APPENDIX C

CITY OF MANDAN, NORTH DAKOTA

ENVIRONMENTAL INSTITUTIONAL CONTROL ZONING DISTRICT

1) Site History - Past and current uses of the area particularly including the history of the diesel release.

The area has been impacted by historical releases of diesel-related petroleum products totaling an estimated one to three million gallons. The releases were associated with fueling activities at the south-adjacent Burlington Northern Santa Fe (BNSF) rail yard property. The impacts include a plume of petroleum free-product underlying the City of Mandan Environmental Institutional Control District.

2) Site Geology

The downtown area of Mandan is located approximately seven tenths of a mile north of the Heart River and 1.5 miles west of the Missouri River. Alluvial deposits underlie the downtown area of Mandan ranging in thickness from 25 to greater than 100 feet. The alluvium is underlain by bedrock that consists of shale and sandstone units. The unconsolidated alluvial sediments form a characteristic, grain-size increasing downward sequence (predominantly silt and clay near the surface grading to coarse sands and gravels with depth).

Specifically, the geology is as follows: concrete and asphalt, typically underlain by unconsolidated fill material composed of a heterogeneous mixture of topsoil, silt, sand, and gravel. As much as 6 feet of fill is present at some locations. The fill is underlain by a low permeability silty clay unit that ranges in thickness from 2 feet to greater than 30 feet that sometimes includes a fine sand fraction. The low permeability unit is approximately 12 feet thick in the vicinity of the free-product plume and thickens with depth to the north, east, and west. Intermingled within this unit are lenses of fine to medium grained silty sands. The silty clay unit is underlain by a discontinuous unit of fine to very fine silty sand that has an average thickness of 6 feet when present. Underlying this unit is a fine- to coarse-grained sand unit that ranges from 3 to 32 feet thick. Sediments beneath this unit are comprised of fine to coarse gravel.

The alluvial aquifer beneath the downtown area of Mandan is unconfined. The typical depth to groundwater based on measurements recorded in on-site monitoring wells is approximately 15 feet but varies according to location and seasonal fluctuations. The depth to groundwater has ranged from a minimum of 11 feet to a maximum of 22 feet (approximately 1625 to 1635 feet above mean sea level [AMSL]). The groundwater within the alluvial aquifer flows from the northwest to the southeast toward the Heart and Missouri rivers under a hydraulic gradient of 0.0001 to 0.0003 feet per foot.

3) Delineation of the petroleum contamination, the vertical and horizontal extent and concentration in the soil and groundwater.

The alluvial character of the subsurface conditions beneath the downtown Mandan area has influenced the occurrence and migration of light non-aqueous phase liquid (LNAPL) in the subsurface. The horizontal and vertical extent of measurable LNAPL is dependent on the elevation of the groundwater.

In general, the area of LNAPL occurrence is bounded to the south by BNSF property, to the north by 2nd Street, to the east by 1st Avenue East and to the west by 3rd Avenue West.

Groundwater and LNAPL measurement data are available from 1987 to the present. Within this time frame, the historical minimum is approximately 1620 feet AMSL; the historical maximum is approximately 1635 feet AMSL).

Concentrations of the dissolved phase contamination exist in the soils and groundwater though these are not as well documented as the concentrations of LNAPL. There are scattered analytical results; however, the results are not likely representative of the area.

4) Pathways – Identify the potential receptors, the nature of the movement of the contamination and the pathways for this movement.

Based on the current and future land use in the Mandan Remediation Project Area (Site), there are opportunities for residents, commercial workers, and utility workers to be exposed to various site media through a number of exposure pathways. Table 1 summarizes the current or potential future exposure pathways and potential populations.

