

# ***In-situ Containment and Treatment of a Free Phase Hydrocarbon Plume Beneath Plant Infrastructure***

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# ***Environmental Problem***

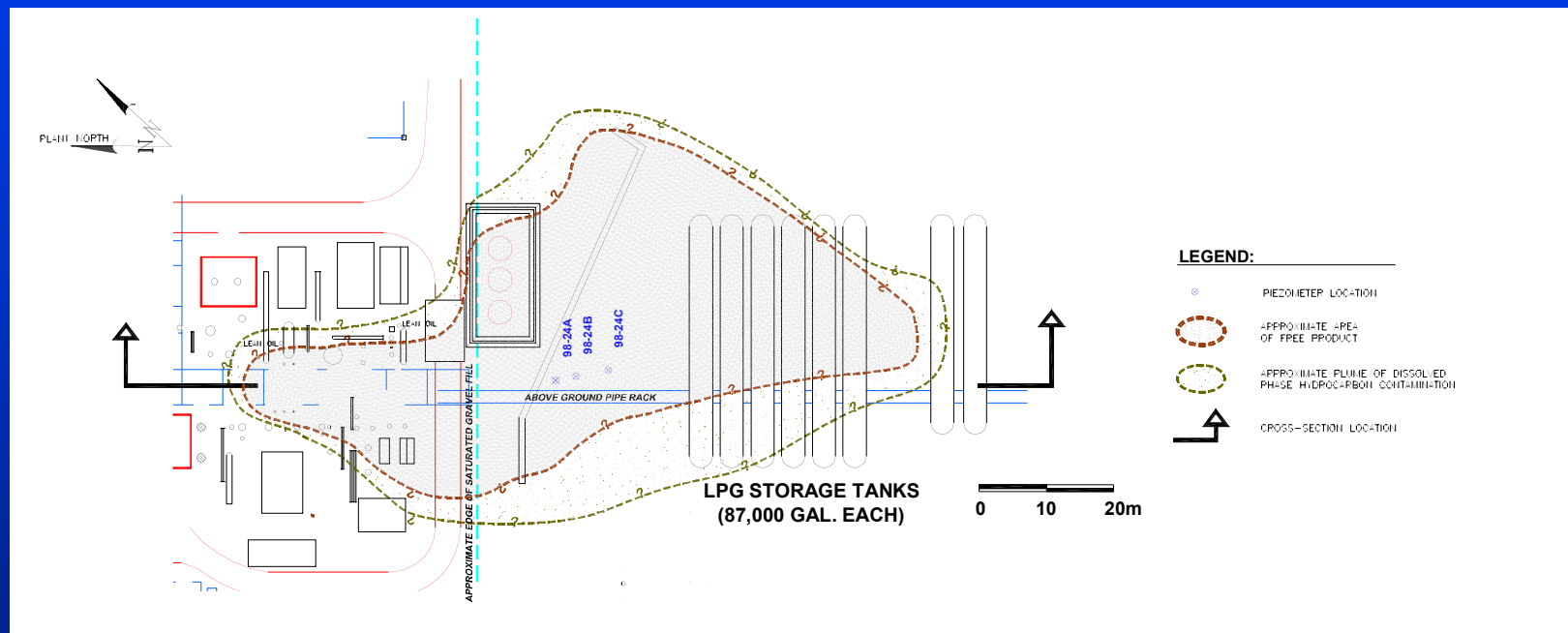
- ⇒ **Hydrocarbon free product was detected in Liquefied Petroleum Gases (LPG) Recovery Area at an Alberta gas plant.**
- ⇒ **Approximate area of 3,100 m<sup>2</sup> with hydrocarbon free product on water table.**



