TABLE 4

SUMMARY OF PRE-1998 INVESTIGATIONS
BN Havre Fueling Facility

Date of Investigation	Work Completed	Purpose of Investigation/Investigative Findings
1985/1986	• Drilled three borings (HV-1, HV-3, and HV-4), constructed six wells (HV-2 and HV-5 through HV-9), and collected groundwater samples from wells HV-6, HV-8, and HV-9 for oil and grease analysis. • Conducted bail down test in wells.	• Determine local groundwater conditions and presence and extent of diesel fuel at request of DHES[a]. • Measurable LNAPL[b] present in wells HV-2, HV-5, and HV-7. • Estimate transmissivity.
April 1986	• Collected a sludge sample from the WWTP[c] for naphthalene and EPA Method 624 constituents.	• Characterize the sludge for disposal.
February 1987	• Collected a sludge sample from the WWTP for naphthalene and EPA Method 624 constituents as presented in the 1987 Havre Waste Characterization Report.	• Characterize the sludge for disposal.
May 1987	• Excavated eight test pits (TP-1 through TP-8), drilled one soil boring (HV-13), and constructed two wells (HV-10 and HV-11).	• Delineate mobile LNAPL zone.
September 1987	• Initiated quarterly groundwater monitoring.	• At request of DHES.
September-December 1987	• Excavated seven test pits (TP-9 through TP-15) and constructed nine wells (HV-13A and HV-14 through HV-21). • Collected groundwater sample from well HV-11 for TPH[d] analysis.	• Delineate mobile LNAPL. • TPH not detected in the sample.
February 1988	• Collected groundwater sample from well HV-21 for EPA Method 8240 constituents and TPH analysis.	• Evaluate groundwater quality.
June 1988	• Constructed recovery well HV-R1 and conducted a pump test.	• Assess the type of recovery equipment applicable to the Facility.
June - December 1989	• Constructed five monitoring wells (HV-22 through HV-26) and seven recovery wells (HV-R2 through HV-R8); collected groundwater samples from wells HV-6, HV-8, HV-9, and HV-25 for EPA Method 8240 constituents.	• Further assess the distribution of mobile LNAPL, evaluate groundwater quality, and select areas from which to initiate recovery operations.
December 1989/January 1990	• Conducted LNAPL recovery operations in eight wells by periodically pumping the wells.	• Initiate LNAPL recovery at the Facility.
June 1990	• Sampled wells HV-6, HV-8, HV-9, and HV-R3 for EPA Method 624 constituents.	• Assess potential mobile LNAPL migration.
October 1990	• Drilled two borings (HV-B1 and HV-B2) adjacent to former 10,000-barrel diesel tank and collected two soil samples from each boring for TPH analysis. • Designed track pan drain system. • Sampled private offsite well located 80 feet northwest of HV-8 for EPA Method 624 constituents and TPH.	• Assess potential diesel release from tank. • Fuel spillage containment/pollution prevention. • Assess offsite groundwater quality.
September - November 1991	• Constructed LNAPL recovery system in vicinity of Western Fueling Area (Recovery Area 2) including constructing nine recovery wells (HV-R9 through HV-R17). • Collected two soil samples from a boring of a recovery well for TCLP[e] extraction and priority pollutant analyses.	• LNAPL recovery. • Evaluate whether soil excavated during recovery system construction could be replaced on the railyard.

