met AECOM personnel along with an archaeological monitor from the Tsleil-Waututh Nation at the Site prior to work commencing. During the fieldwork, no cultural artifacts were identified. The following tasks were completed:

- A derrick, front end loader, and 170 metric tonnes (MT) of rock material comprised of 110 MT of rip rap (24" x 36") and 60 MT of filter rock (4" x 9") was mobilized to Site on a barge by FRPD through the use of a subcontracted marine towing company (refer to **Photo 1** in **Appendix B**).
- Prior to the arrival of the tug and barge, AECOM completed a survey of monitoring wells at the Site and identified that the concrete bases of well protectors at four additional locations (CBP-8, PW17-18, PW17-23, and CBP-16) associated with the Eastern FPTs had become exposed and marked these wells for areas requiring filter rock placement by FRPD.
- Beginning with the Eastern FPTs, rip rap was placed on the Eastern and Western FPTs using a 150-ton crawler crane spud derrick and a clamshell bucket (refer to **Photos 2 and 3** in **Appendix B**). Spuds on the derrick were deployed prior to moving rock material from the barge to the FPTs. Approximately 70 MT and 40 MT of rip rap were placed at the contact point of the rip rap and cobble interface of the Eastern and Western FPTs, respectively, where areas of exposed geogrid and geotextile layers had been observed.
- After depositing rip rap, filter rock was placed around concrete well protectors with exposed bases by using the clamshell bucket to move filter rock from the barge to the Eastern and Western FPTs, followed by hand placement of rock around the exposed bases (refer to **Photos 5 and 6** in **Appendix B**).
 - Approximately 30 MT of filter rock was placed at the base of concrete well protectors at four locations (PW17-1, CBP-2, PW17-6, and CBP-6) associated with the Western FPTs.
 - Approximately 30 MT of filter rock was placed around concrete well protectors at five locations (PW17-31, CBP-8, PW17-18, PW17-23, and CBP-16) associated with the Eastern FPTs. Filter rock was also placed along the southern side of three Sentry Wells (PW17-19, PW17-24, and PW17-29) associated with the Eastern FPTs as the placement of rip rap in these areas posed a risk to access the wells and/or damaging the concrete well protectors.
- Following the completion of the work, remaining filter rock material was placed on the rip rap and cobble layers of the Western FPTs to fill voids between rip rap and further fortify now buried concrete bases. There was no excess rip rap.
- Throughout the maintenance works, AECOM monitored turbidity in surface water as per Condition 7 of Permit 21-076 (refer to **Appendix A**). Turbidity readings are presented in **Table 1**. Elevated turbidity readings were observed within the construction zone (refer to **Photo 7** in **Appendix B**), however not outside of the construction zone (defined as 50 feet from ground disturbance areas) during the maintenance work.
- After the maintenance to the Eastern and Western FPTs was completed, the barge was demobilized from Site on the same day (September 27, 2021).

Refer to **Appendix B** for photos collected during the maintenance of the FPTs.

Refer to **Figure 2** for areas where rip rap and filter rock were placed during maintenance and **Figure 3** for an updated Site Plan post-maintenance.

6. Foreshore Inspections

AECOM has visually inspected the FPTs on a quarterly basis since June 2018 with the three most recent inspections completed on the following dates:

- June 4, 2021
- August 17, 2021
- October 15, 2021.

Monitoring to confirm the absence/presence of NAPL in 12 select monitoring wells (including eight Up Gradient Wells [PW17-01, PW17-04, PW17-09, PW17-13, PW17-16, PW17-21, PW17-26, and PW17-31] and four Organoclay Performance Wells [PW17-05, PW17-17, PW17-22, and PW17-27]) was completed during each of the inspections completed between June and October 2021; none of the gauged wells contained a measurable thickness of NAPL¹. Monitoring results are presented in **Table 2**. Inspections results are presented in **Table 3**.

6.1 Pre-Maintenance

Prior to the maintenance of the FPTs on September 27, 2021 inspections completed on June 4 and August 17, 2021 indicated the thickness of rip rap was a minimum of 1.4 meters in depth, with the exception that rip rap at three locations (CBP-6, PW17-6, and CBP-2) was observed to have shifted exposing the base of these concrete well protectors. Inspections further indicated that there had been some thinning of the cobble mat securing the subsurface components of the FPTs at the contact point between the rip rap and cobble interface on the northern extents of the Eastern and Western FPTs. This has resulted in portions of geogrid and geotextile layers becoming exposed across the portions of the toe of the northern slope for both the Eastern and Western FPTs. The bases of five concrete well protectors (PW17-1, PW17-6, PW17-31, CBP-2 and CBP-6) were observed to be exposed.

As part of the FPTs inspections, hand dug test pits were advanced within the cobble mat of the Eastern and Western FPTs to a depth where the liner was encountered or the maximum depth possible where ground conditions allowed for hand digging. Test pits advanced in the Eastern FPTs revealed sand overlying cobbles to a depth of between 0.40 to 0.48 m below grade, where the liner was encountered. Test pits advanced in the Western FPTs revealed sand overlying cobbles to a depth of between 0.34² to 0.40 m below grade, where the liner was encountered.

No significant deficiencies in the FPTs were found during inspections completed on June 4 and August 17, 2021. The thickness of rip rap was observed to be a minimum of 1.4 meters in depth; the layer of cobbles above the OBB surface was observed to be 0.4 meters deep based on the test pits advanced within the cobble matting. Most Sentry and Compliance Wells are covered in barnacles and seaweed and no significant damage to monitoring wells was observed (some minor chips to well casing and lids observed).

Vegetation was observed on top of the Eastern and Western FPTs near the southern extent of the Site, in proximity to the Up Gradient wells. When feasible, weeds observed on the FPTs were hand pulled and removed during the time of the inspections.

6.2 Post-Maintenance

After completion of the FPTs maintenance on September 27, 2021, the October 15, 2021 inspection indicated that all exposed concrete protector bases and all exposures of geogrid and geotextile layers previously observed were covered, except for one area approximately 0.67 meters (m) long and 0.05 m wide located at the western end of the Eastern FPTs. AECOM covered this exposure with cobbles by hand during the inspection event.

¹ As per ENV Protocol 16, NAPL is considered to be present if a thickness greater than 2 mm is measured in a monitoring well. BC ENV, 2021. Protocol 16. Determining the Presence and Mobility of Nonaqueous Phase Liquids and Odorous Substances (Version 3.0). Victoria, BC.

https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p16_jan_2021_revisions_final_signed.pdf

² This test pit was terminated at 0.34 m below grade before the liner was encountered due to water infiltrating the test pit preventing further advancement.

Hand dug test pits advanced in the Eastern FPTs revealed sand overlying cobbles to a depth of between 0.40 to 0.46 m below grade, where the liner was encountered. The test pit advanced in the Western FPTs revealed sand overlying cobbles to a depth of 0.41 m below grade, where the liner was encountered.

