2.0 ENVIRONMENTAL SETTING

The following section describes the regional environmental setting of the Bosque and Leon River watersheds study area including the former NWIRP McGregor site.

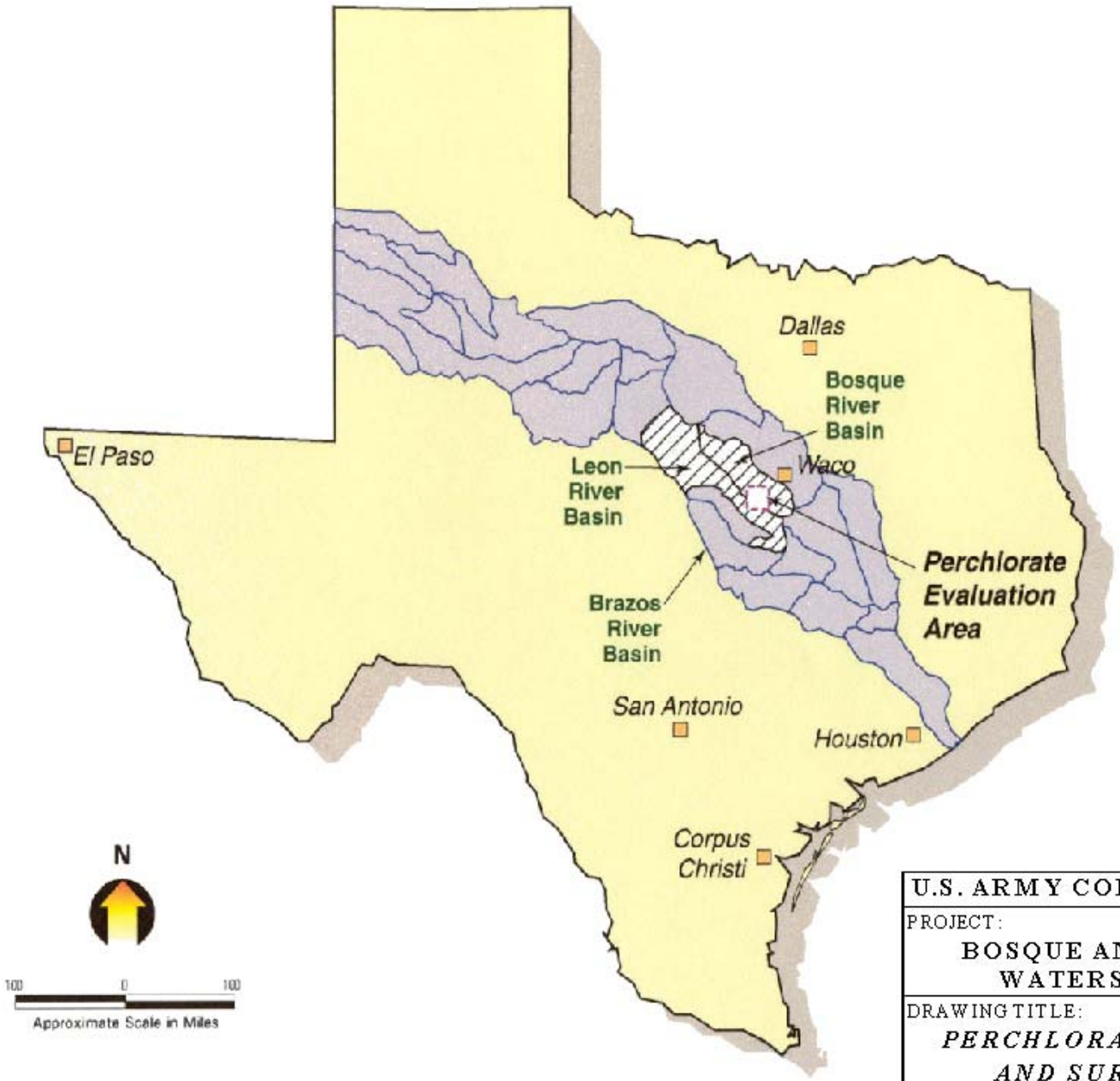
2.1 STUDY AREA LOCATION AND DESCRIPTION

The USACE perchlorate study area comprises portions of the Bosque River watershed and the Leon River watershed, two watersheds that supply surface water to Lake Waco and Lake Belton in Central Texas. This study was restricted to perchlorate contamination outside of the NWIRP property boundary. It was not intended to characterize perchlorate contamination within the NWIRP boundary. The NWIRP boundary was considered to be the boundary at the time this study began. The study area does not include former NWIRP areas that were transferred during the course of this study. **Figure 2-1** shows the overall study area location.

