Voluntary Evaluation, Risk Assessment, and Closure of an Active Locomotive Fueling Facility

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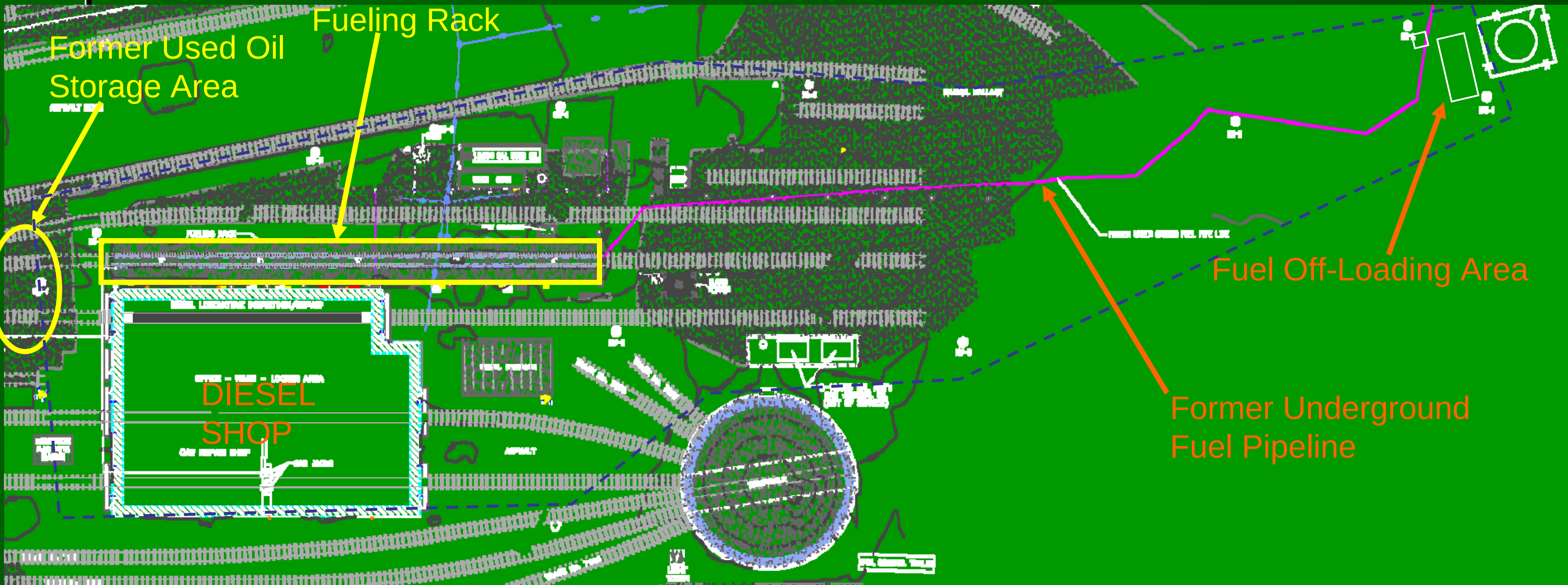
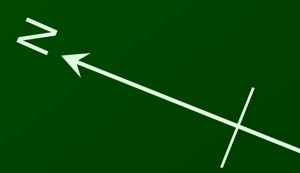
Site Description & Background

- Active rail yard since 1903
- Operations include:
  - Locomotive fueling
  - Locomotive lubrication
  - Light maintenance
- Underground fuel line conveyed fuel from AST to fueling rack
- 2001 – Underground fuel line replaced with above ground piping

Site Description & Background





Purpose of Study

- Site entered into Missouri VCP, 2000
  - Evaluate historical petroleum hydrocarbon impacts from
    - Locomotive fueling
    - Underground fuel pipeline
    - Fuel off-loading area
    - Former used oil storage area
- Tier 1 Site Assessment per CALM document
- Obtain Certificate of Completion from MDNR