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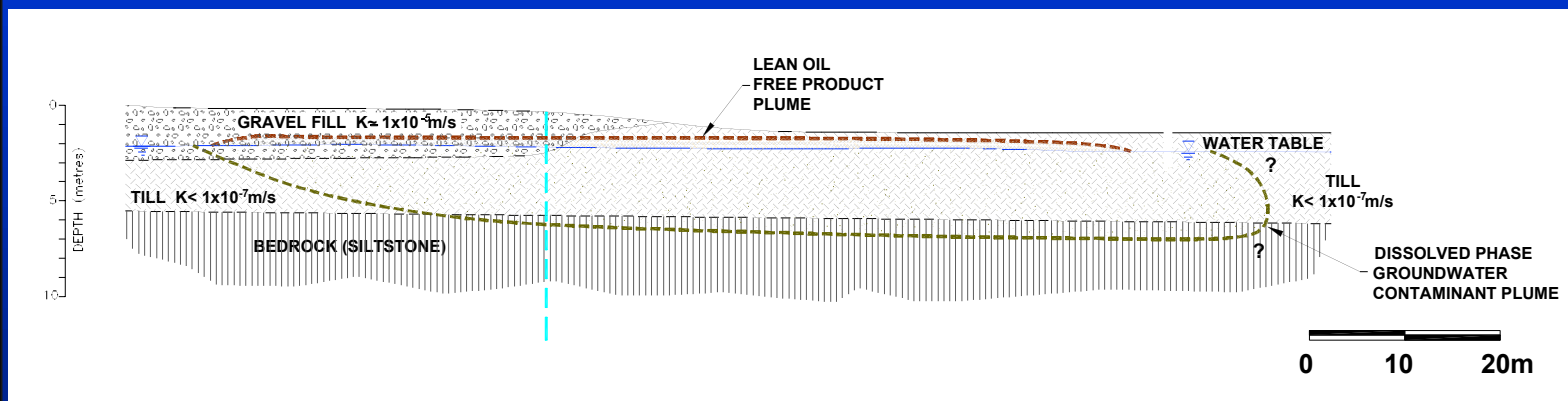
# Plan View of Site



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# Site Description

- ⇒ **Plume located within the process area and straddles two hydrogeological units.**



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## **Site Description Continued**

- ⇒ **Source area beneath the process facilities consists of granular fill. ( $K = 10^{-5}$  m/s)**
- ⇒ **Approximately 10 m downgradient gravel thins out to native till. ( $K = 10^{-8}$  m/s)**
- ⇒ **Groundwater surface located approximately 1.5 mbgs in the fill and 0.5 mbgs in the till.**



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# **Remediation Goals**

- ⇒ **No disturbance to infrastructure/operations**
- ⇒ **Containment of free product and dissolved phase plumes**
- ⇒ **Recovery of free product (reduce seepage)**



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# **Remediation Options**

- ⇒ **Excavation and ex-situ treatment**
- ⇒ **Soil vapour extraction**
- ⇒ **Multi-phase extraction**
- ⇒ **Product skimming**
- ⇒ **Dual phase pumping**
- ⇒ **Trench and gate cutoff system**



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# ***Remediation Approach***