No significant deficiencies in the FPTs were found during inspections completed on October 15, 2021, the thickness of rip rap was observed to be a minimum of 1.4 meters in depth; the layer of cobbles above the OBB surface was observed to be 0.4 meters deep based on the three test pits advanced within the cobble matting as part of the inspections. Most Sentry and Compliance Wells are covered in barnacles and seaweed and no significant damage to monitoring wells was observed (some minor chips to well casing and lids observed).

Vegetation was observed on top of the Eastern and Western FPTs near the southern extent of the Site. Some overhanging vegetation from the Canadian Pacific Rail Right of Way is encroaching on the Eastern and Western FPTs and may need to be cut in the future.

7. Summary

The FPTs maintenance and inspections completed between June and October 2021, are summarized below:

- On September 27, 2021 the FPTs was upgraded with additional rock material to address concerns identified during the quarterly inspections.
 - 170 metric tonnes (MT) of rock material comprised of 110 MT of rip rap (24" x 36") and 60 MT of filter rock (4" x 9") was mobilized to Site and placed on the Eastern and Western FPTs.
 - Rip rap was placed at the contact point between the rip rap and cobble layer of the Eastern and Western FPTs to cover exposed geogrid and geotextile materials. The placement of new rip rap extends the limits of the rip rap embankment at both the Eastern and Western FPTs by approximately 1 to 1.5 m.
 - Filter rock was placed around nine concrete well protectors (PW17-1, CBP-2, PW17-6, CBP-6, PW17-31, CBP-8, PW17-18, PW17-23, and CBP-16) previously observed to have exposed concrete well protector bases as well as around three Sentry Wells (PW17-19, PW17-24, and PW17-29) where the placement of rip rap posed a risk to accessing the wells and/or damaging the concrete well protectors.
- The October 15, 2021 inspection completed after the FPTs maintenance indicated that all previously exposed concrete well protector bases and all exposures of geogrid and geotextile layers previously observed were covered, except for one small area approximately 0.67 m x 0.05 m in size located at the western extent of the Eastern FPTs. AECOM covered this exposure with cobbles by hand during the inspection event. Based on observations made between 2020 and 2021, exposures of the geogrid and geotextile layers may re-occur in the future; it is anticipated the exposures will unlikely compromise the integrity of the FPTs, based on analytical results from porewater sampling events completed at the Site in 2020 and 2021.
- During inspections completed June to October 2021, none of the gauged monitoring wells contained a measurable thickness of NAPL.
- No significant concerns were noted during visual inspections of the FPTs completed between June and October 2021. Most Sentry and Compliance Wells are covered in barnacles and seaweed. Significant damage to monitoring wells was not observed.
- Some overhanging vegetation from the Canadian Pacific Rail Right of Way is encroaching on the FPTs and may need to be cut in the future.

8. References

- AECOM, 2016. Foreshore Remedial Action Plan below Area 2 Eastern Impounding Basin – Chevron Burnaby Refinery, Burnaby, BC. AECOM, October 27, 2016.
- AECOM, 2017a. Foreshore Passive Treatment System Monitoring and Maintenance Plan, Down Slope from the Eastern Impounding Basin, Area 2, Parkland Burnaby Refinery, Burnaby, BC. Appendix K of the Foreshore Passive Treatment System Construction Report, Parkland Burnaby Refinery, Burnaby, BC. AECOM, December 21, 2017.
- AECOM, 2017b. Foreshore Final Remedy Construction Environmental Management Plan, Parkland Burnaby Refinery, British Columbia. AECOM, June 28, 2017.
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- AECOM, 2021. Foreshore 2020 and 2021 Monitoring Report (January 2020 – March 2021) Below Area 2 – Eastern Impounding Basin, Parkland Burnaby Refinery, Burnaby, British Columbia. AECOM, June 10, 2021.
- GeoWest Engineering (Geowest), 2020. Rip Rap Enhancement Memo, Parkland Burnaby Refinery, Burnaby, BC, April 9, 2020.
- GeoWest Engineering (Geowest), 2021. Email from Calum Buchan of Geowest to Johnathan Beamer of FRPD Re: Parkland Refinery – Rock Quantities. September 22, 2021.
- VFPA (Vancouver Fraser Port Authority), 2017. Vancouver Fraser Port Authority, Project and Environmental Review Report and Permit 16-180, Chevron Canada Limited, Chevron Refinery Foreshore Final Remedy, 5201 Penzance Drive, Burnaby. May 24, 2017.

Attachments

Figures	Figure 1:	Site Map and Foreshore Sampling Locations (Pre-Maintenance)
	Figure 2:	Foreshore Maintenance
	Figure 3:	Map and Foreshore Sampling Locations (Post-Maintenance)
Tables	Table 1:	Turbidity Readings, Foreshore Passive Treatment System Maintenance, Parkland Burnaby Refinery
	Table 2:	Porewater Monitoring Data (June – October 2021), Foreshore Post FPTs Construction, Parkland Burnaby Refinery
	Table 3:	Foreshore Passive Treatment System Inspections (June – October 2021), Post FPTs Construction, Foreshore Parkland Burnaby Refinery
Appendices	Appendix A:	VFPA Project Permit 21-076
	Appendix B:	Photolog

Authors



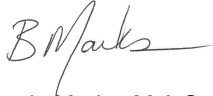
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AECOM Canada Ltd.

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The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("AECOM") for the benefit of Parkland Refining B.C. Ltd. ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