Physical Setting & Geology

- Broad alluvial valley, flood plain
- Fill material – 2 to 3 feet gravel, sand, clayey silt
- Native soil – alluvial materials (clayey silt, silty clay, sand & gravel lenses)
- Water table ~ 10 to 15 feet below grade
- Groundwater flow – southeast toward river
  - Average hydraulic gradient – 0.015 ft/ft
- No free product

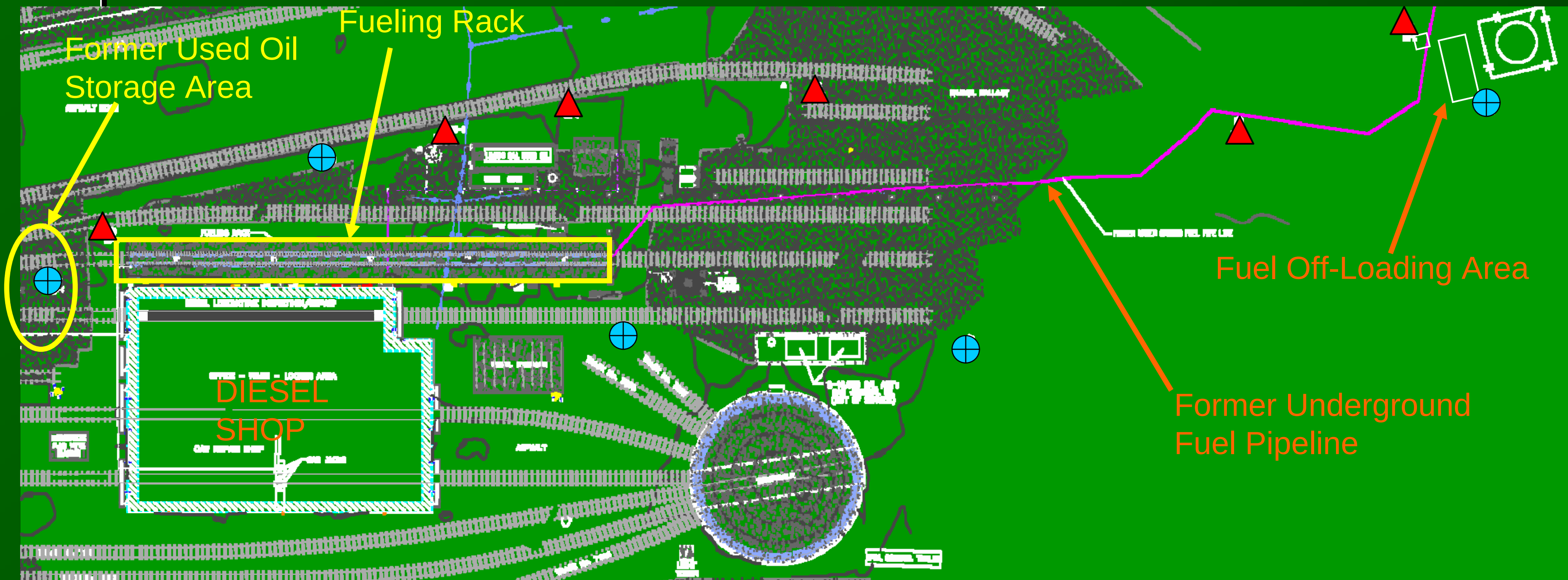
Land & Water Use

- Land is zoned for mixed industrial, offices, & warehousing
- Nearest residential area, two blocks south
- City ordinance prohibits installation and use of drinking water wells
- Municipal water intake 8 miles upstream on river

Tier 1 Site Assessment

- Four key areas of concern:
  - – Locomotive fueling rack
  - – Former underground fuel pipeline
  - – Fuel off-loading area
  - – Former used oil storage area
- Chemicals of Concern – in general
  - – TPH-DRO, also GRO
  - – VOCs (BTEX, MTBE), SVOCs
  - – RCRA Metals

