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Final Safety Analysis Report, Revision 0
(Public Version)

WCS Consolidated Interim Storage Facility
Final Safety Analysis Report

(Public Version)

Docket Number 72-1050

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General References

This reference section captures the references to this Site Specific License Technical Specifications and the General License UFSARs incorporated by reference as discussed in Section 1.6.

[Gen-1] Materials License No. SNM-2515, Appendix A, "WCS Consolidated Interim Storage Facility Technical Specifications," Amendment 0, USNRC Docket No. 72-1050.

[Gen-2] "Rancho Seco Independent Spent Fuel Storage Installation Safety Analysis Report," NRC Docket No. 72-11, Revision 4.

[Gen-3] TN Americas, "Updated Final Safety Analysis Report for the Standardized Advanced NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," NRC Docket No. 72-1029, TN Americas Document No. ANUH-01.0150, Revision 6.

[Gen-4] TN Americas, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," NRC Docket No. 72-1004, TN Americas Document No. NUH-003, Revision 14.

[Gen-5] NAC International, "NAC Multipurpose Cask Final Safety Analysis Report," Revision 10, USNRC Docket Number 72-1025.

[Gen-6] NAC International, "Final Safety Analysis Report for the UMS Universal Storage System," Revision 10, USNRC Docket Number 72-1015.

[Gen-7] NAC International, "MAGNASTOR® Final Safety Analysis Report," Revision 7, USNRC Docket Number 72-1031.

CHAPTER 1
INTRODUCTION AND GENERAL DESCRIPTION OF INSTALLATION

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1. INTRODUCTION AND GENERAL DESCRIPTION OF INSTALLATION

This Safety Analysis Report (SAR) describes the design and forms the licensing basis for the 10 CFR 72 [1-1] facility license of the Interim Storage Partners' (ISP's) WCS Consolidated Interim Storage Facility (WCS CISF) to be located in Andrews County, Texas.

The quality assurance (QA) program applicable to this design satisfies the requirements of 10 CFR 72, Subpart G and is described in the Quality Assurance Program Description [1-2]. To facilitate U.S. Nuclear Regulatory Commission (NRC) review of this application, this SAR has been prepared in compliance with the information and methods defined in Revision 0 of NRC NUREG-1567 [1-3].

This SAR describes a facility designed to accept commercial spent nuclear fuel and Greater-than-Class C (GTCC) waste contained in dual-purpose (transportation/storage) cask and canister systems that have been approved by the NRC for spent nuclear fuel. The NUHOMS®-MP187 GTCC waste canister is currently included in a specific license for storage and is also certified by the NRC for transport under 10 CFR Part 71. The GTCC waste canisters for the NAC systems are certified by the NRC for transport under 10 CFR Part 71. The WCS CISF will ultimately accommodate 40,000 metric tons Uranium or Mixed-Oxide, or metric tons heavy metal (MTHM), and will have a service life of at least 40 years. This initial SAR, however, is for phase 1 of the project, which is to material defined in Conditions 8A and 8B of the license for storage in the same canisters and overpacks as those currently in use at several reactor sites in the United States.

This chapter provides a summary of the SAR. The following information is included: (1) a general description of the WCS CISF; (2) a general description of the systems and operations; (3) analysis of the WCS CISF operations; (4) identification of agents and contractors; and (5) material incorporated into this SAR by reference.

1.1 Introduction

Interim Storage Partners (ISP) is a joint venture (JV) between Waste Control Specialists LLC and Orano CIS LLC formed to design, license, construct, and operate the WCS CISF.

Waste Control Specialists currently operates two separate Low-Level Radioactive Waste (LLRW) disposal facilities at the Andrews County site, including the Texas Compact Disposal Facility. Orano CIS, through its parent Orano USA, is a leading company in the safe management, dry storage and transportation of spent nuclear fuel with more than 30 years of experience in the United States.

The need for an interim storage facility for spent nuclear fuel arises as a result of the ongoing decades long search for a disposal solution for the nation's spent nuclear fuel. In 2012, the presidential-appointed Blue Ribbon Commission on America's Nuclear Future issued a report recommending that at least one interim storage facility be sited in the U.S., while a permanent disposal site is being developed.

Consistent with the recommendation of the Blue Ribbon Commission on America's Nuclear Future, the WCS CISF will provide dry storage capacity for canisterized spent nuclear fuel and GTCC waste at the WCS CISF site in the same storage overpack designs as those currently licensed and used at the original storage sites. ISP is seeking a license to operate a CISF for spent fuel and GTCC waste storage for 40 years in accordance with 10 CFR Part 72.

Construction of the WCS CISF is planned to start in September 2021 and operation is planned to begin in July 2023.

The WCS CISF will be located within the owner-controlled area of the existing Waste Control Specialists site, which is operated by Waste Control Specialists. The site comprises approximately 14,000 acres in Andrews County, Texas. It is characterized by isolation from population centers, a sound foundation for structures, and favorable conditions of meteorology, seismology, and hydrology.

The proposed location of the CISF site within the Waste Control Specialists site is on the north west corner. Figure 1-1 shows the general location of the WCS CISF at the Waste Control Specialists site.

Spent nuclear fuel at the WCS CISF will be stored in cask systems that have been previously approved by the NRC. These cask systems include transportable canister-based storage systems. It is ISP's intent that all NRC approved dual-purpose (transportation/storage) or multi-purpose (transportation/storage/ disposal) cask systems be acceptable for use at the WCS CISF over time. For Phase I of the WCS CISF application, six (6) cask systems consisting of eleven (11) different canisters plus GTCC waste canisters stored in five (5) overpacks are proposed for storage at the WCS CISF. These cask systems are described in SARs that are docketed by the NRC. Appendix H of the SAR addresses canisterized GTCC waste. Table 1-1 provides a listing of the various cask systems proposed for storage at the WCS CISF.

The cask systems listed in Table 1-1 were originally approved for 20 years. CoC 1004 has been renewed for an additional 40 years. Applications for License Renewal for SNM-2510, CoC 1029, and CoC 1025 for an additional 40 years are currently being reviewed by the NRC. The remaining cask systems in the WCS CISF License Application have not yet reached 20 years of time in service and therefore work has not yet begun to develop the applications for License Renewal for these systems. As these systems approach 20 years of service time, their applications for License Renewal, including Aging Management Program (AMP) requirements, will be submitted to the NRC for review and approval. Any canisters stored at the WCS CISF will have been loaded under these previously approved NRC CoCs and licenses, and their "time in service" clock for triggering the implementation of required AMP activities will have begun at the time of loading for each individual canister. Therefore, the AMP activities for any of the canisters stored at the site will be established and approved well in advance of license renewal for the site-specific license for the WCS CISF. Similarly, AMP activities for the storage overpacks at the WCS CISF will be established by their respective CoCs and licenses, but their "time in service" clocks will begin at the time of their loading at the WCS CISF. As the aging management activities associated with the individual CoCs and licenses under which the systems were originally loaded have not been approved at this time, a condition imposed on this license [1-4] is to incorporate the required aging management activities into this license within 120 days of the effective date of the renewal authorization of a given authorized cask system's CoC or license, or within 120 days of the effective date of this license, whichever is later.

The canister-based cask systems require transfer of the canister from the transportation cask to the storage overpack. These transfers are performed in either the Cask Handling Building or the Storage Area, depending on the cask system design. All transfer and handling activities are accomplished in a dry mode using cask transfer equipment and WCS CISF structures, systems, and components (SSCs). The WCS CISF design, as presented in the SAR, does not employ a spent fuel pool or other bare fuel handling capability.

Chapter 3 identifies the important-to-safety (ITS) SSCs for the cask systems and the WCS CISF and those not-important-to-safety (NITS) SSCs that are necessary for the operation of the WCS CISF. Cask system SSCs are used to the maximum extent possible in the design of the WCS CISF and are described in the design and licensing basis documents associated with each cask system. The use of previously approved cask systems is an integral part of the WCS CISF design basis. The WCS CISF SSCs that are ITS include the Canister Transfer System and overhead cranes in the Cask Handling Building and the storage pads for the vertical storage systems.

The physical, thermal, and radiological characteristics of the spent nuclear fuel (SNF) to be stored at the WCS CISF are defined in the respective cask system SARs.

1.2 General Description of Installation

The WCS CISF is designed as a stand-alone facility and consists of a storage area, and support facilities. The facility boundary is established at the outer limits by the Part 73 Owner Controlled Area (OCA). The Protected Area (PA) boundary is approximately 660 feet inside of the OCA boundary. The storage area is approximately 330 feet inside of the PA boundary. These areas are shown in Figure 1-2, “WCS CISF Site Boundary Layout.”

Figure 1-3 is a blow-up view of the facility showing the storage area and the support facilities inside the Protected Area. Support facilities include the Cask Handling Building, the Security and Administration Building, Transport Haul Route, and Rail Access.

The SSCs that are important-to-safety are listed in Table 3-5. Table 3-5 also lists the SSCs that are classified as not important-to-safety. Because there is no waste generated during the storage phase, there are no gaseous, liquid, or solid radioactive waste treatment systems associated with the storage system. Likewise, heat removal is totally passive in the overpacks and no active cooling system is required. Therefore, there are no required Instrumentation and Control Systems for the WCS CISF.

1.2.1 Location and Site Characteristics

The WCS CISF is located approximately 32 miles west of the city of Andrews, Texas, and five miles east of the city of Eunice, New Mexico. The WCS CISF facility is located approximately one-half mile east of the Texas-New Mexico state boundary and one mile north of Texas Highway 176. The Waste Control Specialists site occupies parts of Section 16 and 17, Block A-29, Public School Land, Andrews County, Texas included in approximately 25 square miles of property (primarily in Texas with nominal acreage in New Mexico) controlled by Waste Control Specialists LLC in northwestern Andrews County, Texas. Waste Control Specialists LLC will retain control of the Site, free and clear of any liens, claims or encumbrances, and will make available the portion of the Site to be used for the WCS CISF under a long-term lease.

The WCS CISF is situated in an arid, isolated part of the state. Figure 1-4 shows the location of the facility with respect to known or easily identifiable landmarks. Figure 1-4, as supplemented by Figure 1-1, illustrates county boundaries, rail access, highways, and major roads.

The approximate coordinates of the site are 32° 27' 08" north latitude and 103° 03' 35" west longitude.

1.2.2 Principal Design Criteria

The WCS CISF principal design criteria are based on the site characteristics, the design criteria associated with the cask systems listed in Table 1-1 that have been previously approved by the NRC, and specific criteria required for the WCS CISF design.

The cask systems listed in Table 1-1 meet the WCS CISF design criteria. Table 1-2 provides a summary of the WCS CISF principal design criteria.

1.2.3 Facility Descriptions

The major facilities at the WCS CISF are the Cask Handling Building and the storage area. The Cask Handling Building is approximately 175 feet long by 193 feet wide by 72 feet high. The building is a two-bay steel structure designed to support two overhead cranes used to remove transportation casks from the rail car. One bay of the building will house the Canister Transfer System described in Section 1.3.1.2 and the other bay will be available for direct transfer of transportation casks from the rail car to the transport vehicle. A 2,400 square foot area of the building is set aside for cask storage. The building plan view is shown in Figure 1-7. Figure 1-8 is a section through the building showing the overhead crane locations. Air monitors and dosimeters are located in the building for monitoring purposes. The building is not designed or intended to provide confinement or shielding for SNF or GTCC materials. The building is classified as ITS - Category B. The purpose of the Cask Handling Building is to receive and prepare for storage shipments of dual-purpose canister systems. It will also receive GTCC waste canisters for storage at the site. It is also designed to process canisters stored at the site for off-site shipment. The Cask Handling Building is designed to handle canisterized material and does not have the capability to handle bare fuel.

As Low As Reasonably Achievable (ALARA) principles are incorporated, to the maximum extent practical, throughout the facility design to reduce radiation exposure to facility personnel. Cranes/lifting devices for both transferring the NUHOMS® transportation/transfer casks from the transportation skid to the transfer trailer/skid and to upright the NAC transportation casks are designed to minimize the need for facility personnel to be near the loaded cask. NUHOMS® lifting equipment is NITS as the lift heights of the loaded casks are maintained below 80 inches at all times after removal of the impact limiters. The analysis of bounding drop scenarios shows that a NUHOMS® transportation/transfer cask will maintain structural integrity of the DSC confinement boundary and maintain basket geometry from an 80 inch (from the bottom of the cask to the “ground”) drop. The Special Lifting Devices used to upright the NAC transportation casks for transfer to the canister transfer system are ITS. The ITS canister transfer system for the vertical transfer of canisters is remotely operated and the transfer equipment used to make the transfer to the storage overpacks is substantially identical to that used to transfer the canister into dry storage at the reactor facilities where the material was initially stored.

The storage area is a large area comprised of concrete storage pads and storage overpacks. The purpose of the storage area is to provide safe storage for the canisterized spent nuclear fuel in cask systems that were previously approved by the NRC. The pads and approach aprons are designed to meet the applicable requirements of these previously approved cask systems. The storage area will be constructed in phases, as necessary. Phase 1 is designed to accommodate approximately 5,000 MTHM of spent nuclear fuel and GTCC waste in approximately 470 storage overpacks. Figure 1-6 shows the Phase 1 storage area. The individual storage pads are constructed of reinforced concrete at approximately ground level. Horizontal storage module pads will have concrete approach aprons. Vertical storage module pads will be surrounded by gravel approach roads.

The Security and Administration Building is a commercially designed and fabricated steel building with a reinforced concrete floor and foundation. The building primarily functions as the location for the Central Alarm Station and for Health Physics spaces. Additionally, the building provides additional security and administration spaces and is the main personnel entrance and exit for the facility. Figure 1-9 shows the Security and Administration Building Layout.

The remainder of the WCS CISF facilities provide support functions such as fuel receipt, security, and fire protection. Table 1-3 provides a list of the WCS CISF facilities and their functions.

1.2.4 Materials To Be Stored

Only canisters that have been previously approved by the NRC to store and transport commercial light water (PWR and BWR) spent nuclear fuel and GTCC waste will be received at the WCS CISF. The controls for limiting the types and forms of spent nuclear fuel received at the WCS CISF include those placed on the cask systems by the NRC-issued site licenses or certificates of compliance for the included transportation and storage systems. The approved systems are listed in Section 2.1 of the Technical Specifications [1-4], which include an additional limitation on uncanned high burnup fuel. The type, form and sources authorized for storage include:

- Canisterized spent nuclear fuel elements from commercial nuclear utilities licensed pursuant to 10 CFR Part 50 and associated radioactive materials related to the receipt, transfer, and storage of that spent nuclear fuel.
- Uranium or Mixed-Oxide (MOX) in the form of intact spent fuel assemblies, damaged fuel assemblies, and fuel debris, as specified in Section 2.1 of the WCS CISF Technical Specifications [1-4].
- Canisterized GTCC waste that consists of only reactor related low-level radioactive waste generated as a result of plant operation and decommissioning where the radionuclide concentration limits of Class C waste in 10 CFR 61.55 are exceeded. This waste may include such components as incore components, core support structures, and small reactor related miscellaneous parts resulting from the reactor vessel internals segmentation/decommissioning processes.

- All waste stored within the various GTCC canisters will be in the physical form of activated metals that may have surface contamination. The GTCC canisters will not contain process wastes containing paper, plastics or ion exchange resins that could result in the generation of combustible gases or chemical or galvanic corrosion reactions with the canister.

Aging Management considerations for the canisters and storage overpacks are discussed in Section 11.5.

1.2.4.1 Use of NRC Approved Storage Cask Systems

For Phase 1 of the ISP application, canisterized spent nuclear fuel and GTCC waste are stored at the WCS CISF in six cask storage systems previously approved by the NRC. The six storage systems used at the WCS CISF during Phase 1 are:

1. NUHOMS® MP187 Storage System as Configured for the WCS CISF

   NUHOMS® MP187 Cask Storage System as configured for the WCS CISF is described in “Rancho Seco Independent Spent Fuel Storage Installation Safety Analysis Report” Revision 4, NRC Docket No. 72-11. This configuration includes the overpack and canisters included in NRC SNM License 2510, Amendment 4. Specifically, the NUHOMS® MP187 Storage System will use the HSM (Model 80) overpack to house one of three types of approved spent fuel canisters, the FO-DSC, FC-DCS or FF-DSC. The contents of the NUHOMS® MP187 Storage System during Phase 1 are those contents currently authorized in NRC SNM License 2510, Amendment 4.

2. Standardized Advanced NUHOMS® Storage System as Configured for the WCS CISF

   Standardized Advanced NUHOMS® Storage System as configured for the WCS CISF is described in “Updated Final Safety Analysis Report for the Standardized Advanced NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel” TN Americas Document No. ANUH-01.0150, Revision 6, NRC Docket No. 72-1029. This configuration includes the overpack and canister included in NRC Certificate of Compliance 72-1029, Amendments 0, 1, and 3. Specifically, the Standardized Advanced NUHOMS® Storage System will use the AHSM overpack to house the NUHOMS® 24PT1 spent fuel canister. The contents of the Standardized Advanced NUHOMS® Storage System during Phase 1 are those contents currently authorized in NRC Certificate of Compliance 72-1029, Amendments 0, 1, and 3.

3. Standardized NUHOMS® Storage System as Configured for the WCS CISF

   Standardized NUHOMS® Storage System as configured for the WCS CISF is described in “Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel” TN Americas Document No. NUH-003, Revision 14, NRC Docket No. 72-1004. This configuration includes the overpack and canisters included in NRC Certificate of Compliance 72-1004, Amendments 3-13. Specifically, the Standardized NUHOMS® Storage System will use the HSM Model 102 overpack to house either the NUHOMS® 61BT or NUHOMS® 61BTH Type 1 spent fuel canister. The contents of the Standardized NUHOMS® Storage System during Phase 1 are those contents currently authorized in NRC Certificate of Compliance 72-1004, Amendments 3-13.

4. NAC-MPC Storage System as Configured for the WCS CISF

   NAC-MPC Storage System as configured for the WCS CISF is described in “NAC Multipurpose Cask Final Safety Analysis Report”, Revision 10, NRC Docket No. 72-1025. This configuration includes the overpack and canisters included in NRC Certificate of Compliance 72-1025, Amendments 0-6. Specifically, the NAC-MPC Storage System will use the VCC overpack to house one of three approved spent fuel canisters, the Yankee Class, Connecticut Yankee or LACBWR. The contents of the NAC-MPC Storage System during Phase 1 are those contents currently authorized in NRC Certificate of Compliance 72-1025, Amendments 0-6.

5. NAC-UMS Storage System as Configured for the WCS CISF

   NAC-UMS Storage System as configured for the WCS CISF is described in “Final Safety Analysis Report for the UMS Universal Storage System”, Revision 10, NRC Docket No. 72-1015. This configuration includes the overpack and canisters included in NRC Certificate of Compliance 72-1015, Amendments 0-5. Specifically, the NAC-UMS Storage System will use the VCC overpack to house NAC-UMS Class 1 through 5 canisters. The contents of the NAC-UMS Storage System during Phase 1 are those contents currently authorized in NRC Certificate of Compliance 72-1015, Amendments 0-5.

6. MAGNASTOR Storage System as Configured for the WCS CISF

   MAGNASTOR Storage System as configured for the WCS CISF is described in “MAGNASTOR Final Safety Analysis Report”, Revision 7, NRC Docket No. 72-1031. This configuration includes the overpacks and canisters included in NRC Certificate of Compliance 72-1031, Amendments 0-3, Revision 1, and Amendments 4 and 5. The MAGNASTOR Storage System will use the CC1, CC2, CC3 or CC4 overpacks to house four approved types of canisters, the TSC1 through TCS4 canisters. The contents of the MAGNASTOR Storage System during Phase 1 are those contents currently authorized in NRC Certificate of Compliance 72-1031, Amendments 0-3, Revision 1, and Amendments 4 and 5.

Descriptions of the storage systems used at the WCS CISF are summarized in Table 1-1.

In addition Table 1-1 addresses the canisters for storing GTCC waste in the storage overpack designs described in Appendix H under the WCS’s CISF license.

- The GTCC Canister to be stored in the NUHOMS MP187 Cask Storage System as configured for the WCS CISF is described in Appendix C of the “Rancho Seco Independent Spent Fuel Storage Installation Safety Analysis Report” Revision 4, NRC Docket No. 72-11. This configuration includes the overpack and canister included in NRC SNM License 2510, Amendment 4. Specifically, the NUHOMS MP187 Storage System will use the HSM (Model 80) overpack to house the GTCC waste canister. The contents of the NUHOMS MP187 Storage System during Phase 1 are those contents currently authorized in NRC SNM License 2510, Amendment 4 for the GTCC waste.
- The GTCC-Canister-CY and GTCC-Canister-YR to be stored in the NAC MPC Storage System as configured for the WCS CISF are described in Appendix H and “NAC-STC, NAC Storage Transport Cask Safety Analysis Report”, Revision 17, USNRC Docket No. 71-9235. This configuration includes the overpack included in NRC Certificate of Compliance 72-1025, Amendments 0-6 and the GTCC-Canister-CY and GTCC-Canister-YR included in NRC Certificate of Compliance No. 9235. Specifically, the NAC-MPC Storage System will use the VCC overpack to house either the GTCC-Canister-CY or GTCC-Canister-YR. The contents of the GTCC-Canister-CY or GTCC-Canister-YR during Phase 1 are those contents currently authorized in NRC Certificate of Compliance No 9235.

- The GTCC-Canister-MY to be stored in the NAC UMS Storage System as configured for the WCS CISF is described in Appendix H and "Safety Analysis Report for the UMS® Universal Transport Cask", Revision 2, USNRC Docket No. 71-9270. This configuration includes the overpack included in NRC Certificate of Compliance 72-1015, Amendments 0-5 and the GTCC-Canister-MY included in NRC Certificate of Compliance No. 9270. Specifically, the NAC-UMS Storage System will use the VCC overpack to house the GTCC-Canister-MY. The contents of the GTCC-Canister-MY during Phase 1 are those contents currently authorized in NRC Certificate of Compliance No 9270.
- The GTCC-Canister-ZN to be stored in the MAGNASTOR Storage System as configured for the WCS CISF is described in Appendix H and "Safety Analysis Report for the MAGNATRAN Transport Cask", Revisions 12A, 14A and 15A, USNRC Docket No. 71-9356. This configuration includes the overpack included in NRC Certificate of Compliance 72-1031, Amendments 0-3, Revision 1, and Amendments 4 and 5 and the GTCC-Canister-ZN included in "Safety Analysis Report for the MAGNATRAN Transport Cask", Revisions 12A, 14A and 15A, USNRC Docket No. 71-9356. Specifically, the MAGNASTOR Storage System will use one of the CC1 through CC4 overpacks to house the GTCC-Canister-ZN. The contents of the GTCC-Canister-ZN during Phase 1 are those contents currently addressed in "Safety Analysis Report for the MAGNATRAN Transport Cask", Revisions 12A, 14A and 15A, USNRC Docket No. 71-9356.

1.2.4.2 Pre-Shipment Review of Canisters

ISP will verify that every spent fuel canister received at the WCS CISF would comply with the terms, conditions of use, and technical specifications of one of the six storage systems listed in Section 2.1 of the Technical Specifications [1-4], when stored in the canister's approved overpack.

This verification will include a determination of the Certificate amendment under which the canister was loaded and an evaluation of any changes made to the canister under 10 CFR 72.48.

If it is determined, prior to acceptance, that a loaded canister does not comply, ISP would undertake further evaluation to determine if their site specific license should be amended, or if an evaluation done under 10 CFR 72.48 for the WCS CISF would support such a change without an amendment.

ISP will review 10 CFR 72.48 evaluations completed by other licensees or Certificate holders and determine if these evaluations can be clearly shown to be applicable to WCS CISF. ISP will prepare its own 72.48 evaluations in such instances.

ISP shall maintain procedures for and records of its reviews performed according to this section.

1.2.5 Waste Products Generated During Operations

As described in Chapter 6, there are minimal radioactive wastes generated at the WCS CISF. Gaseous and liquid wastes are not generated at the WCS CISF. Small volumes of solid radioactive waste may be produced from routine operations involving contamination surveys and decontamination activities involving incoming and outgoing transportation casks and equipment. Potential solid waste streams are collected and temporarily stored on site until authorization under Waste Control Specialists Low Level Radioactive Waste (LLRW) License RML R04100 allows for processing and disposal.

1.3 General Description of Systems and Operations

A general description of the WCS CISF systems and operations is provided in this section. The systems described relate to the receipt, handling, transfer, and storage of canisterized spent nuclear fuel and GTCC waste. In general, the same systems provide the corresponding function for canister retrieval and off site shipment operations.

1.3.1 WCS Consolidated Interim Storage Facility Systems

The major systems for the WCS CISF include the following: Cask Off-Loading and Loading System in the Cask Handling Building, Canister Transfer System (for vertical systems) and Transfer Cask or Storage Overpack Carrier System. These systems are used to transfer canisterized spent nuclear fuel and GTCC waste from transportation systems to storage overpacks and are used to retrieve canisters for off-site shipment.

1.3.1.1 Cask Off-Loading and Loading System

The purpose of the Cask Off-Loading and Loading System is to remove transportation casks from the cask railcars and to move transportation casks onto the railcars for shipment from the WCS CISF. Major components include two 130-ton capacity overhead bridge cranes. The overhead bridge cranes and associated lifting fixtures are used to perform a horizontal transfer of the NUHOMS® transportation/transfer cask from the railcar (skid) onto the transfer skid for transfer operations. This transfer is performed without lifting the loaded NUHOMS® transportation/transfer cask above a height of 80” and is classified as NITS. The ITS overhead bridge cranes are also used to upright the NAC transportation casks. An ITS VCT is then used to place the casks under the Canister Transfer System for the vertical storage systems. The VCT is also used to place the transportation cask under the overhead crane, which is used to down end the transportation cask onto the railcar for offsite transport.

1.3.1.2 Canister Transfer System

For vertical systems, the ITS Canister Transfer System is used to transfer spent nuclear fuel and GTCC waste canisters from the uprighted transportation casks to vertical storage overpacks. Major components include a shielded transfer cask, mobile gantry crane and ancillary equipment used to move the canisters from the upright transportation cask to the vertical storage overpack. This system is not used with the NUHOMS® Systems.

1.3.1.3 Transfer Cask or Vertical Cask Transporter

For NUHOMS® Systems the purpose of this equipment is to transfer the cask out to the Horizontal Storage Module (HSM) and transfer the canister into the HSM or retrieval of same. For vertical systems, the purpose of this equipment is to place the uprighted transportation cask under the Canister Transfer System and to transfer the storage overpack from the transfer station to the storage pad or to return the overpack to the transfer station when the canister is to be shipped off-site. Major components for the NUHOMS® System include the transfer trailer, skid, skid positioning system, HSM/cask restraint system, hydraulic ram and alignment equipment. The major component for the vertical system is a VCT to move the cask from the transfer station to the storage pad.

1.3.1.4 Waste Management Systems

The WCS CISF does not have any major radioactive waste management systems. The only radioactive wastes generated are the result of residual quantities of radioactive contamination on the transportation casks. Solid wastes generated during the decontamination process are disposed of at a licensed disposal facility.

1.3.1.5 Not Used

1.3.1.6 Storage Pad

For the NUHOMS® Systems the basemat and approach slabs are not relied upon to provide any safety function. There are no structural connections or other positive means to transfer shear between the modules and the foundation slab. The HSMs are not connected to the basemat. They resist horizontal forces by friction. Therefore, basemat and approach slabs are considered NITS and are designed, constructed, maintained, and tested as commercial-grade items.

The concrete storage pads loaded with NAC-MPC, NAC-UMS, and MAGNASTOR VCC systems meet the concrete storage pad properties presented in CoC No. 1025, Section B 3.4, CoC No. 1015, Section B 3.4, and CoC No. 1031, Sections 4.3.1 and 5.4, respectively. There are no structural connections or other positive means to transfer shear between the VCC systems and the slab. The VCC systems are not connected to the basemat, and resist horizontal forces by friction. The storage pads used for placement of NAC-MPC, NAC-UMS, and MAGNASTOR VCCs are classified as ITS, as identified in Chapter 3 and Chapter 7.

1.3.2 WCS Consolidated Interim Storage Facility Operations

Loaded transportation casks containing spent fuel or GTCC waste canisters are received via rail car. Security inspections and radiation surveys are performed in accordance with 10 CFR Part 71 and transportation cask CoC requirements.

The transportation casks are radiologically surveyed, impact limiters removed, their cavities are vented and tested, and they are decontaminated as necessary. Once receipt is completed under the provisions of 10 CFR Part 71, the cask is prepared to be removed from the railcar so that the canister can be transferred to the storage overpack. For NUHOMS® Systems, the cask is lifted horizontally from the transportation skid and placed on the transfer trailer where it is readied to be transferred to the storage pad and its designated HSM. The canister/cask is then transferred to the storage pad where the canister is inserted into its HSM. For vertical systems, the transportation cask is uprighted, placed in the transfer station, and made ready such that the canister can be retrieved with a shielded transfer cask and the canister transferred to the storage overpack. Once the canister is transferred to the storage overpack, the overpack is then moved using the VCT out to the storage pad and placed in its designated location for storage.

For canister retrieval operations, the operational sequences for placing the canister into storage are reversed.

1.4 Analysis of Operations

This section provides a summary of the analyses performed for normal operations, off-normal and accident conditions.

1.4.1 Normal Operations – Dose Assessment

ALARA practices and dose reduction techniques are incorporated into the design of the WCS CISF. The receipt and transfer operations incorporate the ALARA principles and operational experience gained from the operations of these NRC licensed cask systems. The calculated operational exposures are very conservative, as the assumed dose rates on and around the transport/transfer casks are assumed to be for design basis transportation sources and the assumed dose rates on and around the storage overpacks are based on design basis source terms in the existing storage FSARs. These storage source terms, in most cases, are much higher than what can be accommodated by the transportation cask and therefore significant decay is required prior to shipment to the WCS CISF.

The maximum calculated occupational exposure for normal transfer operations is 232 person-rem when the 5,000 MTHM and GTCC waste canisters are placed into storage. Chapter 9 and its associated appendices provide a detailed evaluation of occupational exposures.

1.4.2 Normal Operations – Establishment of the Controlled Area (Site) Boundary

An analysis was performed to identify the location of the controlled area boundary to ensure compliance with 10 CFR 72.104 (a) (dose rate ≤ 25 mrem/yr). As noted above, the dose rates assumed on the surface of the storage overpacks are based on the design basis source terms in the licensed storage systems at the reactor sites.

The annual expected yearly dose at the nearest site boundary for the fully loaded (5,000 MTHM plus GTCC waste canisters) WCS CISF is 7.52E-5 person-rem, including direct radiation (including skyshine) and contributions due to inhalation, submersion and ingestion from non-leak-tight containers. Chapters 9 and 11 and their associated appendices provide a detailed evaluation of site boundary exposures.

1.4.3 Accident Analysis

1.4.3.1 Safety Analysis Process

Chapter 12 and design specific appendices provide analysis for the off-normal and accident conditions for the approved storage systems. Chapter 12 defines the design basis events for each authorized cask system. The WCS CISF Technical Specifications [1-4] complete the design safety basis by defining the operational controls and limits placed on WCS CISF operations and lists the necessary administrative controls or programs established for the site. Chapter 14 provides the basis for the Technical Specifications.

1.4.3.2 Safety Analysis Methodology

The storage of spent nuclear fuel at the WCS CISF is based on the use of cask systems that have been previously approved by the NRC. The associated systems' storage FSARs and transportation SARs provide design basis information regarding radiological hazards for the individual systems to be used at the WCS CISF. The FSARs/SARs identify design basis events that are classified as either normal, off-normal or accidents for each approved system. Normal events include such operations as transportation package receipt, inspection, transfer of the canisters to the storage overpack and storage at the WCS CISF until ready to be transported off-site. Off-normal events are those events which are expected to occur with moderate frequency during transfer and storage operations. In general, the consequences of these events have no radiological safety implications and do not have a significant impact on ITS design functions. Accident conditions are those events that occur infrequently and could reasonably be expected to occur during the lifetime of the WCS CISF. These events include low probability design basis accidents which establish a conservative design basis for ITS SSCs. These events include natural phenomena such as earthquakes and tornados, and man-made events such as cask drop.