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- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
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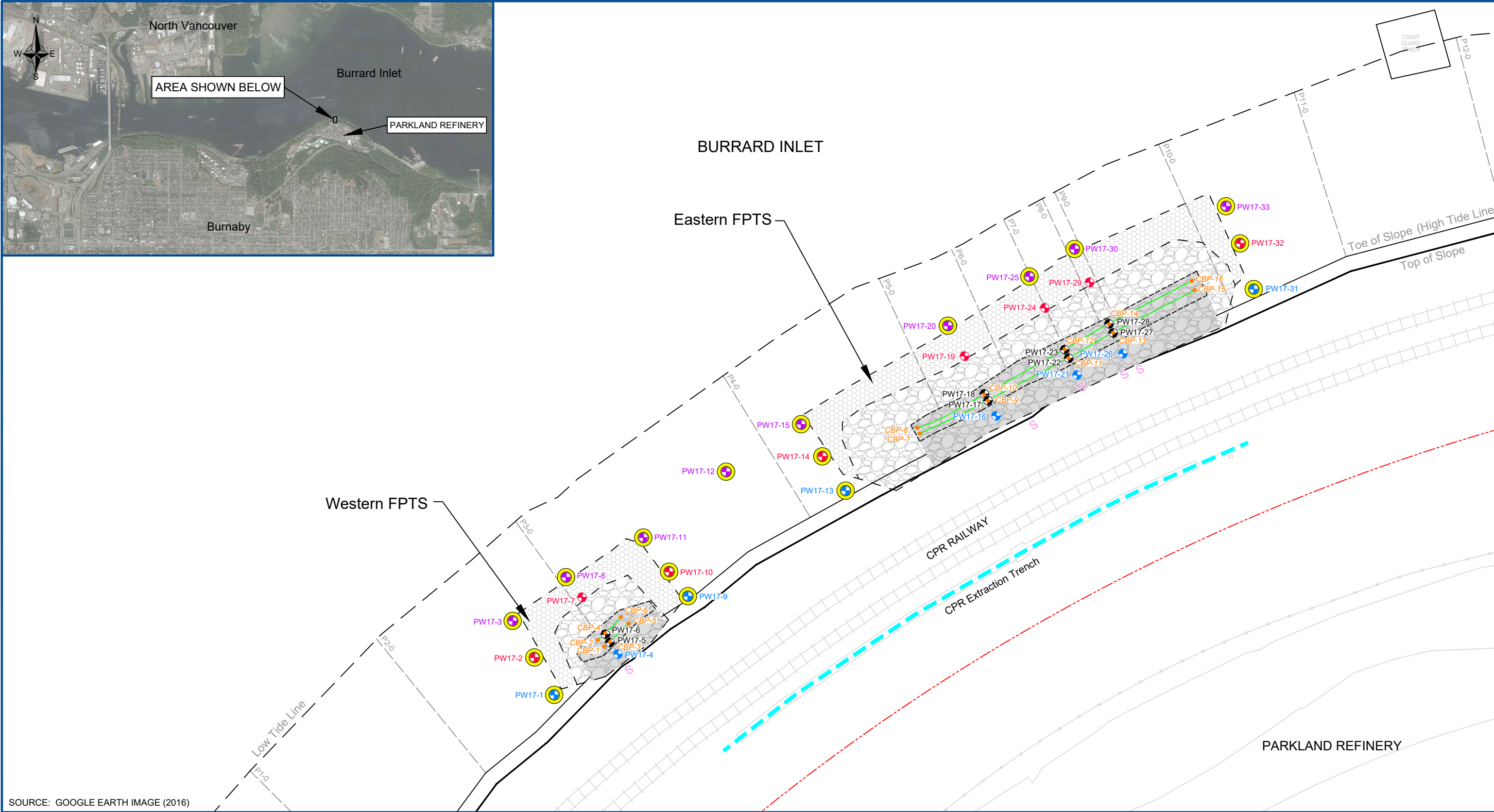
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Figures



SOURCE: GOOGLE EARTH IMAGE (2016)

LEGEND:

- Property Line
Fence Line
Foreshore Sampling Transect
CPR Extraction Trench

- Impermeable Sheet
Cobble Mat
Rip Rap Embankment
French Drain
NAPL Seep Observed in 2010
Contingency Biodegradational Piping

POREWATER SAMPLES

- Compliance Well
Sentry Well
Performance Well
Up Gradient Well
ENV Requires Notifications?

ABBREVIATIONS:

- COC Contaminants of Concern
CPR Canadian Pacific Railway
ENV BC Ministry of Environment & Climate Change Strategy
NAPL Non-Aqueous Phase Liquid
RBMT Risk-Based Management Targets

NOTES:

1. The Foreshore Passive Treatment System (FPTS) was installed between July 12 and October 21, 2017.
2. BC ENV requires written notification within 30 days of exceedances of COCs above RBMTs in select wells.
3. BC ENV requires immediate verbal and written notification of COCs above Upper Cap Concentrations (Protocol 11) in all wells.



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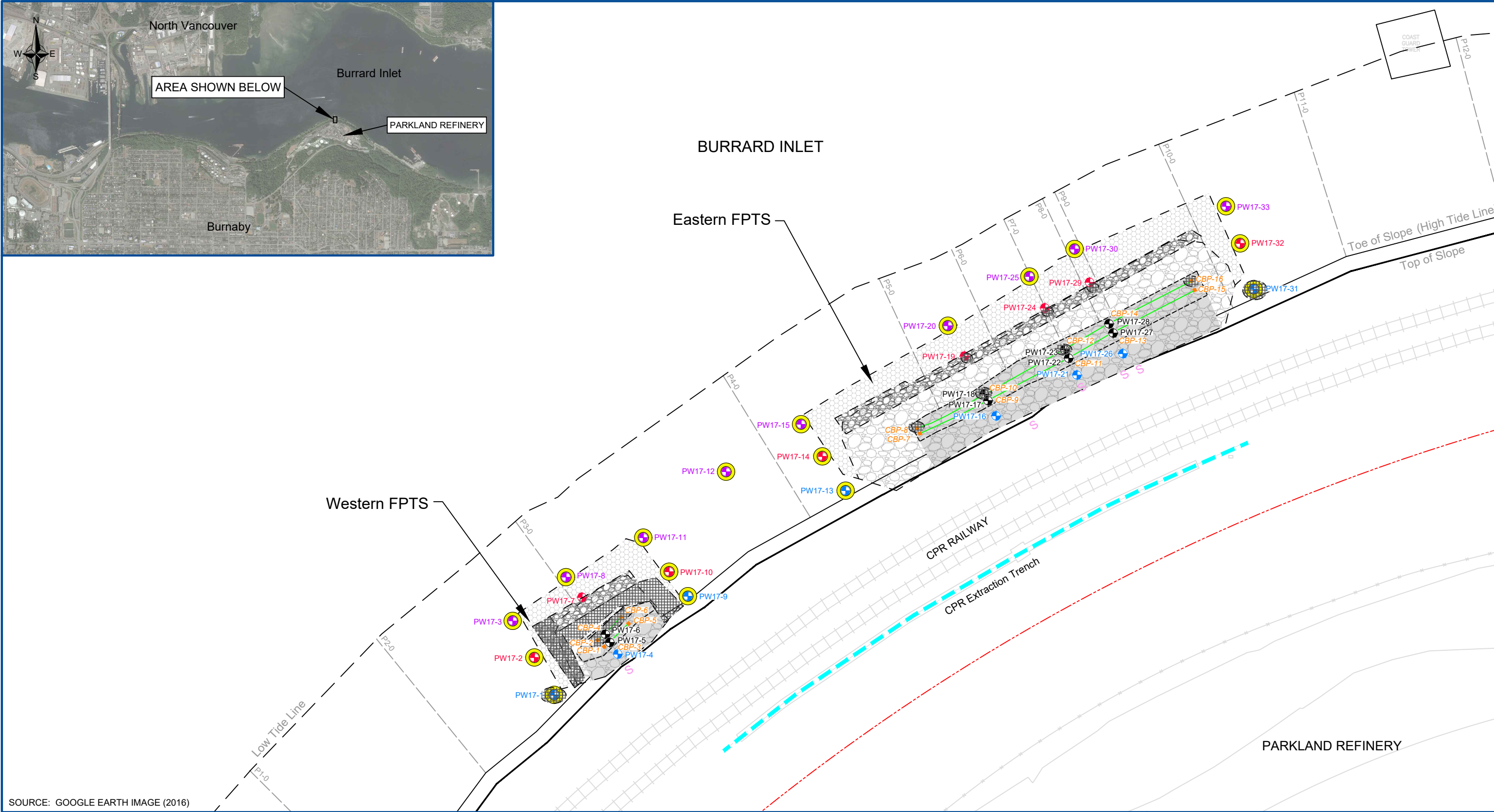
SITE MAP AND FORESHORE SAMPLING LOCATIONS
(PRE-MAINTENANCE)

2021 Foreshore Passive Treatment System Maintenance and Inspection Memo,
Foreshore Below Area 2 - Parkland Refinery, Burnaby, B.C.