## **Phased in-situ approach selected:**

**Phase I: installation of a hydrocarbon recovery trench within the core of the plume (Installed in 1999)**

**Phase II: Installation of Trench and Gate System at the downgradient edge of the plume (Installed in 2000)**

**Phase III: Installation of additional recovery wells in gravel fill section (in progress)**



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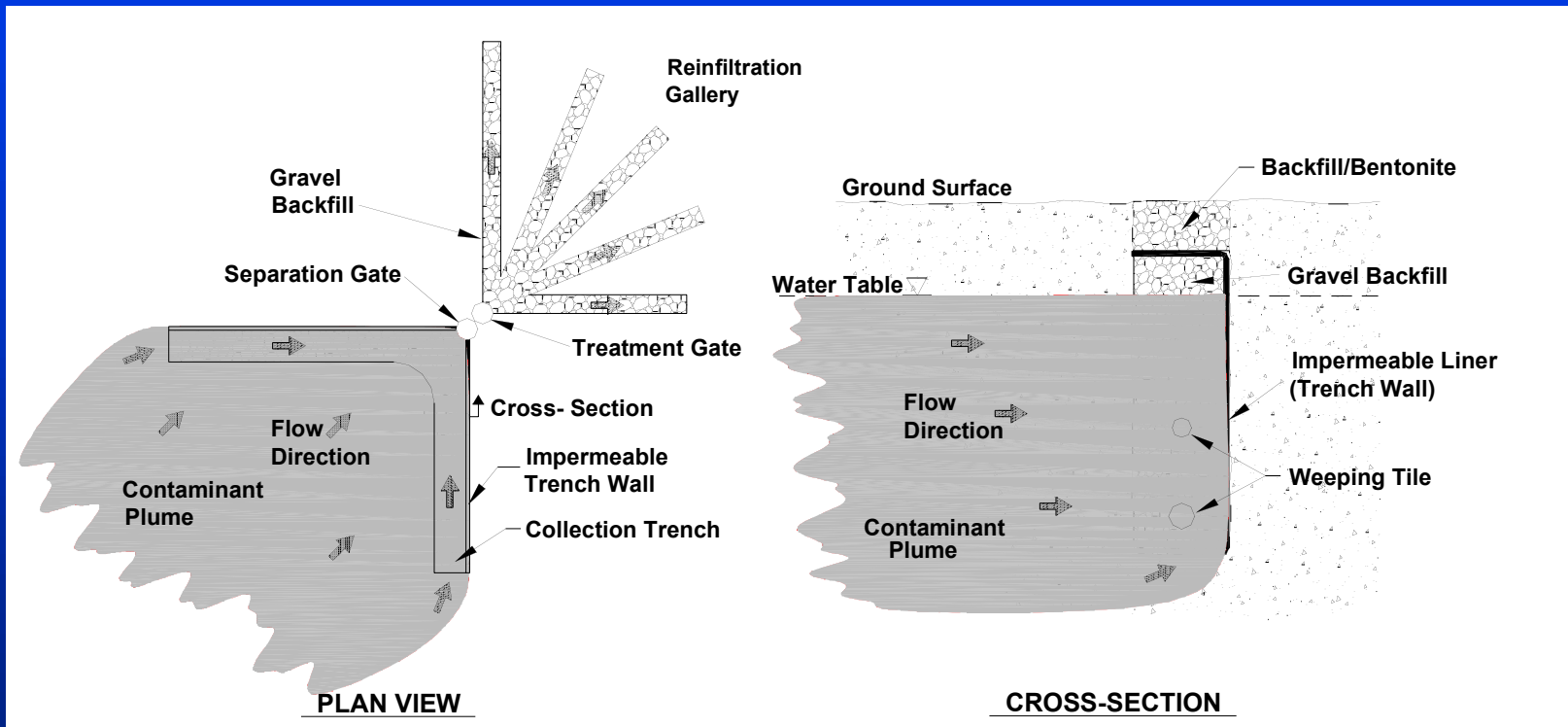
# ***Trench and Gate Components***

- ⇒ **A permeable “V” shaped trench directing groundwater flow to the ‘gate’**
- ⇒ **A free product separation gate**
- ⇒ **A dissolved phase treatment gate**
- ⇒ **A post-treatment re-infiltration gallery**