1.4.3.3 Results

For most of the accidents analyzed, there are no radiological consequences produced as a direct result of the event, and there are no impacts on ITS design functions. These negligible consequences are attributed primarily to the use of NRC approved storage systems and the implementation of operating controls and limits. However, recovery operations may involve some occupational exposure to personnel. The analyses results indicate that there are no credible accident scenarios for the WCS CISF which would result in a loss of confinement accident or a radiological release in excess of the radiological dose criterion of 10 CFR 72.106.

1.4.3.4 Technical Specifications

The WCS CISF Technical Specifications [1-4] define the operating controls and limits and the administrative controls. The Technical Specifications, including the relevant portions of the individual storage system Technical Specifications, provide defined operating limits and controls for each system for storage at the WCS CISF.

The administrative controls presented in this SAR include the organization and management structure, response plans, procedures, programs, controls, record keeping requirements, review and audit procedures, and reporting necessary to assure that the operations involved in the storage of canisterized spent nuclear fuel and GTCC waste at the WCS CISF are performed in a safe manner.

1.4.4 Safety Management

The ISP management policy and highest priority is to ensure that all operations are conducted safely. Implementation of this policy is made through a consolidated safety management program. This program entails radiation protection, conduct of operations, and quality assurance.

1.4.4.1 Radiation Protection Program

The radiation protection program ensures that all operations are performed in a manner that ensures occupational exposures are maintained within prescribed regulatory limits and are ALARA. ALARA considerations have been integrated into the design of the WCS CISF and incorporated into all operating procedures.

1.4.4.2 Conduct of Operations Program

The conduct of operations program ensures that the WCS CISF is operated in a professional and safe manner. Highlights of this program include the following:

- The ISP organization provides clear lines of responsibilities and ensures independence of organizations. This ensures ISP has an effective organization with appropriate oversight.
- ISP performs an extensive test program, including an operational readiness review, prior to beginning normal operations. The test program ensures that the WCS CISF structures, systems, and components are operated in a dependable manner so as to perform their intended function.
- ISP maintains a systematic training program to ensure proficiency of all facility personnel.
- ISP maintains a formal procedure management program that ensures all ITS operations are performed using detailed written, approved, and controlled procedures.
- ISP joint venture member Waste Control Specialists has a detailed emergency preparedness program and conducts periodic drills and training. This ensures that site personnel are prepared to respond to emergencies as they arise.

1.4.4.3 Quality Assurance Program

Interim Storage Partners has adopted the TN Americas Quality Assurance Program for its use. The TN Americas Quality Assurance Program Description Manual (QAPDM) is docketed under 71-0250. The activities associated with the WCS CISF are governed by the applicable portions of the TN Americas QA program as described in TN Americas LLC Quality Assurance Program Description Manual for 10 CFR Part 71, Subpart H and 10 CFR Part 72, Subpart G, [1-2]. The QA program meets the requirements of 10 CFR 72, Subpart G.

1.5 Identification of Agents and Contractors

ISP has overall responsibility for the engineering, design, licensing, and construction of the WCS CISF.

TN Americas and Waste Control Specialists are the contractors for the design and operation of the WCS CISF. TN Americas is also the contractor for the design and fabrication of the HSMs, and associated auxiliary systems for the NUHOMS® systems. TN Americas is also the contractor for the NUHOMS® cask systems and is responsible for cask transportation licensing, fabrication, testing, and delineation of any cask specific requirements.

NAC International is the contractor for the design and fabrication of the NAC storage overpacks and ITS storage pads on which the NAC storage overpacks will be stored. NAC International is also the contractor for the NAC cask systems and is responsible for cask transportation licensing, fabrication, testing, and delineation of any cask specific requirements.

ISP will also use various contractors for site preparation and construction, as necessary.

1.6 Material Incorporated by Reference

This section provides a list of the safety analysis reports incorporated by reference as part of the SAR. The list of the SAR sections that reference one or more of the below documents is provided in Table 1-4.

1.6.1 NUHOMS® Systems

1.6.1.1 Transportation SARs

TN Americas, "NUHOMS®-MP197 Transport Packaging Safety Analysis Report," Revision 17, USNRC Docket Number 71-9302.

TN Americas, "Safety Analysis Report for the NUHOMS®-MP187 Multi-purpose Cask," Revision 17, USNRC Docket Number 71-9255.

1.6.1.2 Storage SARs

"Rancho Seco Independent Spent Fuel Storage Installation Safety Analysis Report," NRC Docket No. 72-11, Revision 4.

TN Americas, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," NRC Docket No. 72-1004, TN Americas Document No. NUH-003, Revision 14.

TN Americas, "Updated Final Safety Analysis Report for the Standardized Advanced NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," NRC Docket No. 72-1029, TN Americas Document No. ANUH-01.0150, Revision 6.

1.6.2 NAC International Systems

1.6.2.1 Transportation SARs

NAC International, "NAC-STC, NAC Storage Transport Cask Safety Analysis Report," Revision 17, USNRC Docket Number 71-9235.

NAC International, "Safety Analysis Report for the UMS® Universal Transport Cask," Revision 2, USNRC Docket Number 71-9270.

NAC International, "Safety Analysis Report for the MAGNATRAN Transport Cask," Revisions 12A, 14A, and 15A, USNRC Docket Number 71-9356.

1.6.2.2 Storage SARs

NAC International, "NAC Multipurpose Cask Final Safety Analysis Report," Revision 10, USNRC Docket Number 72-1025.

NAC International, "Final Safety Analysis Report for the UMS Universal Storage System," Revision 10, USNRC Docket Number 72-1015.

NAC International, "MAGNASTOR® Final Safety Analysis Report," Revision 7, USNRC Docket Number 72-1031.

1.7 References

1-1 Title 10, Code of Federal Regulations, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste."

1-2 "TN Americas LLC Quality Assurance Program Description Manual for 10 CFR Part 71, Subpart H and 10 CFR Part 72, Subpart G," current revision.

1-3 NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities," Revision 0, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, March 2000.

1-4 SNM-2515 Technical Specifications (See [Gen-1]).

1-5 Reg Guide 1.76, "Design-Basis Tornado and Tornado Missiles For Nuclear Power Plants," Revision 1, March 2007.

1-6 NUREG-0800, Standard Review Plan, Section 3.3.1 "Wind Loading," 3.3.2 "Tornado Loads" and Section 3.5.1.4 "Missiles Generated by Tornado and Extreme Winds," Rev 3, March 2007.

1-7 NUREG-0800, Standard Review Plan, Section 3.5.1.4 "Missiles Generated by Natural Phenomena," Revision 2, July 1981.

1-8 ISP document "WCS Consolidated Spent Fuel Interim Storage Facility Environmental Report, Docket No. 72-1050," Revision 3.

1-9 Reg Guide 1.60. "Design Response Spectra for Seismic Design of Nuclear Power Plants," Revision 2, July 2014.

1-10 AECOM "Site Specific Seismic Hazzard Evaluation and Development of Seismic Design Ground Motions," Study Number WCS-12-05-100-001, Revision 0.

Table 1-1
Storage Systems at the WCS CISF

<table>
<tr><th>Cask System</th><th>NRC Docket No.</th><th>Canister</th><th>Overpack</th></tr>
<tr><td rowspan="4">NUHOMS® MP187 Cask System</td><td rowspan="4">71-9255
72-11 (SNM-2510)</td><td>FO-DSC</td><td rowspan="4">HSM (Model 80)</td></tr>
<tr><td>FC-DSC</td></tr>
<tr><td>FF-DSC</td></tr>
<tr><td>GTCC Canister</td></tr>
<tr><td>Standardized Advanced NUHOMS® System</td><td>71-9255
72-1029</td><td>NUHOMS® 24PT1</td><td>AHSM</td></tr>
<tr><td rowspan="2">Standardized NUHOMS® System</td><td rowspan="2">71-9302
72-1004</td><td>NUHOMS® 61BT</td><td rowspan="2">HSM Model 102</td></tr>
<tr><td>NUHOMS® 61BTH Type 1</td></tr>
<tr><td rowspan="5">NAC-MPC</td><td rowspan="5">71-9235
72-1025</td><td>Yankee Class</td><td rowspan="5">VCC</td></tr>
<tr><td>Connecticut Yankee</td></tr>
<tr><td>LACBWR</td></tr>
<tr><td>GTCC-Canister-CY</td></tr>
<tr><td>GTCC-Canister-YR</td></tr>
<tr><td rowspan="2">NAC-UMS</td><td rowspan="2">71-9270
72-1015</td><td>Classes 1 through 5</td><td rowspan="2">VCC</td></tr>
<tr><td>GTCC-Canister-MY</td></tr>
<tr><td rowspan="2">MAGNASTOR</td><td rowspan="2">71-9356
72-1031</td><td>TSC1 through TSC4</td><td rowspan="2">CC1 through CC4</td></tr>
<tr><td>GTCC-Canister-ZN</td></tr>
</table>

Table 1-2
Summary of WCS CISF Principal Design Criteria
(3 pages)

Design Parameter	Design Criteria	Condition	Applicable Codes, Standards and Basis
Type of fuel	Commercial, light water reactor spent fuel	Normal	N/A
Storage Systems	Transportable canisters and storage overpacks docketed by the NRC	Normal	See Table 1-1
Fuel Characteristics	Criteria as specified in previously approved CoCs and licenses for included systems	Normal	See Table 1-1
Tornado (Wind Load)	Max translational speed: 40 mph Max rotational speed: 160 mph Max tornado wind speed: 200 mph Radius of max rotational speed: 150 ft Tornado pressure drop: 0.9 psi Rate of pressure drop: 0.4 psi/sec	Accident	Reg Guide 1.76 [1-5] NUREG-800[1-6]
Tornado (Missile)	Automobile 4000 lb, 112 ft/s Schedule 40 Pipe 287 lb, 112 ft/s Solid Steel Sphere 0.147 lb, 23 ft/s	Accident	NUREG-800[1-7]
Floods	The WCS CISF is not in a floodplain and is above the Probable Maximum Flood elevation, and will remain dry in the event of a flood.	Accident	Section 2.4.2.2
Seismic (Ground Motion)	Site-specific ground-surface uniform hazard response spectra (UHRS) with 1E-4 annual frequency of exceedance (AFE) having peak ground acceleration (PGA) of 0.250 g horizontal and 0.175 g vertical. (Table 1-5 and Figure 1-5)	Accident	AECOM Study Number WCS-12-05-100-001[1-10]
Vent Blockage	For NUHOMS® Systems: Inlet and outlet vents blocked 40 hrs For MPC and UMS Systems: Inlet and outlet vents blocked 24 hrs For MAGNASTOR Systems: Inlet vents blocked 58 hrs	Accident	N/A
Fire/Explosion	For NUHOMS® Systems: Equivalent fire 300 gallons of diesel fuel For Vertical Systems: Equivalent fire 50 gallons of fuel	Accident	N/A

Table 1-2
Summary of WCS CISF Principal Design Criteria
(3 pages)

Design Parameter	Design Criteria	Condition	Applicable Codes, Standards and Basis
Cask Drop	For NUHOMS® Systems: Transfer Cask Horizontal side drop or slap down 80 inches VCCs for MPC Systems: Drop height 6 inches VCCs for UMS and MAGNASTOR Systems: Drop height 24 inches	Accident	N/A
Transfer Load	For NUHOMS® Systems only: Normal insertion load 60 kips Normal extraction load 60 kips	Normal	NA
Transfer Load	For NUHOMS® Systems only: Maximum insertion load 80 kips Maximum extraction load 80 kips	Off-Normal/ Accident	N/A
Ambient Temperatures	Normal temperature range 44.1 – 81.5°F	Normal	Section 2.3.3.1
Off-Normal Temperature	Maximum temperature 113°F	Off-Normal	Section 2.3.3.1
Extreme Temperature	Maximum temperature 113°F	Accident	Section 2.3.3.1
Solar Load (Insolation)	Horizontal flat surface insolation 2949.4 BTU/day-ft^2 Curved surface solar insolation 1474.7 BTU/day-ft^2	Normal	10 CFR Part 71
Snow and Ice	Snow Load 10 psf	Normal	Section 2.3.2.4
Dead Weight	Per design basis for systems listed in Table 1-1	Normal	N/A
Internal and External Pressure Loads	Per design basis for systems listed in Table 1-1	Normal	N/A
Design Basis Thermal Loads	Per design basis for systems listed in Table 1-1	Normal	N/A
Operating Loads	Per design basis for systems listed in Table 1-1	Normal	N/A
Live Loads	Per design basis for systems listed in Table 1-1	Normal	N/A

Table 1-2
Summary of WCS CISF Principal Design Criteria
(3 pages)

Design Parameter	Design Criteria	Condition	Applicable Codes, Standards and Basis
Radiological Protection	Public wholebody ≤ 5 Rem Public deep dose plus individual organ or tissue ≤ 50 Rem Public shallow dose to skin or extremities ≤ 50 Rem Public lens of eye ≤ 15 Rem	Accident	10 CFR 72.106
Radiological Protection	Public wholebody ≤ 25 mrem/yr (1) Public thyroid ≤ 75 mrem/yr(1) Public critical organ ≤ 25 mrem/yr(1)	Normal	10 CFR 72.104
Confinement	Per design basis for systems listed in Table 1-1	N/A	N/A
Nuclear Criticality	Per design basis for systems listed in Table 1-1	N/A	N/A
Decommissioning	Minimize potential contamination	Normal	10 CFR 72.130
Materials Handling and Retrieval Capability	Cask/canister handling system prevent breach of confinement boundary under all conditions Storage system allows ready retrieval of canister for shipment off-site	Normal	10 CFR 72.122(1)
Cask Handling Building	Prevent building collapse under design-basis tornado and tornado-generated missile loading, prevent building collapse under design-basis seismic loading	Accident	Section 7.5.3.2

Note:

1. In accordance with 10 CFR 72.104 (a)(3) limits include any other radiation from uranium fuel cycle operations within the region.

Table 1-3
WCS CISF Facilities and Functions

Facility	Function
Cask Handling Building	Receive, inspect and prepare for storage, shipments of canisterized spent nuclear fuel and GTCC waste. Prepare canisterized spent nuclear fuel and GTCC waste stored at the site for off-site transport. Provide for transportation cask light maintenance.
Storage Area	Provide location for safe storage of canisterized spent nuclear fuel and GTCC waste.
Security and Administration Building	Provide main operation center and armory for site security and emergency equipment; control personnel, rail and vehicle access to the WCS CISF facilities; and provide administrative functions related to transport, communication and tracking center/facility, training and visitor center.
Receiving Area	Location to perform DOT/NRC required inspections of arriving railcars.

Table 1-4
Table of Topical Reports (SARs) Incorporated by Reference
(3 pages)

Chapter	Description	Applicable SARs (Docket Number)
01	INTRODUCTION AND GENERAL DESCRIPTION OF INSTALLATION	Section 1.6 (1.6 Material Incorporated by Reference)
A.3	Appendix A.3 - Design Criteria for NUHOMS® MP187 System	72-11 71-9255
B.3	Appendix B.3 - Design Criteria for Standardized Advanced NUHOMS® System	72-1029 72-11 71-9255
C.3	Appendix C.3 - Design Criteria for Standardized NUHOMS® System 61BT	72-1004 71-9302
D.3	Appendix D.3 - Design Criteria for Standardized NUHOMS® System 61BTH	72-1004 71-9302
E.3	Appendix E.3 - Design Criteria for NAC-MPC	72-1025
F.3	Appendix F.3 - Design Criteria for NAC-UMS	72-1015
G.3	Appendix G.3 - Design Criteria for NAC-MAGNASTOR	72-1031
A.4	Appendix A.4 - Operating Systems for NUHOMS® MP187 System	72-11
B.4	Appendix B.4 - Operating Systems for Standardized Advanced NUHOMS® System	72-1029
C.4	Appendix C.4 - Operating Systems for Standardized NUHOMS® System 61BT	72-1004
D.4	Appendix D.4 - Operating Systems for Standardized NUHOMS® System 61BTH	72-1004
E.4	Appendix E.4 - Operating Systems for NAC-MPC	72-1025
F.4	Appendix F.4 - Operating Systems for NAC-UMS	72-1015
G.4	Appendix G.4 - Operating Systems for NAC-MAGNASTOR	72-1031
A.7	Appendix A.7 - Structural Evaluation for NUHOMS® MP187 System	72-11 71-9255
B.7	Appendix B.7 - Structural Evaluation for Standardized Advanced NUHOMS® System	72-1029 72-11 71-9255
C.7	Appendix C.7 - Structural Evaluation for Standardized NUHOMS® System 61BT	72-1004 71-9302
D.7	Appendix D.7 - Structural Evaluation for Standardized NUHOMS® System 61BTH	72-1004 71-9302
E.7	Appendix E.7 - Structural Evaluation for NAC-MPC	72-1025

Table 1-4
Table of Topical Reports (SARs) Incorporated by Reference
(3 pages)

Chapter	Description	Applicable SARs (Docket Number)
F.7	Appendix F.7 - Structural Evaluation for NAC-UMS	72-1015
G.7	Appendix G.7 - Structural Evaluation for NAC-MAGNASTOR	72-1031
A.8	Appendix A.8 - Thermal Evaluation for NUHOMS® MP187 System	72-11 71-9255
B.8	Appendix B.8 - Thermal Evaluation for Standardized Advanced NUHOMS® System	72-1029 72-11 71-9255
C.8	Appendix C.8 - Thermal Evaluation for Standardized NUHOMS® System 61BT	72-1004 71-9302
D.8	Appendix D.8 - Thermal Evaluation for Standardized NUHOMS® System 61BTH	72-1004 71-9302
E.8	Appendix E.8 - Thermal Evaluation for NAC-MPC	72-1025
F.8	Appendix F.8 - Thermal Evaluation for NAC-UMS	72-1015
G.8	Appendix G.8 - Thermal Evaluation for NAC-MAGNASTOR	72-1031
A.9	Appendix A.9 - Radiation Protection for NUHOMS® MP187 System	72-11 71-9255
B.9	Appendix B.9 - Radiation Protection for Standardized Advanced NUHOMS® System	72-1029 71-9255
C.9	Appendix C.9 - Radiation Protection for Standardized NUHOMS® System 61BT	72-1004 71-9302
D.9	Appendix D.9 - Radiation Protection for Standardized NUHOMS® System 61BTH	72-1004 71-9302
E.9	Appendix E.9 - Radiation Protection for NAC-MPC	72-1025
F.9	Appendix F.9 - Radiation Protection for NAC-UMS	72-1015
G.9	Appendix G.9 - Radiation Protection for NAC-MAGNASTOR	72-1031
A.10	Appendix A.10 - Criticality Evaluation for NUHOMS® MP187 System	72-11
B.10	Appendix B.10 - Criticality Evaluation for Standardized Advanced NUHOMS® System	72-1029
C.10	Appendix C.10 - Criticality Evaluation for Standardized NUHOMS® System 61BT	72-1004
D.10	Appendix D.10 - Criticality Evaluation for Standardized NUHOMS® System 61BTH	72-1004
E.10	Appendix E.10 - Criticality Evaluation for NAC-MPC	72-1025

Table 1-4
Table of Topical Reports (SARs) Incorporated by Reference
(3 pages)

Chapter	Description	Applicable SARs (Docket Number)
F.10	Appendix F.10 - Criticality Evaluation for NAC-UMS	72-1015
G.10	Appendix G.10 - Criticality Evaluation for NAC-MAGNASTOR	72-1031
A.11	Appendix A.11 - Confinement Evaluation for NUHOMS® MP187 System	72-11
B.11	Appendix B.11 - Confinement Evaluation for Standardized Advanced NUHOMS® System	72-1029
C.11	Appendix C.11 - Confinement Evaluation for Standardized NUHOMS® System 61BT	72-1004
D.11	Appendix D.11 - Confinement Evaluation for Standardized NUHOMS® System 61BTH	72-1004
E.11	Appendix E.11 - Confinement Evaluation for NAC-MPC	72-1025
F.11	Appendix F.11 - Confinement Evaluation for NAC-UMS	72-1015
G.11	Appendix G.11 - Confinement Evaluation for NAC-MAGNASTOR	72-1031
A.12	Appendix A.12 - Accident Analyses for NUHOMS® MP187 System	72-11 71-9255
B.12	Appendix B.12 - Accident Analyses for Standardized Advanced NUHOMS® System	72-1029 72-11 71-9255
C.12	Appendix C.12 - Accident Analyses for Standardized NUHOMS® System 61BT	72-1004 71-9302
D.12	Appendix D.12 - Accident Analyses for Standardized NUHOMS® System 61BTH	72-1004 71-9302
E.12	Appendix E.12 - Accident Analyses for NAC-MPC	72-1025
F.12	Appendix F.12 - Accident Analyses for NAC-UMS	72-1015
G.12	Appendix G.12 - Accident Analyses for NAC-MAGNASTOR	72-1031

Table 1-5
Ground Surface DRS

Period (sec)	Horizontal (g)	Vertical (g)
0.01	0.250	0.175
0.03	0.347	0.287
0.04	0.406	0.377
0.05	0.473	0.471
0.08	0.586	0.539
0.10	0.610	0.466
0.15	0.504	0.310
0.20	0.399	0.216
0.25	0.314	0.157
0.30	0.262	0.126
0.40	0.198	0.094
0.50	0.154	0.076
0.60	0.124	0.063
0.75	0.096	0.051
1.00	0.067	0.038
1.50	0.039	0.024
2.00	0.025	0.016
3.00	0.014	0.0088
4.00	0.0094	0.0063
5.00	0.0068	0.0047
7.52	0.0029	0.0020
10.00	0.0016	0.0011