Lake Waco and Lake Belton serve as water supply sources for approximately 500,000 people in the surrounding communities including Waco, Killeen, Belton, and Temple (U.S. Census Bureau, 2001). Former NWIRP McGregor straddles the watershed boundary between Lake Waco and Lake Belton. Thus, stormwater runoff and groundwater flowing from the NWIRP McGregor site are components of these drinking water supplies. **Figure 2-2** shows the location of NWIRP, the study area, and Lakes Belton and Waco.

The city of Temple's intake structure downstream of the Lake Belton dam defines the southern boundary of the study area. The eastern boundary of the study area extends north from the city of Belton, located to the west of U.S. Interstate 35, and continues northeast along U.S. Interstate 35 to the dam at Lake Waco. The dam at Lake Waco defines the northern boundary of the study area. Finally, the western boundary of the study area extends northwest away from Lake Belton along the western edge of the Leon River. The study area does not include environmental investigations within the boundaries of NWIRP McGregor, as other parties are conducting these investigations. In addition to perchlorate contamination originating at NWIRP McGregor, this study also addresses potential perchlorate contamination originating at Fort Hood, which adjoins the western boundary of the study area. However, the USACE study was not intended to address or serve as an environmental investigation within the boundaries of Fort Hood.

NWIRP McGregor is located approximately 20 miles to the southwest of Waco, Texas, and formerly encompassed approximately 9,750 acres of generally flat-lying land at the eastern border of the Texas Hill Country. Based on information from the September 11, 2002 NWIRP Restoration Advisory Board meeting, approximately 6,000 acres have been transferred to the City of McGregor as part of the decommissioning of this facility. State Highway 317 runs along the eastern edge of NWIRP McGregor, and FM 2671 runs along much of its southern boundary. The town of McGregor, Texas is located at the northeast corner of NWIRP McGregor.



U.S. ARMY CORPS OF ENGINEERS

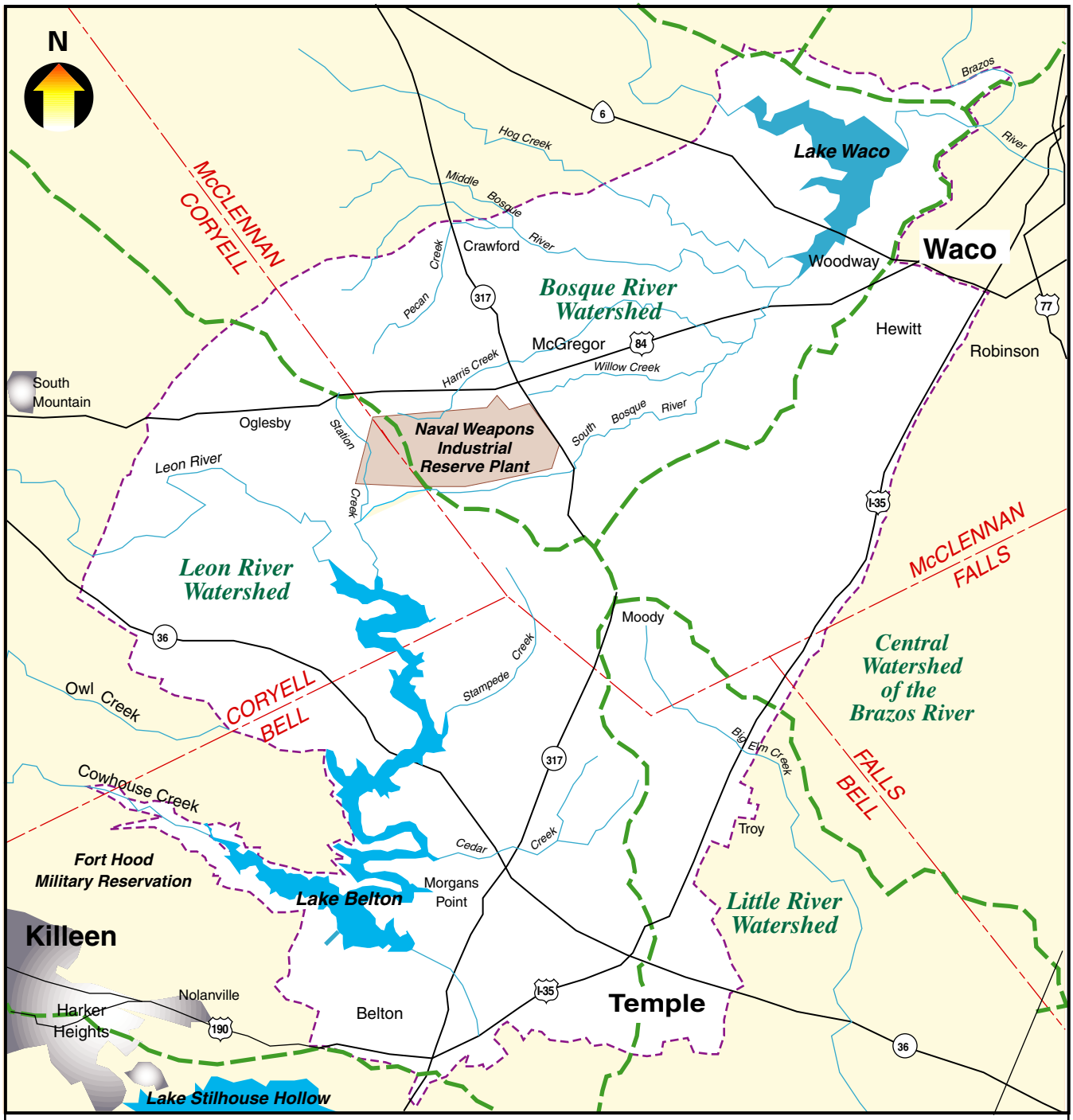
PROJECT:
BOSQUE AND LEON RIVER WATERSHEDS STUDY