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SUMMARY OF PRE-1998 INVESTIGATIONS
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Date of Investigation	Work Completed	Purpose of Investigation/Investigative Findings
April 1992	• Constructed wells HV-9A and HV-18A. • Started recovery operations at Area 2.	• Replace wells HV-9 and HV-18, which were destroyed during construction activities. • LNAPL recovery.
April and August 1992	• Conducted investigation in area north of BN WWTP and bulk fuel storage tanks. Excavated gravel-filled interceptor trench perpendicular to city's sewer; constructed 25 temporary monitoring points (MP-1 through MP-25) and one monitoring well (HV-27); and excavated backhoe trench along former BN sewer lines. (Note: Two of the temporary monitoring points, MP-18 and MP-19, were constructed adjacent to the former lagoon sewer line.) • Drilled six temporary monitoring points (MP-D1 through MP-D6) in vicinity of former Diesel Shop Fueling Area (Area 3).	• Investigate diesel fuel in this area and assess potential offsite migration of diesel fuel. No LNAPL was observed in MP-18 and MP-19, advanced adjacent to former lagoon sewer line. • LNAPL recovery. • Assess extent of LNAPL in area and assist in siting recovery wells and designing recovery system in Area 3.
October 1992	• Constructed 10 recovery wells (HV-R18 through HV-R27) in vicinity of Area 3. • Collected one composite sample from borings of recovery wells for TCLP extraction and priority pollutant analyses.	• LNAPL recovery. • Evaluate whether soil excavated during recovery system construction could be replaced on the railyard.
November 1992	• Completed construction of LNAPL recovery system for Area 3.	• LNAPL recovery.
April 1993	• Restarted recovery operations at the Facility, including recovery operations at Area 3 and LNAPL interceptor trench.	• LNAPL recovery.
June 1993	• Conducted investigation of LNAPL distribution in vicinity of WWTP lagoons and city's sewer. Constructed 10 monitoring wells (HV-28 through HV-37), one vadose zone well (HV-28A), and one temporary monitoring point (MP-26). Collected one soil sample from boring HV-36 for modified EPA Method 8015 constituents. • Completed a backhoe excavation (test pit TP-16) along north wall of the bulk fuel tank containment area. • Constructed recovery well HV-R28 in Area 1.	• Evaluate extent of LNAPL in the area. • Measurable LNAPL detected in wells HV-28, HV-29, HV-30, HV-31, HV-37, and temporary monitoring point MP-26. No LNAPL or odor observed in wells HV-32 and HV-35. • Delineate LNAPL. • LNAPL recovery.
July/August 1993	• Conducted subsurface investigation of LNAPL distribution in area south of Recovery Area 2. Constructed six wells (HV-38 through HV-43); drilled three soil borings (MP-2-1, MP-2-2, and MP-2-3); and collected groundwater samples from wells HV-6, HV-9A, HV-27, HV-32, HV-35, HV-39, HV-40, and HV-43 for TPH analysis. Sample from well HV-43 also analyzed for EPA Method 624 constituents. • Expanded Area 2 recovery system. • Completed construction of LNAPL recovery system at Area 1 (included installing belt skimmers in wells HV-R7 and HV-R28).	• Respond to reported presence of LNAPL and vapors in elevator shaft at the Park Hotel (south of Recovery Area 2). • TPH detected in samples from wells HV-9A, HV-39, HV-40, and HV-43; TPH not detected in samples from wells HV-6, HV-27, HV-32, and HV-35. • LNAPL recovery. • LNAPL recovery.
July/August 1993	• Olympus installed a vapor extraction blower at the Park Hotel • Olympus installed a sump pump in the bottom of the evaluator shaft that discharged to the city sewer system (under agreement with the city).	• To vent the Park Hotel elevator shaft. • To recovery LNAPL within the elevator shaft.