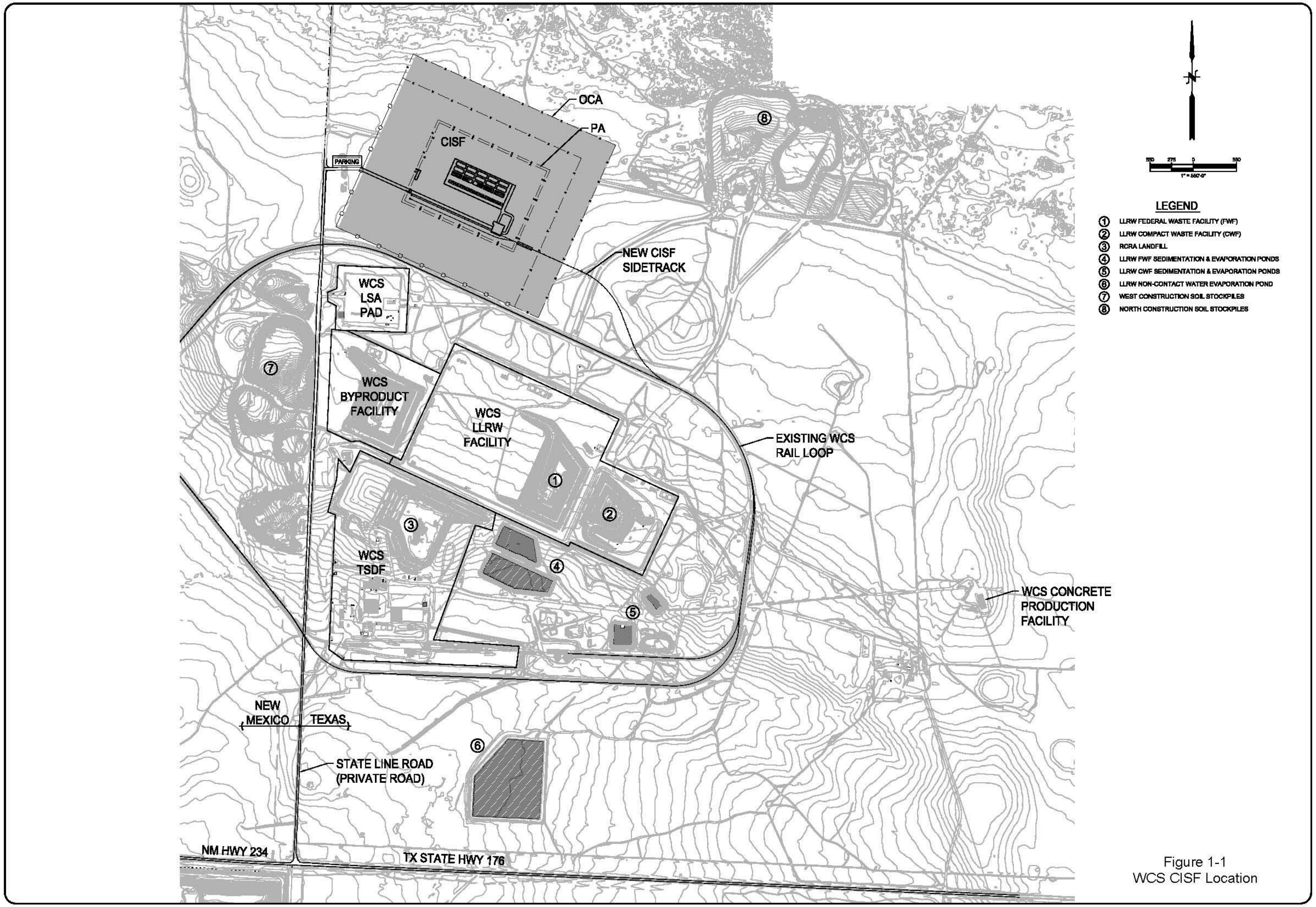

Figure 1-1
WCS CISF Location

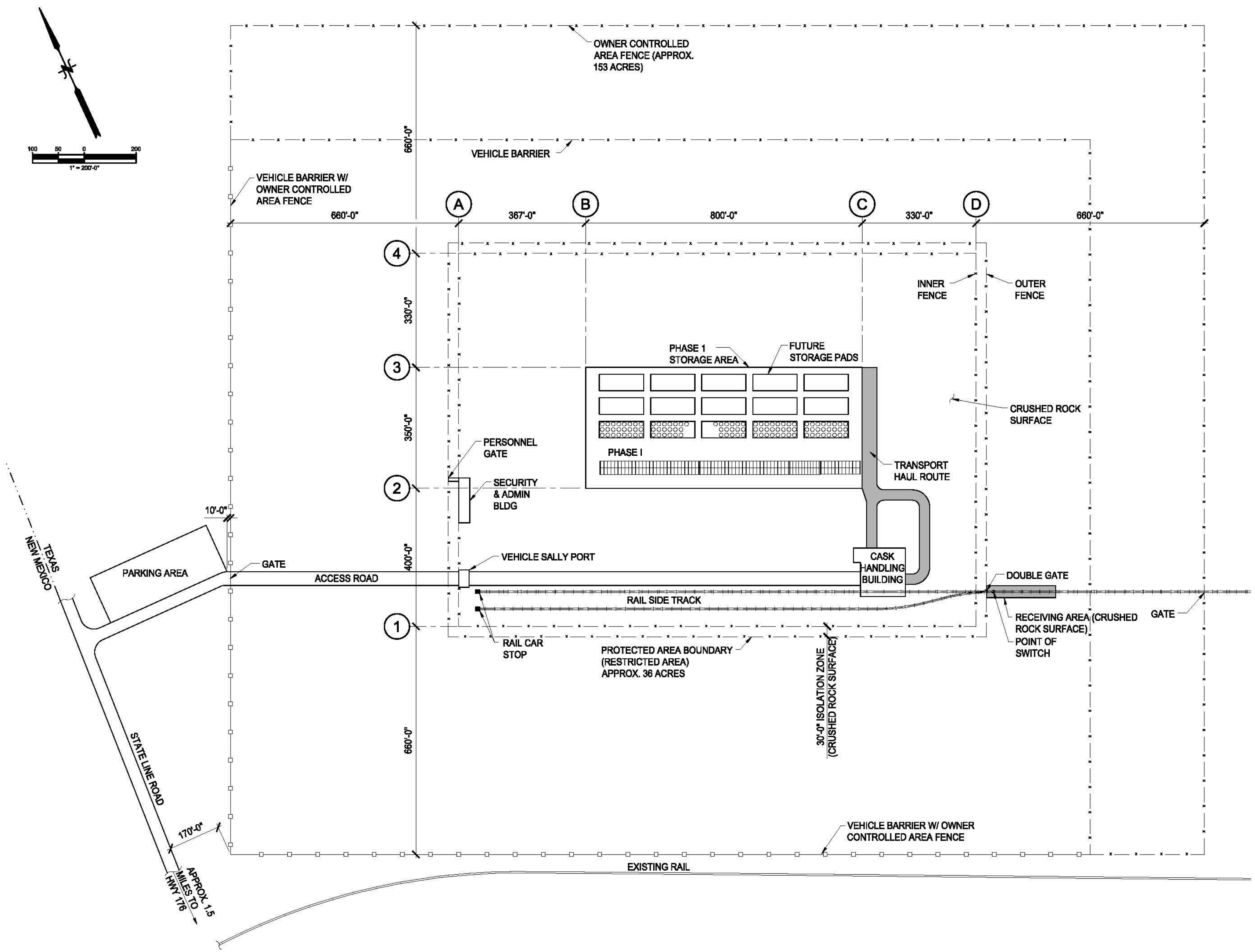

Figure 1-2
WCS CISF Site Boundary Layout

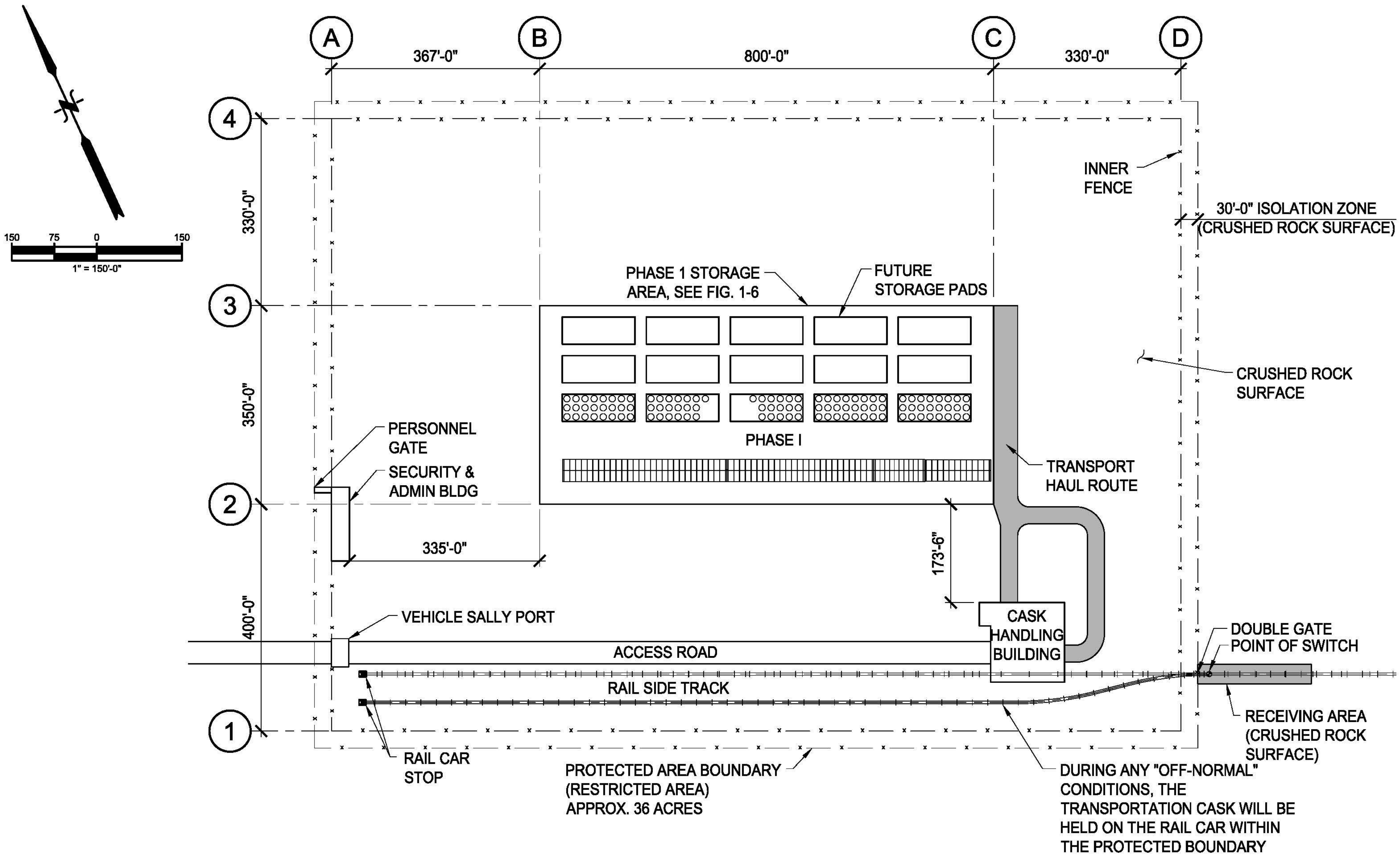

Figure 1-3
WCS CISF Site Overview

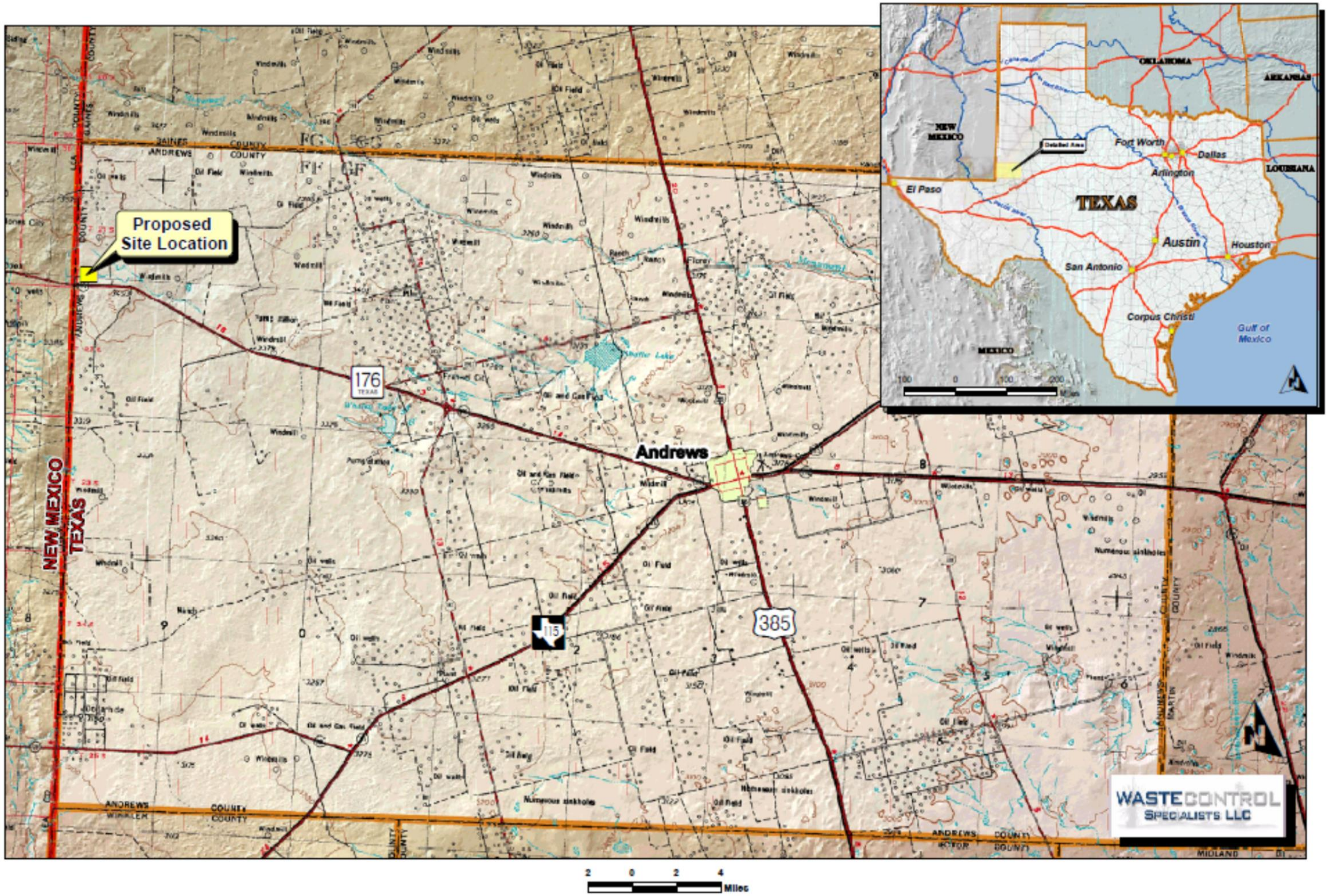

Figure 1-4
Site Location Map

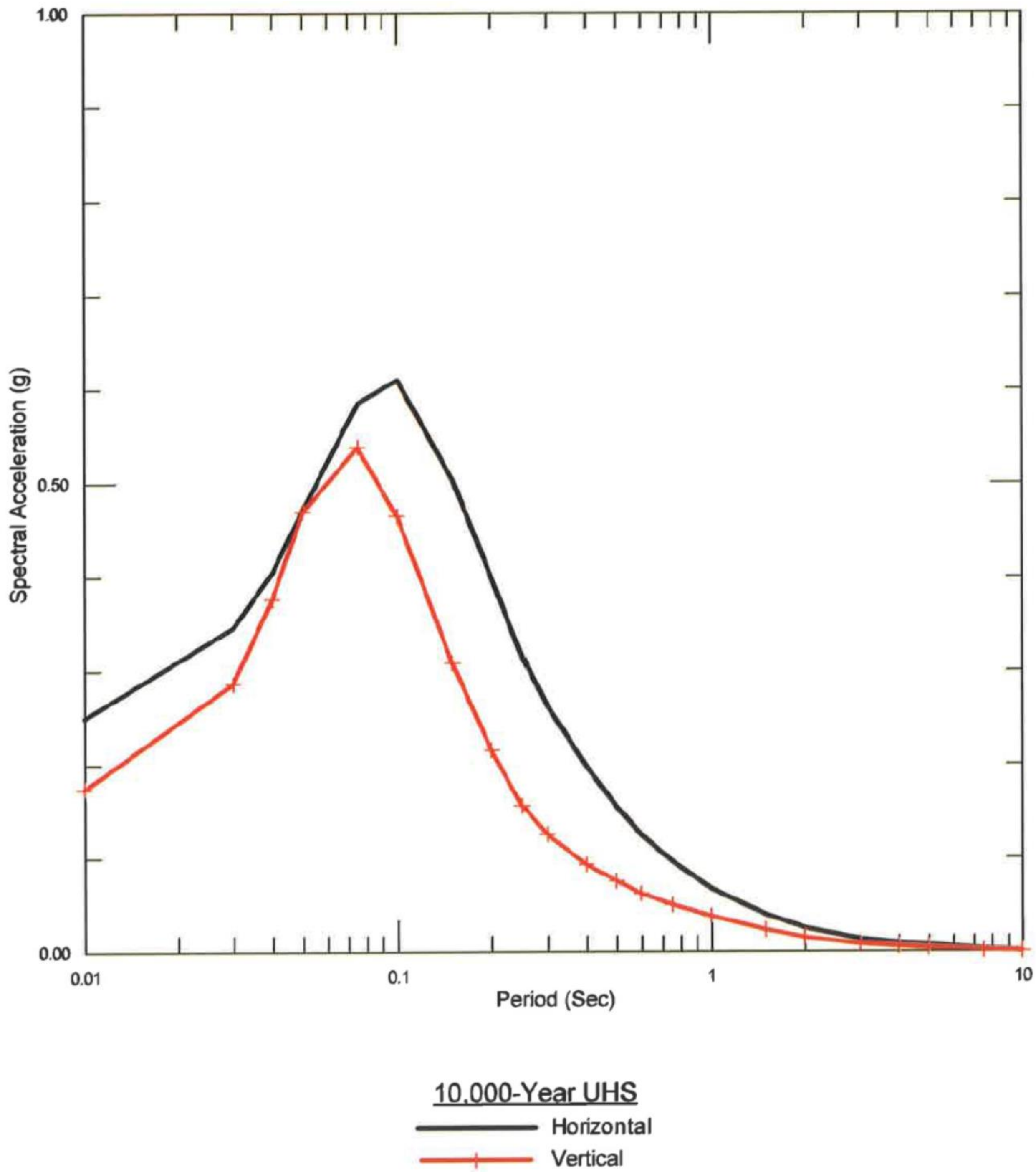

Figure 1-5
10,000-Year Return Period Response Spectra (5% Damped)

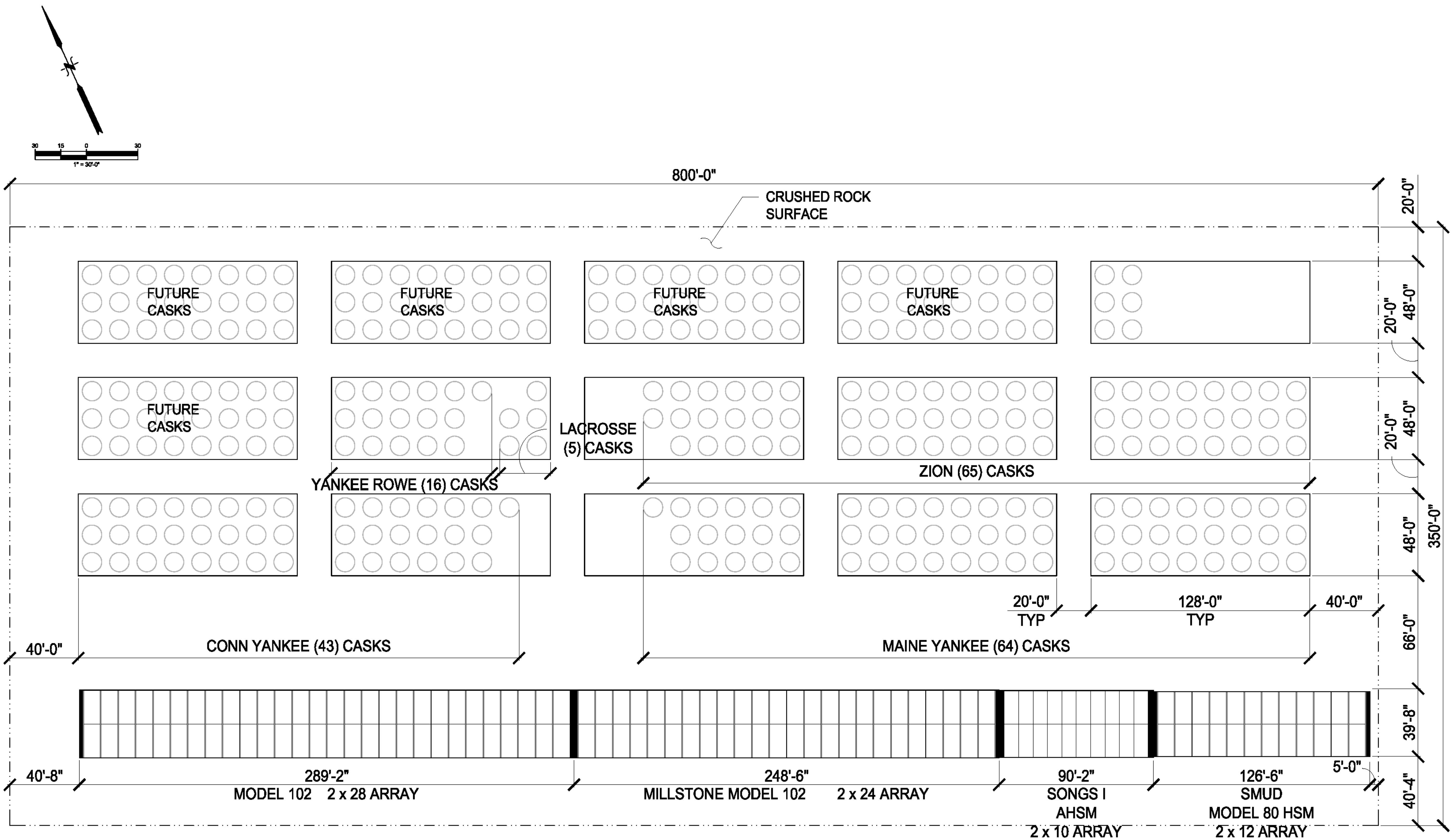

Figure 1-6
WCS CISF Storage Pad Layout

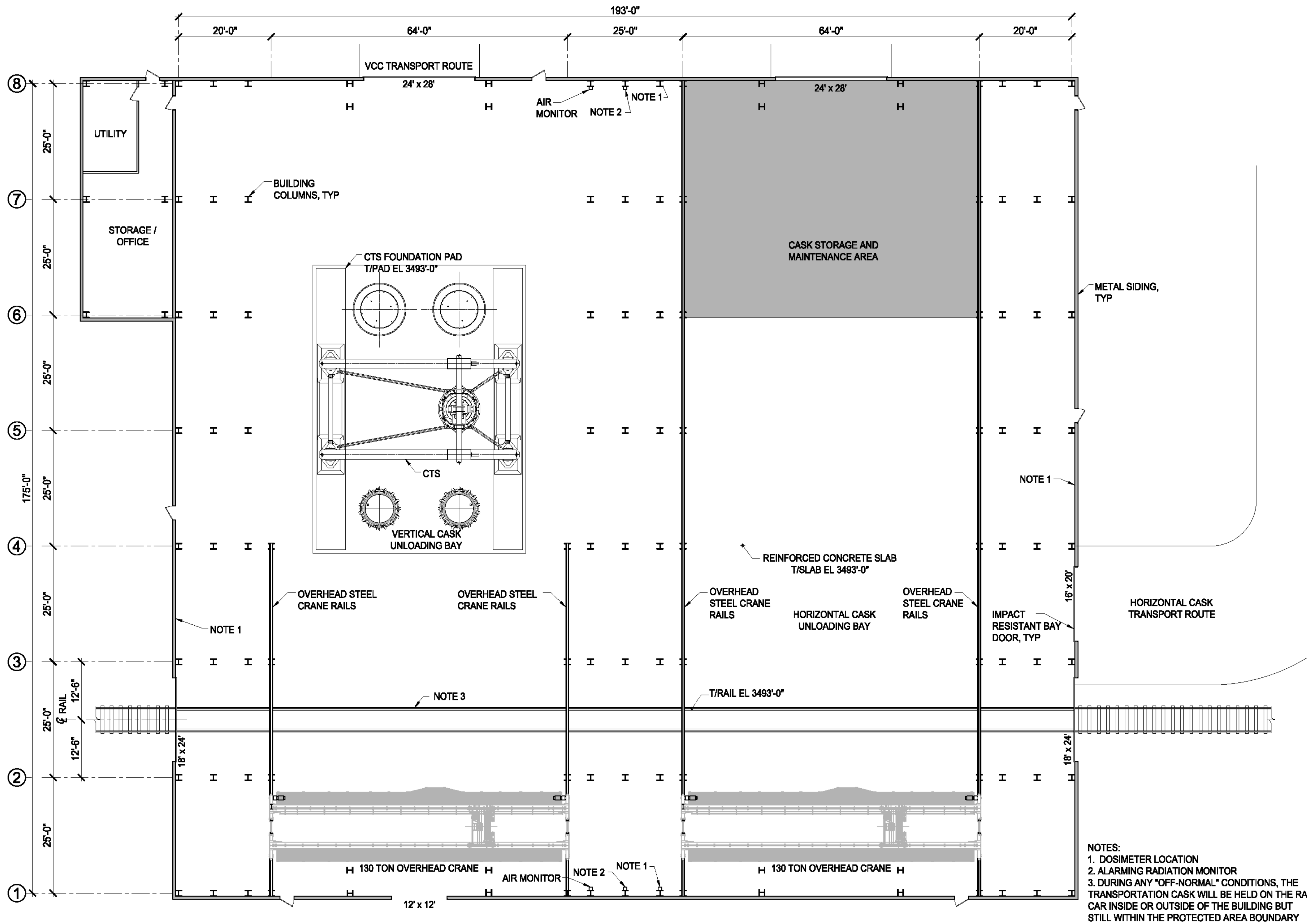

Figure 1-7
Cask Handling Building Plan

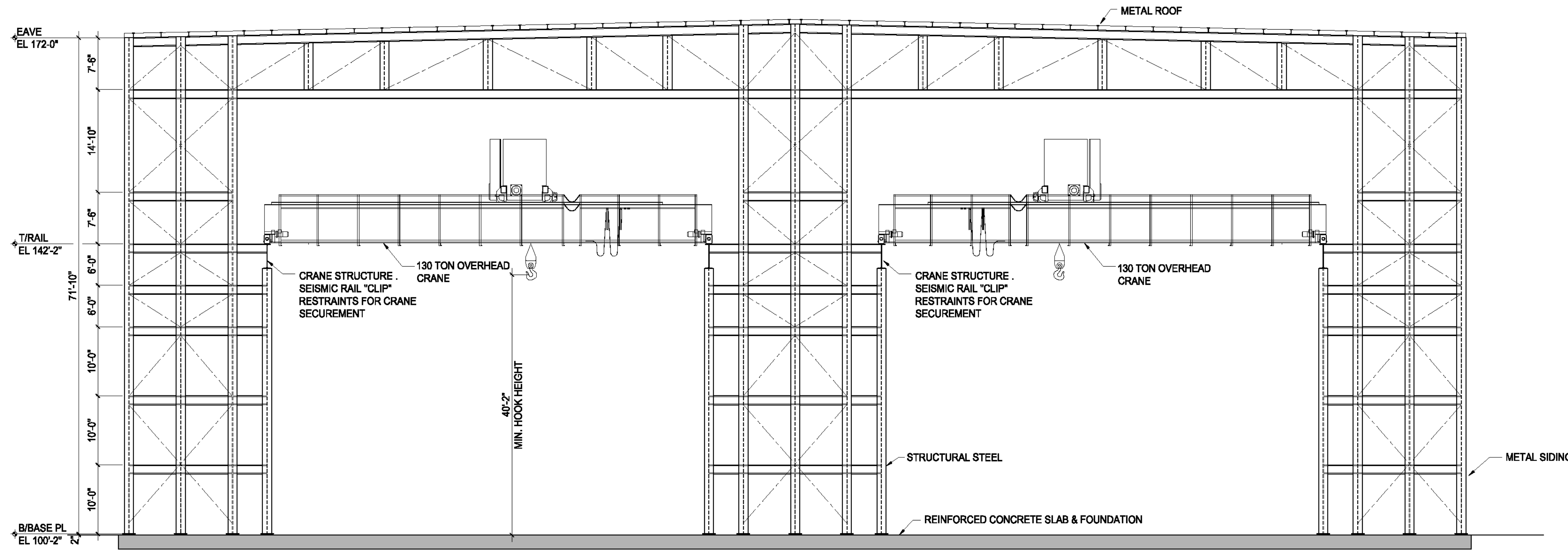

Figure 1-8
Cask Handling Building Section View

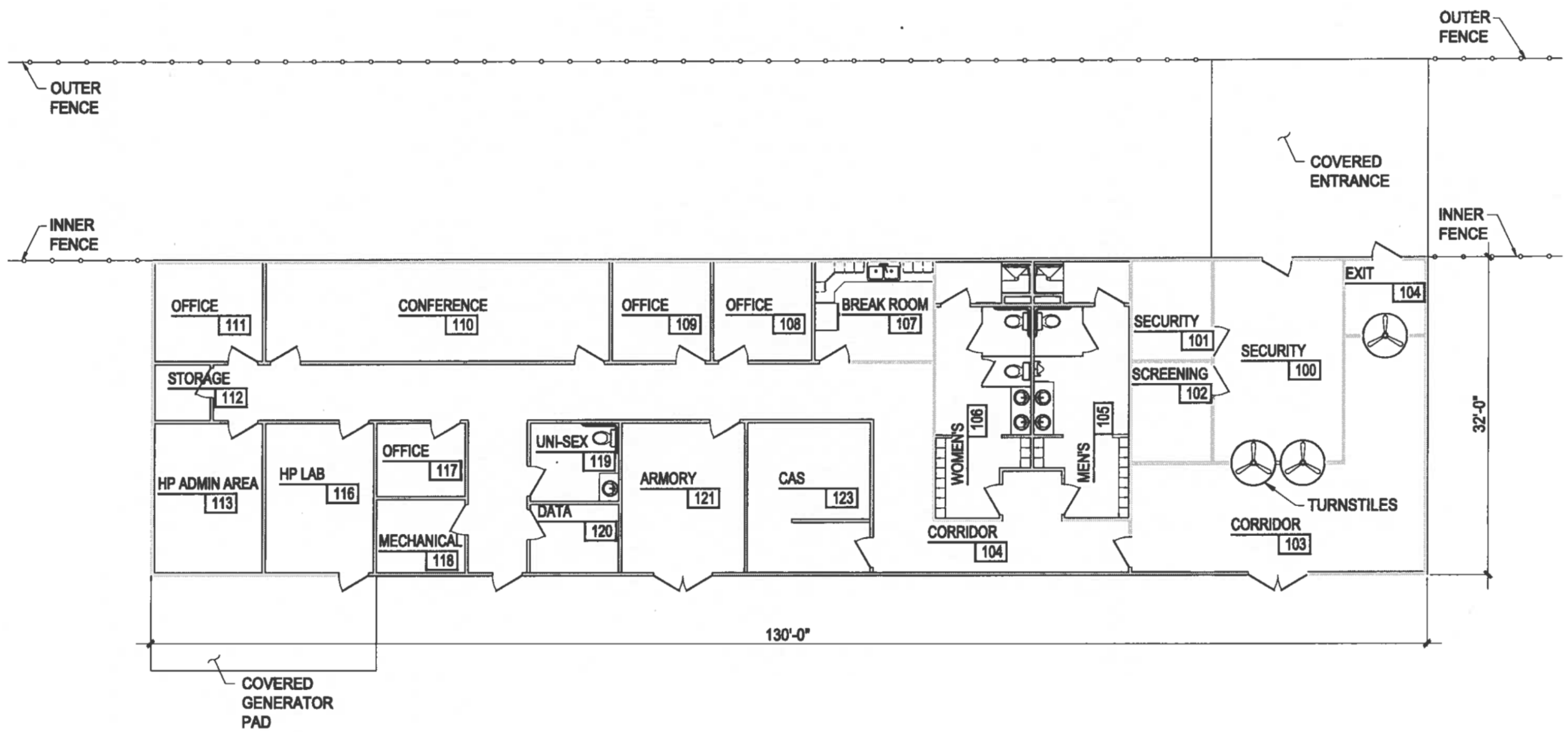

Figure 1-9
Security Administration Building Plan

CHAPTER 2
SITE CHARACTERISTICS

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2. SITE CHARACTERISTICS

The purpose of Chapter 2 is to provide the site characteristics applicable to Interim Storage Partners' (ISP's) WCS Consolidated Interim Storage Facility (WCS CISF) which is located on land leased from Waste Control Specialists. Waste Control Specialists LLC controls approximately 14,000 acres of land in northwestern Andrews County. Within this property, Waste Control Specialists currently operates a commercial waste management facility on approximately 1,338 acres of land (the existing facility) and the remaining acreage is mostly undeveloped land. The WCS CISF will be located north and adjacent to the existing facility approximately 300 meters from the north edge of the rail loop as seen in Figure 2-1. The approximate coordinates for Phase I of the WCS CISF site are latitude 32° 27' 08" north longitude 103° 03' 35" west longitude. The existing maximum and minimum elevations of the site are about 3520 feet and 3482 feet mean sea level (msl), respectively. Eunice, the closest community, is located approximately 8 kilometers (5 miles) west at the cross-junction of New Mexico Highways 207 and 234. The WCS CISF is about 51 kilometers (32 miles) northwest of Andrews, Texas, and approximately 32 kilometers (20 miles) south of Hobbs, New Mexico. The nearest population center with an international airport is Midland-Odessa, located 103 kilometers (64 miles) southeast of the proposed WCS CISF.

More generally, the WCS CISF site is located at the southwestern edge of the Southern High Plains. This part of Andrews County is a gently southeastward sloping plain with a natural slope of about 8 to 10 feet per mile. A topographic map of the area is shown in Figure 2-2.

The Waste Control Specialists site has two approved Resource Conservation and Recovery Act (RCRA) permits from the TCEQ (HW-50398[2-34] and HW-50397[2-33]) and a Toxic Substances Control Act (TSCA) authorization from the United States Environmental Protection Agency (EPA). Waste Control Specialists also possesses radioactive material license (RML) R04100[2-31] and R05807[2-32] for low-level radioactive wastes (LLRW) and byproduct material, respectively [https://www.epa.gov/enforcement/toxic-substances-control-act-tsca-and-federal-facilities].

2.1 Geography and Demography of Site Selected

The WCS CISF is situated in northwest Andrews County on the southwestern edge of the Southern High Plains. The entire Waste Control Specialists site is approximately 14,000 acres with all acreage being controlled by Waste Control Specialists. The nearest population center of 25,000 or more is Hobbs, NM about 20 miles northwest of the WCS CISF.

Land uses within a few miles of the WCS CISF include agriculture, cattle ranching, drilling for and production from oil and gas wells, quarrying operations, uranium enrichment, municipal waste disposal, and the surface recovery and land farming of oil field wastes. Surface quarrying of caliche, sand and gravel is conducted in New Mexico, approximately one mile west of the WCS CISF. The oil field waste recovery facility is adjacent to this quarry. The Lea County, New Mexico municipal solid waste landfill is located adjacent to the state line to the immediate south and west of the WCS CISF. Uranium Enrichment Company (URENCO) operates a centrifuge technology, uranium enrichment facility about one mile to the southwest of the HW-50397 RCRA landfill location.

The 15-mile radius area around the WCS CISF is very low population with some industry and mostly ranch land and very little seasonal variation in population. In the Environmental Report, Appendix A, the Socioeconomic Impact Assessment includes 2010 Census data and Figure 1.1-1 in Appendix A shows cities and towns within a 30 mile radius of the WCS CISF.

Except for a historical marker and picnic area approximately 5.5 km (3.3 mi) from the WCS CISF at the intersection of New Mexico Highways 234 and 18, there are no known public recreation areas or state or federal parks within 8 km (5 mi) of the WCS CISF.

The following nonindustrial water resources are located in the proposed WCS CISF vicinity:

- A manmade pond on the adjacent quarry property owned by Permian Basin Materials (Permian, 2016[2-29]).
- Baker Spring, an intermittent surface-water feature situated about 2,500 feet west of the WCS CISF that contains water seasonally.
- Several cattle-watering holes where groundwater is pumped by windmill and stored in aboveground tanks.
- Monument Draw, a natural shallow drainageway situated several kilometers southwest of the WCS CISF. Local residents indicated that Monument Draw only contains water for a short period of time following a significant rainstorm (LES, 2005[2-19]).

The nearest residential area is due west of the WCS CISF in the city of Eunice, New Mexico, which is approximately 8 km (5 mi) away. The closest residence from the center of the WCS CISF is approximately 6 km (3.8 mi) away on the east side of Eunice, New Mexico.

Population centers (more than 25,000 persons) and communities (places less than 25,000 persons) are shown below with distance from the site and 2010 census population (see Figure 2-25):

- Andrews, Andrews County, Texas: 32 miles southeast: 11,088 persons
- Eunice, Lea County, New Mexico: 6 miles west: 2,922 persons
- Hobbs, Lea County, New Mexico: 20 miles north; 34,122 persons
- Jal, Lea County, New Mexico: 23 miles south; 2,047 persons
- Lovington, Lea County, New Mexico: 39 miles north-northwest; 11,009 persons
- Seminole, Gaines County, Texas: 32 miles east-northeast; 6,430 persons
- Denver City, Gaines County, Texas: 40 miles north-northeast; 4,479 persons

For additional information regarding the demographics of the general project area and potential socioeconomic impacts associated with the proposed WCS CISF, please refer to the Socioeconomic Impact Assessment in Appendix A of the Environmental Report.

Population within a 5-mile radius centered on the proposed WCS CISF consists of scattered residences located in the eastern portion of the City of Eunice in Lea County, New Mexico. The closest residents to the WCS CISF reside within the 20 homes located approximately 4 to 5 miles west of the project. The locations of these homes with relation to the proposed WCS CISF estimated population counts are shown in Figure 2-19 Present Population Distribution within 5 miles of the WCS CISF.

The estimated 2014 population within a 5-mile radius is 55 persons. This estimate assumes 20 households identified based on 2014 aerial photos superimposed with concentric one-mile radius circles. Household size was determined using an average household size of 2.71 persons according to 2010 census data for Census Tract 8/Block Group 2 in Lea County and by applying that average household size to the number of households identified. Because of the remoteness of the proposed WCS CISF and because a majority of the land within the 5-mile radius is controlled by Waste Control Specialists, it is unlikely that the permanent population within a 5-mile radius would change significantly during the proposed license period.

No transient or institutional populations are known within 5 miles of the proposed WCS CISF. There are no known public recreation areas or state or federal parks within the 5-mile radius. Texas State Highway 176, a two-lane highway generally oriented east-west, is the only public transportation facility that provides access to the existing Waste Control Specialists commercial waste management facility. Land uses within a few miles of the WCS CISF include agriculture, cattle ranching, drilling for and production from oil and gas wells, quarrying operations, uranium enrichment, municipal waste disposal, and the surface recovery and land farming of oil field wastes.

Based on U.S. Census Bureau decennial data, Lea County experienced a historical annual percentage growth rate of 0.55% from 1970 to 2010. Applying this historical annual percentage growth rate of 0.55%, the projected 2064 population within the 5-mile radius is 72 persons, an increase of 17 persons from the estimated 2014 population. Table 2-8 provides the population projection calculations for the populated sectors within a 5-mile radius of the proposed WCS CISF. This projection is conservative but appropriate given existing land uses and limited land area available for development. Figure 2-20, Projected Population Distribution within 5 Miles of the WCS CISF, illustrates the projected population distribution within the 5-mile radius based on the 0.55% annual percentage growth rate.

Two other possible scenarios were investigated based on 2010-2040 population projections prepared by the Geospatial and Populations Studies Group - University of New Mexico. Applying an annual percentage growth rate of 2.4 percent (based on projected Lea County Populations 2010-2040) results in a 2064 population projection of 177 persons. With a 1.2 percentage annual growth rate, which is half of the projected growth rate for Lea County (2010-2040), projected population by 2064 would be 100 persons. Table 2-9 and Table 2-10 exhibit these calculations for the populated sectors within a 5-mile radius. Ultimately, these growth scenarios were deemed too aggressive given existing land uses and the limited land area available for development within populated sectors.

2.2 Nearby Industrial, Transportation and Military Facilities

The only industrial facilities located within five mile of the WCS CISF boundary are URENCO USA, Permian Basin Materials, the Lea County landfill, a future travel stop and Sundance Services, Inc. (Figure 2-3). URENCO USA is a uranium enrichment facility that uses centrifuge technology to provide uranium enrichment services. Waste Control Specialists operates several permitted and licensed facilities immediately south of the WCS CISF, including a RCRA landfill, a low-level radioactive waste facility and a byproduct materials landfill. The WCS Facilities include several fuel (diesel, gasoline, and propane) tanks used for fueling heavy equipment and facility operations. Tanks range in size from 350 gallons to 8,000 gallons. These tanks are identified in Table 2-20.

Permian Basin Materials operates a quarry and crushing operation, wherein caliche, sand and gravel are mined, crushed and screened for commercial sales and used in making concrete (Permian, 2016[2-29]). Occasional blasting is a normal part of quarry operations. Accident hazards associated with blasting activities are evaluated in SAR Chapter 12. Sundance Services, Inc. provides oilfield waste disposal services. Sundance Services is authorized by the New Mexico Energy, Minerals and Natural Resources Department to operate the waste oil treating plant, and also manages produced water, solids and drilling muds. Sundance Services is also authorized to landfarm solids (Sundance, 2016[2-30]).

The Lea County (New Mexico) Municipal Landfill is located to the southwest and across New Mexico Highway 234 from WCS CISF. This landfill disposes of municipal solid waste for the Lea County Solid Waste Authority under New Mexico Environmental Department Permit Number SW-98-08(P). The landfill services Lea County and its municipalities. The Lea County Municipal Landfill does not generate or receive hazardous waste (Lea, 2016[2-16]).

Construction has started on a travel stop operated by Love's Travel Stops & Country Stores located at the intersection of New Mexico State Highway 18 and Hwy 176. This facility, which will provide fuel for highway vehicles, is located more than 3.5 miles from the WCS CISF.