DRAWING TITLE:
PERCHLORATE STUDY AREA AND SURROUNDINGS

MWH
MONTGOMERY WATSON HARZA

Sheet 1 of 1 Sheets

SCALE:	FIGURE:
Not to Scale	2-1



Watershed Boundaries

Study Area Boundary

5 0 5

Approximate Scale in Miles

U.S. Army Corps of Engineers

PROJECT:

BOSQUE AND LEON RIVER WATERSHEDS STUDY

DRAWING TITLE:

PERCHLORATE EVALUATION AREA

MWH
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SCALE: Not to Scale

FIGURE: 2-2

2.2 REGIONAL TOPOGRAPHY

The study area includes portions of McLennan, Coryell and Bell counties and lies in the Washita Prairie, the easternmost part of the Grand Prairie of Texas. The study area is characterized by gently rolling hills and terrain comprised of limestone covered by shallow soil and open land vegetation. Creeks and rivers incise this surface, and cliffs and bluffs develop along these waterways (EnSafe, 1999a).

The land surface in the vicinity of NWIRP McGregor consists of sloping, gently rolling hills and plains underlain by the Georgetown Main Street Limestone. Portions of the facility slope toward the drainage tributaries of the South Bosque River, Harris Creek, and Station Creek (EnSafe, 1999a). Other small drainage ditches and various tributaries contribute to these larger streams. Small bluffs rise above some of the creeks and streams, particularly along tributaries of Harris Creek and the South Bosque River. Elevations at the base range from 840 feet above mean sea level in the northwest corner to 630 feet above mean sea level in the southeast corner of the NWIRP McGregor property. The majority of the property slopes to the southeast, except for the southwest corner where it slopes southwest towards Station Creek.

2.3 REGIONAL GEOLOGY

The Balcones Fault System, a north-northeast trending zone that closely parallels U.S. Interstate 35, is located along the eastern edge of the study area (Hartmann and Scranton, 1992). The system is located at the confluence of two major physiographic systems: the Gulf Coastal Plain and the North Central Plains. Cretaceous rock units dip to the southeast across the Balcones Fault System and into the Gulf Coast Basin. Beds strike northeast to southwest. The Balcones Fault Zone forms a regional boundary that is distinguished by a line of low hills that rise approximately 150 feet above the surrounding plain. However, the line of hills in the study area is erosional and is not directly the result of the faulting in the area (Dr. Joe Yelderman, personal communication, August 1999).

Two normal, northeast trending faults of the Balcones Fault System cross the Leon River Valley, both of which are about 2,000 feet downstream from the Lake Belton dam. Displacements on both faults are about 30 feet and fault blocks are downthrown to the east (USACE, 1998).

Former NWIRP McGregor is situated atop the McGregor High. The McGregor High is a structural feature in the subsurface that caused erosion and nondeposition during the early Cretaceous, but it is questionable whether this has anything to do with the current topographic divide that occurs on the surface in the study area (Dr. Joe Yelderman, personal communication, August 1999).