PARKLAND REFINING (B.C.) LTD.

DATE:	PROJECT NO.:	DRAWN BY:	REVISION NO.:	DRAWING NO.:
November 2021	60653584	SGC	0	FIGURE 1

AECOM



SOURCE: GOOGLE EARTH IMAGE (2016)

LEGEND:

Property Line	Impermeable Sheet	POREWATER SAMPLES
Fence Line	Cobble Mat	Compliance Well
Foreshore Sampling Transect	Rip Rap Embankment	Sentry Well
CPR Extraction Trench	French Drain	Performance Well
Filter Rock Placement (2021)	NAPL Seep Observed in 2010	Up Gradient Well
Rip Rap Placement (2021)	Contingency Biodegradational Piping	ENV Requires Notifications?

ABBREVIATIONS:

COC	Contaminants of Concern
CPR	Canadian Pacific Railway
ENV	BC Ministry of Environment & Climate Change Strategy
NAPL	Non-Aqueous Phase Liquid
RBMT	Risk-Based Management Targets

NOTES:

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4. BC ENV requires immediate verbal and written notification of COCs above Upper Cap Concentrations (Protocol 11) in all wells.

GRID NORTH



metres

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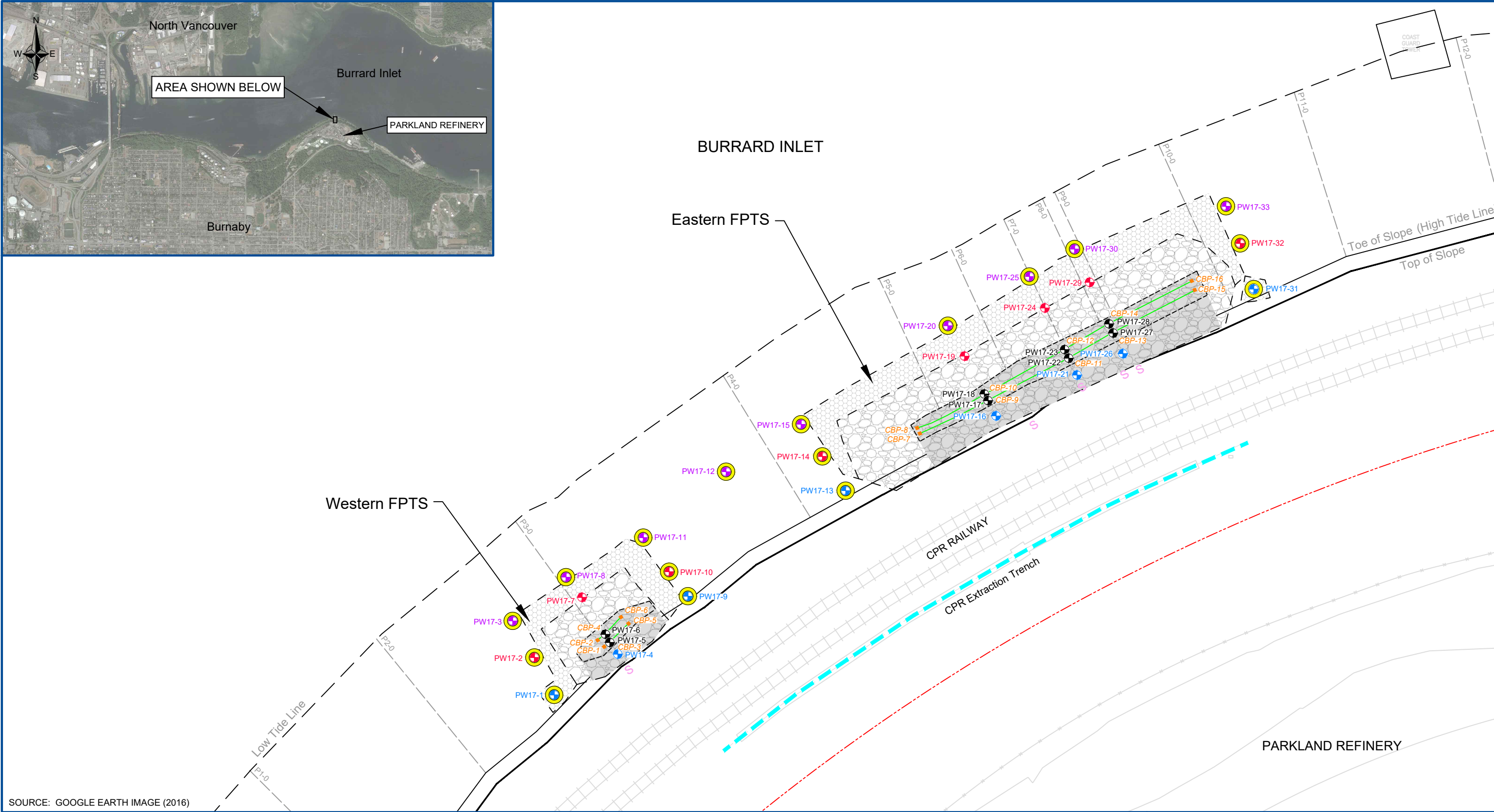
FORESHORE MAINTENANCE

2021 Foreshore Passive Treatment System Maintenance and Inspection Memo,
Foreshore Below Area 2 - Parkland Refinery, Burnaby, B.C.

PARKLAND REFINING (B.C.) LTD.

DATE:	PROJECT NO.:	DRAWN BY:	REVISION NO.:	DRAWING NO.:
November 2021	60653584	SGC	0	FIGURE 2

AECOM



SOURCE: GOOGLE EARTH IMAGE (2016)

LEGEND:

- Property Line
Fence Line
Foreshore Sampling Transect
CPR Extraction Trench

- Impermeable Sheet
Cobble Mat
Rip Rap Embankment
French Drain
NAPL Seep Observed in 2010
Contingency Biodegradational Piping



POREWATER SAMPLES

- Compliance Well
Sentry Well
Performance Well
Up Gradient Well
ENV Requires Notifications?



ABBREVIATIONS:

- COC Contaminants of Concern
CPR Canadian Pacific Railway
ENV BC Ministry of Environment & Climate Change Strategy
NAPL Non-Aqueous Phase Liquid
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metres
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SITE MAP AND FORESHORE SAMPLING LOCATIONS
(POST-MAINTENANCE)

2021 Foreshore Passive Treatment System Maintenance and
Inspection Memo,
Foreshore Below Area 2 - Parkland Refinery, Burnaby, B.C.

PARKLAND REFINING (B.C.) LTD.