DD Landfarm, a non-hazardous oilfield waste disposal facility that closed in August 2013 and is undergoing decommissioning and post-closure monitoring, is located approximately 4 km (2.5 miles) west of the proposed WCS CISF.

There are no military facilities within a mile of the WCS CISF. The closest military facility is Cannon Air Force Base is the closest at a distance of approximately 135 miles.

The Texas & New Mexico Railway (TXN) is a railway consisting of 111 miles of track that generally run north-south between the Union Pacific lines in Monahans, Texas and its termination in Lovington, New Mexico. The railway is 4.8 miles from the WCS CISF at its closest point. The TXN railway is evaluated for potential explosions in Chapter 12 using guidance from Regulatory Guide 1.91, Evaluations of Explosions Postulated to Occur at Nearby Facilities and on Transportation Routes near Nuclear Power Plants, Revision 2. The evaluation considers the case of one rail car carrying an explosive cargo as well as a unit train of ten rail cars carrying explosive cargo. The existing Waste Control Specialists railroad spur and loop exits the Texas & New Mexico Railway near Eunice, New Mexico as shown in Figure 2-3. This spur continues east until it reaches the existing Waste Control Specialists facility where it forms a loop around the facility. The rail side track to the WCS CISF will begin by connecting to the northeast side of the existing loop and terminate inside the PA after going through the CHB. The spur and rail loop are owned and controlled by ISP partner WCS. No potentially explosive cargo will be allowed on these railways.

Texas State Highway 176 is a two-lane highway with 3.6 m (12 foot) wide driving lanes, 2.4 m (8 foot) wide shoulders and a 61m (200 foot) wide right-of-way easement on each side. Access to the site is directly off of Texas State Highway 176. Texas State Highway 176 is approximately 1.5 miles from the WCS CISF. New Mexico Highway 18 is a four-lane highway approximately 3.5 miles from the WCS CISF. Texas State Highway 176 is evaluated for potential explosions in Chapter 12 using guidance from Regulatory Guide 1.91, Evaluations of Explosions Postulated to Occur at Nearby Facilities and on Transportation Routes near Nuclear Power Plants, Revision 2.

A natural gas pipeline owned by Energy Transfer LP runs parallel to Texas State Highway 176 within an easement on Waste Control Specialists property. The pipeline is approximately 7,700 feet from the WCS CISF at its closest point. Directly adjacent to and parallel to the Energy Transfer LP natural gas pipeline is an additional buried 14 inch diameter pipeline which is in idle status. The pipeline is also owned by Energy Transfer LP and it has been idle for over 15 years. Finally, a 10-inch diameter buried CO_2 pipeline runs along the western and northern boundary of New Mexico Section 32. This pipeline is over 8,000 feet from the WCS CISF at its closes point.

In addition to industrial and transportation facilities, gas and oilfield operations are common in west Texas. Regionally, the WCS CISF is located in the Permian Basin of west Texas and southeast New Mexico, which is one of the most important petroleum-producing regions in the United States, containing several thousand oil and gas wells [2-56]. Significant petroleum storage, however, is not located within 5 miles of the WCS CISF. Locally within the Waste Control Specialists property boundaries, oil and gas activity also is very limited. There is no active oilfield activity within the WCS CISF footprint area and only one documented dry hole in the immediate area of the WCS CISF (Figure 2-36). That dry hole has been cemented to the surface and proper plugging and abandonment protocol was observed. There is no evidence of any undocumented or "orphan" wells in the vicinity of the WCS CISF. If any open boreholes indicative of orphan wells are discovered during the construction process, these will be properly assessed and remediated using proper plugging and abandonment procedures in accordance with Texas Regulations. ISP joint venture member Waste Control Specialists also holds 100% of the Operating Rights for producing oil, gas, and other minerals for the area of land where the storage pads for Phase I and the future phases of the WCS CISF would be located. These rights allow ISP joint venture member Waste Control Specialists to prevent any drilling (horizontal or vertical) under storage pads for oil, gas, and other minerals. Based on Figure 2-36, 10 out of 12 locations (83%) are dry or no longer producing, which indicates there is little economically viable oil and gas resources within 1 mile of the WCS CISF and chances of petroleum recovery activities in this area are unlikely. As explained in SAR Section 2.6.2 and in the Probabilistic Seismic Hazard Analysis in Attachment D to SAR Chapter 2, it was determined there is a relatively low seismic hazard at the Waste Control Specialists site even with petroleum recovery activities.

SAR Chapter 12 Section 12.2 provides evaluations of the potential hazards these facilities present to the WCS CISF.

2.2.1 Aircraft Hazard Evaluation

ISP performed an aircraft hazards evaluation for the WCS CISF to demonstrate adequate assurance that the risks from aircraft hazards are sufficiently low. NRC regulations pertaining to siting evaluation, 10 CFR 72.90, require that proposed spent fuel storage installations be examined with respect to the frequency and severity of external natural and man-induced events that could affect the safe operation of the facility. The NRC accepts that spent fuel storage installations do not need to be designed to withstand aircraft crashes if there is less than one-in-one-million ($1x10^{-6}$) annual probability of occurrence [2-42].

For the WCS CISF aircraft hazard evaluation, relevant guidance from Standard Review Plan NUREG 0800 (Section 3.5.1.6-Aircraft Hazards) [2-43] was followed. Although NUREG 0800 is intended for light-water reactor designs, the approach for estimating aircraft hazard is considered to be relevant guidance for the WCS CISF.

This evaluation considers nearby airports, federal airways, holding and approach patterns, military airports, training routes, and training areas. Recorded flight data, taken from a 10 nautical mile (12 mile) radius of the WCS CISF, over a recent two-year period (2017-2018) was reviewed and used to obtain federal airway flight frequencies. Airport and airway locations were determined using flight map information available from the FAA [2-44]. All of the twelve airports within 50 miles of the WCS CISF in the three counties (Andrews County TX, Gaines County TX and Lea County NM) in Texas and New Mexico were identified. There is no military base or airport within 50 miles of the WCS CISF. Federal airway and military training route locations were determined using the FAA Instrument Flight Rules (IFR) Enroute Aeronautical Charts [2-45]. Finally, for this evaluation, the protected area boundary was conservatively increased from 36 acres (0.06 square miles) for phase 1 of this project to envelope the eventual 130 acres (0.21 square miles) of the protected area, effectively covering the additional 98 acres that will be added for the anticipated seven additional phases of the project.

NUREG 0800 Section 3.5.1.6 provides proximity screening criteria for evaluating whether the probability of aircraft crash is less than an order of magnitude to 10E-7 per year. However, as the WCS CISF site has two Federal airways that pass near enough to the site (V68 and Q20), the conservative NUREG 0800 screening criteria are not satisfied. In this case, NUREG 0800 states that a detailed review of aircraft hazards be performed. The review seeks a description of aviation uses in the airspace near the proposed site, including airports and approach paths, Federal airways, restricted airways, and military uses.

NUREG 0800 Section 3.5.1.6 also provides acceptable methods for calculating the probability per year of an aircraft crashing into the plant. The evaluation considers in-flight crash rate per mile, width of airway, number of flights per year along the airway, and effective area of the site. Similarly, the evaluation considers civilian and military airport locations. The details of the evaluation are described in the sections below.

2.2.1.1 Site Description

The WCS CISF has a protected area boundary of 36 acres (0.06 square miles) which contains the Security and Administration Building, the Cask Handling Building and the Storage Area where the cask shipments arrive, and the canisters are off loaded and placed into storage. As indicated above, for this evaluation, the protected area boundary was increased to 130 acres (0.21 square miles), effectively covering the future seven phases of the project. Therefore, this evaluation is conservative as the actual protected area boundary is only 28% of the effective plant area assumed in this evaluation. The concrete storage casks, which contain canisterized SNF, are positioned on concrete pads located within the protected area boundary. The robust designs of the dry cask storage systems that will be within the protected area boundary provide additional defense-in-depth against radiological release, as these systems are passive (air-cooled) and designed to provide physical protection and radiation shielding.

2.2.1.2 Nearby Federal Airways

NUREG 0800 Section 3.5.1.6 seeks a description of the aviation uses in the airspace near the site. Resources made available from the FAA were used to identify Federal airways within a 10 nautical mile (12 mile) radius of the site. Commercial aircraft flight plans are limited to the Federal Airways that make up the enroute airspace structure of the National Airspace System (NAS). The enroute airspace structure of the NAS consists of three strata. The first stratum low altitude airways in the United States can be navigated using Navigational Aids (NAVAIDs), have names that start with the letter V, and are called Victor Airways. They cover altitudes from approximately 1,200 feet above ground level (AGL) up to, but not including 18,000 feet above mean sea level (MSL). The second stratum high altitude airways in the United States all have names that start with the letter J and are called Jet Routes. These routes run from 18,000 ft to 45,000 ft. The third stratum allows random operations above flight level (FL) 450, i.e. 45,000 ft.

There are also area navigation (RNAV) routes, which provide users with an ability to fly direct routes between any two points. In conjunction with the high-altitude routing (HAR) program, area navigation (RNAV) routes have been established to provide for a systematic flow of air traffic in specific portions of the enroute flight environment. The designator for these RNAV routes begins with the letter Q. Low altitude RNAV only routes are identified by the letter "T" prefix, followed by a three-digit number (T-200 to T-500).

The search within a 10 nautical mile radius identified that there are multiple federal airways near the WCS CISF: V68, Q20, and J66 [2-45]. The low-altitude airway is V68 and the two high-altitude airways are Q20 and J66. These airways are described in more detail as follows:

Low Altitude Airways (Figure 2-38 and Figure 2-39) [2-45]

- V68 is a low-altitude east-west route (113° out of Lea County Regional Airport N32°38.29' W103.16.16' toward Midland Airpark Airport N32°00.56' W102°11.42'). Its centerline passes approximately 4 miles from the plant site and has a width of 9.21 miles (8 nautical miles).

High Altitude Airways (Figure 2-40) [2-45]

- Q20 is a high-altitude northwest-southeast RNAV route (121° out of HONDS, NM N33°34"00', W104°51"12' toward FUSCO, TX N31°10"37' W101°19"45'). Its centerline passes approximately 4 miles from the plant site and has a width of 9.2 miles (8 nautical miles).
- J66 is a high-altitude east-west Jet route (254° out of Big Spring, TX N32°23.14' W101°29.02' toward Newman, TX N31°57.10' W106°16.34'). Its centerline passes approximately 12 miles from the plant site and has a width of 9.2 miles (8 nautical miles).

2.2.1.3 Flight Path Movements

Flight movement data for commercial and general aviation flights was provided by FlightAware, LLC. The spatial extent of data was a 10 nautical mile radius from the site location and covered a two-year time period (from January 1, 2017 to December 3, 2018). The data included information pertaining to aircraft location (latitude/longitude), direction of travel, origin, destination, aircraft type, time, and ground speed.

Table 2-14 provides a summary of flight movements and indicates that there were [ ] flight movements in 2017 and 2018, respectively. Note that the data for December 2018 was incomplete so the flight movements of each airway were proportionally extrapolated based on the available data from December 1st to 3rd. Since the flight movements in the first eleven months of 2018 increased by 6.36% compared with those in 2017, the overall flight movements in December 2018 were judged to have the same increase over December 2017 (i.e., 6.36%). Flight movements were segregated into high altitude (>18,000 ft) and low altitude (<18,000 ft) flights. There were a small number of flights with no altitude information provided. These flights are designated as 'other' in Table 2-14.

2.2.1.4 Military Training Routes

Military aircraft would fly within designated Military Training Routes (MTRs), which may or may not be flown under air traffic control. Airspace above the United States from the surface to 10,000 feet above sea level is limited to 250 knots (indicated airspeed) by FAA regulations. There is a military exception to this requirement, the Military Training Route Program, a joint venture by the FAA and the Department of Defense (DOD), developed for use by military aircraft to gain and maintain proficiency in tactical "low-level" flying. These low-level training routes are generally established below 10,000 feet for speeds in excess of 250 knots.

The review of IFR enroute Aeronautical Charts from FAA identified that there is a MTR in the vicinity of the WCS CISF: IR-128 and its reciprocal IR-180 (referred to as IR-128/180) [2-45]. This airway is described as follows:

Military Training Routes (Figure 2-38 and Figure 2-39)

- IR 128/180 is a low-altitude east-west military training route. IR-180 is a clockwise route while IR-128 is the reciprocal counter clockwise route. One of its segments crosses the New Mexico/Texas state border. The centerline of this segment passes approximately 15 miles from the plant site and has a width of 8.1 miles (7 nautical miles, 4 nautical miles on plant side and 3 on the other).

There are other MTRs, IR-178 and IR-192/194, which are further away and not considered in this review. Additional information for IR 128/180, including their distances from the site, is included in Table 2-15.

Military operations were not included in the summary of flight path movements in Table 2-14. The WCS CISF is near the border of two Air Route Traffic Control Centers (ARTCC), ZAB (Albuquerque, NM) and ZFW (Ft. Worth, TX) [2-46]. The total number of flights handled by ZFW and ZAB is provided in Table 2-16. There are approximately 6.36% military operations. It is judged that the ratio of flight classes passing through the WCS CISF site within a 10 nautical mile diameter circle is the same as flight classes handled by ZFW and ZAB. Therefore, the military operations passing through the WCS CISF site 10 nautical mile diameter circle is calculated as 5142 for the year 2018.

2.2.1.5 Airports

In addition to airways, NUREG 0800 Section 3.5.1.6 seeks a description of airports in the vicinity of the site. There are twelve (12) local and regional airports close by the WCS CISF, which are located in Andrews County TX, Gaines County TX, and Lea County NM. These airports are within a 50 nautical mile (57.5 mile) radius of the CIS Facility site. Of these airports, only the Lea County Regional (HOB) airport has a Federal Aviation Administration (FAA) funded air traffic control tower [2-48].

A summary of the airplane operations at airports near the WCS CISF are provided in Table 2-17. Airport operation numbers have been gathered from 2 sources, first is the Air Traffic Activity Data System (ATADS), which contains the official NAS air traffic operations data available for public release [2-44]. The other is GRC Inc.'s AirportIQ 5010 [2-48], which is a compilation of FAA form 5010-5 Airport Master Records and Reports. ATADS gives data as far back as 1990, where AirportIQ gives only the past year's data. Additionally, ATADS only gives data for Airports that have an FAA certified Air traffic control tower, so data for some of the smaller airports has only been sourced from AirportIQ.

Table 2-17 indicates that the closest airport to the site is Lea County Regional Airport (HOB), which is located 4 miles west of Hobbs, NM [2-44] and approximately 18.7 miles northwest from the plant site of the WCS CISF. The Lea County Regional Airport is classified as a small aircraft airport, which primarily serves single engine general aircraft. Recent regional airport statistics (2017) indicate that HOB has approximately 35 flight operations per day [2-48].

As the closest airport to the WCS CISF is approximately 18.7 miles away, it is judged that accidental aircraft crashes, due to airport landing and take-off operations, are low risk. Further, it is noted that NUREG 0800 Section 3.5.1.6 indicates that the probability of general aviation aircraft crash is extremely-low for distances further than 5 miles from end-of-the-runway locations. This observation provides confidence that the risk of airport crash is low, especially for an airport (HOB) that is 18.7 miles from the WCS CISF.

2.2.1.6 Risk Assessment

NUREG 0800 Section 3.5.1.6 provides the approach for estimating the probability per year of an aircraft crashing into the WCSF.

$$P_{FA} = C\ x\ N\ x\ \frac{A}{w}$$

Where
P_{FA}= probability per year of an aircraft crashing into the plant
C= in-flight crash rate per mile for aircraft using airway
N= number of flights per year along the airway
A= effective area of the plant in square miles
w= width of airway (plus twice the distance from the airway edge to the site when the site is outside the airway) in miles

The commercial aircraft in-flight crash rate (per mile airway), 'C', is recommended to be 4.0E-10 in NUREG 0800. This crash rate was estimated based on a conservative assumption that a non-catastrophic failure will occur somewhere in the U.S. once per year. NUREG 0800 Section 3.5.1.6 states that if the number of flights on a specific corridor exceed 100 per day, then more detailed analysis may be required. It is noted that the busiest airway near the WSP CISF is high-altitude federal airway J66, which has a minimum distance of 7.6 miles from the WSP CISF. Airway J66 has approximately 157 flights per day. Further, as this airway is a high-altitude (>18,000 ft) east-west corridor, it is judged that most flights on this airway are commercial.

The technical basis supporting the NUREG 0800 crash rate value of 4.0E-10 was reviewed to ensure that this value was appropriate for the J66 airway. The NUREG 0800 estimate was based on a review of crash rate data for all U.S. air operations between 1965 and 1975 [2-46]. During this time period, the linear average of the aircraft miles flown per year is 2.396E9. Based on the conservative assumption of one non-catastrophic failure per year [2-46], the NUREG 0800 aircraft crash rate was derived as the reciprocal of 2.396E9, or approximately 4E-10.

Flight safety in the U.S. has improved considerably in the last 20 years. During this time period, the FAA reports that commercial aviation fatalities in the U.S. have decreased by 95 percent [2-49]. This improvement in safety is primarily due to technological advances in navigation, FAA regulatory/inspection enhancements, and improvements in the sharing of safety and reliability data.

In addition, the total number of flights in the U.S. has increased considerably. World Bank data indicates that the number of passengers carried on U.S. flights in 2015 is more than 5 times the number in 1970 [2-50]. Based on the significant improvements in flight safety and considerable increase in number of flights in the 20 years (or more), it is judged that the NUREG 0800 value for in-flight crash rate (per mile) of 4E-10 can be conservatively assumed for the J66 airway.

As a conservative assumption, the military flights were assumed to be 6.37% of the total flights within the 10 nm radius of the plant. However, it noted that these flights are more likely to be located on the military training routes IR-128/180, which are located at least 10.6 miles away from the WCS CISF (Figure 2-38 and Figure 2-39. In the unlikely event that a military aircraft, loaded with ordnance, crashed on these flight paths, the distance from the plant is such that damage from exploded ordnance would be negligible. On this basis, it is judged that military flights with ordnance are not a risk-significant consideration.

The results of the evaluation are shown in Table 2-18. Based on site-specific flight information and nearby airway locations, the annual probability of aircraft crash at the WCS CISF is approximately 3.81E-7. This is lower than the one-in-one-million (1x10-6) annual probability of occurrence required by the NRC [2-42].

To provide an additional conservative value of the aircraft impact crash probability, the hypothetical scenario of all airways passing directly over the site was considered. Table 2-19 provides results of the evaluation. The annual probability of aircraft crash at the WCS CISF is approximately 7.38E-7, which is also lower than the one-in-one-million ($1x10^{-6}$) annual probability of occurrence required by the NRC [2-42].

The evaluation results, based on site-specific flight information and nearby airport locations, indicate that the annual probability of aircraft crash at the WCS CISF is approximately 3.81E-7. Using a conservative approach (i.e., all flights pass over the site), the annual probability of occurrence is computed to be less than 7.38E-7. Both probabilities are below the NRC annual probability of occurrence threshold of 1.0E-6 for aircraft crash. An additional conservatism in both approaches is the assumption that the effective area is equivalent to the full size of the protected area (130 acres) versus the actual area size for Phase 1 (36 acres). On this basis, it is judged that aircraft crash presents low risk to public health and safety and is therefore not necessary to be included as a design basis consideration.

2.3 Meteorology

The proposed WCS CISF has been examined with respect to site, local and regional climatological and meteorological conditions and history that demonstrate that the safe operation of the facility would not be affected.

2.3.1 Regional Climatology

The Weather Forecast Office at Midland, Texas covers the High Plains where the proposed WCS CISF is located. The climate of the WCS CISF in Andrews County, TX can best be described as "semi-arid continental" marked with four seasons. Summers are typically hot, dry weather with the relative humidity being generally low. July is the hottest month with high temperatures occasionally reaching above 100 degrees Fahrenheit. January is the coldest month, although the winters are not generally severe. Temperatures occasionally dip below 32 degrees Fahrenheit.

Precipitation levels are generally very low in this arid climate. The precipitation tends to be heavier in the summer and fall.

During the winter, the regional weather is often dominated by a high-pressure system in the central part of the western United States and a low-pressure system in north-central Mexico. The region is affected by a low-pressure system located over Arizona in the summer.

2.3.2 Local Meteorology

The Weather Forecast Office at Midland-Odessa, Texas covers the High Plains where the proposed WCS CISF is located. In addition to the weather forecast office in Midland, climatological data for atmospheric variables such as temperature, pressure, winds, and precipitation are also collected at stations in Jal, New Mexico; Hobbs, New Mexico; and Andrews, Texas. Table 2-1 indicates the distances and directions of these stations from the WCS CISF and the length of record for the reported data in the application. Additionally, Waste Control Specialists compiled meteorological and climatology data from on-site and off-site stations for the Waste Control Specialists Low Level License R04100 (TCEQ 2015) and this data, which includes the period 1914 to 2006, is included in Attachment H. Attachment H includes compiled meteorological and climatology data from four (4) stations within 65 miles of the WCS CISF.

The WCS CISF and surrounding meteorological stations listed above are all located in a climatic region classified within the Köppen Classification System as BSk or Arid semi-cold. The CISF elevation is approximately 1,044 meters msl and the surrounding meteorological stations range from 947 meters msl to 1,118 meters msl and are listed in Table 3.6-1 in the CISF Environmental Report, Section 3.6.2.

Using a series of tables and wind-rose diagrams from on and off-site stations, Attachment H demonstrates that data collected from within 65 miles of the site can be considered representative of the general climate of the site.

The Midland-Odessa monitoring station is the closest first-order National Weather Service station to the WCS CISF. First-order weather stations record a complete range of meteorological parameters for 24-hour periods, and they are usually fully instrumental and operated by the National Weather Service (http://www.ncdc.noaa.gov/homr/).

2.3.3 Onsite Meteorological Data

Meteorological data have been collected on the Waste Control Specialists property from four (4) meteorological tower stations. The towers were located in positions where the measurements will accurately represent overall site meteorology for the WCS CISF. The map shown in Figure 2-4 illustrates where the stations are located in relation to the WCS CISF. The equipment is checked daily and calibrated quarterly. Waste Control Specialists follows a meteorological measurement program that is consistent with Regulatory Guide 1.23, which is cited in NUREG-1567. Details for each station at the Waste Control Specialists site are listed below:

- Waste Control Specialists stations on-site include Tower 1 (Figure 2-21), which has been collecting data since March 2009, measures temperature, wind direction, wind speed, relative humidity at 2 and 10 meters, barometric pressure, solar radiation, and rain at 2 meters only. Data averages, unless otherwise noted, are based on available historic records from 2009-2015. Waste Control Specialists has sensors at both the 2-meter (lower) and 10-meter (upper) height intervals. Tower 1 was installed using a Met One Model 970666 30-foot guyed fold over tower. Specifications for the instrumentation and install are in Attachment G.
- The ER Tower (Figure 2-22), which has been collecting data since July 2009, measures temperature, wind direction, wind speed, relative humidity at 2 and 10 meters, barometric pressure, solar radiation, and rain at 2 meters only. Data averages, unless otherwise noted, are based on available historic records from 2009-2015. Waste Control Specialists has sensors at both the 2-meter (lower) and 10-meter (upper) height intervals. The ER Tower was installed using a Met One Model 970666 30-foot guyed fold over tower. Specifications for the instrumentation and install are in Attachment G.
- The WeatherHawk West and East Tower (Figure 2-23 and Figure 2-24) have been collecting data since March 2009. They measure temperature, wind direction, wind speed, relative humidity, barometric pressure, solar radiation, and rain at roughly 4 meters. Data averages, unless otherwise noted, are based on available historic records from 2009-2015. Specifications for the instrumentation and install are in Attachment G.

Measurements for all parameters, listed in Table 2-11, are taken at 10-minute, 60-minute and 24-hour averages and recorded/stored on a dedicated Campbell Scientific data logger at each station. Routinely the data loggers automatically download their content to a server in Dallas, TX for long-term storage. Data loggers can be remotely accessed via password protected radio telemetry; and the server can be securely accessed via a password protected Internet connection. Table 2-11 lists the meteorological parameters measured and at what heights. Information for the Met One Towers and the WeatherHawk Series regarding range, accuracy, and resolution is listed in Table 2-12.

2.3.3.1 Maximum and Minimum Temperatures

The Western Regional Climate Center (www.wrcc.dri.edu) has historic temperature data for Andrews, TX. The temperature data currently available spans from 1962 until 2010. The average maximum and minimum temperatures, the record high temperature and low temperature for each month, and the annual high and low temperature for these years is shown on Table 2-2. Table 2-2 was used to provide normal, off-normal, and extreme temperature information for the WCS CISF site.

Normal Temperature (NUHOMS® System): The normal temperature range is taken as the low and high mean monthly temperature (44.1°F to 81.5°F).

Normal Temperature (NAC System): The normal ambient temperature is taken as the maximum yearly average temperature. In addition to the temperature information provided in Table 2-2, temperature data from the Midland-Odessa monitoring station between 2000 and 2015 was used to provide yearly average temperatures (Table 2-13). The maximum yearly average temperature is 67.1°F.

Off-Normal Temperature (NUHOMS® System): The NUHOMS® System uses the extreme high temperature to evaluate that system for off-normal temperature conditions. That value is taken as the highest temperature recorded over the time period (113°F) in the data set represented in Table 2-2. The off-normal minimum temperature is 30.1°F, which is the minimum mean daily temperature shown in Table 2-2.

Off-Normal Temperature (NAC System): The NAC System uses a rolling average temperature to evaluate that system for the off-normal temperature condition. In addition to the temperature information provided in Table 2-2, temperature data from the Midland-Odessa monitoring station between 2000 and 2015 was used to provide 3-day average ambient temperatures. These temperatures are determined by taking the daily average temperature averaged over three consecutive days for each day of the year. The lowest average 3-day temperature and the highest average 3-day temperature is shown in Table 2-13. The minimum average and maximum average values averaged over the data set represented in Table 2-13 are 27.9°F and 93.5°F.

Extreme Temperature (NUHOMS® and NAC Systems): The extreme temperature range is taken as the lowest (-1°F) and highest (113°F) temperatures recorded over the time period as shown in Table 2-2.

2.3.3.2 Extreme Winds and Atmospheric Stability

Regionally wind speeds are usually more moderate, although relatively strong winds often accompany occasional frontal activity during late winter and spring months and sometimes occur just in advance of thunderstorms. Frontal winds may exceed 13 meters per second (30 miles per hour) for several hours and reach peak speeds of more than 22 meters per second (50 miles per hour).

Wind speed and direction data measured at the on-site Waste Control Specialists meteorological stations from 2010 to 2015 is shown on wind rose diagrams in Figure 2-4, Figure 2-5, Figure 2-6, Figure 2-7, and Figure 2-8. The data used to create the wind rose diagrams is located on compact discs in Attachment A. The wind roses show the percent of the time (rings) that the wind blows from each of the 16 directions (N, NNE, NE, NNW) by the length of the bars. The shading of the bars also indicates the frequency of occurrence of wind speeds within the wind speed classes shown on the figures. The on-site data indicates that for this period from 2010 to 2015 the average wind speed ranged from 6.07 knots to 10.53 knots. The wind direction is predominantly from the south. The diagrams indicate that wind gusts in excess of 22 mph generally blow from the southwest or northeast.

The neighboring National Enrichment Facility (NEF) site analyzed wind speed and direction from the Midland-Odessa First Order weather station for the years 1987 to 1991. Calculated annual mean wind speed was 5.1 meters per second (11.4 miles per hour), with prevailing winds from the south and a maximum 5-second wind speed of 31.2 meters per second (70 miles per hour). The Pasquill stability classes range from A to F, with the most stable classes – E and F – occurring 18.9 and 13 atmospheric percent of the time, respectively. The least stable classes, A and B, occur 0.3 and 3.5 percent of the time, respectively. NEF compared this data against data generated at Waste Control Specialists from October 1999 through August 2002, and found similar wind patterns and distribution of wind speed between Midland-Odessa and Waste Control Specialists locations (EIS for NEF, 2005).

2.3.3.3 Tornado and Sever Weather Conditions

Two F2 Class (wind speed from 113 to 157 mph) tornadoes have been recorded in Andrews County, TX from 1950 through 2015 according to data reported by NOAA [www.noaa.gov accessed 2015]. NOAA reports there were eight F1 Class (wind speed 73 to 112 mph) tornadoes recorded in Andrews County since 1950. No F4 or F5 tornados have ever been reported in the vicinity of the WCS CISF.

Tornados are classified using the F-scale with classifications ranging from F0-F5 as follows:

- F0-classified tornados have winds of 64 to 116 kilometers per hour (40 to 72 miles per hour)
- F1-classified tornados have winds of 117 to 181 kilometers per hour (73 to 112 miles per hour)
- F2-classified tornados have winds of 182 to 253 kilometers per hour (113 to 157 miles per hour)
- F3-classified tornados have winds of 254 to 332 kilometers per hour (158 to 206 miles per hour)
- F4-classified tornados have winds of 333 to 419 kilometers per hour (207 to 260 miles per hour)
- F5-classified tornados have winds of 420 to 512 kilometers per hour (261 to 318 miles per hour)

The WCS CISF is located about 805 kilometers (500 miles) from the coast. Because hurricanes lose their intensity quickly once they pass over land, a hurricane would most likely lose its intensity before reaching the WCS CISF and dissipate into a tropical depression.

Blowing sand or dust may occur occasionally in the area due to the combination of strong winds, sparse vegetation, and the semi-arid climate. High winds associated with thunderstorms are frequently a source of localized blowing dust. Most episodes of dust prevail for only six hours or less, when visibility is restricted to less than 0.5 mile. Statistical information is lacking on seasonal distribution intensity and duration of dust storms for the region. Recent data in Lubbock, Texas (110 miles northeast of the WCS CISF) indicates blowing dust an average of 12 times in the spring and 9 times during the remainder of the year (Bomar, 1995[2-4]).

2.3.3.4 Precipitation Exposure

The Western Regional Climate Center (www.wrcc.dri.edu) has historic precipitation data for Andrews, TX starting in 1914. The maximum observed 24-hour rainfall (from 1914 until 2012) amount at Andrews, TX is 7.6 inches in July 1914. Historic precipitation and snow data for Andrews, TX from 1914 to 2006 can be found in Table 2-3 and Table 2-4.

Rainfall records from the four (4) on-site meteorological stations on-site are included on compact discs in Attachment A.

Summer rains fall almost entirely during brief, but frequently intense thunderstorms. The general southeasterly circulation from the Gulf of Mexico brings moisture from these storms into the State of New Mexico, and strong surface heating combined with orographic lifting as the air moves over higher terrain causes air currents and condensation. Orographic lifting occurs when air is intercepted by a mountain and is forcefully raised up over the mountains, cooling as it rises. If the air cools to its saturation point, the water vapor condenses and a cloud forms.

As these storms move inland, much of the moisture is precipitated over the coastal and inland mountain ranges of California, Nevada, Arizona, and Utah. Much of the remaining moisture falls on the western slope of the Continental Divide and over northern and high-central mountain ranges. Winter is the driest season in New Mexico except for the portion west of the Continental Divide. This dryness is most noticeable in the Central Valley and on eastern slopes of the mountains. In New Mexico, much of the winter precipitation falls as snow in the mountain areas, but it may occur as either rain or snow in the valleys.

Snow loads for the WCS CISF are based on ASCE Design Criteria 7-10 (2010[2-41]) and are 10 pounds per square foot.

Data from the Midland-Odessa Weather Station indicate the relative humidity throughout the year ranges from 51.5 to 65 percent, with the highest humidity occurring during the early morning hours.

2.3.3.5 Thunderstorms and Lightning Strikes

The mean number of annual thunderstorm days for Hobbs, NM and Midland, TX is 25.5 and 36.4, respectively. No records are maintained for the frequency of thunderstorms and lightning at the proposed WCS CISF; however, the actual number of events can be expected to be similar to these regional data. For Andrews County, there are no reported lightning events from 1950 to 2016 that have caused deaths, injury, property damage or crop damage (http://www.ncdc.noaa.gov/stormevents/, accessed 2016).