Sampling Locations



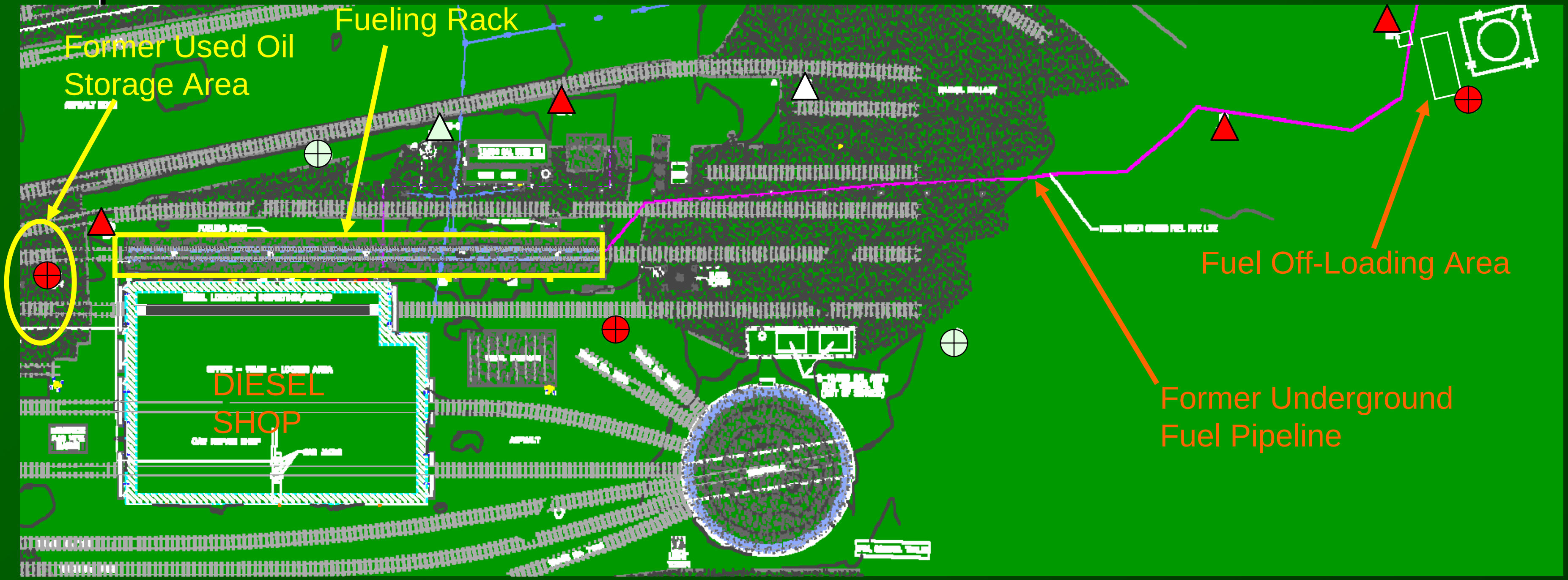
Monitoring Wells

Soil Borings

Tier 1 Scenario A (Unrestricted Land Use)

- Soil Target Concentrations (STARC)
  - Combined soil ingestion/dermal contact/inhalation pathway (C_{idi})
  - Soil-leaching-to-groundwater (C_{Leach})
- Soil Results Exceeding STARCs
  - TPH-DRO (diesel fuel) > 200 mg/kg at 7 locations (0-3 feet)
  - Benzo(a)pyrene > 0.2 mg/kg at 4 locations (0-3 feet)