A thin veneer of soil occurring in two physiographic provinces immediately underlies the study area: Grand Prairie and Blackland Prairie. Soils in the Grand Prairie province form

over areas underlain by marl and limestone, whereas soils in the Blackland Prairie province overlie areas underlain by shale, marl, and chalk.

In general, the soil in the study area is not mature and frequently contains fragments of the limestone parent material. Soil thickness ranges from 0 to 6 feet below ground surface (fbgs) and average two feet in depth. Vertical hydraulic conductivities range from 0.06 to 0.20 inches per hour, except in the presence of vertical desiccation cracks, which presumably increase vertical hydraulic conductivity. Desiccation cracks are a result of high clay content and form during extended periods of dryness (USACE, 1998).

Beneath the soil lies a transgressive-regressive sequence of early to middle Cretaceous fractured limestone of the Washita and Fredericksburg Divisions. These divisions primarily consist of interbedded shale and limestone. The early Cretaceous Trinity Group, also consisting of interbedded shale and limestone, underlies these units (EnSafe, 1998a). In the vicinity of NWIRP McGregor, the Georgetown Formation of the Washita Division is exposed and consists of the following members from approximate 0-100 fbgs:

- Main Street Limestone;
- Pawpaw Shale;
- Weno Limestone; and
- Denton Marl (EnSafe, 1998a).

The Main Street Limestone is characterized as a fine to medium crystalline nodular limestone that has an average thickness of 35 feet. This unit is highly fractured and contains shallow groundwater. The lower portion of the Main Street Limestone was initially characterized as non-water bearing because it is less weathered and contains fewer fractures and porosity features (EnSafe, 1998a). More recently, new data have been utilized to demonstrate that this zone is a zone of lower conductivity that is correlative across the NWIRP McGregor site (Montgomery Watson, 1999; Clark, 2000).

A sharp contact separates the Main Street Limestone from the underlying Pawpaw Shale, which acts as an aquitard and consists of light gray shale that grades to silty shale with depth. The Pawpaw Shale is approximately 5 to 7 feet thick (EnSafe, 1998a).

The Weno Limestone is nodular, bedded limestone with alternating thin marl beds. The unit has a sharp upper contact, gradational lower contact and is approximately 36 feet thick in the McGregor Quadrangle (EnSafe, 1998a).

Finally, the Denton Marl is composed of soft marl with limestone ledges and has an approximate thickness of 7 feet (EnSafe, 1998a).

2.4 REGIONAL HYDROGEOLOGY

As discussed above, the Bosque and Leon River watersheds are comprised primarily of limestone and marl. These rocks primarily belong to the Washita Prairie Edwards Aquifer, the most significant water-bearing formation (Cannata and Yelderman, 1987; Cannata, 1988; Myrick, 1989). Depth to water in the unconfined aquifer is typically less than 10 meters (Cannata, 1988; Collins, 1989). Recharge to the aquifer occurs in the uplands of the watersheds, where thinner soils and exposed bedrock fractures allow downward water percolation (Myrick, 1989). The primary flow through the aquifer is through fractures and bedding plans and is controlled by topography, with flow originating at the hills, and moving down to the valleys (Cannata, 1988; Collins, 1989, Myrick, 1989). Discharge of water is generally to streams and springs. Water quality typically reflects an increase in total dissolved solids (TDS) with depth.

The hydraulic conductivity of the aquifer has been calculated to range from 10^{-3} m/s to 10^{-10} m/s (Clark, 2000). Aquifer heterogeneity is controlled locally by fractures caused by weathering, and regionally due to changes in lithology and tectonics.

Hydrogeology of the study area was described in detail in Section 5.2 of the *Final Conceptual Site Model* (MWH, 2002a).

2.5 REGIONAL HYDROLOGY

Regional drainage and surface water in the study area flow toward the Brazos River, then southeast toward the Gulf of Mexico. The Brazos River Basin drains 15 percent of Texas's land area and eventually empties into the Gulf of Mexico.

In the study area, a number of rivers drain the surrounding watersheds into the Brazos River Basin, including the Bosque, Leon, and Little Rivers. In addition, local creeks and streams contribute to these principal tributaries to the Brazos River.

Former NWIRP McGregor is located on a topographic high near the confluence of four watersheds, two of which occur in the study area, the Leon River watershed and the Bosque River watershed.

Figure 2-2 shows the location of each watershed within the study area. The headwaters of several tributaries within these watersheds originate at NWIRP McGregor. Hydrology of the Bosque and Leon River watersheds is described in detail in Section 5.4 of the *Final Conceptual Site Model* (MWH, 2002a).