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Date of Investigation	Work Completed	Purpose of Investigation/Investigative Findings
April/May 1994	• Constructed 11 recovery wells (HV-R31 through HV-R36 and HV-R39 through HV-R43) in Recovery Area 3; constructed two temporary monitoring points and one monitoring well (MP-3-1, MP-3-2, and HV-45) west of the recovery system. • Drilled five temporary monitoring points (MP-2-4 through MP-2-8) in vicinity of Area 2 Recovery System and Park Hotel; collected one soil sample during drilling of MP-2-7 for geotechnical parameters; and constructed three recovery wells (HV-R29, HV-R37, and HV-R44), which were outfitted with passive recovery canisters. • Conducted investigation in area of the Bullhook Creek. Work included drilling 12 boring/temporary monitoring points (BH-1 through BH-12); constructing three monitoring wells (HV-44, HV-46, and HV-47) and two recovery wells (HV-R30 and HV-R38); and excavating a LNAPL interceptor trench equipped with a passive recovery unit. Collected three soil samples from well boring HV-46 for geotechnical parameters. • Cleaned eastern and western Bullhook Creek box culverts and sealed all cracks using a pressure-injected, high-strength epoxy.	• Delineate mobile LNAPL area and expand recovery system. • Further characterize mobile LNAPL area and expand recovery system. • Evaluate source and extent of LNAPL in area. • LNAPL recovery. • LNAPL zone appeared to be centered along box culvert, extending from an area just south of the former 6-inch fuel line to the mouth of box culvert. • Attempt to eliminate LNAPL seepage into Bullhook Creek.
July/August 1994	• Conducted subsurface investigation at Recovery Areas 1 and 2 and Northside Recovery Area. Work included constructing 20 monitoring wells (HV-48 through HV-67) and drilling three soil borings (MP-1-1, MP-1-2, and MP-2-9). • Expanded Bullhook Recovery Area with the addition of two recovery wells (HV-R45 and HV-46).	• Delineate the extent of mobile LNAPL in areas. • LNAPL recovery.
March 1995	• Initiated Bioventing Feasibility Study Treatability.	• Alternative LNAPL remediation technology.
April/May 1995	• Conducted Facility-wide LNAPL occurrence investigation using a StrataProbe sampling system. Sampled 87 locations; each soil sample visually inspected for evidence of LNAPL or residual LNAPL smearing and screened using a PID[(f)]. • Collected six subsurface soil samples for total extractable hydrocarbon analysis.	• Better delineate LNAPL zones at the Facility. • Provide quantitative information on the presence of a dissolved TPH in saturated zone.

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Date of Investigation	Work Completed	Purpose of Investigation/Investigative Findings
September 1995	• Constructed seven monitoring wells (HV-68 through HV-74) and five recovery wells (HV-R47 through HV-R51) and drilled three soil borings (MP-3-3, MP-3-4, and MP-27). • Collected LNAPL and groundwater samples from well HV-14, and collected subsurface soil samples from well borings HV-R47 and HV-R50 for chemical and physical properties. • Completed design of LNAPL interceptor trench along northern property boundary and expanded Area 3 recovery system.	• Verify StrataProbe investigation results, provide information to facilitate LNAPL recovery/interceptor trench design, and provide long-term downgradient monitoring. • Evaluate potential mobility of LNAPL. • LNAPL recovery.
October - December 1995	• Constructed First Street North Interceptor Trench, equipped with three LNAPL skimming wells with belt skimmers and three dewatering wells (DW-1, DW-2, and DW-3). • Constructed 220-foot-long LNAPL recovery trench east of Recovery Area 2.	• Recovery of LNAPL that may migrate northward from the railyard. • LNAPL recovery.
April - June 1996	• Placed belt skimmer in 220-foot-long LNAPL recovery trench and connected it to the existing recovery system.	• LNAPL recovery.
July 1996	• Collected groundwater samples from wells HV-6, HV-38, HV-57, and HV-69 for analyses of indicators of natural attenuation.	• Acquire data on the geochemical indicators of natural bioremediation.
January 1997	• Olympus sealed the Park Hotel elevator shaft by applying grout and an epoxy sealer to the floor of the shaft.	• Prevent vapors and LNAPL from entering the elevator shaft.
September-October 1997	• Constructed three monitoring wells (HV-75, HV-76, and HV-77). • Collected groundwater samples from wells HV-8, HV-27, HV-35, HV-52, HV-53, HV-75, HV-76, and HV-77 for analysis of BTEX(g) and DRO(h). • Collected groundwater samples from wells HV-8, HV-27, HV-35, HV-53, HV-75, HV-76, and HV-77 for analysis of BTEX, DRO, and volatile and extractable petroleum hydrocarbons.	• Evaluate the nature, extent, and potential risk associated with diesel fuel migration in the North Havre area.

Notes:
(a) DHES = Montana Department of Health and Environmental Sciences.
(b) LNAPL = Light non-aqueous phase liquid.
(c) WWTP = Wastewater treatment plant.
(d) TPH = Total petroleum hydrocarbons.
(e) TCLP = Toxicity characteristic leaching procedure.
(f) PID = Photoionization detector.
(g) BTEX = Benzene, toluene, ethylbenzene, and xylenes.
(h) DRO = Diesel range organics.