DATE:	PROJECT NO.:	DRAWN BY:	REVISION NO.:	DRAWING NO.:
November 2021	60653584	SGC	0	FIGURE 3

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Tables

TABLE 1
TURBIDITY READINGS
FORESHORE PASSIVE TREATMENT SYSTEM MAINTENANCE
PARKLAND BURNABY REFINERY
2021 FORESHORE PASSIVE TREATMENT SYSTEM MAINTENANCE AND INSPECTION MEMO

Date	Time ¹	Sample Location	Turbidity (NTU)	Comments
		Background / Inside / Outside of Construction zone ⁴	<p>When background is less than or equal to 50 nephelometric turbidity units (NTU), induced turbidity shall not exceed 5 NTU above the background values; and</p> <p>When background is greater than 50 NTU, induced turbidity shall not exceed the background values by more than 10% of the background value.^{2,3}</p>	
27-Sep-21	8:00	Background	8.29	Background sample collected prior to work commencing
27-Sep-21	9:49	Inside	9.06	Taken during riprap placement
27-Sep-21	9:58	Outside	1.37	Taken during riprap placement
27-Sep-21	10:20	Inside	<u>137</u>	Taken during riprap placement
27-Sep-21	10:50	Inside	<u>389</u>	Taken during filter rock placement
27-Sep-21	12:12	Outside	8.09	Taken during filter rock placement
27-Sep-21	12:42	Inside	<u>294</u>	Taken during riprap placement
27-Sep-21	13:39	Outside	3.15	Taken during filter rock placement

Notes

¹ Seawater samples were collected at the start, mid-way and at the end of the work period or when there was evidence of a direct or indirect release or deposit of sediment or sediment laden water into the aquatic environment.

² Samples were collected from seawater outside of the construction zone to determine background turbidity.

³ Water Quality Criteria stipulated within VFPA Project Permit 21-076.

⁴ The construction zone is defined as areas that may potential direct or indirect release or deposit of sediment or sediment laden water into the aquatic environment. For the project, it is set at 50 feet from any ground disturbance activities.

NTU = nephelometric turbidity units

Concentration exceeds criteria

TABLE 2
POREWATER MONITORING DATA (JUNE - OCTOBER 2021)
POST FPTs CONSTRUCTION
FORESHORE PARKLAND BURNABY REFINERY
2021 FORESHORE PASSIVE TREATMENT SYSTEM MAINTENANCE AND INSPECTION MEMO

Sample ID	Date Sampled	Sample Time	Low Tide	Total Depth of Well (m from TOC) ²	Top of Casing Elevation (TOC, mASL) ¹	Well Diameter (mm)	Screened Interval (m bgs)	Headspace Vapour Concentration (ppm unless otherwise noted)	Depth to Product (m from TOC)	Apparent Product Thickness (mm)	Depth to Water (DTW, m from TOC)	Porewater Elevation (mASL) ¹	Observations
PW17-01	4-Jun-21	8:28	12:00	1.329	29.12	50	0.85-1.15	5	---	ND	0.842	28.28	---
	17-Aug-21	10:31	11:30	1.33	29.12	50	0.85-1.15	ND	---	ND	0.825	28.30	---
	15-Oct-21	9:28	11:00	1.321	29.12	50	0.85-1.15	20	---	ND	0.794	28.33	---
PW17-04	4-Jun-21	9:21	12:00	3.378	31.19	50	0.45-0.75	0	---	ND	2.954	28.24	---
	17-Aug-21	10:17	11:30	3.351	31.19	50	0.45-0.75	5	---	ND	2.991	28.20	---
	15-Oct-21	9:21	11:00	3.371	31.19	50	0.45-0.75	0	---	ND	2.759	28.43	---
PW17-05	4-Jun-21	9:24	12:00	3.071	30.22	50	0.64-1.00	0	---	ND	2.206	28.01	---
	17-Aug-21	10:24	11:30	3.08	30.22	50	0.64-1.00	5	---	ND	2.273	27.95	---
	15-Oct-21	9:24	11:00	3.075	30.22	50	0.64-1.00	0	---	ND	2.053	28.17	---
PW17-09	4-Jun-21	9:13	12:00	1.354	28.55	50	0.85-1.15	10	---	ND	0.292	28.26	---
	17-Aug-21	10:08	11:30	1.350	28.55	50	0.85-1.15	60	---	ND	0.415	28.14	---
	15-Oct-21	9:17	11:00	1.354	28.55	50	0.85-1.15	5	---	ND	0.455	28.10	---
PW17-13	4-Jun-21	9:07	12:00	1.309	28.9	50	0.85-1.15	15	---	ND	0.534	28.37	---
	17-Aug-21	10:00	11:30	1.31	28.9	50	0.85-1.15	30	---	ND	0.558	28.34	---
	15-Oct-21	9:10	11:00	1.311	28.9	50	0.85-1.15	20	---	ND	0.374	28.53	---
PW17-16	4-Jun-21	8:55	12:00	3.266	31.44	50	0.45-0.75	5	---	ND	2.699	28.74	---
	17-Aug-21	9:43	11:30	3.205	31.44	50	0.45-0.75	ND	---	ND	2.862	28.58	---
	15-Oct-21	9:01	11:00	3.234	31.44	50	0.45-0.75	25	---	ND	2.726	28.71	---
PW17-17	4-Jun-21	8:57	12:00	3.194	30.76	50	0.64-1.00	0	---	ND	2.067	28.69	---
	17-Aug-21	9:49	11:30	3.190	30.73	50	0.64-1.00	ND	---	ND	2.202	28.53	---
	15-Oct-21	9:05	11:00	3.193	30.73	50	0.64-1.00	10	---	ND	2.060	28.67	---
PW17-21	4-Jun-21	8:41	12:00	3.358	31.38	20	0.45-0.75	0	---	NM	NM	NM	Tip of probe not attached - Solinst Model 102 narrow interface probe for pieziometer in PW17-21 came from rental supplier without probe on end. No signal when in contact with water. Could only measure total depth of well.
	17-Aug-21	10:41	11:30	3.367	31.38	20	0.45-0.75	ND	---	ND	2.736	28.64	Mouse nest
	15-Oct-21	9:34	11:00	3.355	31.38	20	0.45-0.75	5	---	ND	2.430	28.95	Empty mouse nest
PW17-22	4-Jun-21	8:39	12:00	3.513	31.14	50	0.64-1.00	0	---	ND	2.45	28.69	---
	17-Aug-21	9:39	11:30	3.49	31.14	50	0.64-1.00	ND	---	ND	2.591	28.55	---
	15-Oct-21	8:56	11:00	3.488	31.14	50	0.64-1.00	5	---	ND	2.423	28.72	---
PW17-26	4-Jun-21	8:34	12:00	3.785	31.81	50	0.45-0.75	15	---	ND	3.087	28.72	---
	17-Aug-21	9:22	11:30	3.775	31.81	50	0.45-0.75	10	---	ND	3.150	28.66	---
	15-Oct-21	8:47	11:00	3.777	31.81	50	0.45-0.75	25	---	ND	2.945	28.87	---
PW17-27	4-Jun-21	8:31	12:00	3.784	31.4	50	0.64-1.00	0	---	ND	2.724	28.68	---
	17-Aug-21	9:29	11:30	3.800	31.4	50	0.64-1.00	ND	---	ND	2.855	28.55	---
	15-Oct-21	8:51	11:00	3.805	31.4	50	0.64-1.00	10	---	ND	2.522	28.88	---
PW17-31	4-Jun-21	8:23	12:00	1.253	29.31	50	0.85-1.15	0	---	ND	0.178	29.13	---
	17-Aug-21	9:10	11:30	1.255	29.31	50	0.85-1.15	ND	---	ND	0.405	28.91	---
	15-Oct-21	8:41	11:00	1.254	29.31	50	0.85-1.15	25	---	ND	0.379	28.93	---