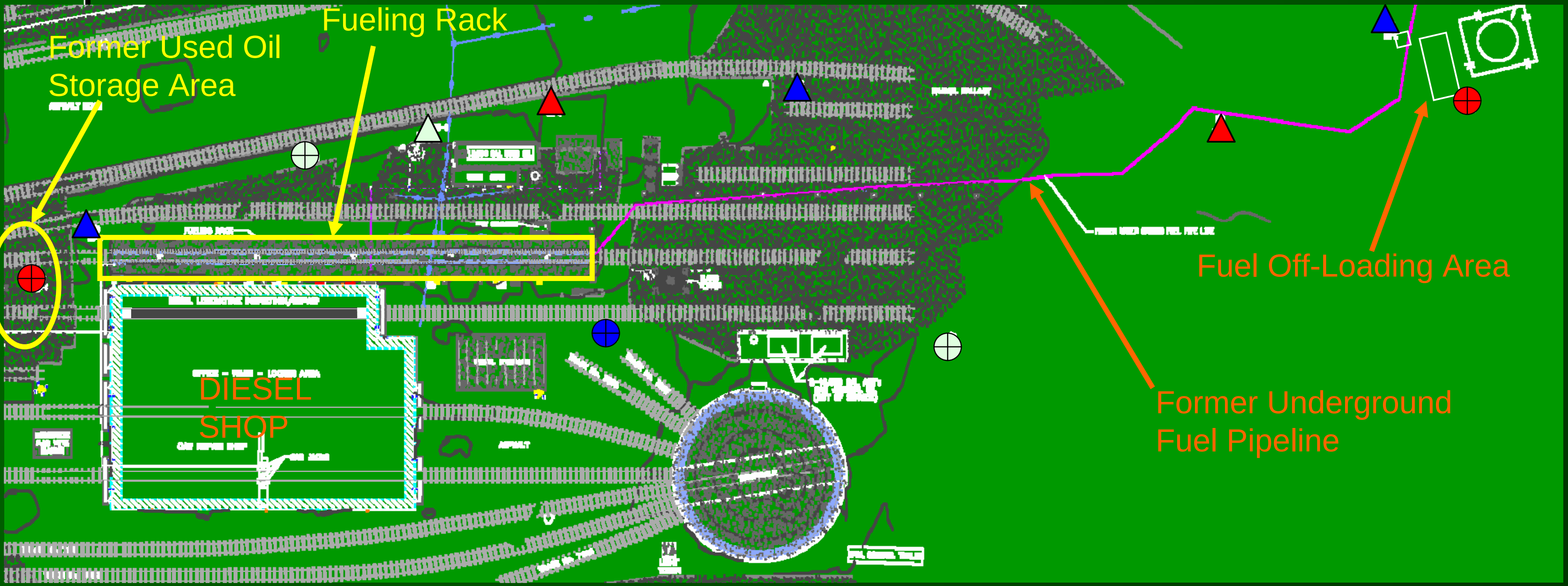
TPH-DRO > Scenario A STARC



Monitoring Wells

Soil Borings

BAP > Scenario A STARC



Monitoring Wells
Soil Borings

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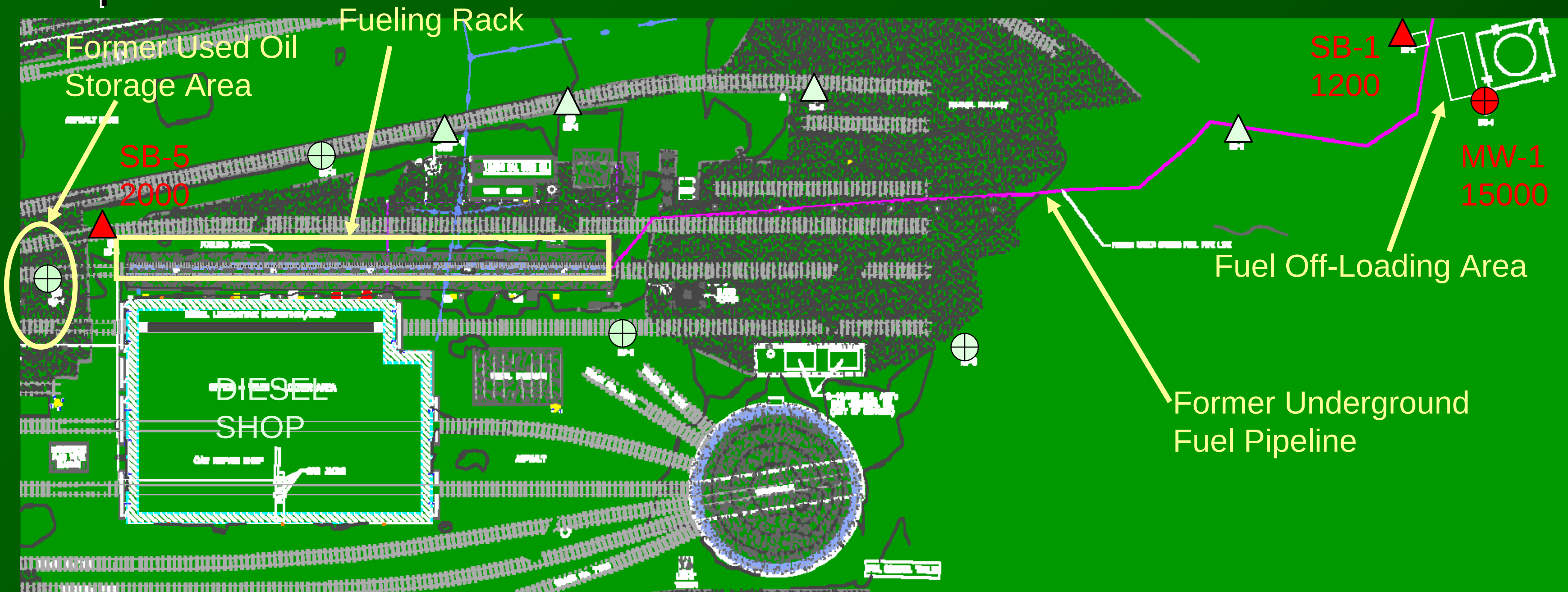
Tier 1 Scenario A
(Unrestricted Land Use)

- Groundwater Target Concentrations (GTARC)
  - None of the results exceeded the Scenario A GTARCs

Tier 1 Scenario C (Industrial Land Use)

- Exposure scenario for the Site is Industrial
- Maximum concentrations compared to Scenario C STARCs (C_{IDI} and C_{LEACH})
  - TPH-DRO
    - 1,000 mg/kg C_{IDI} (No C_{LEACH})
    - 3 locations, range 1200 to 15,000 mg/kg

Results Above Scenario C STARC



Monitoring Wells

Soil Borings

15000 TPH-DRO (mg/kg)

Tier 1 Data

- Tier 1 data represent conditions across the Site; suitable for developing health-based risk levels for TPH because
  - Worst case areas sampled
  - One type of product - TPH-DRO
  - TPH degrades to progressively less toxic substances

So Now What?

- CALM guidance document:
  - No toxicity value for TPH
  - No guidance for developing a health-based cleanup level for TPH
- Missouri RBCA still being developed
- Other states (Massachusetts, Washington, Texas); also TPHCWG guide documents

THE CHALLENGE

- Already have representative TPH data (un-fractionated)
- Really wanted to avoid re-sampling
  - Fractionated TPH analysis $$$$$$$!
- How to use existing, un-fractionated TPH data to develop a health-based cleanup level?

TWO GENERAL APPROACHES

- First Approach
  - Identify the product by GC analysis of environmental samples; compare to chromatographic standards for products.
  - Once product identified, use whole product toxicity value to calculate cleanup level

First Approach

- Advantages –
  - Can use with existing data
  - Produces one cleanup value for all TPH impacted areas
- Disadvantages –
  - Whole product toxicity value is intended for fresh product
  - Toxicity of fresh products ≠ toxicity of degraded products
  - Change in chemical composition over time causes uncertainty in the applicability of the toxicity value and the calculated cleanup level

Second Approach

- Use single constituent with a known toxicity (i.e., pyrene) as surrogate to represent a portion or all of a petroleum product
  - Approach used by MADEP, TCEQ, TPHCWG – requires fractionated analyses

Second Approach

- Another Variation –
  - Use assumed or estimated fractional composition of degraded product to develop a weighted average toxicity value based on surrogates for fractions (Tonner-Navarro, et al, 1998).