2.3.3.6 Mixing Heights

Mixing height is defined as the height above the earth's surface through which relatively strong vertical mixing of the atmosphere occurs. G.C. Holzworth developed mean annual morning and afternoon mixing heights for the contiguous United States (Holzworth, 1972[2-14]). According to Holzworth's calculations, the mean annual morning and afternoon mixing heights at the WCS CISF are approximately 436 meters (1,430 feet) and 2,089 meters (6,854 feet), respectively. Table 2-5 shows the average morning and afternoon mixing heights for Midland-Odessa, Texas.

2.3.3.7 Air Quality

To assess air quality, the EPA has established maximum concentrations for pollutants that are referred to as the National Ambient Air Quality Standards (http://www3.epa.gov/ttn/naaqs/criteria). Table 2-6 presents a list of the NAAQS Air Quality Standards. Six criteria pollutants are used as indicators of air quality: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead (EPA, 2016[2-36]). Both Lea and Andrews Counties are in attainment for all of the EPA criteria pollutants [2-36].

2.3.4 On-Site Meteorological Measurement Program

Meteorological data have been collected on the Waste Control Specialists property from four (4) meteorological towers stations shown in Figure 2-4 and listed below:

- Waste Control Specialists stations on-site include Tower 1, which has been collecting data since March 2009, and it measures temperature, wind direction, wind speed, relative humidity at 2 and 10 meters, barometric pressure, solar radiation, and rain at 2 meters only. Data averages, unless otherwise noted, are based on available historic records from 2009-2015. Waste Control Specialists has sensors at both the 2-meter (lower) and 10-meter (upper) height intervals.
- The ER Tower has been collecting data since July 2009 and it measures temperature, wind direction, wind speed, relative humidity at 2 and 10 meters, barometric pressure, solar radiation, and rain at 2 meters only. Data averages, unless otherwise noted, are based on available historic records from 2009-2015. Waste Control Specialists has sensors at both the 2-meter (lower) and 10-meter (upper) height intervals.
- The WeatherHawk West Tower has been collecting data since March 2009 and it measures temperature, wind direction, wind speed, relative humidity, barometric pressure, solar radiation, and rain at roughly 10 feet. Data averages, unless otherwise noted, are based on available historic records from 2009-2015.
- The WeatherHawk East Tower has been collecting data since March 2009 and it measures temperature, wind direction, wind speed, relative humidity, barometric pressure, solar radiation, and rain at roughly 10 feet. Data averages, unless otherwise noted, are based on available historic records from 2009-2015.

2.3.5 Diffusion Estimates

For normal and off-normal conditions, an atmospheric dispersion coefficient is calculated using D-stability and a wind speed of 5 m/sec and a 100 m distance to the controlled area boundary. The controlled area boundary is farther than 100 m from the WCS CISF so use of 100 m is conservative. For accident conditions, a dispersion coefficient is calculated using F-stability and a wind speed of 1 m/sec. These atmospheric conditions are consistent with the guidance of NUREG-1536 [2-38] and NUREG-1567 [2-39]. The smallest vertical plane cross-sectional area of one Horizontal Storage Module (HSM) is conservatively used as the vertical plane cross-sectional area of the building: area = HSM Width * HSM Height = 9’8” x 15’ = 20,880 in^2 = 13.47 m^2.

The atmospheric dispersion coefficients can be determined through selective use of Equations 1, 2, and 3 of Regulatory Guide 1.145 [2-40] for ground-level relative concentrations at the plume centerline. For D-stability, 5 m/sec wind speed and a distance of 100 m, the horizontal dispersion coefficient, σ_y, is 8 m per Figure 1 of [2-40]. The vertical dispersion coefficient, σ_z, is 4.6 m per Figure 2 of [2-40]. The correction factor at these conditions is determined to be 1.122 per Figure 3 of [2-40].

For F-stability, 1 m/sec wind speed and a distance of 100 m, the horizontal dispersion coefficient, σ_y, is 4 m per Figure 1 of [2-40]. The vertical dispersion coefficient, σ_z, is 2.3 m per Figure 2 of [2-40]. The correction factor at these conditions is 4 per Figure 3 of [2-40].

With the three values of χ/Q determined, the higher χ/Q value of the first two (Equation 1 and Equation 2) is compared with the last one (Equation 3) and the lower of those two is evaluated as the appropriate atmospheric dispersion coefficient per guidance of Regulatory Guide 1.145 [2-40].

The parameters used and the calculated atmospheric dispersion coefficients are summarized in Table 2-7.

2.4 Surface Hydrology

2.4.1 Hydrologic Description

The WCS CISF is located in western Andrews County, Texas nearly at the Texas – New Mexico border, just north of Texas Highway 176 approximately 32 miles west of Andrews, Texas and 5 miles east of Eunice, New Mexico. There are no maps of special flood hazard areas for this location published by the Federal Emergency Management Agency (FEMA). The proposed WCS CISF is not located in wetlands per the National Wetlands Inventory (see Figure 2-9). The Site Location and Surrounding Topography Map, Attachment B Figure 1.1-1, shows the WCS CISF location with respect to the surrounding topography and drainage features and the Waste Control Specialists property boundary.

From a surface water perspective, the general area is characterized by ephemeral drainages, sheet flow, minor gullies and rills, internally-drained playas, and a salt lake basin (identified in Figure 1.1-1 as a Depression Pond in Attachment B). The salt lake basin is the only naturally-occuring, perennial (year-round) water body located near the WCS CISF; the internally drained salt lake basin is located approximately 5 miles from the eastern boundary of the WCS CISF and rarely has more than a few inches of water at scattered locations within the bottom footprint. Surface drainage from the WCS CISF does not flow into this basin. Other perennial surface water features are man-made, including various stock tanks (often replenished by shallow windmill wells) located across the area and the feature denoted as the Fish Pond on Figure 1.1-1, which is located at the Permian Basin Materials quarry (formerly Wallach Concrete) west of the WCS CISF and is also replenished by well water. In addition, Sundance Services, LLC operates the Parabo Disposal Facility for oil and gas waste west of the WCS CISF. Water collects periodically in excavated and/or diked areas at this disposal facility and in the active quarry areas at this property adjacent to and west of the Waste Control Specialists property in New Mexico.

The nearest surface water drainage feature to the WCS CISF is Monument Draw in Lea County, New Mexico, a reasonably well-defined, southward-draining draw about 3 miles west of the WCS CISF. The draw does not have through-going drainage and loses surface expression after it enters Winkler County, Texas. (Note: there are two surface drainage features named Monument Draw in the vicinity: Monument Draw, New Mexico, a south-flowing ephemeral stream in Lea County, New Mexico, and Monument Draw, Texas (same name), an east-flowing ephemeral stream in Andrews County, Texas). East of Monument Draw, New Mexico and south of the WCS CISF is a local topographic high known as Rattlesnake Ridge. This poorly defined ridge parallels the Texas-New Mexico border and crests about 125 feet higher than Monument Draw, New Mexico (Nicholson and Clebsch, 1961[2-27]).

The Waste Control Specialists permitted area is on the southwestern slope of the drainage divide between the Pecos River and the Colorado River. In the immediate vicinity of the WCS CISF, the slope is southwest toward Monument Draw, New Mexico at about 50 feet per mile. The maximum and minimum elevations of the permitted area are about 3490 feet and 3415 feet msl, respectively.

Small surface depressions (buffalo wallows) and a few established playa basins are present within a 6.2-mile radius of the WCS CISF. The largest of the surface depressions within the permitted area is a small playa about 15 acres in size approximately one-half mile northeast of the existing RCRA landfill. Remnant deposits of a filled and now partially covered playa or salt lake basin are found about 3 miles east of the permitted area. Surface drainage from the area north and east of the WCS CISF flows eastward into this basin.

Baker Spring is a manmade feature located at a historic quarry on Waste Control Specialists property about 2,510 feet west of the WCS CISF in Lea County, New Mexico. This feature was formed by excavation of the caliche caprock to the top of the underlying red bed clays. After periods of rainfall, the depression may hold water for an extended period; during dry cycles, the depression may be dry for extended periods.

The National and Oceanic and Atmospheric Administration's National Weather Service Office for Hobbs, New Mexico indicates that the minimum average annual precipitation recorded is 2.01 inches in 2011 and the maximum average annual precipitation recorded is 32.19 inches in 1941[www.noaa.gov]. The annual precipitation on average is approximately 14 inches.

The WCS CISF is located on the southwest-facing slope that transitions from the Southern high Plains to the Pecos Valley physiographic section. The Southern High Plains is an elevated area of undulating plains with low relief encompassing a large area of west Texas and eastern New Mexico. In Andrews County, the southwestern boundary of the Southern High Plains is poorly defined, but in this report is considered to be where the caprock caliche is at or relatively close to the surface, such as on and near the WCS CISF.

The main surface water drainage in the area is Monument Draw, an ephemeral stream about 3 miles west of the WCS CISF, in New Mexico. Ephemeral streams or drainage ways flow briefly only in direct response to precipitation in the immediate locality. Monument Draw is a reasonably well-defined, southward draining feature (although not through-going) that is identified on the USGS topographic maps that serve as the base map source for Attachment B Figure 1.1-1.

An ephemeral drainage feature, referred to as the Ranch House Draw crosses the Waste Control Specialists property from east to west, generally to the south of the WCS CISF, as shown in Figure 1.1-1 in Attachment B. This feature is discernible from the topographic relief depicted on Figure 1.1-1 in Attachment B, although it is much less pronounced than Monument Draw. This drainage feature is a relict drainage way that is choked with windblown sand and is not through-going to Monument Draw. Most of the drainage from the area of the WCS CISF is down slope toward the Ranch House Draw, with a small portion of the drainage from this area toward the southwest. Surface water eventually infiltrates into the windblown sands and dune fields to the south and southwest of the WCS CISF. There are no ephemeral drainages that cross the WCS CISF. Most of the immediate area of the WCS CISF is drained from northwest to southeast by sheet flow. Sheet flow is a term describing overland flow or down slope movement of water taking the form of a thin, continuous film.

Playas, or small, internally-drained basins, occur on the Waste Control Specialists property. The playas are dry most of the time. Some of the playas occasionally hold water after relatively large precipitation events; however, the ponded water rapidly dissipates through infiltration, evaporation, and plant uptake. An established playa basin is present on the eastern edge of the WCS CISF. Surface topography maps indicate approximately 10 feet of relief in the playa.

The combination of low annual precipitation, relatively high potential evapotranspiration, permeable surficial soils down gradient of the WCS CISF, and topographic relief results in well-drained conditions. The engineering design and construction of the WCS CISF will eliminate areas that might promote ponding. Diversion berms and a collection ditch will direct stormwater from upstream drainage areas around the WCS CISF.

There are no public or private surface water drinking-water supplies in the WCS CISF vicinity. Potable water supply for the WCS CISF will tie-in to existing potable water lines at the Waste Control Specialists site. There are scattered windmills in the general area that take water from isolated pockets of groundwater perched on top of the red bed clay. This water is utilized primarily for livestock watering.

The WCS CISF is located on the southwest-facing slope that transitions from the Southern High Plains to the Pecos Valley physiographic section.

2.4.2 Floods

The WCS CISF storage area, which is within the WCS CISF site, is defined as the area within the protected area fence whose boundary is defined by a rectangle 2360 feet by 2430 feet, as indicated on the Developed Drainage Plan, Figure 2-35. Included in the storage area are the security and administration building, the Cask Handling Building, the storage pads and a portion of the WCS CISF rail side track. The WCS CISF storage area is approximately 132 acres and is graded for surface drainage with slopes of approximately 0.8 % from the northwest to the southeast. Developed elevations across the WCS CISF storage area range from 3506 ft msl at the northwest corner to 3486 ft msl near the southeast corner.

All of the surface water runoff from the storage area will drain into the large playa southeast of the site. Flow arrows on Figure 2-35, Developed Drainage Area Map, provide the detailed drainage patterns for the WCS CISF site.

The WCS CISF is not located in the 100-year floodplain, the 500-year floodplain or the floodplain resulting from the probable maximum precipitation (PMP)/ probable maximum flood (PMF). Attachment B presents the Flood Plain Study for the WCS CISF. Attachment B also includes a copy of a floodplain study performed in 2006 for the operational area south of the WCS CISF, which includes a playa area near the southeast corner of the WCS CISF.

2.4.2.1 Flood History

The climate of the area is classified as semiarid, characterized by dry summers and mild, dry winters. Annual precipitation on average is approximately 14 inches and annual evaporation exceeds annual precipitation by nearly five times. The area is subject to occasional winter storms, which produce snowfall events of short duration.

Rainfall records from July 2009 through December 2015, provided by Waste Control Specialists from a weather station near the WCS CISF, indicate an average annual rainfall of 12.6 inches and a maximum twenty-four hour rainfall total of 3.62 inches (Attachment A). According to Waste Control Specialists personnel, surface water runoff has not overflowed roads or existing drainage features at the Waste Control Specialists site during this time frame.

2.4.2.2 Flood Design Considerations

There has been no history of flooding at the WCS CISF site and the WCS CISF is not located in the 100-year floodplain. All surface water runoff from the storage area/protected area will leave the WCS CISF just north of the southeast corner of the storage area and will drain into a large playa southeast of the WCS CISF. A small amount of surface water runoff from the west side of the WCS CISF storage area will drain southwest. Flow arrows on Figure 2-35, Developed Drainage Area Map, provide the detailed drainage patterns for the WCS CISF.

The WCS CISF Drainage Evaluation and Floodplain Analysis (Attachment B) models the 100-year flood, the 500-year flood and the PMF to evaluate the effects on the WCS CISF.

The only analysis of significance from a flooding standpoint is the water level in the playa area resulting from the PMP event. The result is that the WCS CISF storage area is above the maximum water level elevation resulting from that storm event as demonstrated in Attachment B. The area west of the WCS CISF drains freely and does not result in any ponded water to create a flood area near the WCS CISF.

As noted previously, a stormwater collection ditch and berm are to be constructed up-gradient from the WCS CISF storage area. The ditch and berm are to be constructed as a matter of operational convenience to minimize (not prevent) run-on of stormwater during precipitation events by diverting it around the operational storage area. Figure 2-26 (CJI Drawing C-1) show the location of the Collection Ditch and Berm. Figure 2-27 through Figure 2-30 (CJI Drawings C-2, C-3, C-4, and C-5) show plan and profile of the collection ditch and berm. Berms and ditches upgradient of the storage area will be constructed of on-site available red bed compacted clay and armored with on-site available caliche in order to minimize erosion and seepage. It is unlikely that seepage through or under the berms would occur due to the materials used to construct the berms and to the routine inspection and maintenance performed on all areas upgradient of the storage pads. The storage area is sloped to promote drainage across the area, which will result in short-term overland flow of stormwater falling directly on the storage area during some precipitation events. The overland flow across the storage area will be temporary in nature. Compromise of the ditch and berm may result in increased flow across the storage area as a result of some precipitation events, but again, it would be short term and temporary. The maximum berm height will be 2.6 feet. The site will be graded so that stormwater runoff flows off and around the storage pads. Assuming the berm were to breach, and the peak Probable Maximum Precipitation discharge reached a storage pad, the estimated depth of the flow is approximately 3 inches (Addendum A of Attachment B). The storage pad area is approximately three times the area from which run-on might emanate, thus the majority of the overland flow results from the stormwater that falls directly on the pad. The area upgradient of the storage area is predominately a sand dune area with little to no developed drainage paths, which has the effect of lessening the overland flow of water from that area during the storm events. In order to provide a conservative analysis of the flood effects, the flood events are modeled without including the collection ditch and berms, which provides the greatest possible area contributing runoff into the playa.

As indicated in Section 4.0 of the December 2016 revision of the March 2016 report entitled *Centralized Interim Storage Facility Drainage Evaluation and Floodplain Analysis* (Attachment B of SAR Chapter 2):

"The local PMP [probable maximum precipitation] floodplain analysis yielded the PMF elevation near the CISF site of 3488.9 ft msl. Elevations of the storage pads vary from 3490 ft msl to 3504 msl. Elevations of the foundations of the security/administration building and the Cask Handling Building are 3496 ft msl and 3493 ft msl, respectively."

The finish floor elevations of the Security and Administration building and the Cask Handling Building are 7 feet and 4 feet, respectively, above the PMF elevation and will not be impacted by the PMF. The detailed calculations for determining the water level elevations in the playa can be found in Attachment B.

2.4.2.3 Effects of Local Intense Precipitation

The Flood Plain Study in Attachment B includes calculations for a PMP using a 500-year frequency storm event and the limits of the floodplain. The results from these additional storms that were modeled describe a floodplain that is still shallow and wide that is too distant from the WCS CISF to ever be any threat. The soils in the area of the WCS CISF are classified as hydrologic group A/B, which means the soils have high infiltration and transmission rates as shown on Attachment B, Flood Plain Report, Figure No. 2.2.1-1, Soils Boundary Map of the SAR. Infiltrating rainwater is quickly redistributed and removed by evapotranspiration (Grisak, et al., 2011 [2-57). Precipitation occasionally exceeds the infiltration capacity, with transient ponding evidenced by enhanced vegetation in the playas (WCS, 2007 [2-52]). There are no localized playas or drainageways in the proposed WCS CISF vicinity.

2.4.3 Probable Maximum Flood on Streams and Rivers

There are no streams or rivers on or in the vicinity of the WCS CISF. Monument Draw, an ephemeral stream, is the closest main surface water drainage and is about 3 miles west of the WCS CISF in New Mexico, so the WCS CISF would be unaffected by flooding on streams of rivers. While Monument Draw is typically dry, the maximum historical flow occurred on June 10, 1972 and measured 36.2 cubic meters per second (1,280 cubic feet per second).

2.4.4 Potential Dam Failures (Seismically Induced)

There are no dams on or in the vicinity of the WCS CISF. The Waste Control Specialists RCRA and LLRW facilities currently have five (5) manmade evaporation ponds used for sedimentation control and evaporation. In addition to the WCS ponds, there are a series of manmade ponds to the southwest in New Mexico. As indicated in Section 2.6.5, the maximum elevation of the embankment structure of any of these ponds is lower than the minimum elevation of any structure at the CISF. If a seismic event were to cause slope failure, the inherent topography would preclude any adverse effects to the CISF.

2.4.5 Probable Maximum Surge and Seiche Flooding

Surges and seiches are typically observed on lakes or seas. There are no surface bodies of water on or near the WCS CISF where such a phenomenon would be a safety concern at the WCS CISF. There are currently five evaporation ponds at the Waste Control Specialists site and they are designed with spillways on the south side so any seiche or surge would flow south away from the WCS CISF.

2.4.6 Probable Maximum Tsunami Flooding

The WCS CISF is located about 805 kilometers (500 miles) from the coast. The WCS CISF is sufficient distance from the coastline that tsunami flooding is not a hazard.

2.4.7 Ice Flooding

The WCS CISF is not located in an area where ice flooding is a concern. There are no streams or rivers on or in the vicinity of the WCS CISF. Monument Draw, an ephemeral stream, is the closest main surface water drainage and is about 3 miles west of the WCS CISF in New Mexico, so the WCS CISF would be unaffected by ice blockage and ice flooding.

2.4.8 Flooding Protection Requirements

The WCS CISF is not located in an area where flooding protection is required. There are no maps of special flood hazard areas for this location published by the Federal Emergency Management Agency (FEMA).

2.4.9 Environmental Acceptance of Effluents

There are no radioactive or other effluent releases associated with the proposed WCS CISF.

Stormwater runoff is not expected to contain any radiological effluents and WCS CISF stormwater runoff will be directed to the natural drainage system. Domestic wastes will be directed to above ground tanks on-site and the tanks will be periodically drained and all wastes will be transported off-site for disposal.

2.5 Subsurface Hydrology

The High Plains aquifer of west Texas, the principal aquifer in west Texas, consists of water-bearing units within the Tertiary Ogallala Formation and underlying Cretaceous rocks (Nativ and Gutierrez, 1988[2-26]). Hydrogeologically, the High Plains aquifer is viewed as a single, hydraulically connected aquifer system, and groundwater exists under both unconfined and confined conditions. The term Ogallala aquifer is used interchangeably with the High Plains aquifer, since regionally, the Ogallala Formation is the primary component of the High Plains aquifer (Dutton and Simpkins, 1986[2-8]). Regionally the sands, gravels and sandstones that have been variously ascribed to the Tertiary Ogallalla Formations, the Tertiary aged sections of the Gatuña Formation, and the Cretaceous Antlers Formation are distinct and independent. Locally, these units are situated in the same stratigraphic interval and hydrogeologically they represent a single hydrostratigraphic unit overlying the Triassic red beds, the distinctive red and purple mudstones, siltstones, and sandstones of the Triassic Dockum Group. The hydrostratigraphic unit of undifferentiated sands and sandstones of the Ogallala/Antlers/Gatuña is locally referred to as the OAG unit. However, the Ogallala and Cretaceous aquifers are evaluated independently in the literature and will be addressed individually in the discussion below.

The Cenozoic Alluvium aquifer and the Triassic Dockum Group aquifer are considered either major (Cenozoic Alluvium) or minor (Dockum Group) aquifers in this part of west Texas (Mace, 2001[2-20]) and will also be addressed below.

The shallowest water bearing zone is about 225 feet deep at the WCS CISF. Figure 2-10 is a groundwater contour map indicating the OAG unit is largely unsaturated beneath the WCS CISF. The nearest downgradient drinking water well identified in the hydrogeologic unit is located approximately 6.5 miles to the east of the proposed WCS CISF at a residence on the Letter B Ranch. The method of storage (dry cask), the nature of the canisters, the extremely low permeability of the red bed clay and the depth to groundwater beneath the WCS CISF preclude the possibility of groundwater contamination from the operation of the WCS CISF.

Ogallala Aquifer

The Ogallala Formation aquifer is the primary freshwater aquifer within the regional study area and serves as the principal source of groundwater in the Southern High Plains (Cronin, 1969[2-6]). The southern and eastern limits of the Ogallala aquifer lie to the north and east of the WCS CISF.

Regionally, the Ogallala aquifer thickens to the north and east of the currently permitted Waste Control Specialists facility (Blandford et al., 2003[2-3]) as shown on cross sections in Figure 2-11 and Figure 2-12. The saturated thickness of the Ogallala aquifer ranges from a few feet to approximately 300 feet in the Southern High Plains (Nativ, 1988[2-25]). Groundwater within the Ogallala aquifer is typically under water table conditions, with a regional hydraulic gradient toward the southeast ranging from approximately 10 feet/mile to 15 feet/mile. The average hydraulic conductivity of the Ogallala aquifer is about 10 feet/day with higher values preferentially distributed in depositional channels. Assuming an average hydraulic gradient of 12.5 feet/mile and a porosity of 0.20, the average rate of flow in the regional Ogallala aquifer is 43 feet/year.

The primary sources of recharge to the Ogallala aquifer are playas, headwater creeks, and irrigation return flow (Blandford et al., 2003[2-3]). Regionally, the recharge rate to the Ogallala aquifer is estimated to be of the order of 0.35 inches/year (Mullican et al., 1997[2-24]). Blandford et al., (2003)[2-3] estimated predevelopment recharge at less than 0.083 inches/year. In a 2003 numerical model of the Ogallala aquifer, prescribed recharge beneath irrigated lands was on the order of 1.25 to 2.25 inches/year, and recharge beneath non-irrigated agricultural lands ranged from 0.25 to 2.0 inches/year (Blandford et al., 2003[2-3]). Groundwater discharge from the Ogallala aquifer occurs naturally through springs, underflow, evaporation, and transpiration, but is also removed artificially through pumping. Throughout much of the Southern High Plains, groundwater discharge from the Ogallala aquifer exceeds recharge, and water levels have consistently declined. In some regions, however, water levels remained reasonably stable between 1960 and 2000 or even increased, indicating that recharge is the same or greater than discharge/pumping (Blandford et al., 2003[2-3]).

Water quality data for three Ogallala aquifer wells, located within two miles of the WCS CISF, were obtained from a review of Texas and New Mexico state records for western Andrews County, Texas and eastern Lea County, New Mexico.

Review of the water quality data indicates that the local Ogallala aquifer contains fresh to slightly saline water (TDS ≤ 3000 mg/L). The Ogallala Formation, if present, is not water bearing in the WCS CISF area.

Cretaceous Aquifer (Antlers Formation)

The Cretaceous aquifer of the Southern High Plains is also considered to be part of the High Plains Aquifer (Nativ and Gutierrez, 1988[2-26]). The regional hydraulic gradient of the Cretaceous aquifer is toward the southeast, similar to the overlying and often hydraulically interconnected Ogallala aquifer.

The Cretaceous aquifer of the Southern High Plains consists of a basal unit (Trinity or Antlers Formation sandstone), an intermediate unit (Edwards Formation limestone), and an upper unit (Kiamichi/Duck Creek Formation sandstone and limestone). Where present and water bearing in the subsurface, the Cretaceous aquifer in the Southern High Plains is used as a source of groundwater (Nativ and Gutierrez, 1988[2-26]). The Cretaceous Antlers Formation has been identified in the vicinity of the WCS CISF and in the subsurface immediately below the WCS CISF; however, it is unsaturated but for a few isolated perched lenses.

Triassic Dockum Group Aquifer

The Dockum Group regionally consists of Triassic fluvial and lacustrine clays, shales, siltstones, sandstones and conglomerates. The Dockum Group consists of five formations, the lowermost of which is the Santa Rosa Formation, followed by the Tecovas, the Trujillo, the Cooper Canyon, and the Redonda Formations. Only the Santa Rosa, Tecovas, Trujillo and Cooper Canyon Formations are present in the vicinity of the WCS CISF. Water from the Dockum Group aquifer is used as a replacement for, or in combination with, the Ogallala aquifer as a regional source for irrigation, stock and municipal water (Dutton and Simpkins, 1986[2-8]).

There are two water-bearing sandstone formations in the Dockum Group in the vicinity of the WCS CISF. Both yield non-potable water with less than 5,000 mg/L total dissolved solids. The Santa Rosa Formation sandstone at the base of the Dockum Group is about 250 feet thick and is considered the best aquifer within the Dockum Group (Bradley and Kalaswad, 2003[2-5]). The top of the Santa Rosa Formation sandstone is at 1,140 feet below ground surface at the WCS CISF (Figure 2-13). The Trujillo Formation sandstone, the other Dockum Group water-bearing formation in the area, is about 100 feet thick. The top of the Trujillo Formation is about 600 feet below ground surface (Figure 2-13). About 450 feet of very low permeability Dockum Group fluvial and lacustrine clays separate the two formations.

The lower Dockum Group aquifer is recharged by precipitation where Dockum Group sediments are exposed at land surface (Bradley and Kalaswad, 2003[2-5]). However, most of the recharge to the sandstones in the lower Dockum Group (comprising the Santa Rosa and Trujillo Formation sandstones) is considered to have occurred during the Pleistocene (Dutton, 1995[2-7]; Dutton and Simpkins, 1986[2-8]) some 15,000 to 35,000 years before present. Topographically controlled groundwater basin divides were developed during the Pleistocene by the erosion of the Pecos and Canadian River valleys. Prior to the development of these groundwater basin divides, the lower Dockum aquifer was recharged by precipitation on its outcrop area in eastern New Mexico. However, since the development of the Pecos and Canadian River valleys, the lower Dockum aquifer in Texas has been cut-off from its recharge area. Without recharge, the lower Dockum aquifer experiences a net loss of groundwater from withdrawal by wells and by seepage (Dutton and Simpkins, 1986[2-8]). The regional hydraulic gradient of the lower Dockum aquifer, which is toward the southeast, is approximately 15 feet/mile. Based on water levels encountered during logging of the two deep wells at the Waste Control Specialists site, water levels in the lower Dockum aquifer range from 2,852 feet msl (Santa Rosa Formation) to 3,172 feet msl (Trujillo Formation). Transmissivity of the lower Dockum aquifer ranges from 3180 ft^2/day to about 10 ft^2/day and storativity, based on two values, is 0.0001 and 0.002 (Dutton and Simpkins, 1986[2-8]). Based on the transmissivity values noted above, an average thickness of 350 feet of combined Santa Rosa and Trujillo Formation sandstones, a porosity of 0.15, and a gradient of 15 feet/mile, the rate of groundwater flow is estimated to be between 17 feet/year and 0.6 feet/year.

The upper portion of the Dockum Group (Cooper Canyon Formation) serves as an aquitard in the regional and local study area (Nicholson and Clebsch, 1961[2-27]; Dutton and Simpkins, 1986[2-8]). This is supported by the fact that the hydraulic head of the lower Dockum aquifer is significantly lower than that of the overlying Ogallala aquifer throughout much of the regional study area. This relative head difference, approximately 200 to 300 feet in western Andrews County, suggests that the lower Dockum aquifer is receiving essentially no recharge from cross-formational flow (Nativ, 1988[2-25]). The primary limiting factors on recharge to the Dockum Group aquifer include the low-permeability aquitard characteristics of the upper Dockum Group and cut-off by the Pecos River Valley of historical recharge areas in eastern New Mexico.

Cenozoic Alluvium Aquifer

The Cenozoic Alluvium aquifer, also referred to as the Cenozoic Pecos Alluvium aquifer (Jones, 2001[2-15]), is regional in extent, but it is not present in the vicinity of the WCS CISF.

2.5.1 Salt Dissolution and Sink Holes

The proposed WCS CISF is located over Permian-age halite-bearing formations, and the possibility of dissolution and its effects on the long-term performance of the WCS CISF have to be considered. Robert M. Holt, PhD and Dennis W. Powers, PhD developed three conceptual hydrologic models of dissolution processes (shallow, deep and stratabound) based on experience and features found in the Delaware Basin west of the WCS CISF. Investigations showed that no features in the study area at and around the WCS CISF indicated any past dissolution, and the hydrologic systems at the site limit the potential for future dissolution and/or sinkholes. The full discussion and results of the study are detailed in “Evaluation of Halite Dissolution in the Vicinity of Waste Control Specialists Disposal Site, Andrews County, TX” and the report is located in Attachment F.

2.6 Geology And Seismology

2.6.1 Basic Geology

This section discusses the regional geology and site-specific geology. Figure 2-13 is presented to identify the geologic formations of the region. This stratigraphic column adopts the nomenclature of Lehman (1994a[2-17], 1994b[2-18]) for the Dockum Group and includes the entire stratigraphic sequence typical of the Central Basin Platform of the west Texas Permian Basin (Bebout and Meador, 1985[2-2]). Figure 2-14 presents the Hobbs Sheet of the Geologic Atlas of Texas, 1:250,000 scale. The map shows surficial lithologic exposures, geologic descriptions of the formations that are exposed, topography infrastructure and governmental boundaries in the area surrounding the Waste Control Specialists permitted area.

Site Specific Geology

Two cross sections in the vicinity of the WCS CISF were created using boring logs from former site investigations. The locations of the cross sections are shown on Figure 2-15. Two cross sections in the vicinity of the WCS CISF are included as Figure 2-16 and Figure 2-17 and the associated boring logs are included in Attachment C.

The geologic formations of concern, beneath of the WCS CISF comprise, from oldest to youngest, the Triassic Dockum Group, the Late Tertiary Ogallala Formation, the Pleistocene windblown sands of the Blackwater Draw Formation, and Holocene windblown sands. A regional hard caliche pedisol, termed the Caprock caliche, developed on all pre-Quaternary formations before the Blackwater Draw sands were deposited. A less indurated caliche has also formed in portions of the upper Blackwater Draw Sands. Unlike the Caprock caliche, the Blackwater Draw caliche is not regionally extensive.

A stratigraphic column of the WCS CISF area for the above units is provided in Figure 2-37. This CISF site-specific stratigraphic column was developed from data collected from site boring logs. The boring logs are presented in Attachment C.

The WCS permitted facilities are located over a geologic feature referred to as the red bed ridge. The red bed ridge is an expression of the top of the Triassic Dockum Group. The ridge is buried beneath the late Tertiary caprock caliche, which developed on all pre-Quaternary formations on the southern High Plains. Beneath the caprock caliche is the remnant Cretaceous Antlers Formation, which is not observed in bore holes at the CISF, and the Quaternary alluvial and windblown sands of the Ogallala, Gatuña and Blackwater Draw Formations, which are in turn covered by 10 to 20 feet of recent windblown sand. WCS site investigations have followed the convention suggested by Hawley (1993) to refer to the late Tertiary to Quaternary formations south of the red bed ridge as Gatuña and those north of the ridge as Ogallala (Hawley, 1993[2-51]).