Notes:

1 - Elevations are in Parkland Datum = Geodetic Datum + 91.52 feet.

m - metres

m bgs - metres below ground surface

mASL - metres above sea level

mg/L - milligrams per liter

mm - millimetres

ppm - parts per million

--- - no observations

DTW - depth to water

FPTS - Foreshore Passive Treatment System

NA - not applicable

ND - not detected

TOC - top of casing

TABLE 3
FORESHORE PASSIVE TREATMENT SYSTEM INSPECTIONS (JUNE - OCTOBER 2021)
POST FPTS CONSTRUCTION
FORESHORE PARKLAND BURNABY REFINERY
2021 FORESHORE PASSIVE TREATMENT SYSTEM MAINTENANCE AND INSPECTION MEMO

Date	FPTS	Rip Rap layer maintained at 1.4m	Cobble layer above OBB surface layer maintained at 0.4m	Rip Rap or Cobble replacement Required	Vegetation present above treatment cells or OBB surface layer	Vegetation Removal Required	Damaged Monitoring Wells	Comments
4-Jun-21	Eastern	Yes	Yes	No	No growth above treatment cells or OBB surface layer. Vegetation growth along Up Gradient Wells as well as overhanging on southern edge of the barrier.	No. Hand pulled all weeds. Overhanging vegetation on the south side of the barrier should be monitored; potential removal planned in the future.	No	No major damage; all wells have barnacles and seaweed growth on the outer surface of the protective casing; minor chipping is present on the protective casing as well. Base exposed on CBP-6. Base of concrete protectors exposed on PW17-1, PW17-6, PW17-31 and CBP-2.
	Western	Yes	Yes	No	No growth above treatment cells or OBB surface layer, vegetation growth along Up Gradient Wells wells as well as overhanging on southern edge of barrier.	No. Hand pulled all weeds. Overhanging vegetation on the south side of the barrier should be monitored; potential removal planned in the future.	No	Geogrid and filter fabric exposed in ten areas (six on the Eastern FPTS and four on the Western FPTS) along the contact point between the rip rap and cobble interface. TP1: Sand from 0 - 0.05mbgs; Cobble from 0.05 - 0.45mbgs; Liner encountered TP2: Sand from 0 - 0.02mbgs; Cobble from 0.02 - 0.48 mbgs; Liner encountered TP3: Cobble from 0 - 0.40mbgs
17-Aug-21	Eastern	Yes	Yes	No	Weeds growing along top of barrier; overhanging vegetation along southern side; no growth above treatment cells or OBB layer	Recommend removing overhanging vegetation; handpulled weeds.	No	All wells outside FPTS have barnicle growth and seaweed; minor chipping. Base of concrete protectors exposed on PW17-1, PW17-6, PW17-31 and CBP-2. Geogrid and filter fabric exposed in ten areas (six on the Eastern FPTS and four on the Western FPTS) along the contact point between the rip rap and cobble interface.
	Western	Yes	Yes	No	Weeds growing along top of barrier; overhanging vegetation along southern side; no growth above treatment cells or OBB layer	Recommend removing overhanging vegetation; did not need to handpull weeds.	No	TP1: Sand from 0 - 0.20mbgs; Cobble from 0.20 -0.42mbgs; Liner encountered TP2: Sand from 0 - 0.08 mbgs; Cobble from 0.08 - 0.44 mbgs; Liner encountered TP3: Cobble from 0 - 0.34mbgs, water infiltrated into test pit, preventing further advancement.
15-Oct-21	Eastern	Yes	Yes	No	Weeds growing on southern side of barrier; Overhanging vegetation along southern side; No growth on top of treatment cells or OBB layer	Recommend trimming overhanging vegetation on southern side.	No	All wells outside FPTS have barnicle and seaweed growth as well as minor chipping; CBP-8, PW17-6, CBP-5, PW17-18, PW17-28 minor chipping from rock placement. No concrete bases of well protectors exposed. Geogrid and filter fabric exposed in one area of Eastern FPTS, cobbles placed on top.
	Western	Yes	Yes	No	Sparse weeds on southern edge of barrier; Overhanging vegetation along southern side; No growth along treatment cells or OBB layer	Recommend trimming overhanging vegetation on southern side.	No	TP1: Sand from 0 - 0.13mbgs; Cobble from 0.13 - 0.46mbgs; Liner encountered TP2: Cobble from 0 - 0.40 mbgs; Liner encountered TP3: Cobble from 0 - 0.41mbgs; Liner encountered

Abbreviations:
FPTS - Foreshore Passive Treatment System NA - Not applicable
NM - Not monitored m bgs - metres below ground surface
OBB - Oleophilic biobarrier

Appendix A

VFPA Project Permit 21-076



PORT of
vancouver

Vancouver Fraser
Port Authority

May 17, 2021

Leslie Southern
AECOM Canada Ltd.
3292 Production Way, Suite 330
Burnaby, BC V5A 4R4

Dear Leslie Southern:

Re: Parkland Foreshore Passive Treatment System Repairs, Burnaby
PROJECT PERMIT 21-076

Reference is made to your May 14, 2021 application. The Vancouver Fraser Port Authority (the "Port Authority") understands AECOM Canada Ltd. on behalf of Parkland Refining (BC) Ltd. (the "Permit Holder") proposes to reinstate rip rap and filter rock on exposed sections of the Foreshore Passive Treatment System (FPTS) (the "Project") located on the intertidal foreshore north of the Parkland Burnaby Refinery, 5201 Penzance Drive, Burnaby. The FPTS was constructed at the site in 2017 under Project Permit 16-180. Inspections conducted in 2020 and 2021 identified thinning of the cobble matt at the contact point between the rip rap and cobble interface resulting in exposures of geogrid and geotextile. In addition, rip rap has shifted, exposing the base of a concrete well protector.

The Project consists of using a crane located on a spud derrick to pick up rip rap and filter rock from a barge and place it on or adjacent to exposed areas which require additional material. Filter stone will be placed by hand to prevent damage to the concrete well protectors. The derrick will be spudded down offshore so that the maximum reach of the crane will allow the operator to pick up rip rap from the barge and place it on the foreshore. The barge and crane spud derrick will be towed to site on the morning of the work. The tug will remain on site until work has been completed.