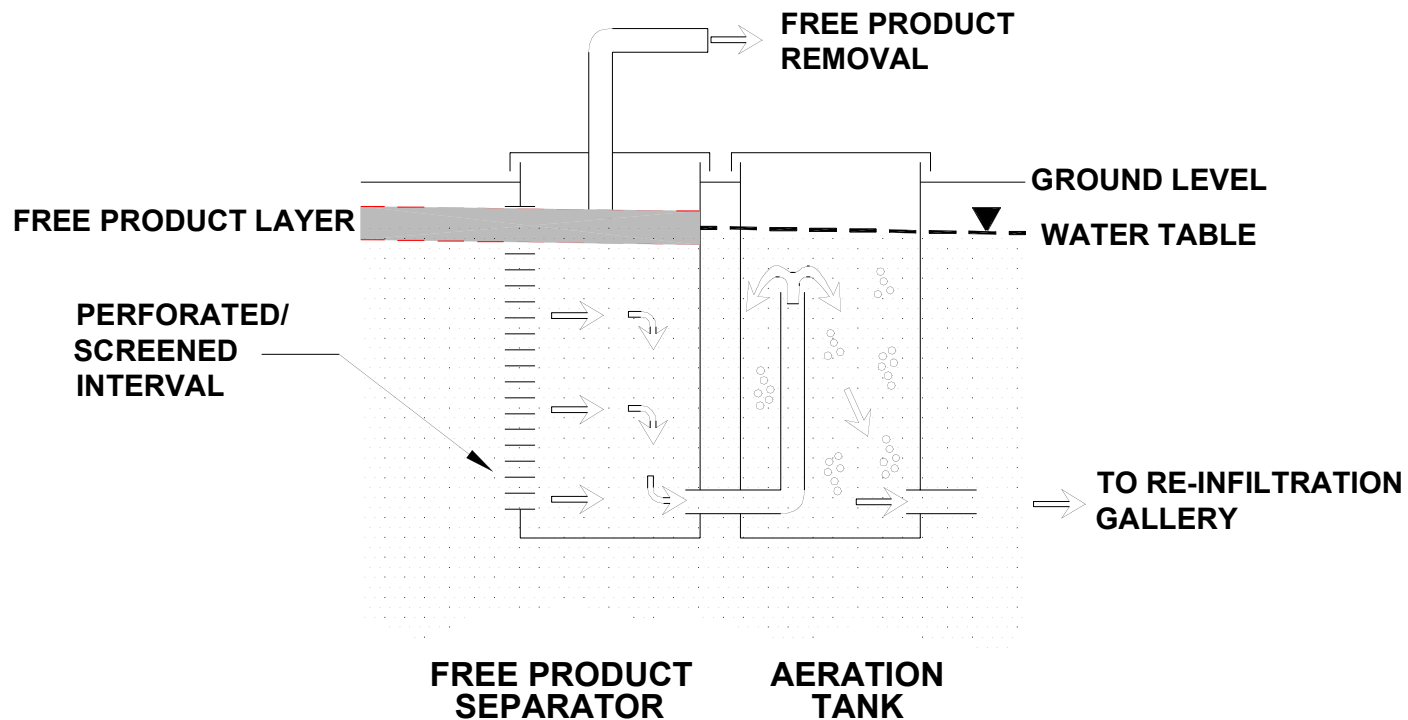
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# Trench and Gate System - Schematic