As a consequence, Gatuña is not present at the CISF site. The depth to the top of red beds at the CISF is approximately 50 to 80 feet, based on the logs of borings shown in Figure 2-15, Figure 2-16 and Figure 2-17. The northward slope gradient of the top of the red beds across the CISF ranges from approximately 0.98% (based on red bed elevations between TP-64 (3435 ft msl) and PZ-46 (3414 ft msl) and 0.84%, based on red bed elevations between TP-65 (3437 ft msl) and PZ-47 (3414 ft msl). At the CISF, the maximum apparent slope on the late Pliocene erosional surface of the red beds is 1.77%, between TP-84 (3432 ft msl) and PZ-36 (3419 ft msl).

In the immediate vicinity of the WCS facility, the axis of the red bed ridge occurs from approximately the northwest corner of the Byproduct landfill to the southeast corner of the Compact Facility, continuing southeastward beyond the WCS landfills. The axis is not located under the CISF area. The nearest location of the crest of the buried ridge to the CISF is approximately 1200 feet south along State Line Road. At this location, the depth to the crest of the red beds is about 34 ft, based on the log of boring B-1 in Figure 5-4 from WCS (Waste Control Specialists LLC, 2007 [2-43]). The elevations of the top of red beds are estimated from Figure 2-16 and Figure 2-17, with locations estimated from Figure 2-15 and Figure 2-35.

Regional Geology

The red bed ridge is the position of a drainage divide that has separated two major fluvial systems throughout late Cenozoic time (Hawley, 1993 [2-51]; Fallin, 1988 [2-53]). This area was uplifted at the start of the Laramide Orogeny when the Cretaceous seas retreated. From the late Paleocene to near the end of the Pliocene the area was subject to erosion, removing most of the Cretaceous deposits. The relatively resistant limestones over the partially silicified Cretaceous Antlers Formation on the crest of the ridge may have effectively capped the red bed ridge, maintaining the ridge as a mesa or inter-drainage high. The axis of the red bed ridge remains coincident today with a local topographic high, between Monument Draw Texas, which drains to the Colorado River, and Monument Draw New Mexico, which drains to the Pecos River. In Andrews County, the buried red bed ridge plunges to the south/southeast at about 8 to 10 feet per mile, similar to the surface topography, and the crest of the surface water drainage divide is virtually coincident with the crest of the underlying red bed ridge.

The WCS CISF is located over the north-central portion of a prominent subsurface structural feature known as the Central Basin Platform. The Central Basin Platform is a deep-seated horst-like structure that extends northwest to southeast from southeastern New Mexico to eastern Pecos County, Texas. The Central Basin Platform is flanked on three sides by regional structural depressions known as the Delaware Basin to the southwest and the Midland Basin to the northeast, and by the Val Verde Basin to the south.

From the Cambrian to late Mississippian, west Texas and southeast New Mexico experienced mild structural deformation that produced broad regional arches and shallow depressions (Wright, 1979[2-37]). The Central Basin Platform served intermittently as a slightly positive feature during the early Paleozoic (Galley, 1958[2-9]). During the Mississippian and Pennsylvanian, the Central Basin Platform uplifted between ancient lines of weakness (Hills, 1985[2-13]), and the Delaware, Midland, and Val Verde Basins began to subside, forming separate basins.

Late Mississippian tectonic events uplifted and folded the platform and were followed by more intense late Pennsylvanian and early Permian deformation that compressed and faulted the area (Hills, 1963[2-12]). Highly deformed local structures formed ranges of mountains oriented generally parallel to the main axis of the platform (Wright, 1979[2-37]).

This period of intense late Paleozoic deformation was followed by a long period of gradual subsidence and erosion that stripped the Central Basin Platform and other structures to near base-level (Wright, 1979[2-37]) forming the Permian Basin. The expanding sea gradually encroached over broad eroded surfaces and truncated edges of previously deposited sedimentary strata. New layers of arkose, sand, chert pebble conglomerate and shale deposits accumulated as erosional products along the edges and on the flanks of both regional and local structures. Throughout the remainder of the Permian, the Permian Basin slowly filled with several thousand feet of evaporites, carbonates, and shales.

From the end of the Permian until late Cretaceous, there was relatively little tectonic activity except for periods of slight regional uplifting and downwarping. During the early Triassic, the region was slowly uplifted and slightly eroded. These conditions continued until the late Triassic, when gentle downwarping formed a large land-locked basin in which terrigenous deposits of the Dockum Group accumulated in alluvial floodplains and as deltaic and lacustrine deposits (McGowen, et al., 1979[2-21]). In Jurassic time, the area was again subject to erosion.

During Cretaceous time, a large part of the western interior of North America (including west Texas and southeastern New Mexico) was submerged by a large continental shelf sea. A thick sequence of Cretaceous rocks was deposited over most of the area. Locally, the Cretaceous sequence of sediments was comprised of a basal clastic unit (the Trinity, Antlers, or Paluxy sands) and overlying shallow marine carbonates.

Uplift from the west and southward and eastward–retreating Cretaceous seas were coincident with the Laramide Orogeny, which formed the Cordilleran Range west of the Permian Basin. The Laramide Orogeny uplifted the region to essentially its present position, supplying sediments for the nearby late Tertiary Ogallala Formation. The major episode of Laramide folding and faulting occurred in the late Paleocene. There have been no major tectonic events in North Americas since the Laramide Orogeny, except for a brief period of minor volcanism during the late Tertiary in northeastern New Mexico and in the Trans-Pecos area. Hills (1985)[2-13] suggests that slight Tertiary movement along Precambrian lines of weakness may have opened joint channels which allowed the circulation of groundwater into Permian evaporite layers. The near-surface regional structural controls may be locally modified by differential subsidence related to groundwater dissolution of Permian salt deposits (Gustavson, 1980[2-10]).

In Figure 2-3, small circular features seen on the aerial photo began as small erosional depressions on the land surface. These depressions accumulated water, which variably dissolved surficial or near-surface pedogenic calcrete and carbonate. This process enlarged the depressions and accumulated sediment as the calcrete was dissolved (Holt and Powers, 2007a, [2-54]). They are surficial and show no signs of collapse and subsidence that would indicate dissolution of the much deeper evaporite-bearing formations. Analysis of cores and geophysical logs reveal no evidence of post-depositional dissolution of evaporites that would lead to such collapse (Attachment F). There is no evidence that human activities initiated these depressions. These features are unrelated to oil and gas exploration and extraction activities in the site area. The main part of these depressions ranges from a few hundred feet to more than 1000 feet in length and none of the localized features appear to reach a depth of 10 ft. Studies of playa fill indicate these features are thousands to tens of thousands of years old and older (Holliday et al., 1996, [2-55]). There is no indication that these features will form naturally at the site of the WCS CISF in the near geological future.

The Central Basin Platform is an area of moderate, low intensity seismic activity based on data obtained from the U.S. Geological Survey (USGS) Earthquake Data Base available from the National Earthquake Information Center (http://neic.usgs.gov/). Typical of the central U.S., there is a marked absence of mapped Quaternary faults and few of the known earthquakes can be associated with a specific geologic structure. In the 2014 U.S.G.S. National Hazard Maps, the site area was characterized as one of relatively low seismic hazard.

2.6.2 Vibratory Ground Motion

The WCS CISF lies in a region with crustal properties that indicate minimum risk due to faulting and seismicity. Crustal thickness is the most reliable predictor of seismic activity and faulting in intracratonic regions. Crustal thickness in the vicinity of the WCS CISF is approximately 30 miles (50 km), one of the three thickest crustal regions in North America (Mooney and Braile, 1989[2-22]). In comparison, the crustal thickness of the Rio Grande Rift is as little as 7.5 miles (12 km) in places.

In 2016, a Probabilistic Seismic Hazard Evaluation using Nuclear Regulatory Commission (NRC) guidance was completed for the WCS CISF. The Seismic Hazard Evaluation (Attachment D) was prepared under the technical supervision of Dr. Ivan Wong, head of Seismic Hazards Group, AECOM, Oakland, CA and the analysis was performed consistent with the professional standards of the Texas Board of Professional Geoscientists.

The objectives of the Seismic Hazard Analysis were to (1) estimate the levels of ground motions that could be exceeded at a specific annual frequency (or return period) at the site by performing a probabilistic seismic hazard analysis (PSHA), (2) incorporate the site-specific effects of the near-surface geology on the ground motions, and (3) develop Design Response Spectra (DRS) at the ground surface for the site and corresponding histories.

Significant earthquakes (moment magnitude [**M**] > 5.0), however have occurred in the site region including the 1992 **M** 5.0 Rattlesnake Canyon earthquake about 30 km from the WCS CISF. Some occurrences of induced seismicity have also proven to be spatially correlated to active hydrocarbon production in the region. Typical of the central U.S., there is a marked absence of Quaternary faults and few of the known earthquakes can be associated with a specific geologic structure. In the 2014 U.S. Geological Survey (USGS) National Hazard Maps, the site area was characterized as one of relatively low seismic hazard.

Spectral-analysis-of-surface-wave (SASW) surveys were performed at the WCS CISF by the University of Texas at Austin to obtain shear-wave velocity (V_s) profiles down to the Trujillo sandstone at a depth of about 600 feet.

To estimate ground motions, four Next Generation of Attenuation (NGA)-West2 ground motion prediction models for the western U.S. (WUS) and the EPRI (2013) [2-36] models for the central and eastern U.S. (CEUS) were utilized. For the NGA-West2 models, a time-averaged shear wave velocity (V_s) in the top 100 feet (V_s30) of 760 m/sec was used. The EPRI (2013) [2-36] ground motion models are defined for hard rock or a V_s30 of 2,830 m/sec and greater. To address the epistemic uncertainty on which models are appropriate, both the NGA-West2 and EPRI (2013) [2-36] models were used in the PSHA weighted 0.60 and 0.40, respectively.

Based on the PSHA and the inputs of the seismic source model and ground motion models, seismic hazard curves for both firm and hard rock were calculated. The absence of late-Quaternary faulting and the low to moderate rate of background seismicity, even that associated with petroleum recovery activities, results in relatively low seismic hazard at the WCS CISF. The largest contributor to the hazard at the WCS CISF is the background seismicity (the Southern Great Plains seismic source zone and Gaussian smoothing).

A site response analysis was performed to estimate ground motions at the WCS CISF incorporating the site-specific geology. The hazard curves were weighted based on the weights assigned to the NGA-West2 and EPRI (2013) [2-36] ground motion models and a 10,000 year return period horizontal Uniform Hazard Spectrum (UHS) was calculated. A 10,000-year return period vertical UHS was also calculated using the NRC V/H ratios. On Table 3 in Attachment D is the horizontal and vertical UHS for a return period of 10,000 years. The ground surface design response spectrum peak horizontal acceleration for 0.01 seconds is 0.25 g and the vertical is 0.175 g.

Historic and recent seismic activity for the Texas regional area from 1973 to 2015 can be seen on Figure 2-18.

2.6.3 Surface Faulting

Two types of faulting were associated with early Permian deformation. Most of the faults were long, high-angle reverse faults with several hundred feet of vertical displacement that often involved the Precambrian basement rocks (Hills, 1985[2-13]; Bebout and Meador, 1985[2-2]). The second type of faulting is found along the western margin of the Central Basin Platform where long strike-slip faults, with displacements of tens of miles, are found (Hills, 1985[2-13]). All of the major faulting in the vicinity of the Central Basin Platform occurred in response to tectonic forces active before the global plate tectonic reorganization that created the North American continent (Bally et al., 1989[2-1]). The Paleozoic faults exhibit low natural microseismicity as a result of passive response to relatively low levels of tectonic stress in the trailing edge of the westward-drifting North American plate. The closest Quaternary faults are in the Guadalupe Mountains (Muehlberger, 1979[2-23]), about 100 miles southwest of the WCS CISF.

The large structural features of the Permian Basin are reflected only indirectly in the Mesozoic and Cenozoic rocks, as there has been virtually no tectonic movement within the basin since the Permian (Nicholson and Clebsch, 1961[2-27]). The Central Basin Platform is located approximately 7000 feet beneath the present land surface and the Permian and Triassic sediments drape over the top of the Platform structure. The faults that uplifted the platform do not appear to displace the younger Permian sediments. The northernmost fault, located at the Matador Uplift, terminates in lower Wolfcampian sediments.

The regional geologic and tectonic information does not indicate the presence of significant post-Permian faulting within the regional study area. Permian period with basin subsidence matching sediment accumulation. Post-Permian activity in the entire Permian Basin consisted of localized tectonic pulses. The basin has remained stable for the last 200 million years (Seismic Hazard Evaluation Attachment D).

Two regional stratigraphic cross section constructed in the vicinity of the WCS CISF using oil and gas well logs are shown as Figure 2-11 and Figure 2-12. The locations of the cross sections are also shown on the figures. These cross sections depict the major stratigraphic units that occur within about 2000 feet below ground surface in the vicinity of the WCS CISF. The stratigraphic units depicted on Figure 2-11 and Figure 2-12 include the upper Ogallala Antlers Gapuña unit of a few tens of feet in thickness, the underlying Triassic red beds of the Dockum Group with a thickness of 1,000 to 1,500 feet, the underlying Permian Dewey Lake Formation red beds, and the Permian evaporates of the Rustler and Salado Formations. These cross sections do not indicate the presence of significant faulting in the upper 2,000 feet of sediments within 3 to 4 miles of the WCS CISF.

The closest areas of faulting that affect Quaternary strata are faults associated with the Basin and Range physiographic province. Tectonically, Basin and Range faulting is associated with crustal extension and thinning in southwestern North America due to right lateral shear between the Pacific plate and the North American plate. This extension is the cause of the Rio Grande Rift, which is an area with numerous Quaternary faults located approximately 200 miles west of the WCS CISF.

The closest Quaternary faults listed in the United States Geological Survey (USGS) Quaternary Fault and Fold Database (http://earthquakes.usgs.gov/qfaults) are faults that are associated with the range-front of the Guadalupe Mountains and are located along the southwestern base of the mountain range. The closest Quaternary fault is an unnamed fault at the base of the Guadalupe Mountains, listed as fault No. 907 in the database and located approximately 104 miles southwest of the WCS CISF in Guadalupe Mountains National Park in Culberson County, Texas. This fault is a down-to-the-west range-bounding normal fault, with the most recent deformation estimated at less than 1.6 million years ago (Ma) (http://earthquakes.usgs.gov/qfaults). A second fault associated with this region is the Guadalupe Fault listed as fault No. 2058 and located 108 miles west of the WCS CISF in Chaves and Otero Counties, New Mexico. This fault may be the re-activation of a late Tertiary Basin and Range fault. The age of the faulted deposits have not been studied, but the oldest faulted strata are believed to be as old as the penultimate glaciation based on the stratigraphic sequence present, placing the oldest age of deformation at approximately 130 thousand years ago (ka). The most recent deformation of this fault is believed to be less than 15 ka. There are additional Quaternary faults located south of the two faults listed, along the southwestern base of the Guadalupe Mountains in Texas.

The next closest area of Quaternary faulting listed on the USGS Quaternary Fault and Fold Database is the Alamogordo fault, which is divided into three sections. The sections of the Alamogordo fault closest to the WCS CISF are fault Nos. 2045b and 2045c on the USGS Quaternary Fault and Fold Database. These faults are located approximately 170 miles west of the WCS CISF in Otero County, New Mexico. The Alamogordo fault is the range-bounding structure of the Sacramento Mountains. The faults are down-to-the west faults, much like those associated with the Guadalupe Mountain range. The most recent deformation is listed as less than 130 ka in the USGS Quaternary Fault and Fold Database. There is no surface evidence of quaternary faulting within the Waste Control Specialists property.

During landfill excavation activities at Waste Control Specialists site, an apparent southward-dipping reverse fault in a sandstone in the upper portion of the Triassic red beds of the original RCRA landfill excavation were located in 2004. Since regulatory criteria address the age of faults and the age of any geologic units affected or displaced by faulting, a geologic investigation of the fault was undertaken. The southeast wall of the RCRA landfill was extended about 200 feet to the southeast in May and June 2004, yielding about 60 feet of vertical geologic exposure along a length of about 400 feet. Two benches with subvertical walls were exposed. The relationship between faulting in the Triassic red beds and the overlying Cretaceous Antlers Formation was carefully evaluated to determine if any displacement of the younger Cretaceous deposits had occurred. The Triassic red beds are separated from the overlying Cretaceous Antlers Formation sands and gravels and from a layer of reworked altered clay by a distinct and mappable parting near the top of the gray altered layer of red beds. None of the observed fault planes or slip surfaces in the Triassic red beds in the extensively mapped section cross or offset the parting. In addition, the bedding in the Antlers Formation is continuous where observable and not calichified, and in particular, there are no indications that the Cretaceous-aged Antlers Formation was affected by the faulting in the Triassic red beds. Photos, figures and further details are included in the Waste Control Specialists LLRW License [2-31].

2.6.4 Stability of Subsurface Materials

In the area of the WCS CISF, surficial materials consist of topsoil, recent windblown sand and sands of the Blackwater Draw. A thin veneer of two feet or less of topsoil and windblown sand is present at the surface. The topsoil consists of brown silty sand that contains sparse vegetation debris and roots. The Blackwater Draw consists of sand that is reddish brown, fine to very fine grained, with minor amounts of clay and nodules of soft sandy caliche. Surficial material is underlain by a variable sequence of calcium carbonate-cemented caliche referred to as the caprock caliche. The caprock caliche forms the resistant beds of the Caprock escarpment along the western and eastern margins of the Southern High Plains (Gustavson and Finley, 1985[2-11]). A local surface exposure of the caprock was observed at Baker Spring. At this location, the caliche consists of: approximately six feet of white, highly fractured calcium carbonate cemented feldspathic and quarzitic silt and very fine grained sand; overlying approximately 12 feet of white and pinkish white, massive caliche with extensive concretionary nodule growths (i.e., pisolites) and feldspathic and quartzitic silt and very fine grained sand; resting on top of approximately six feet of pinkish white, calcium carbonate-cemented feldspathic and quartzitic silt, sand and gravel which becomes less cemented with depth. The lower six feet of caliche appears to be well-to-poorly cemented calcium carbonate. The caliche has an irregular basal contact and indicates a gradational transition into primarily uncemented sands and gravels below. The caliche horizon contains varying amounts of feldspathic and quartzitic silt, sand and gravel fragments with a general trend of decreased cementation and increased silt, sand and gravel content with depth.

The WCS CISF subsurface conditions were explored with eighteen soil borings (Geotechnical Engineering report from Geoservices in Attachment E). The boring locations and depths were selected by GEOservices and surveyed by Waste Control Specialists personnel (Attachment E Figures 3, 4, and 5). The soil test borings were advanced using a Cannon skid rig (air rotary) and a CME-55 track rig. N-values were recorded in the field and noted on the boring logs. Soil samples collected during drilling were sent to a lab for visual classification and laboratory testing including: Atterberg Limits; Natural Moisture Content; Particle Size Analysis; Resistivity of Soil; Consolidated Undrained Triaxial Test; Standard Proctor Moisture-Density Tests; California Bearing Ratio; and Consolidation.

At the surface of each of the eighteen soil test borings, residual soils were encountered to auger refusal and/or boring termination depths ranging from 25 to 45 feet below the existing surface elevation. The N-values of the standard penetration resistance test (SPT) were used to evaluate the relative consistency or density of the subsurface. The N-values for the subsurface materials ranged from 4 bpf to 100 blows per 1 inch of penetration, indicating a relative density of very loose to very dense. The relative density of the subsurface materials were most commonly medium dense to very dense. The standard penetration resistance values have likely been inflated due to the caliche.

The natural moisture content of the subsurface materials ranged from 2.5 to 9 percent. Atterberg limits testing on three selected residual samples revealed liquid limits (LL) ranging from 26 to 20 percent and each sample was non-plastic. Wash 200 tests performed on eight soil samples revealed 24 to 45 percent finer than the 200 sieve.

Shear wave velocities for the upper 100 feet below ground surface (bgs) range from 820.3 ft/sec to 23,383 ft/sec. The upper 10 feet of the site is a loose fill material and shear wave velocities for 0-10 feet bgs ranged from 820.3 ft/sec to 1,107 ft/sec. For 15 to 35 feet bgs, the shear wave velocities were 1302 to 1940 feet per second for a stratigraphic unit of silty sands, gravels, and caliche referred to as the Ogallala/Antlers/Gatuna formation (OAG). The Dockum Formation (dense clay) starts at 35 to 40 feet bgs beneath the OAG and shear wave velocities ranged from 2,058 feet/s to 3,383 ft/s. The results of the shear wave studies are located in Table 4 of the Geotechnical Exploration Report (Attachment E). The plot plan of the linear array is shown in Figure 12 of Appendix E of the Geotechnical Report (Attachment E). The engineering properties of site materials by strata, based on the geophysical survey investigation, are contained in Table 8 located in Appendix C of Attachment E.

During the geotechnical investigation, no water was encountered in any of the borings. There are no water table conditions anticipated beneath the site during facility construction and operations. Several monitor wells in the area are installed in the uppermost transmissive zone, and have been dry since installation in 2005 or 2008. The site is underlain by a northerly dipping lower confining unit. Since groundwater was not encountered in any of the 18 soil test borings and given that some of the borings penetrated as deep as 45 feet below the ground surface, it can be concluded that a liquefaction hazard does not exist for the proposed CISF.

Specific calculated allowable bearing capacity values for the CHB and storage pads are presented in Section 4.3 of Attachment E and range between 4,000 psf and 6,000 psf. For other foundations constructed at the proposed CISF, the recommended allowable bearing capacity for design of the foundations is 3,000 pounds per square foot (psf) or less. A one-third increase in the allowable bearing capacity for all load conditions that include transient loads (wind, seismic, other short term loads) is permitted. The 33% increase in allowable bearing capacity (stress) can be applied to load combinations that consider transient loads in conjunction with dead loads. Calculations can be found in Appendix G of Attachment E. A summary table for the site characteristics geotechnical-related parameters can be found in Table 9 in Appendix D of Attachment E. Plans and profiles showing the extent of excavations and backfill are shown in Figure 2-26, Figure 2-31, Figure 2-32, and Figure 2-33. Structural backfill shall comply with the criteria for material, compaction, and quality control specified in Section 4.2.2 of Attachment E.

2.6.5 Slope Stability

The WCS CISF site and surrounding area is nearly flat, so there is little possibility of landslides. Settling or slumping is unlikely because the geologic strata are well consolidated and surface soils have low moisture content. The semi-arid climate helps maintain low moisture content of the soils. Except for sedimentation and evaporation ponds, surface water is absent except during infrequent rainstorms.

As indicated in Sections 2.1 and 2.4, there are several nonindustrial water resources near the CISF. These include ponds, basins, springs, and drainage features. The ponds and basins are depressions and do not have embankments preventing water from escaping. The spring and drainage features do not have embankments. They are ephemeral and precluded from impacting the CISF due to inherent topography.

The WCS property has five manmade ponds used for sedimentation control and evaporation. The maximum elevation of any of the WCS pond embankment overflow structures is 3,454 ft. The minimum elevation of any structure at the CISF is 3,488 ft. Because the WCS pond embankment elevations are over 30 feet lower than the ground elevation of the CISF structures, slope failure of any of the WCS pond embankments would not adversely affect the CISF.

In addition to the five manmade ponds on WCS property, there are a series of manmade ponds to the southwest in New Mexico owned by Sundance Services, Inc. used for their oil field waste disposal operation. The nearest of these ponds is approximately 4,000 feet from the western WCS CISF OCA Boundary. The maximum elevation of all of the overflow points is approximately 3,475 feet. Because the Sundance pond embankment elevations are located at a substantial distance from the CISF and are over 10 feet lower than the ground elevation of any CISF structures, slope failure of any of these pond embankments would not adversely affect the CISF.

There are two stockpile areas, one to the southwest and one to the northeast of the CISF, created during construction of existing WCS landfills. The closest stockpile area is over 2,000 feet from the WCS CISF Phase 1 PA Boundary. This distance is sufficient to preclude any lateral spread from a potential slope failure from having any impact on the CISF.

2.6.6 Volcanism

There is minimal seismic and no volcanic activity near the WCS CISF. There is no evidence of tectonic or volcanic activity near the WCS CISF in the recent past.

2.7 Summary of Site Conditions Affecting Construction and Operating Requirements

The WCS CISF site is located on the southwestern edge of the Southern High Plains, approximately 32 miles northwest of the City of Andrews. This part of Andrews County is a gently southeastward sloping plain with a natural slope of about 8 to 10 feet per mile. The finished grade of the WCS CISF is expected to be sloped gently with an anticipated elevation of 3,485 feet above msl. The WCS CISF site is currently undeveloped and the existing land surface is fairly flat with an average slope of 0.8 percent (%). The existing maximum and minimum elevations of the site are about 3520 feet and 3482 feet msl, respectively. The cover type is desert shrub. The existing Waste Control Specialists railroad is generally aligned parallel with and south of the proposed WCS CISF site boundary.

The entire WCS CISF, including the access road, is above the 100-year flood elevation. The northern most limit of the 100-year floodplain is approximately 4,000 feet southeast of the WCS CISF while the northernmost limits of the 500-year and PMP floodplains are 3965 feet and 3895 feet southeast of the WCS CISF, respectively.

A probabilistic seismic hazard analysis was performed to determine the design basis ground motion at the WCS CISF. The peak ground acceleration for a 10,000 year return period is 0.26 g.

Subsurface soils at the WCS CISF are suitable for supporting conventional foundations under both the static and dynamic loading conditions. There is no potential for liquefaction, collapse, or excessive settlement of these soils. As described in Section 2.6.5, there are no slopes, natural or manmade, close enough to the proposed WCS CISF facilities that their failure would adversely affect these facilities.

Storage overpacks will be used to store canisters containing spent fuel and GTCC waste. The canisters are drained of all liquid prior to being shipped to the WCS CISF. Therefore, liquid releases cannot result from operation of the WCS CISF.

The shallowest water bearing zone is about 225 feet deep at the WCS CISF. The method of storage (dry cask), the nature of the storage casks, the extremely low permeability of the red bed clay and the depth to groundwater beneath the WCS CISF preclude the possibility of groundwater contamination from the operation of the WCS CISF.

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Table 2-1
Weather Stations Located Near the WCS CISF

Station	Distance and Direction from Proposed WCS CISF	Length of Record[1]	Station Elevation (meters)
Hobbs, New Mexico	32 kilometers (20 miles) north of WCS CISF	29 (1981-2010)	1,115
Jal, New Mexico	50 kilometers (31 miles) south of WCS CISF	29 (1981-2010)	947
Andrews, Texas	51 kilometers (32 miles) east of WCS CISF	29 (1981-2010)	967
Midland-Odessa, Texas	103 kilometers (64 miles) southeast of WCS CISF	29 (1981-2010)	1,118

Note:

1. Years of compiled data for climatological analysis.

Table 2-2
Summary of Maximum and Minimum Temperatures for Andrews, TX
Period of Record: 1962 to 2010

MONTH	MEAN MONTHLY TEMPERATURE		MEAN DAILY MAX. TEMPERATURE		MEAN DAILY MIN. TEMPERATURE		HIGHEST DAILY MAX. TEMPERATURE		LOWEST DAILY MIN TEMPERATURE	
	˚C	˚F	˚C	˚F	˚C	˚F	˚C	˚F	˚C	˚F
January	6.7	44.1	14.5	58.1	-1.1	30.1	29.4	85.0	-17.8	0.0
February	9.2	48.6	17.2	63.1	1.1	33.9	31.7	89.0	-18.3	-1.0
March	13.3	56.0	21.8	71.3	4.8	40.6	36.1	97.0	-13.3	8.0
April	18.2	64.7	26.8	80.2	9.4	49.0	37.2	99.0	-5.0	23.0
May	22.7	72.9	31.0	87.8	14.5	58.1	41.7	107.0	0.6	33.0
June	26.6	79.8	34.3	93.8	18.7	65.7	45.0	113.0	8.3	47.0
July	27.5	81.5	34.8	94.6	20.2	68.3	43.9	111.0	13.9	57.0
August	26.7	80.0	33.9	93.0	19.5	67.1	41.1	106.0	12.2	54.0
September	23.3	73.9	30.4	86.8	16.1	61.0	40.0	104.0	3.3	38.0
October	18.3	64.9	26.1	79.0	10.4	50.8	38.3	101.0	-5.6	22.0
November	11.8	53.2	19.4	67.0	4.1	39.4	33.9	93.0	-11.7	11.0
December	7.6	45.6	15.3	59.5	-0.2	31.7	27.2	81.0	-17.2	1.0
Annual	**17.5**	**63.5**	**25.3**	**77.5**	**9.7**	**49.4**	**45.0**	**113.0**	**-18.3**	**-1.0**

Source: www.wrcc.dri.edu

Table 2-3
Andrews, TX Period of Record Precipitation Data (1914-2006)

Precipitation CM (INCHES)	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL
Average	1.24 (0.49)	1.50 (0.59)	1.70 (0.67)	2.41 (0.95)	4.19 (1.65)	4.88 (1.92)	5.74 (2.26)	4.78 (1.88)	5.72 (2.25)	3.78 (1.49)	1.58 (0.62)	1.35 (0.53)	38.86 (15.30)
Maximum	11.40 (4.49)	6.40 (2.52)	8.46 (3.33)	13.67 (5.38)	14.91 (5.87)	18.06 (7.11)	30.23 (11.90)	14.00 (5.51)	20.17 (7.94)	16.16 (6.36)	8.00 (3.15)	7.80 (3.07)	78.66 (30.97)
Minimum	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.36 (0.14)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.36 (0.14)
Max 24 Hr	5.61 (2.21)	2.54 (1.00)	4.70 (1.85)	6.30 (2.48)	7.62 (3.00)	9.40 (3.70)	19.30 (7.60)	6.10 (2.40)	8.90 (3.50)	5.21 (2.05)	5.33 (2.10)	3.94 (1.55)	19.30 (7.60)

Source: Reference [2-31]

Table 2-4
Andrews, TX Period of Record Snow Data (1914-2006)

Snow CM (INCHES)	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL
Average	3.33 (1.31)	1.52 (0.60)	0.08 (0.03)	0.15 (0.06)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.08 (0.03)	1.45 (0.57)	1.98 (0.78)	8.59 (3.38)
Maximum	25.40 (10.00)	17.78 (7.00)	2.54 (1.00)	6.35 (2.50)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.54 (1.00)	35.56 (14.00)	13.97 (5.50)	52.07 (20.50)
Minimum	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Max 24 Hr	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Reference [2-31]

Table 2-5
Average Morning and Afternoon Mixing Heights for Midland-Odessa, Texas

	Winter	Spring	Summer	Fall	Annual
Morning	290 meters (951 feet)	429 meters (1,407 feet)	606 meters (1,988 feet)	419 meters (1,375 feet)	436 meters (1,430 feet)
Afternoon	1,276 meters (4,186 feet)	2,449 meters (8,035 feet)	2,744 meters (9,003 feet)	1,887 meters (6,191 feet)	2,089 meters (6,854 feet)

Source: Reference [2-14]

Table 2-6
EPA National Ambient Air Quality Standards

Pollutant	EPA Standard Value	Standard Type
Carbon Monoxide (CO)		
8-hour Average	9 ppm	Primary
1-hour Average	35 ppm	Primary
Nitrogen Dioxide (NO_2)		
Annual Arithmetic Mean	0.053 ppm (2)	Primary and Secondary
Ozone (O_3)		
8-hour Average	0.070 ppm (3)	Primary and Secondary
Lead (Pb)		
Quarterly Average	1.5 g/m^3 (1)	Primary and Secondary
Particulate (PM_{10})		
24-hour Average	150 µg/m^3	Primary and Secondary
Particulate ($PM_{2.5}$)		
Annual Arithmetic Mean(5)	12.0 µg/m^3	Primary
Annual Arithmetic Mean(5)	15.0 µg/m^3	Secondary
24-hour average(5)	35 µg/m^3	Primary and Secondary
Sulfur Dioxide (SO_2)		
3-hour Average	0.5 ppm	Secondary
1-hour Average	75 ppb (4)	Primary

Notes

1. In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 µg/m^3 as a calendar quarter average) also remain in effect.
2. The level of the annual NO_2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.
3. Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O_3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.
4. The previous SO_2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2) any area for which implementation plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous SO_2 standards or is not meeting the requirements of a SIP call under the previous SO2 standards (40 CFR 50.4(3)), A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the require NAAQS.
5. Averaged over 3 years

Table 2-7
Atmospheric Dispersion Coefficients

Parameter	Normal/Off-Normal	Accident
Stability	D	F
$\overline{U_{10}}$ (m/sec)	5	1
A (m^2)	13.47	13.47
σ_y (m)	8	4
σ_z (m)	4.6	2.3
M	1.122	4
Equation 1 of [2-40] (sec/m^3)	1.635E-03	2.806E-02
Equation 2 of [2-40] (sec/m^3)	5.766E-04	1.153E-02
Equation 3 of [2-40] (sec/m^3)	1.542E-03	8.650E-03
χ/Q (sec/m^3)	1.542E-03	8.650E-03

Table 2-8
Projected Populations Based on Annual Percentage Growth Rate of 0.55%

Sector	2014 Estimated Residences[1]	2014 Estimated Population[2]	Projected Population[3]				
			2024	2034	2044	2054	2064
WNW	2	6	6	7	7	7	8
WSW	18	49	52	55	58	61	64
Total		**55**	**58**	**62**	**65**	**68**	**72**

Source/Note:

1 Residences were identified based on 2014 aerial photos superimposed with concentric one-mile radius circles.

2 The 2014 estimated population was calculated by applying the average household size of 2.71 persons (based on 2010 Census data representing Census Tract 8/Block Group 2 in Lea County) to the number of residences identified on 2014 aerial.