Activities will be conducted in the dry (above the water surface) during appropriate tide levels. All materials will be placed within the footprint of the existing FPTS. The height of the area currently covered in cobble (at the interface with the rip rap) will increase by approximately 0.6 to 0.9 metres.

The Port Authority has completed a review of these activities and concludes that with the implementation of proposed mitigation measures and conditions described in the attached Schedule of Environmental Conditions, the Project is not likely to cause significant adverse environmental effects.

Pursuant to the Port Authorities Operations Regulations under the *Canada Marine Act*, by way of this letter, the Project is authorized to proceed **provided that all of the Conditions outlined on the attached Schedule of Environmental Conditions are adhered to**. In the event of any breach of any of the Conditions, or of any of the background information being determined by the Port Authority to be incorrect or misleading, then the Port Authority, acting at its sole discretion, may arbitrarily cancel this Project Permit. This Project Permit may also be cancelled for any other reasons set out in Section 29 of the Port Authorities Operations Regulations. **This Project Permit is valid until May 30, 2022**. Please contact the undersigned with any questions regarding the Conditions.

Yours truly,

Kim Keskinen
Supervisor, Environmental Programs

cc: Chris Boys, Parkland Refining (BC) Ltd.
Scarlett Chen, Real Estate
Navigation Review



Reference is made to the physical activities (the **Project**) described in the permitting letter that these conditions are attached to. The Port Authority has undertaken and completed a review of the Project in accordance with Section 5 of the Port Authorities Operations Regulations and, as applicable, Section 82 of the *Impact Assessment Act*.

The Project Permit is based on the understanding that the Project consists of minor non-intrusive in-water works, as identified in the permitting letter, and on the understanding that the works will be conducted outside of the navigation channel and that species at risk and archaeological resources are not known to be present in the Project area.

The Permit Holder must have a valid lease, licence, or access agreement for the Project site prior to accessing the Project site or commencing construction or any other physical activities on the Project site. This Permit shall in no way limit any of the Permit Holder's obligations, or the Port Authority's rights, under such lease, licence, or access agreement.

The Project Permit in no way endorses or warrants the design, engineering, or construction of the Project and no person may rely upon the Permit for any purpose other than the fact that the Port Authority has permitted the Project, in accordance with the terms and conditions of the Project Permit.

If at any time the Permit Holder fails to comply with any of the environmental conditions set out below, or if the Port Authority determines that the Permit Holder has provided any incomplete, incorrect or misleading information in relation to the Project, the Port Authority may, in its sole and absolute discretion, cancel its authorization for the Project or change the conditions to which such authorization is subject.

Pursuant to Section 29 of the Port Authorities Operations Regulations, the Port Authority may also cancel its authorization for the Project, or change the conditions to which such authorization is subject, if new information is made available to the Port Authority at any time in relation to the potential adverse environmental effects of the Project.

The following are the minimum conditions that must be followed by the Permit Holder to mitigate potential adverse environmental and other effects:

1. The Permit Holder shall undertake and deliver the Project to total completion in a professional, timely and diligent manner in accordance with applicable standards and specifications described in the application document(s) referenced in the permitting letter. The Permit Holder shall not carry out any other physical activities unless expressly authorized by the Port Authority.
2. The Permit Holder shall at all times and in all respects, comply with and abide by all applicable statutes, laws, regulations and orders from time to time in force and effect, including all applicable environmental, labour and safety laws and regulations.
3. Without limiting the generality of permit condition 2, the Permit Holder shall not, directly or indirectly: (a) deposit or permit the deposit of a deleterious substance of any type in water frequented by fish in a manner contrary to Section 36 of the *Fisheries Act*; or (b) adversely affect fish or fish habitat in a manner contrary to Section 35 of the *Fisheries Act*.
4. The Permit Holder shall contain and collect debris and waste material in the immediate working area within the Project site. The Permit Holder shall dispose of waste material at suitable upland locations and maintain records of off-site disposal.
5. The Permit Holder shall not permit barges or other vessels used during the Project to ground on the foreshore or river/seabed or otherwise disturb the foreshore or river/seabed (including disturbance as a result of vessel propeller wash), excepting only such disturbance as is reasonably required resulting from the use of barge spuds.
6. The Permit Holder shall not disturb the river/seabed outside the Project site.
7. The Permit Holder shall not permit sediment, sediment-laden waters, or other deleterious substances to enter the water during the Project. The Permit Holder shall carry out all physical activities in a manner that prevents induced sedimentation of foreshore and near shore areas and induced turbidity of local waters, and the release of sediment, sediment-laden waters, and turbid waters to the aquatic environment. The Permit Holder shall manage turbidity in compliance with the following water quality criteria:



- a) When background is less than or equal to 50 nephelometric turbidity units (NTU), induced turbidity shall not exceed 5 NTU above the background values; and
- b) When background is greater than 50 NTU, induced turbidity shall not exceed the background values by more than 10% of the background value.

For the purposes of this condition, “background” means the level at an appropriate adjacent reference site (as determined to the satisfaction of the Port Authority) that is affected neither by physical activities at the Project site, nor sediment-laden or turbid waters resulting from physical activities at the Project site.

- 8. Prior to commencing construction or any physical activities, the Permit Holder shall have in place a spill prevention, containment and clean-up plan for hydrocarbon products (including fuel, oil and hydraulic fluid) and any other deleterious substances. Appropriate spill containment and clean-up supplies shall be available on the Project site at all times and all personnel working on the Project shall be trained on the spill prevention, containment and clean-up plan. The Permit Holder shall carry out the Project in accordance with the spill prevention, containment and clean-up plan.
- 9. If the Permit Holder encounters, expects to encounter, or should expect to encounter an actual or potential archaeological resource, the Permit Holder shall:
 - a) Immediately stop any activities that may disturb the archaeological resource or the site in which it is contained (the “Site”);
 - b) Not move or otherwise disturb the archaeological resource or other remains present at the Site;
 - c) Stake or flag the Site to prevent additional disturbances; and,
 - d) Immediately notify the Port Authority by email and phone.
- 10. The Permit Holder shall maintain equipment in good mechanical condition and free of fluid leaks, invasive species, and noxious weeds.
- 11. At least two days prior to commencing any physical activities, the Permit Holder shall notify the Harbour Master and Environmental Programs, email: Harbour_Master@portvancouver.com and EnvironmentalPrograms@portvancouver.com.
- 12. Prior to the commencement of any vessel-related activities, the Permit Holder must contact CCG Marine Communications and Traffic Services (MCTS), (email: NAVWARN.MCTSPRinceRupert@innav.gc.ca Telephone: 250-627-3070) regarding the issuance of a Navigational Warning (NAVWARN) to advise the marine community of potential hazards associated with the Project.
- 13. During any vessel-related activities, the Permit Holder shall:
 - a) Position vessels and equipment associated with the Project in such a manner so as not to obstruct line of sight to navigational aids or markers;
 - b) Exhibit the appropriate lights and day shapes at all times;
 - c) Monitor the VHF channel used for MCTS communications in the respective area at all times and participate as necessary;
 - d) Be familiar with vessel movements in areas affected by the Project;
 - e) Plan and execute the Project in a manner that will not impede navigation or interfere with vessel operations; and,
 - f) When working during night hours, ensure that any working lights do not impede visibility of passing vessels. When not working during night hours, ensure that the rig and associated equipment is moored where it will not impede the safety of navigation and is lit in accordance with all applicable regulations.
- 14. The Permit Holder shall cooperate fully with the Port Authority in respect of any review by the Port Authority of the Permit Holder's compliance with this Permit, including providing information and documentation in a timely manner, as required by the Port Authority. The Permit Holder is solely responsible for demonstrating the Permit Holder's compliance with this Permit. Accordingly, the Permit Holder shall be familiar with the Port Authority's compliance and enforcement program: <https://www.portvancouver.com/development-and-permits/compliance/>