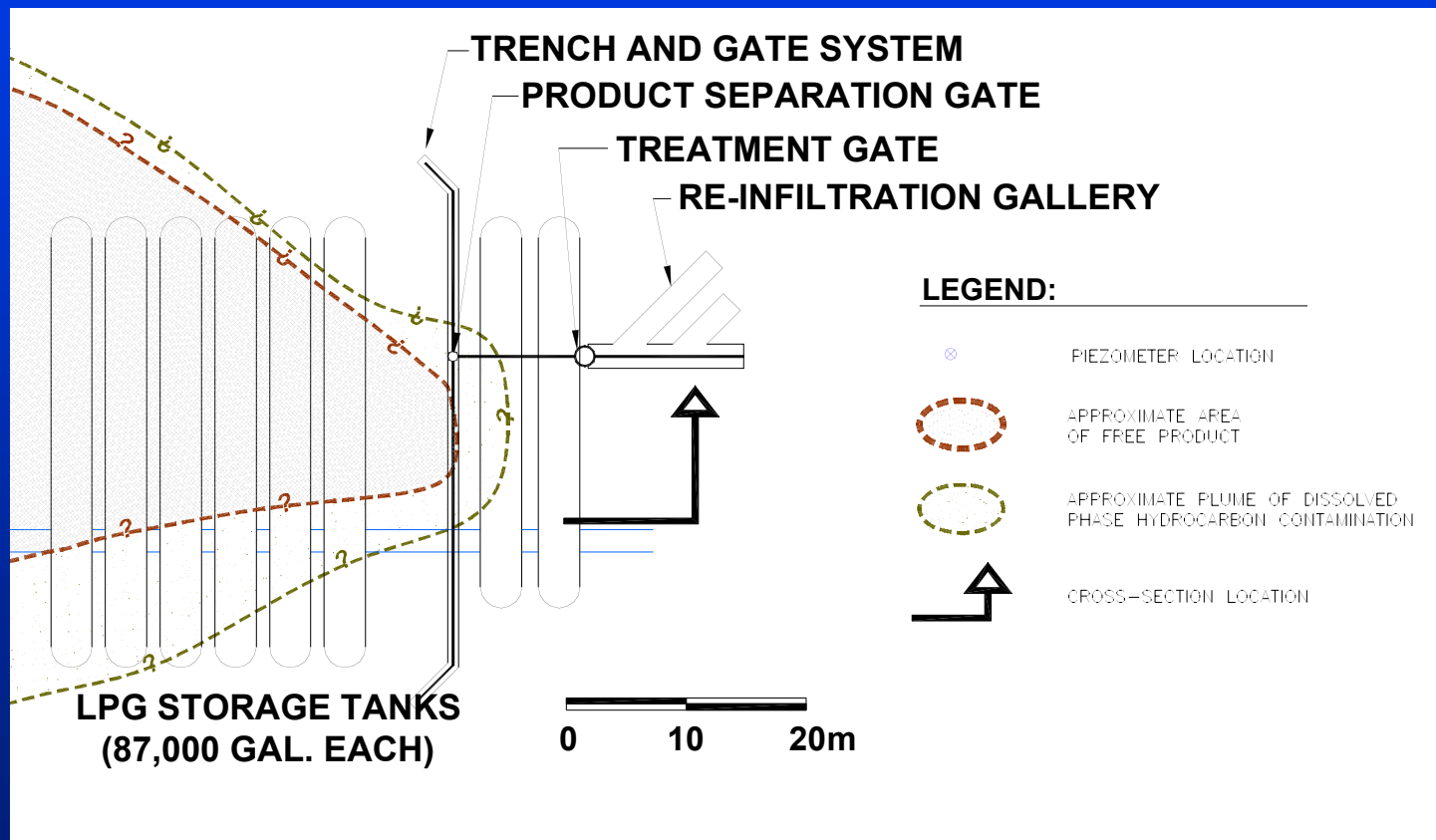
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# Collection and Treatment Gates



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# Plan View of Trench and Gate



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# **Trench and Gate Construction**

Excavation of Collection Trench



Installation of Separation Gate



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# **Product Separation Gate**



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# **Backfilling Gravel into Re-infiltration Gallery**



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# **Compacting Soils around Treatment Gate**



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# ***Dissolved Phase Treatment Gate***



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# **Separation and Treatment Gates**



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# ***Installing Connector Pipe***



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# **Collection Trench**



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# **System Operation**

- ⇒ **System was constructed in Fall 2000.**
- ⇒ **Has been operating since Spring 2001.**
- ⇒ **System was designed to operate continuously for 12 months per year.**



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# ***Performance Review***

**Evaluated via the following metrics:**

- ⇒ **product recovery volumes in the product separation gate; and.**
- ⇒ **groundwater quality before and after treatment in the dissolved phase treatment gate.**