3 The following projected population calculation was utilized: $[(0.55/100)+1]^{10}$ x [(2014, 2024, 2034, 2044, or 2054) Population].

Table 2-9
Projected Populations Based on Annual Percentage Growth Rate of 2.4%

Sector	2014 Estimated Residences[1]	2014 Estimated Population[2]	Projected Population[3]				
			2024	2034	2044	2054	2064
WNW	2	6	8	10	12	15	19
WSW	18	49	62	78	99	125	158
Total		**55**	**70**	**88**	**111**	**140**	**177**

Source/Note:

1 Residences were identified based on 2014 aerial photos superimposed with concentric one-mile radius circles.

2 The 2014 estimated population was calculated by applying the average household size of 2.71 persons (based on 2010 Census data representing Census Tract 8/Block Group 2 in Lea County) to the number of residences identified on 2014 aerial.

3 The following projected population calculation was utilized: $[(2.4/100)+1]^{10}$ x [(2014, 2024, 2034, 2044, or 2054) Population].

Table 2-10
Projected Populations Based on Annual Percentage Growth Rate of 1.2%

Sector	2014 Estimated Residences[1]	2014 Estimated Population[2]	Projected Population[3]				
			2024	2034	2044	2054	2064
WNW	2	6	7	8	9	10	11
WSW	18	49	55	62	70	79	89
Total		55	62	70	79	89	100

Source/Note:

1 Residences were identified based on 2014 aerial photos superimposed with concentric one-mile radius circles.

2 The 2014 estimated population was calculated by applying the average household size of 2.71 persons (based on 2010 Census data representing Census Tract 8/Block Group 2 in Lea County) to the number of residences identified on 2014 aerial.

3 The following projected population calculation was utilized: $[(1.2/100)+1]^{10}$ x [(2014, 2024, 2034, 2044, or 2054) Population].

Table 2-11
Meteorological Tower Measurements

Parameter (Ht above Grnd)	Weather Station				Instrument Manufacturer
	Tower 1	ER Tower	WH East	WH West	
Wind Spd (2 Meters)	X	X			Met One
Wind Spd (10 Meters)	X	X			Met One
Wind Spd (4 Meters)			X	X	Weather Hawk*
Wind Dir (2 Meters)	X	X			Met One
Wind Dir (10 Meters)	X	X			Met One
Wind Dir (4 Meters)			X	X	Weather Hawk*
Air Temp [°F] (2 Meters)	X	X			Met One
Air Temp [°F] (10 Meters)	X	X			Met One
Air Temp [°F] (4 Meters)			X	X	Weather Hawk*
Relative Humidity (2 Meters)	X	X			Met One
Relative Humidity (10 Meters)	X	X			Met One
Relative Humidity (4 Meters)			X	X	Weather Hawk*
Barometric Press (2 Meters)	X	X			Met One
Barometric Press (4 Meters)			X	X	Weather Hawk*
Solar Radiation (2 Meters)	X	X			Met One
Solar Radiation (4 Meters)			X	X	Weather Hawk*
Rain [Tip Bucket] (Ground)	X	X			Met One
Rain [Tip Bucket] (Ground)			X	X	Weather Hawk*

Table 2-12
Meteorological Tower Sensors

Parameter	Sensor	Range	Accuracy	Resolution
WeatherHawk Series 500				
Air Temperature	Capacitive Ceramic	-60 - +140 F	+/-0.9 F @ -40 to 125 F	0.1 F
Relative Humidity	Capacitive thin-film polymer	0-100%	+/- 3% @ 0-90%RH; +/-5% @ 90-100%RH	0.1%
Barometric Pressure	Capacitive Silicon	17.72-32.48 inHg (60-110 kPa)	0.15 inHg @ +32 to +86 F (+-.05 kPa @0-32 C)	.03 inHg @-60 to +140 F (+-.1 kPa @-52 to +60 C)
Solar Radiation	Silicon Pyranometer	300 to 1100 nm (Spectral Range)	Reproducibility +/- 2%	Infinite
Rain	Piezoelectric	9.3 in^2 (collecting area)	<5% (weather dependent)	.001 in
Wind Direction	Ultrasonic	0-360 deg (Azimuth)	+/- 2 deg	1 deg
Wind Speed	Ultrasonic	0-134 mph	+/-.67 mph (+/- 0.3m/s) or +/- 2% whichever is greater	.22 mph (0.1 m/s)
Met One Towers				
Air Temperature	Themistor	-50 to +50 C	+/- 0.10 C	Analog Output with Infinite Resolution
Relative Humidity	Capacitive thin-film polymer	0-100%	+/-3% @ 0-10% and 90-100%; +/- 2% @ 10-90%	Analog Output with Infinite Resolution
Barometric Pressure	Active Solid-State Device	0-100%	+/-0.125% FS	Analog Output with Infinite Resolution
Solar Radiation	Pyranometer	0.4 to 0.7 micrometers	+/- 5%	Analog Output with Infinite Resolution
Rain	Dual-chambered tipping bucket that activates a reed switch	8 in^2 (collecting area)	@ 0.5 in/hour +/- 0.5%; @ 1 in to 3 in/hour +/- 1.0%	0.01 in
Wind Direction	Wire-wound potentiometer	0-360 deg	+/-5 deg	Analog Output with Infinite Resolution
Wind Speed	3-cup anemometer	0-125 mph	+/-1.5% or 0.25 mph	1.79 mph @ 1 sec; 0.03 mph @ 1 min

Table 2-13
Summary of Maximum, Minimum, and 3-Day Average Temperatures (°F) for Midland-Odessa, TX Period of Record: 2000-2015

Year	Average Daily Temperature	Maximum 3-Day Average Temperature	Minimum 3-Day Average Temperature	Maximum Temperature	Minimum Temperature
2000	65.4	90.3	27.5	108	16
2001	64.8	90.3	26.8	105	16
2002	63.8	90.3	31.8	106	17
2003	65.1	91.0	30.2	106	17
2004	63.6	85.8	25.8	103	16
2005	63.8	87.8	26.7	106	6
2006	65.4	88.7	30.7	105	14
2007	63.0	84.3	25.8	102	16
2008	64.2	89.5	31.5	106	14
2009	64.6	89.8	31.0	104	12
2010	63.9	88.2	28.5	109	15
2011	66.7	93.5	14.7	111	5
2012	67.1	90.0	35.3	107	18
2013	64.9	91.2	26.7	109	16
2014	65.5	89.0	26.3	105	13
2015	65.1	90.5	27.5	104	19
Avg.	**64.8**	**89.4**	**27.9**	**106**	**14.4**
Max	**67.1**	**93.5**	**-**	**111**	**-**
Min	**63.0**	**-**	**14.7**	**-**	**5**

Proprietary Information on This Page
Withheld Pursuant to 10 CFR 2.390

Table 2-15
Nearby Federal Airway and Military Training Route NUREG 0800 Screening

<table>
<tr><th>Airway or Pattern</th><th>Type</th><th>Travel Direction</th><th>Distance to Centerline</th><th>Width left of center [mi]</th><th>Width right of center [mi]</th><th>Site side</th><th>Distance to nearest edge [mi]</th></tr>
<tr><td>V68</td><td>Federal</td><td>Either</td><td>3.4</td><td>4.6</td><td>4.6</td><td>N/A</td><td>Over Site</td></tr>
<tr><td>Q20</td><td>Federal</td><td>Either</td><td>3.7</td><td>4.6</td><td>4.6</td><td>N/A</td><td>Over Site</td></tr>
<tr><td>J66</td><td>Federal</td><td>Either</td><td>12.2</td><td>4.6</td><td>4.6</td><td>N/A</td><td>7.6</td></tr>
<tr><td rowspan="2">IR-128/ IR-180</td><td>MTR</td><td>W to E</td><td>15.2</td><td>4.6</td><td>3.5</td><td>Left</td><td rowspan="2">10.6</td></tr>
<tr><td>MTR</td><td>E to W</td><td>15.2</td><td>3.5</td><td>4.6</td><td>Right</td></tr>
</table>

Table 2-16
Military Traffic Handled by ZFW and ZAB in from 1/1/2017 to 12/31/2018

Facility	Air Carrier	Air Taxi	General Aviation	Military	Total
ZFW	2,621,740	782,346	911,447	325,375	4,640,908
ZAB	2,099,849	444,067	485,773	173,764	3,203,453
Total:	4,721,589	1,226,413	1,397,220	499,139	7,844,361
	60.19%	15.63%	17.81%	6.36%	

Table 2-17
Nearby Airport NUREG 0800 Screening

Airports	City, State	Distance from site [mi]	Average Annual Operations	Airport IQ 5010 Operations for 12 months ending:	Operations				Based Aircraft				
					General Aviation (local & itinerant)	Air Taxi	Air Carrier	Military	SE	ME	J	Heli	Ultralight
ANDREWS COUNTY (E11)	Andrews, TX	32.0	6228	4/25/2018	100%				29	2			1
TWO LEGGS (1TA5)	Denver City, TX	34.0	N/A						3				
SEAGRAVES (F97)	Seagraves, TX	46.0	2100	6/20/2018	100%				7				
GAINES COUNTY (GNC)	Seminole, TX	28.3	12125	4/26/2018	99%	1%			16	3			
HAMILTON AIRCRAFT, INC (5TA0)	Seminole, TX	20.5	N/A						3				
SEMINOLE SPRAYING SERVICE (39TE)	Seminole, TX	26.2	2000	N/A	100%				6				
INDUSTRIAL AIRPARK (NM83)	Hobbs, NM	23.4	N/A						11	1			1
LEA COUNTY RGNL (HOB)	Hobbs, NM	18.7	12745	04/01/2017	68%	16%	9%	7%	41	6	5	1	
LEA COUNTY/JAL/ (E26)	Jal, NM	22.9	3000	04/04/2017	100%				7	1	1		
LEA COUNTY-ZIP FRANKLIN MEMORIAL(E06)	Lovington, NM	40.2	2200	04/03/2017	100%				11	1			
NOR LEA COUNTY GENERAL HOSPITAL (NM94)	Lovington, NM	39.2	0	12/30/2004									
TATUM (18T)	Tatum, NM	57.3	500	04/03/2017	100%				3				

Table 2-18
Results of Aircraft Hazard Evaluation (Airways Considered Separately)

Variable Description	Variable	Units	Low Altitude (V68 &other)	High Altitude		Military (6.36%)	Flight data w/o altitude#	Total
				J66 (W-E)	Q20 & Other			
Inflight Crash Rate(NUREG-0800)	C	mi^{-1}	4.00E-10	4.00E-10	4.00E-10	4.00E-10	4.00E-10	
Aircraft Operations within 10 nautical miles of WSC CISF in 2018	N	yr^{-1}	[ ]	[ ]	[ ]	5142	[ ]	[ ]
Width of Airway	w	mi	9.2	24.2	9.2	29.3	9.2	
Area of WCS CISF	A	mi^2	0.21	0.21	0.21	0.21	0.21	
Probability of inflight aircraft impacting WSC CISF	P^{FA}	yr^{-1}	[ ]	[ ]	[ ]	1.47E-08	[ ]	**3.81E-07**

Table 2-19
Probability of Inflight Aircraft Impacting WCS CISF (All airways pass over the site)

Variable Description	Variable	Units	Air Carrier	Air Taxi	General Aviation	Military	Total
Inflight Crash Rate (NUREG-0800)	C	mi^{-1}	4.00E-10	4.00E-10	4.00E-10	4.00E-10	
Aircraft Class		-	60.19%	15.63%	17.81%	6.36%	
Aircraft Operations within 10 nautical miles of WCS CISF in 2018	N	yr^{-1}	[ ]	[ ]	[ ]	5142	
Width of Airway	w	mi	9.2	9.2	9.2	9.2	
Area of WCS CISF	A	mi^2	0.21	0.21	0.21	0.21	
Probability of inflight aircraft impacting WCS CISF	P^{FA}	yr^{-1}	[ ]	[ ]	[ ]	4.69E-08	**7.38E-07**

Table 2-20
Waste Control Specialists Facility Fuel Tank Capacity and Proximity

Waste Control Specialists Facility Fuel Tank Description	Capacity (gal)	Distance to CISF PA[1] (ft)
Treatment Storage and Disposal Facility Propane Tank	1,000	4,950
Mixed Waste Treatment Facility Propane Tank	5,000	4,340
Mixed Waste Treatment Facility Gasoline Tank	5,000	4,400
Mixed Waste Treatment Facility Diesel Tank (Red)	8,000	4,400
Mixed Waste Treatment Facility Diesel Tank (Green)	500	4,400
Low-Level Radioactive Waste Facility Diesel Tank	3,484	3,025
Treatment Storage and Disposal Facility Fire Pump (Diesel)	850	5,000
Low-Level Radioactive Waste Facility Generator (Diesel)	310	2,970
Low-Level Radioactive Waste Facility Fire Pump (Diesel)	850	2,750
Security Generator (Diesel)	350	5,550
Mixed Waste Treatment Facility Generator (Diesel)	280	4,500
NOC Generator (Diesel)	350	4,500

Note 1: Protected Area (PA)