**PORT of
vancouver**

Vancouver Fraser
Port Authority

**VANCOUVER FRASER PORT AUTHORITY (the “Port Authority”)
ENVIRONMENTAL CONDITIONS, MINOR IN-WATER WORKS**


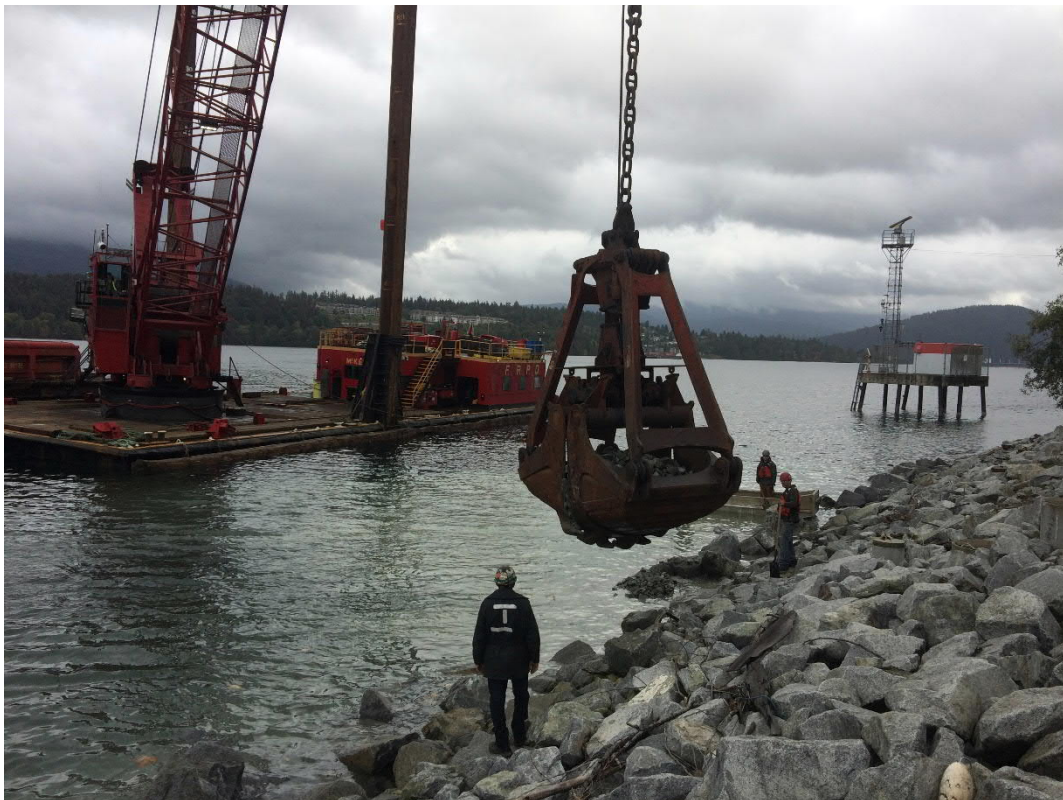
15. The Permit Holder shall review the Permit with all employees, agents, contractors, licensees and invitees working on the Project site, prior to such parties participating in any construction or other physical activities on the Project site. The Permit Holder shall be solely responsible for ensuring that all such employees, agents, contractors, licensees and invitees comply with this Permit.
16. The Permit Holder shall make available upon request by any regulatory authority (such as a Fishery Officer) a copy of this Permit.

The above conditions are based solely upon the Port Authority's review of the Project and in no way limits the authority of, or constitutes any form of permit, authorization or approval by, any other governmental authority having jurisdiction. The Permit Holder is solely responsible for obtaining any and all required permits, authorizations and approvals from any other governmental authority having jurisdiction.



Appendix B

Photolog



APPENDIX B: PHOTOGRAPHIC LOG

Client Name: Parkland Refining (B.C.) Ltd.		Site Location: Foreshore – Downgradient Area 2, Parkland Refinery, Burnaby, BC	Project Number: 60653584
Photo No. 1	Date: Sep. 27 2021		
Direction Photo Taken: From the top of the Eastern FPTs facing west.			
Description: The derrick and barge mobilizing to Site.			
Photo No. 2	Date: Sep. 27, 2021		
Direction Photo Taken: Top of Eastern FPTs looking east.			
Description: Use of the derrick and clamshell bucket to place rip rap on the FPTs.			


APPENDIX B: PHOTOGRAPHIC LOG

Client Name: Parkland Refining (B.C.) Ltd.		Site Location: Foreshore – Downgradient Area 2, Parkland Refinery, Burnaby, BC	Project Number: 60653584
Photo No. 3	Date: Sep. 27, 2021		
Direction Photo Taken: Taken from top of Western FPTs looking west.			
Description: New rip rap at the contact point between the rip rap and cobble interface of the Western FPTs.			
Photo No. 4	Date: Sep. 27, 2021		
Direction Photo Taken: Top of Eastern FPTs; Photo of CBP-8			
Description: Example of concrete well protector with an exposed base prior to placement of filter rock. Taken of CBP-8 located on the Eastern barrier.			

APPENDIX B: PHOTOGRAPHIC LOG

Client Name: Parkland Refining (B.C.) Ltd.		Site Location: Foreshore – Downgradient Area 2, Parkland Refinery, Burnaby, BC	Project Number: 60653584
Photo No. 5	Date: Sep. 27, 2021		
Direction Photo Taken: Top of Eastern FPTs; Photo of CBP-8			
Description: Filter rock placed around CBP-8 to cover the exposed concrete well protector base.			
Photo No. 6	Date: Sep. 27, 2021		
Direction Photo Taken: Top of Western FPTs (right to left is CBP-6 and PW17-6)			
Description: Example of filter rock placed by hand around concrete well protectors with exposed bases.			

APPENDIX B: PHOTOGRAPHIC LOG

Client Name: Parkland Refining (B.C.) Ltd.		Site Location: Foreshore – Downgradient Area 2, Parkland Refinery, Burnaby, BC	Project Number: 60653584
Photo No. 7	Date: Sep. 27, 2021		
Direction Photo Taken: From Eastern FPTs looking northwest.			
Description: Photo of surface water collected during turbidity monitoring inside the construction zone. Photo collected at 10:42am.			