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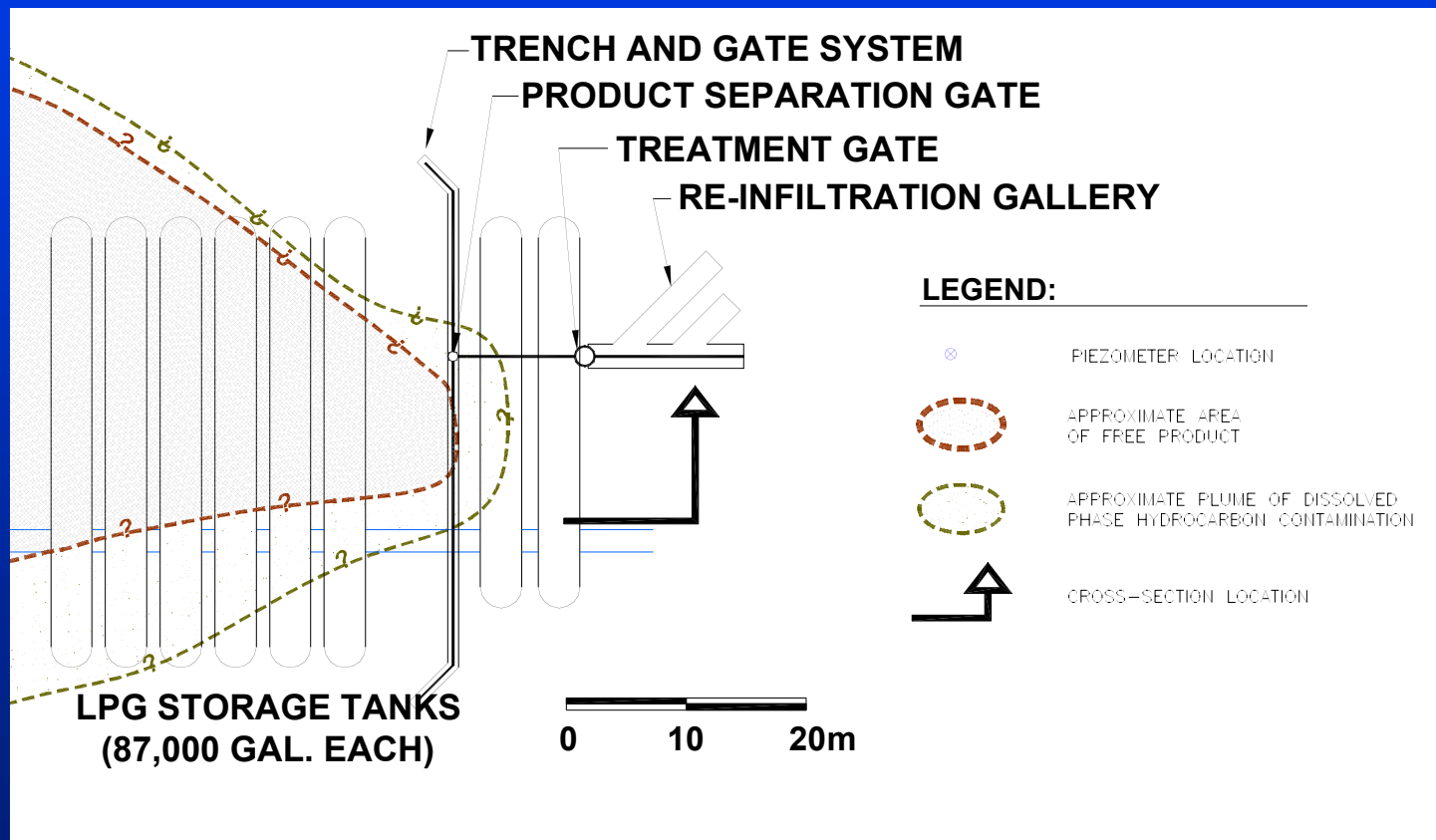
# ***Free Product Recovery***

- ⇒ **To date, there has been no significant entry of free product in the Separation Gate.**
- ⇒ **A fairly continuous hydrocarbon sheen is observed in the gate.**



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# Plan View of Trench and Gate



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# **Trench and Gate System - Water Quality**

Monitoring Station	Date	Benzene	Toluene	Ethylbenzene	Xylenes	TPH (C <sub>3</sub> -C <sub>10</sub> )
CDWQG		0.005	0.024	0.0024	0.3	NC
Product Separation Gate	09/24/01	0.0249	<0.0009	<0.0009	0.223	0.6
	11/13/01	0.022	<0.002	<0.002	0.292	1.2
	06/27/02	0.0552	0.0108	<0.0004	0.186	1.2
Treatment Gate	09/24/01	<0.0004	<0.0004	<0.0004	<0.0012	<0.1
	11/13/01	<0.0004	<0.0004	<0.0004	<0.0012	<0.1
	06/27/02	<0.0004	<0.0004	<0.0004	<0.0012	<0.1



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All units in mg/L

# **Summary**

## **Achieved Remedial Goals:**

- ⇒ **prevented further expansion of free product and dissolved phase plumes;**
- ⇒ **treated dissolved hydrocarbons at the downgradient edge; and,**
- ⇒ **system is well positioned to capture downgradient free product migration**



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