Second Approach

- Advantages
  - Greater relevance and less uncertainty in the result
- Disadvantages
  - Added cost and complexity, especially if non-standard analyses required for samples

Combined Approach for Tier 3

- Use existing data – TPH primarily diesel
- Chromatograms, literature search - degraded product composition
- Literature search for whole product and surrogate toxicity values, exposure variables
- Input into CALM exposure equations
- Provide array of TPH toxicity values, select the most appropriate one for the Site

Whole Product Toxicity Value

- Marine diesel fuel – RfD=0.162 mg/kg/day (USEPA RfD, modified by Statts, Mattie, and Fisher, 1997)
  - Marine diesel is #4 diesel, a residual fuel
    - Residual fuels may have higher % of PAHs
- Conservative value for a #2 Diesel site

Surrogate Toxicity Values

- Nonane and Pyrene
  - MADEP (2001) indicates these are representative single constituent surrogates
- Toxicity values
  - Nonane – RfD = 0.6 mg/kg/day (MADEP, 2001)
  - Pyrene – RfD = 0.03 mg/kg/day (USEPA, 2002)

Weighted Average Toxicity Value

- Existing diesel fuel in soil assumed to be
  - 60% aromatic hydrocarbons (C_{11}-C_{22})
  - 40% aliphatic hydrocarbons (C_9-C_{18})
- Weighted average toxicity value (60% of pyrene value; 40% of nonane value)
  - Composite RfD = 0.3 mg/kg/day
- More specific than the two single constituent values

Exposure Variables

- Three ingestion factors were calculated using the following ingestion rates (IRs):
  - IRs-1 = 100 mg/day (CALM, 1998)
  - IRs-2 = 50 mg/day (USEPA, 1997)
  - IRs-3 = 10 mg/day (Stanek et al., 1997)

Exposure Variables

- Dermal contact
  - Two skin adherence factors (AF) and two skin surface area (SA) assumptions used:
    - CALM default values
      - AF-1 (1 mg/cm^2)
      - SA-1 (4714 cm^2)
    - USEPA recommended default values
      - AF-2 (0.2 mg/cm^2)
      - SA-2 (3300 cm^2)

Exposure Variables

- Inhalation factors –
  - Calculated using Scenario C equations with
    - Volatization factors (calculated)
    - Particulate emissions factors (calculated)
    - Inhalation RfDs from literature (MADEP; Staats, Mattie & Fisher; Tonner-Navarro, et al.)

Calculated Tier 3 STARC Values

Reference Dose and Sources	STARC (1)	STARC (2)	STARC (3)
0.6 mg/kg/day (MADEP, 2001)	1.72E+04	1.74E+04	1.76E+04
0.03 mg/kg/day (USEPA, 2002)	5.28E+03	2.46E+04	3.62E+04
0.162 mg/kg/day (Statts, Mattie, and Fisher, 1997)	1.28E+04	1.97E+04	2.07E+04
0.3 mg/kg/day (composite)	1.24E+04	1.52E+04	1.55E+04

Calculated Tier 3 STARC Values

- Range from 5280 to 36200 mg/kg
- Site-specific Tier 3 STARC
  - 15200 mg/kg
    - Derived using the Composite RfD and the current USEPA default values for exposure variables.

Recommended Tier 3 STARC for TPH

Comparison of Site Data to Recommended Tier 3 STARC		
Sample Concentrations Exceeding Tier 1 STARC		Recommended Tier 3 STARC
Sample	Concentration	Concentration
MW-1 (0-2’)	15000 mg/kg	15200 mg/kg
SB-1 (0-2’)	1200 mg/kg	15200 mg/kg
SB-5 (0-2’)	2000 mg/kg	15200 mg/kg

The End

CERTIFICATE OF COMPLETION

January 2006