Table 1

EXPOSURE MEDIA	EXPOSURE PATHWAY	POTENTIAL RECEPTORS	CURRENT COMPLETE PATHWAY?
Surface Soils (< 3 feet bgs)	Dermal Contact	Residents (adults and children), Commercial Workers, and Utility Workers	N
	Ingestion	Residents (adults and children), Commercial Workers, and Utility Workers	N
	Inhalation-Ambient Air (volatiles & particulates)	Residents (adults and children), Commercial Workers,and Utility Workers	N
	Inhalation-Indoor Air (volatiles)	Residents (adults and children), Commercial Workers, and Utility Workers	Y
	Leaching to Ground Water	Ground Water	Y
Subsurface Soils (> 3 feet bgs)	Dermal Contact	Utility Workers	Y
	Ingestion	Utility Workers	Y
	Inhalation-Ambient Air (volatiles & particulates)	Utility Workers	Y
	Inhalation-Indoor Air (volatiles)	Residents (adult and child) and Commercial Workers	Y
	Leaching to Ground Water	Ground Water	Y
Ground Water	Ingestion	Domestic Wells	Y
	Dermal Contact	Utility Workers	Y
	Inhalation-Ambient Air (volatiles)	Residents (adults and children), Commercial Workers, and Utility Workers	Y
	Inhalation-Indoor Air/Enclosed Space (volatiles)	Residents (adults and children), Commercial Workers, and Utility Workers	Y
	Irrigation	Residents (adults and children), Commercial Workers	Y
	LNAPL Intrusion	Residents (adults and children), Commercial Workers	Y

Notes:

bgs: below ground surface

5) Health and Environmental Impacts – Identify the potential health or environmental impacts to the persons or receptors.

Health and environmental impacts are discussed in detail in the *Task 2005-1-3f Risk Based Screening Level Calculations – Verification and Validation* memorandum by LBG dated January 2006. The following summarizes the results of the LBG report.

The risk-based corrective action evaluation indicates that there are no current exposure scenarios occurring which require immediate action. Long-term risks may exist as follows:

Surface Soil (<3 feet below grade)

Although the site is covered by concrete, asphalt, and buildings, there are instances where populations could be exposed to surface soil. Primarily, utility workers constructing or repairing subsurface utilities would disturb surface soils while excavating. Commercial workers may be exposed incidentally to surface soil depending on their specific location and work activity patterns. There is potential for residential exposures to adults and children living in or near the Site to be incidentally exposed to surface soils. Lastly, considering that potential future land use may include green space, recreational exposures will be addressed.

Current maximum and average concentrations were screened against the Risk Based Screening Levels (RBSL). The soil leaching to groundwater pathway appear to be the current risk driver. There were no exceedences of benzene, toluene, ethyl benzene, xylenes (BTEX) or Total Petroleum Hydrocarbon (TPH) RBSLs. However, there were RBSL exceedences for several of the poly aromatic hydrocarbons (PAHs).

Subsurface Soil (>3 feet below grade)

Most of the subsurface soil exposures are limited to utility workers who may excavate more than three feet below grade to construct or repair utilities. Residents and commercial workers would also have the potential for indirect exposure to subsurface soil via vapors migrating into buildings with basements or slab-on-grade buildings in the remediation area.

Current maximum and average concentrations in subsurface soil three to twelve feet below grade were screened against all of the calculated subsurface RBSLs. The maximum concentration of ethylbenzene exceeded the RBSL, but the average concentration was less than the RBSL. Remaining exceedences in subsurface soil were PAHs.

For subsurface soils located greater than twelve feet below grade, only the soil leaching to groundwater RBSL applies. For this pathway, there were several compounds for which the average concentration exceeded the screening criteria including benzene and most of the PAHs.

Ground Water

Domestic wells are present at the Site which presents a risk of ingestion and/or COC volatilization through irrigation of the groundwater. Groundwater concentrations were screened against site-specific RBSLs (irrigation and utility worker dermal contact). There were no exceedences of RBSLs. In addition, all samples collected were non-detect for all PAHs.

Residents and commercial workers would also have the potential for indirect exposure to ground water via vapors migrating into buildings with basements or slab-on-grade buildings in the remediation area. For this pathway, site-specific indoor air sampling results indicated that the risk drivers were benzene, ethylbenzene, 1,2,4-Trimethylbenzene (TMB) and 1,3,5-TMB. All other compounds were below residential and commercial indoor air screening levels.

For buildings with basements, light non-aqueous phase liquid (LNAPL) or free phase diesel fuel may be encountered if high water table incidents occur.