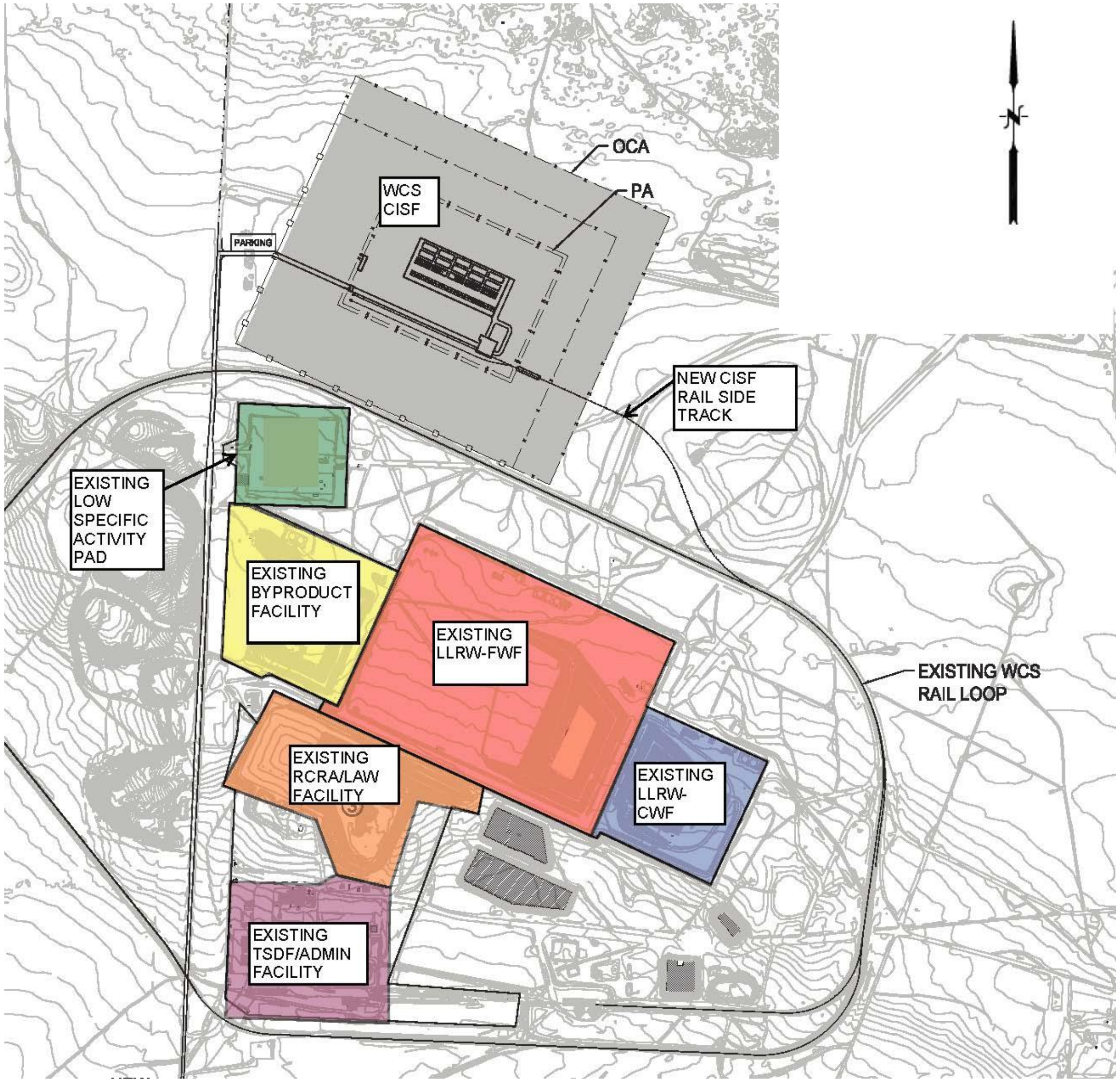

Figure 2-1
Waste Control Specialists Facility Site Plan

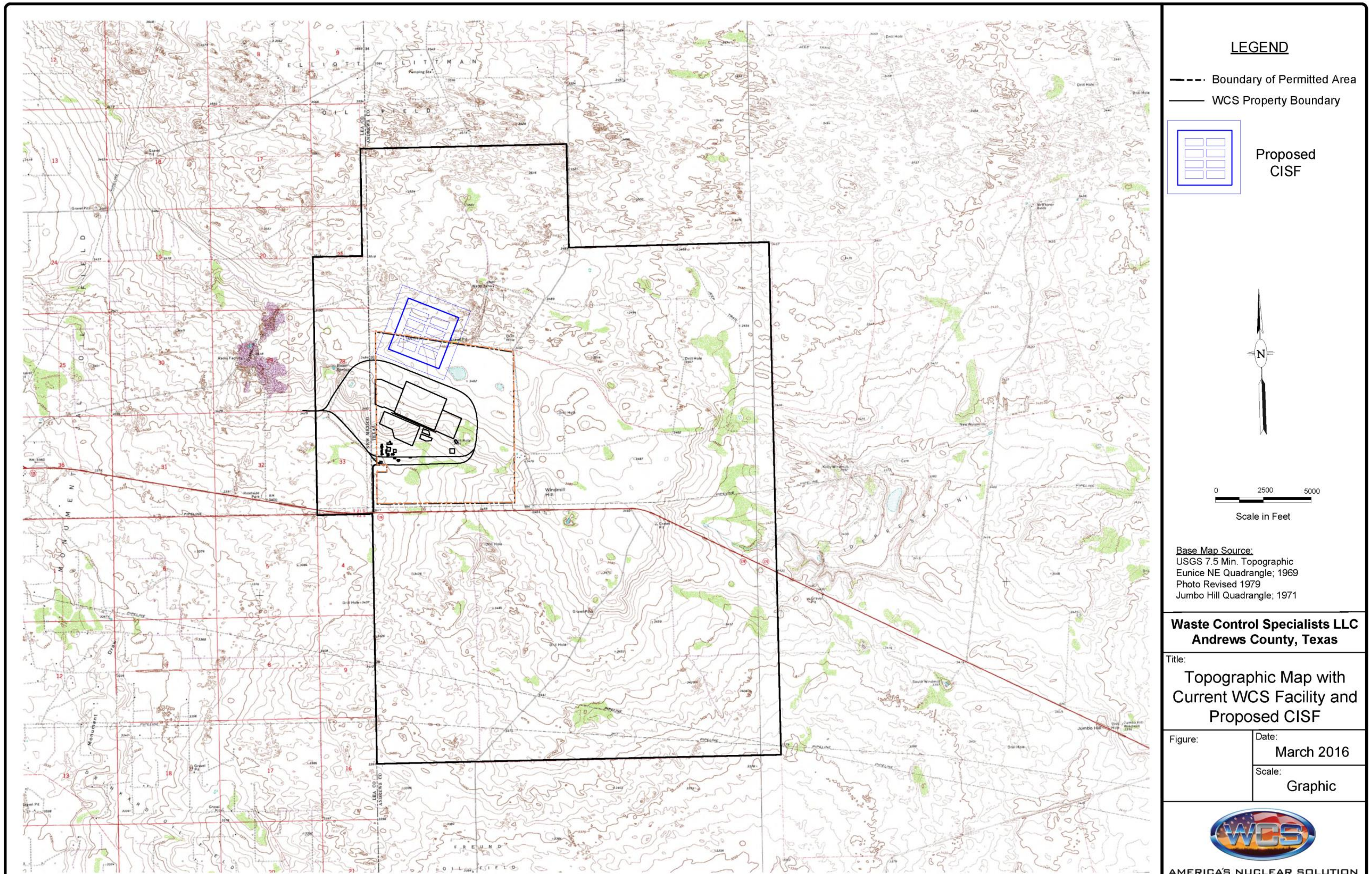

Figure 2-2
Waste Control Specialists Facility Site Plan

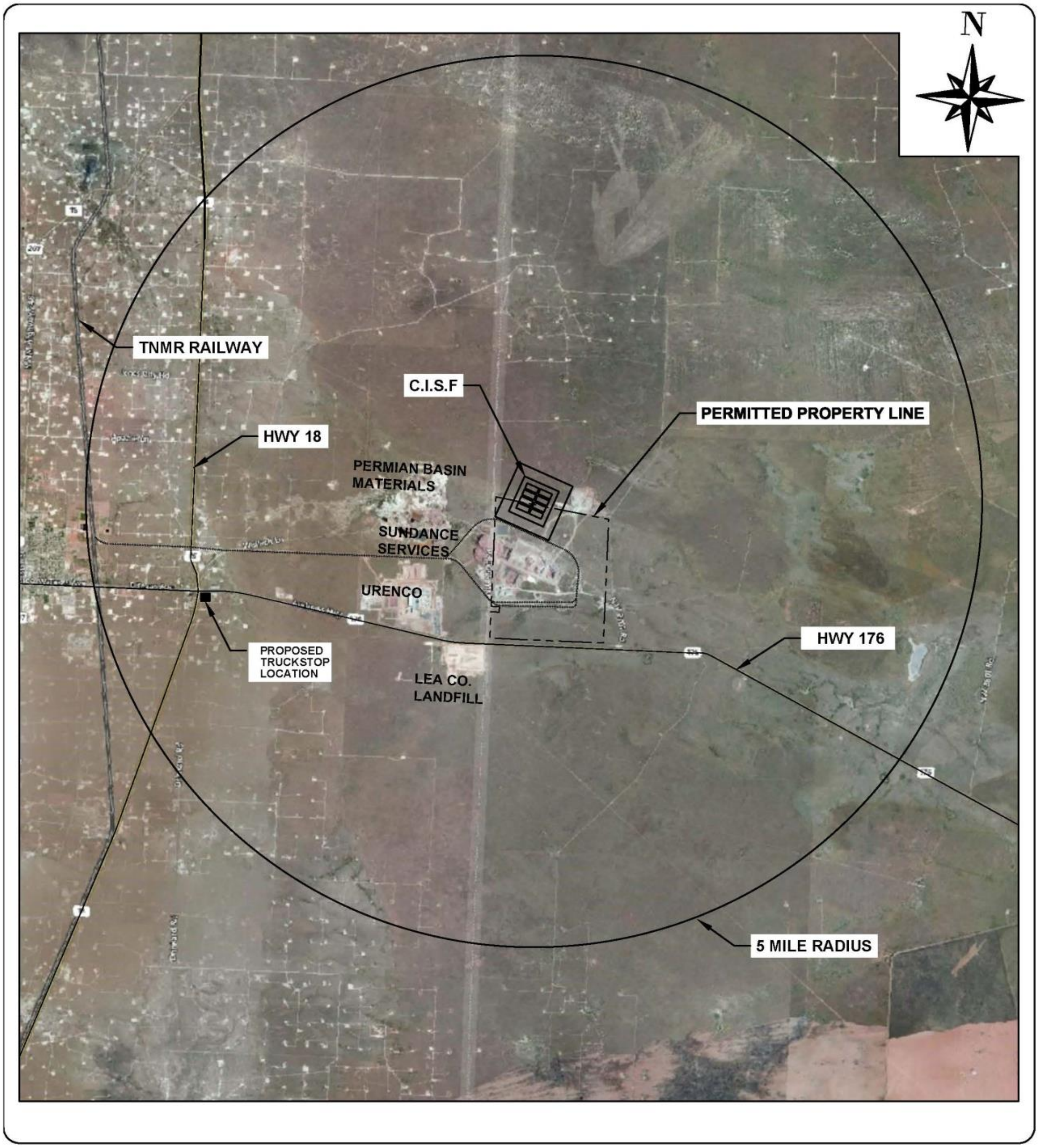

Figure 2-3
Proposed WCS CISF 5-mile Radius

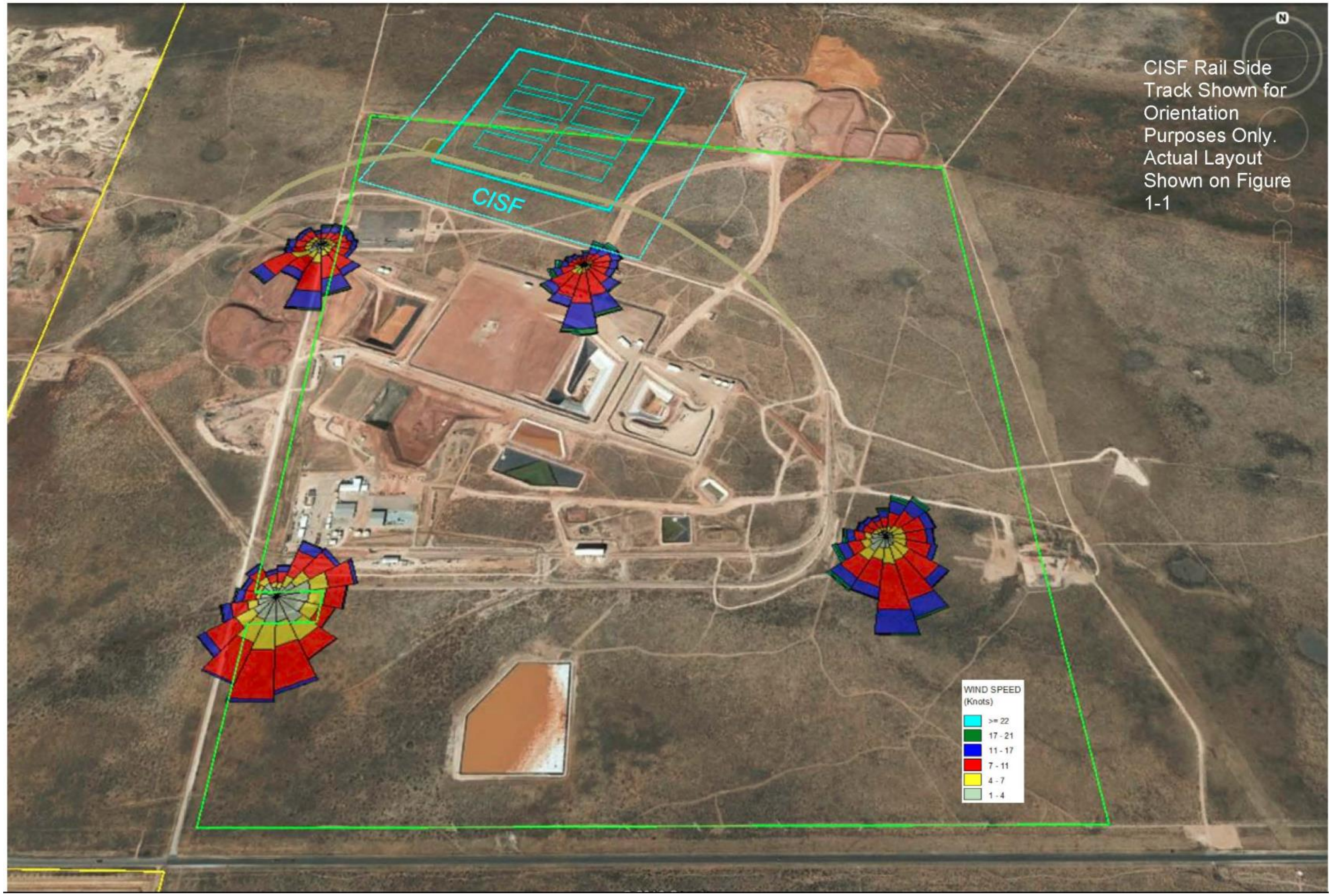

Figure 2-4
Wind Rose Location Map

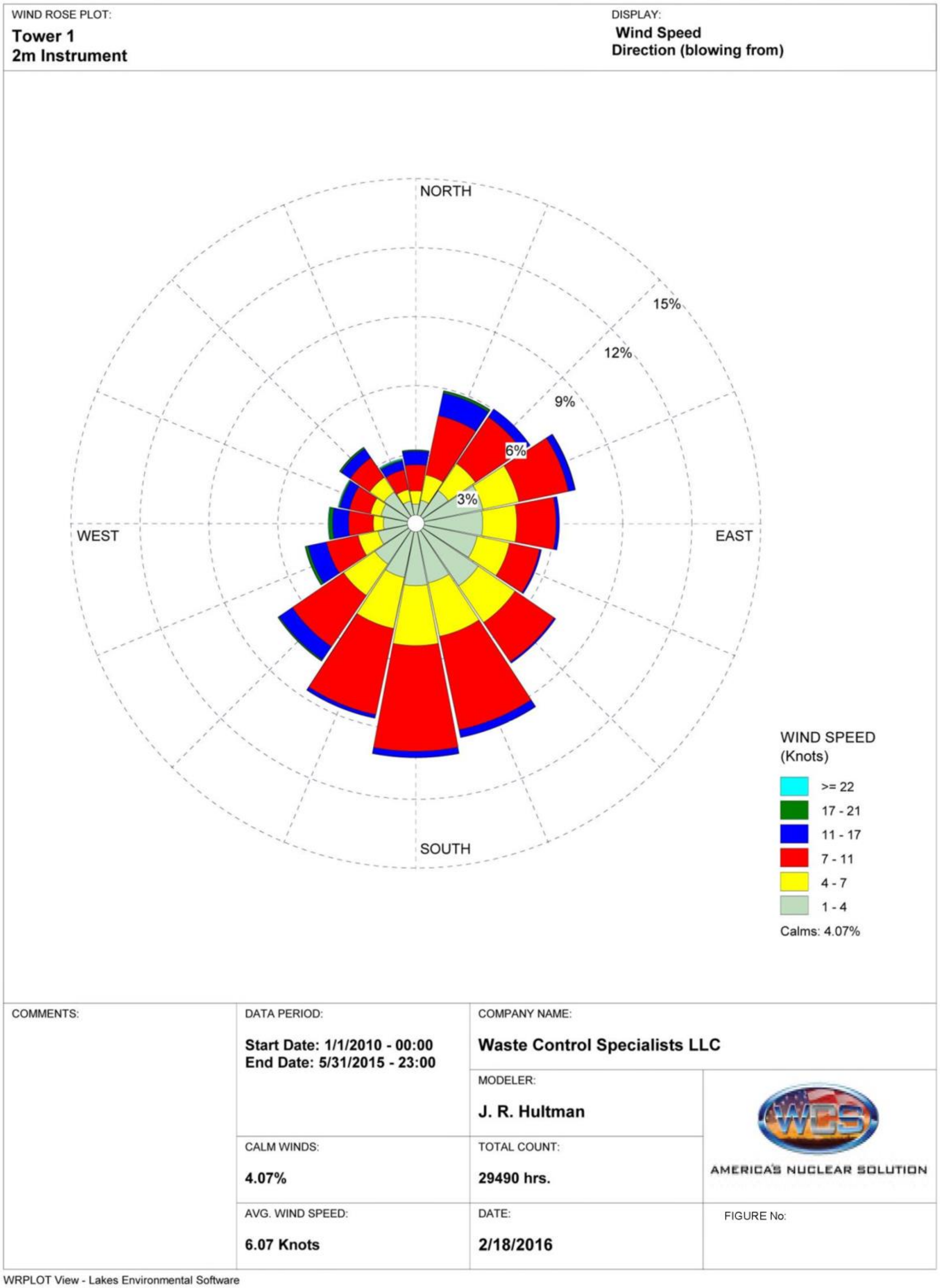

Figure 2-5
Waste Control Specialists Wind Rose Plot: Tower 1

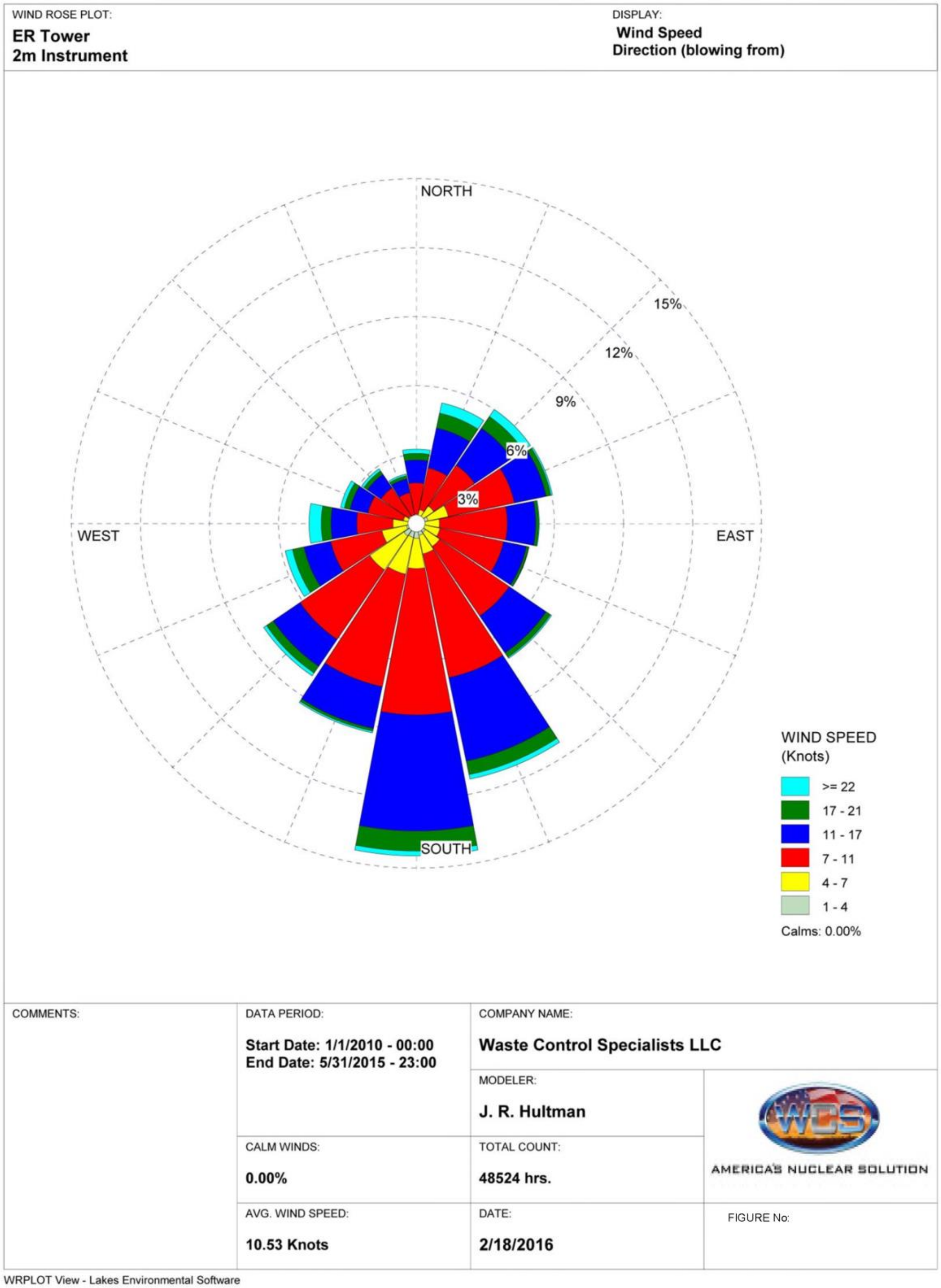

Figure 2-6
Waste Control Specialists Wind Rose Plot: ER Tower

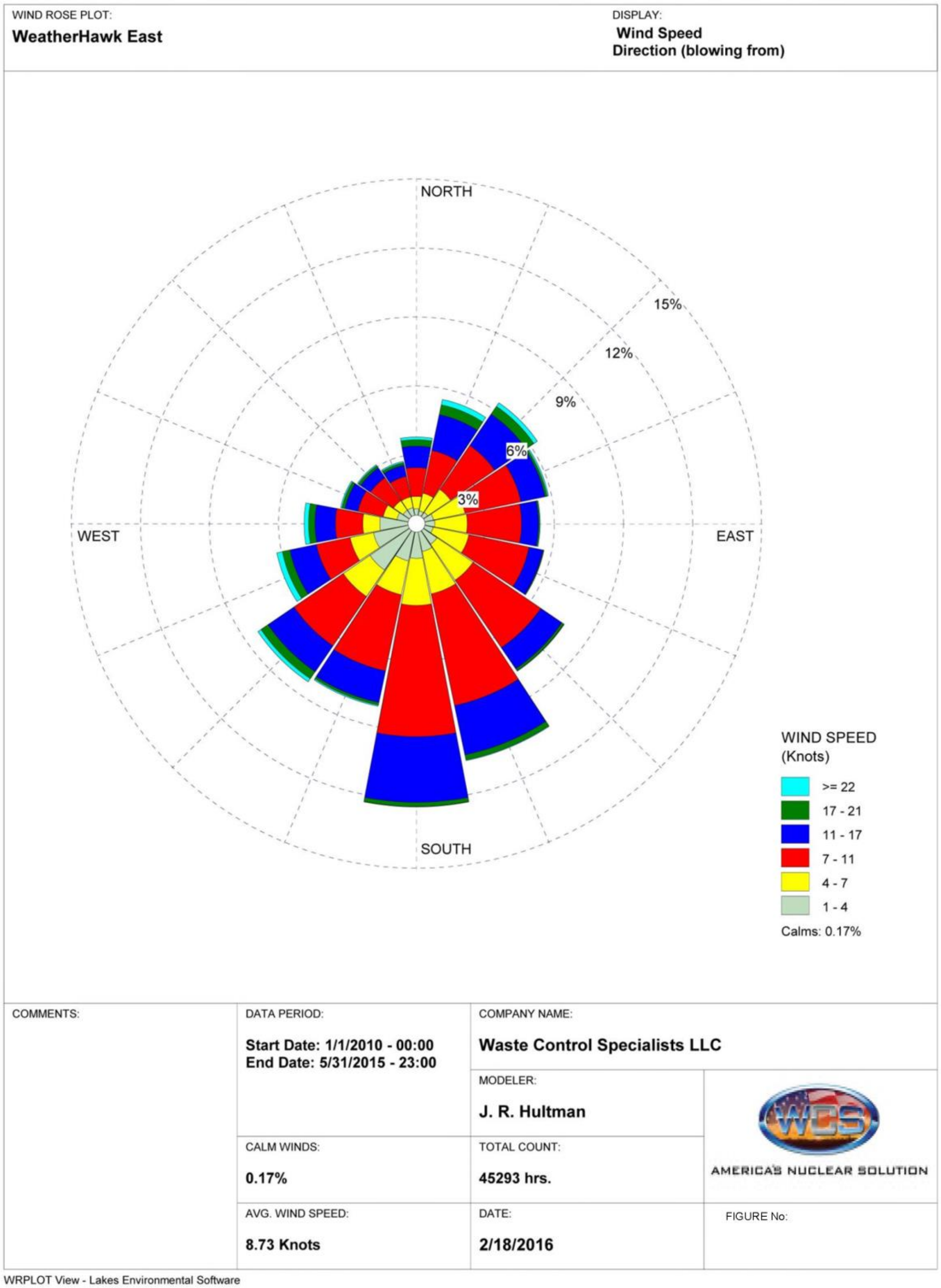

Figure 2-7
Waste Control Specialists Wind Rose Plot: WeatherHawk East

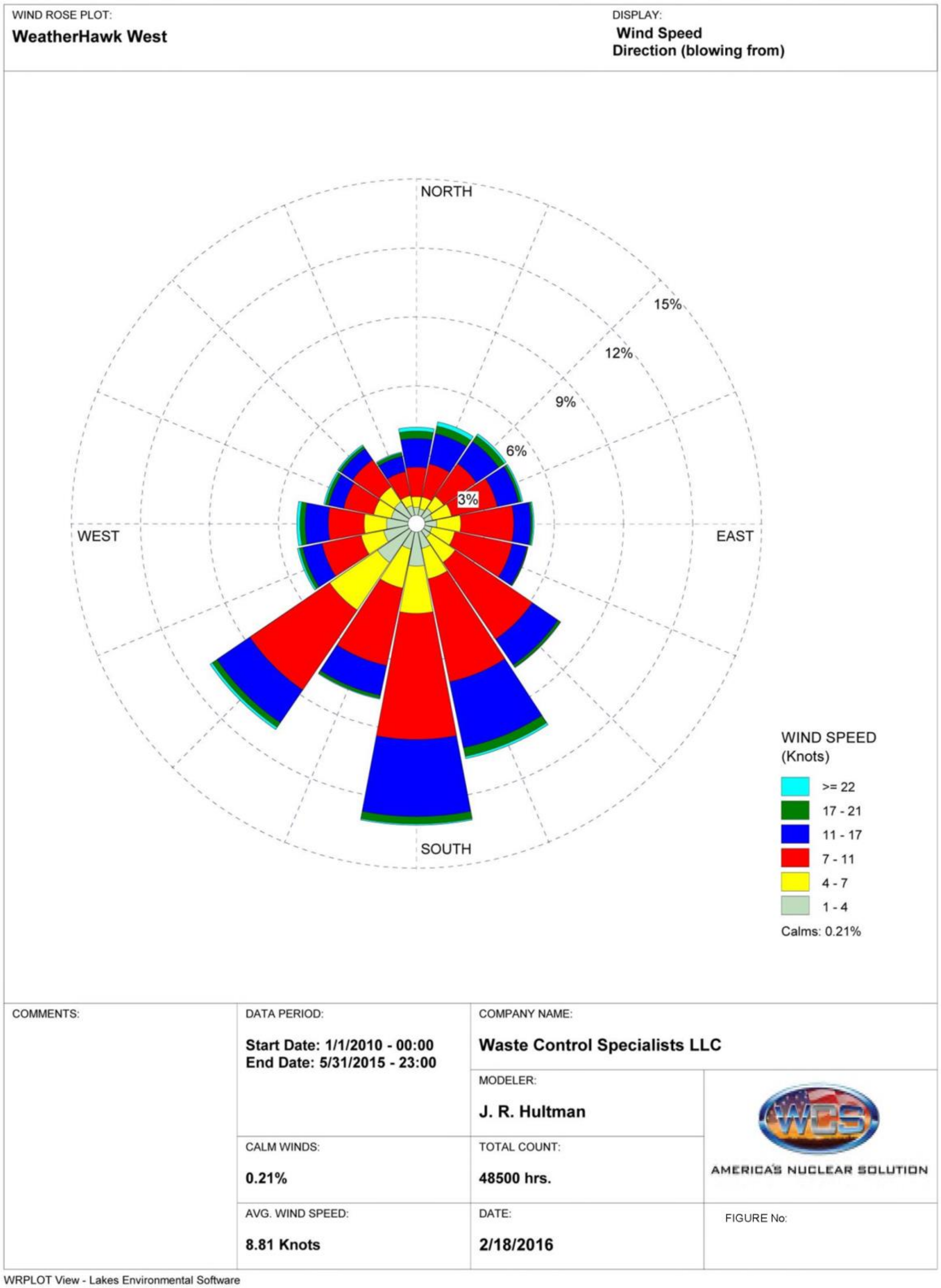

Figure 2-8
Waste Control Specialists Wind Rose Plot: WeatherHawk West

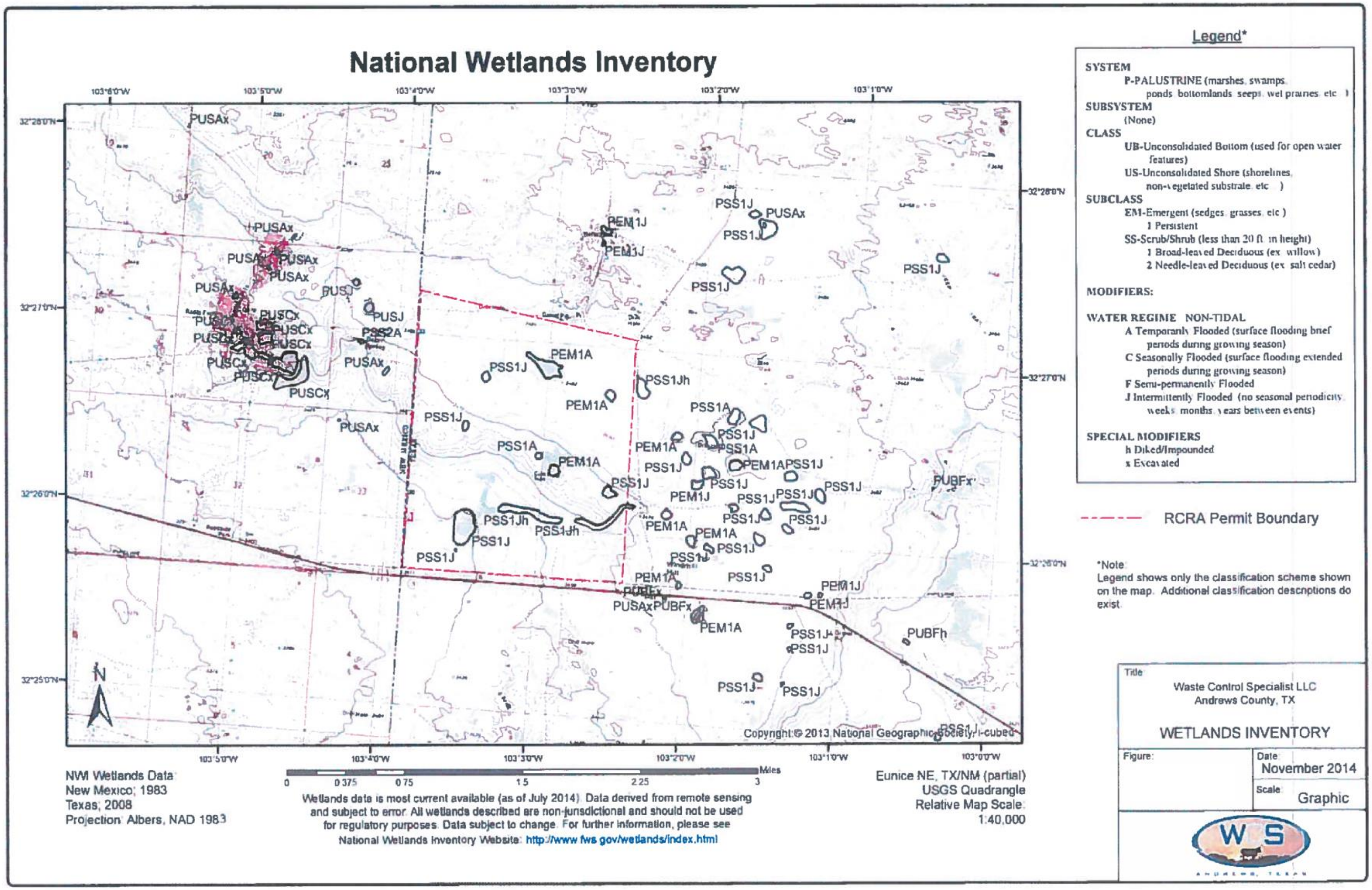

Figure 2-9
Wetlands Inventory

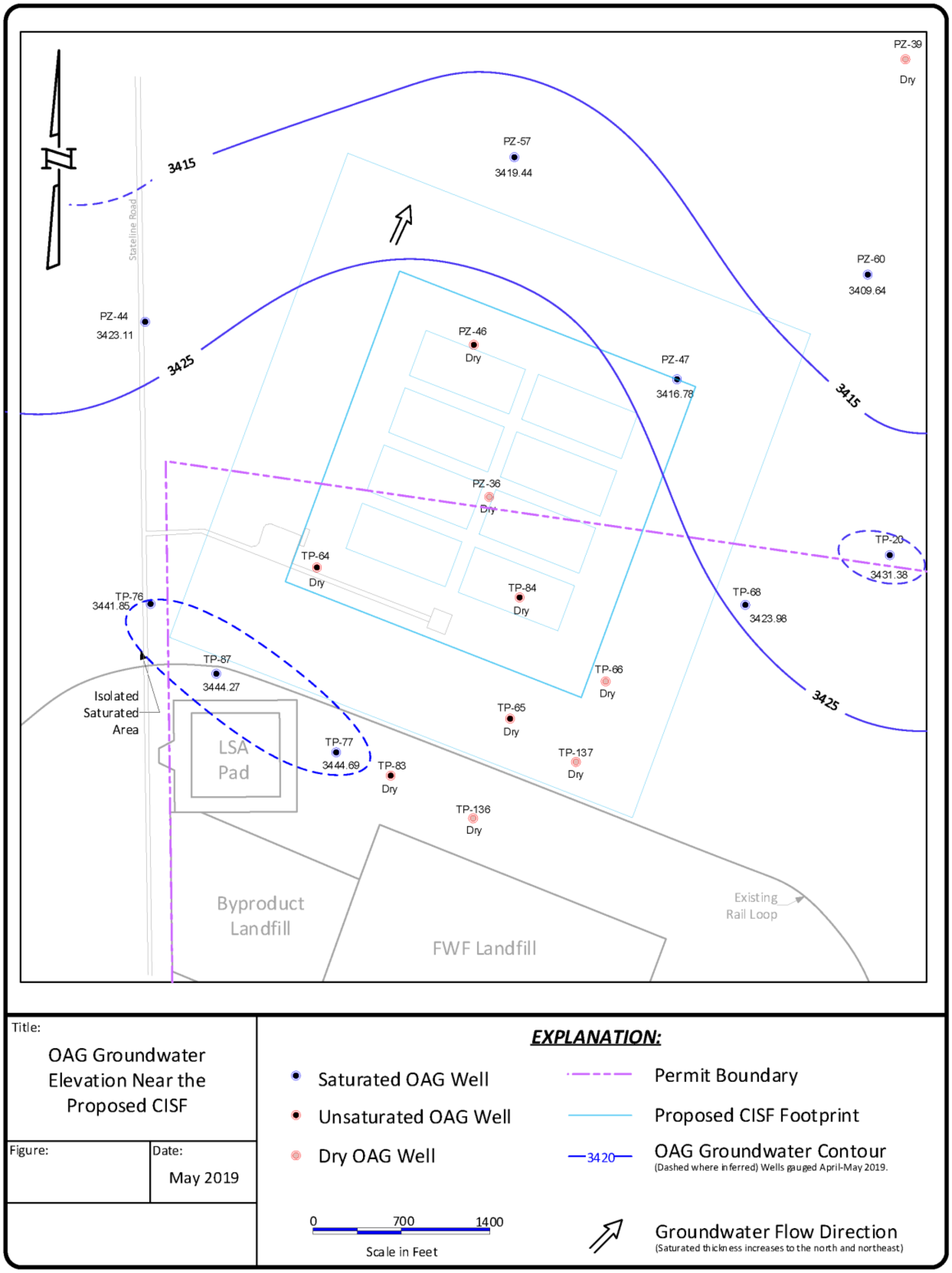

Figure 2-10
OAG Groundwater Elevation Near the Proposed WCS CISF

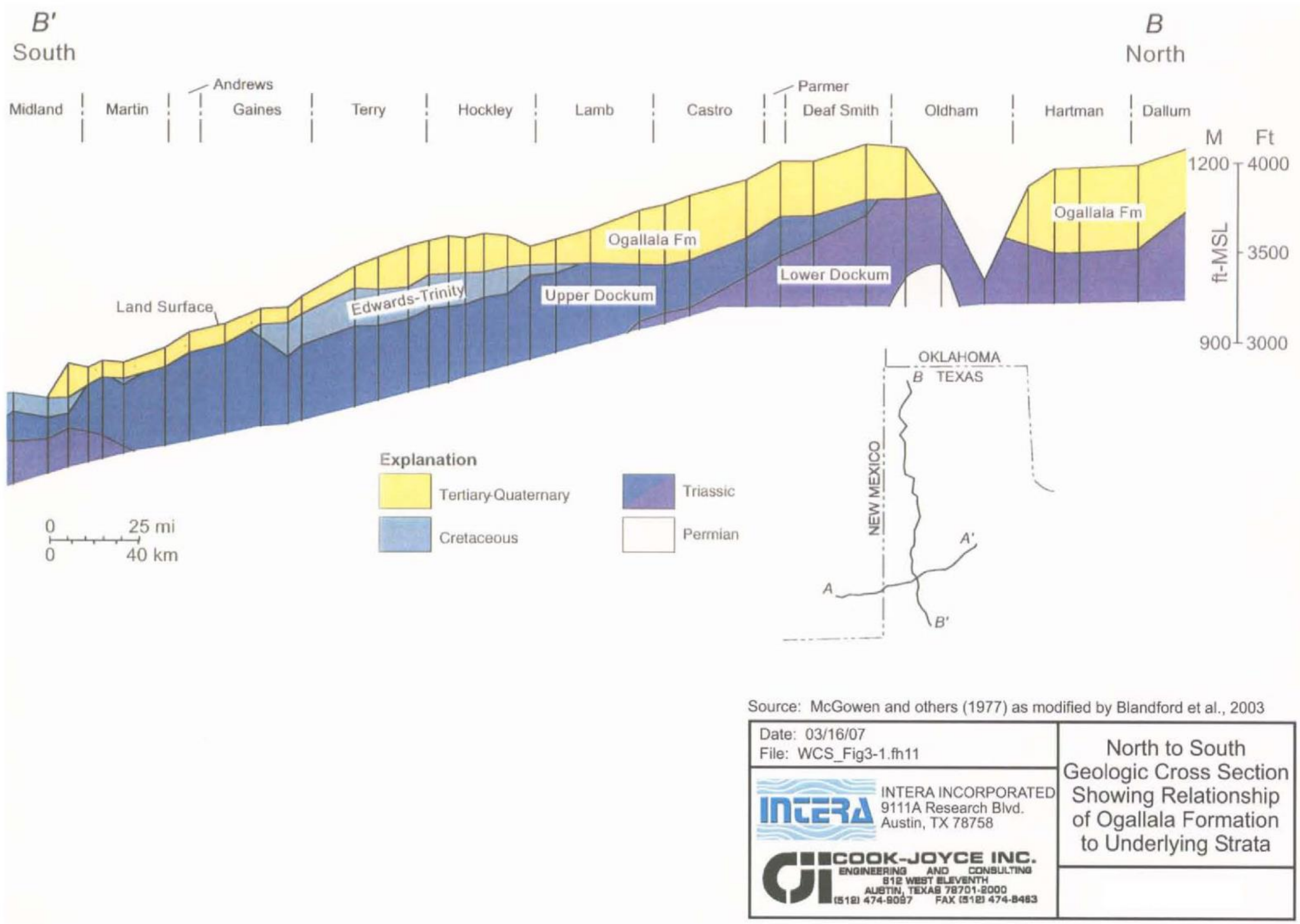

Figure 2-11
North to South Geologic Cross Section Showing Relationship of Ogallala Formation to Underlying Strata

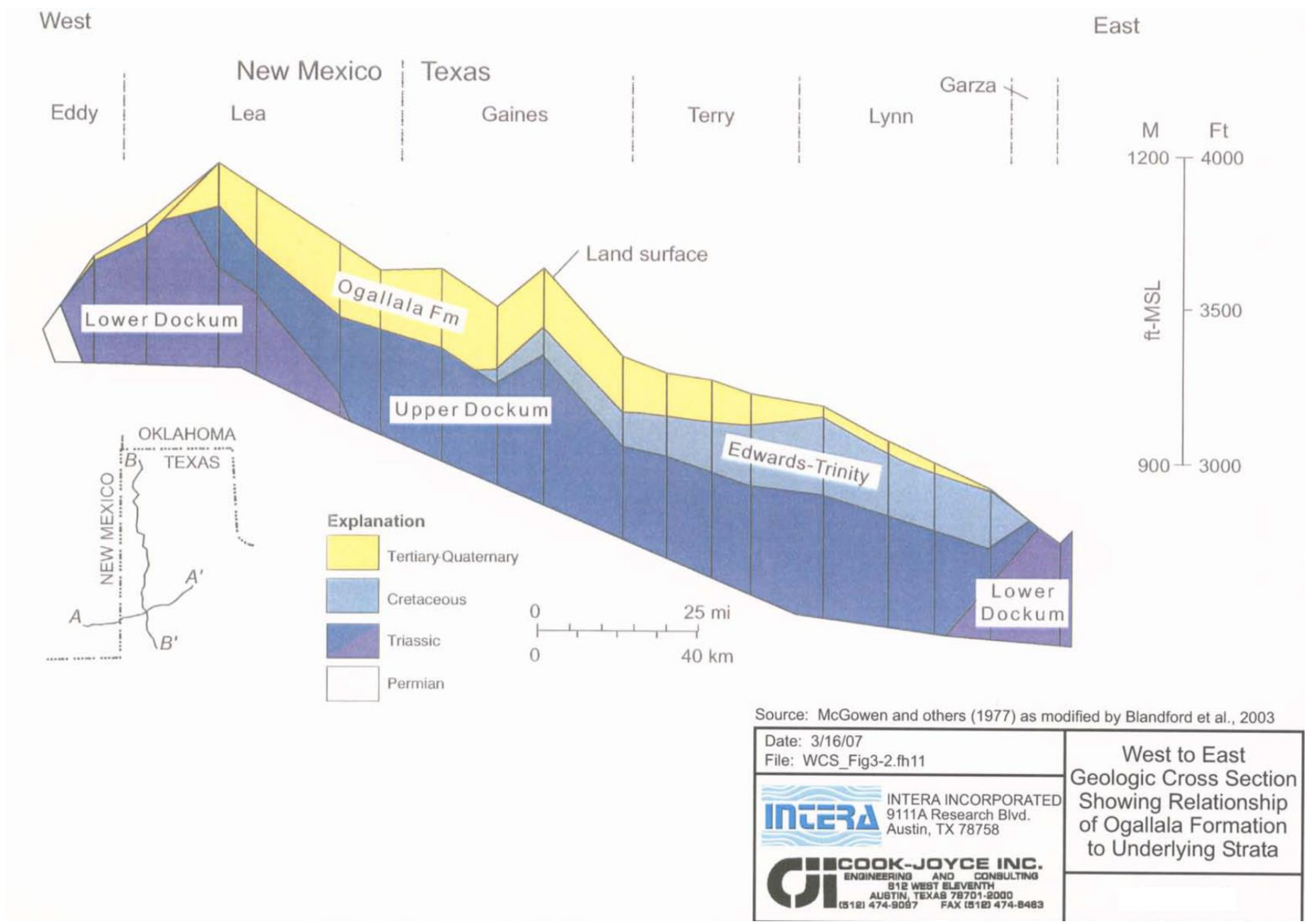

Figure 2-12
West to East Geologic Cross Section Showing Relationship of Ogallala Formation to Underlying Strata

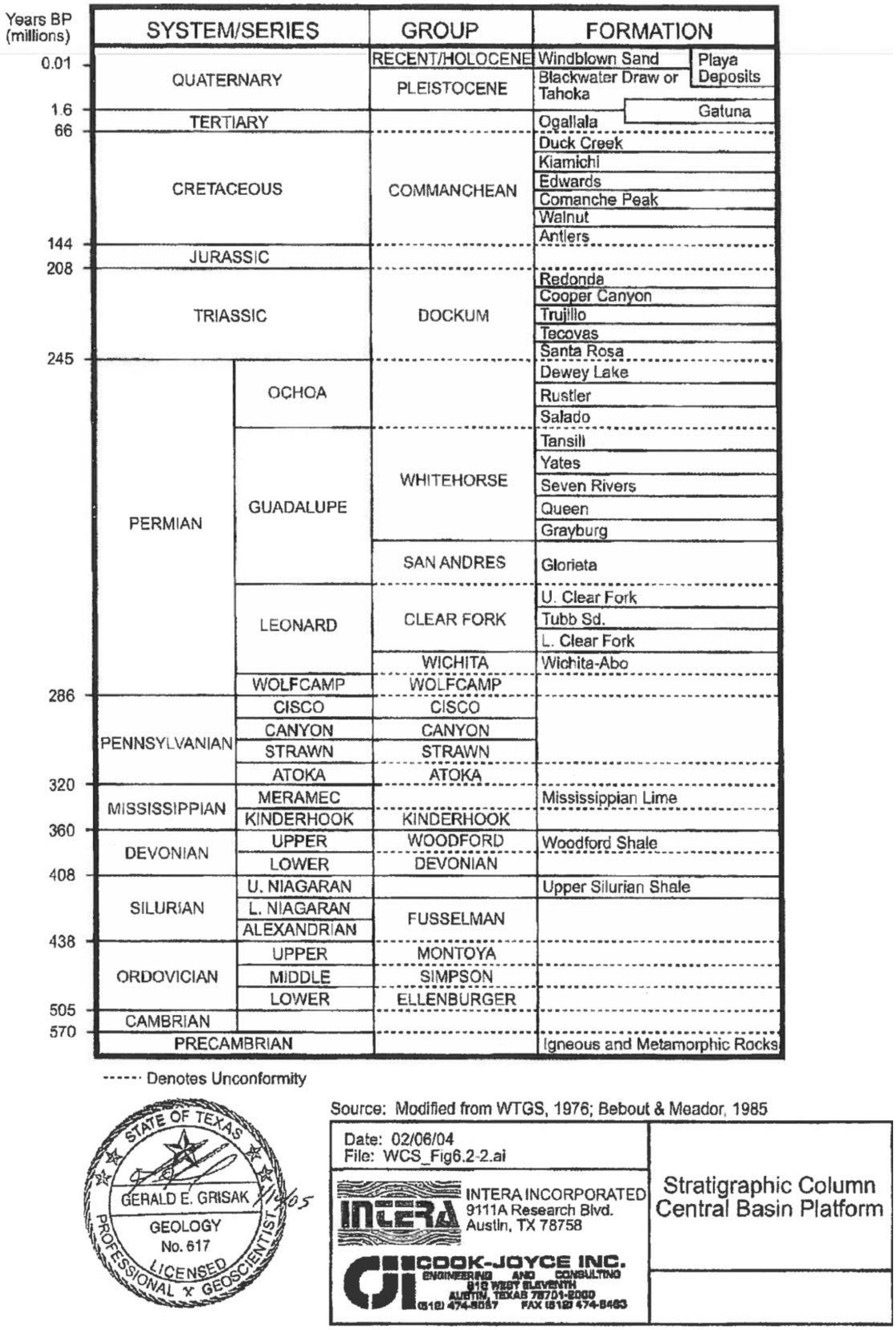

Figure 2-13
Stratigraphic Column Central Basin Platform

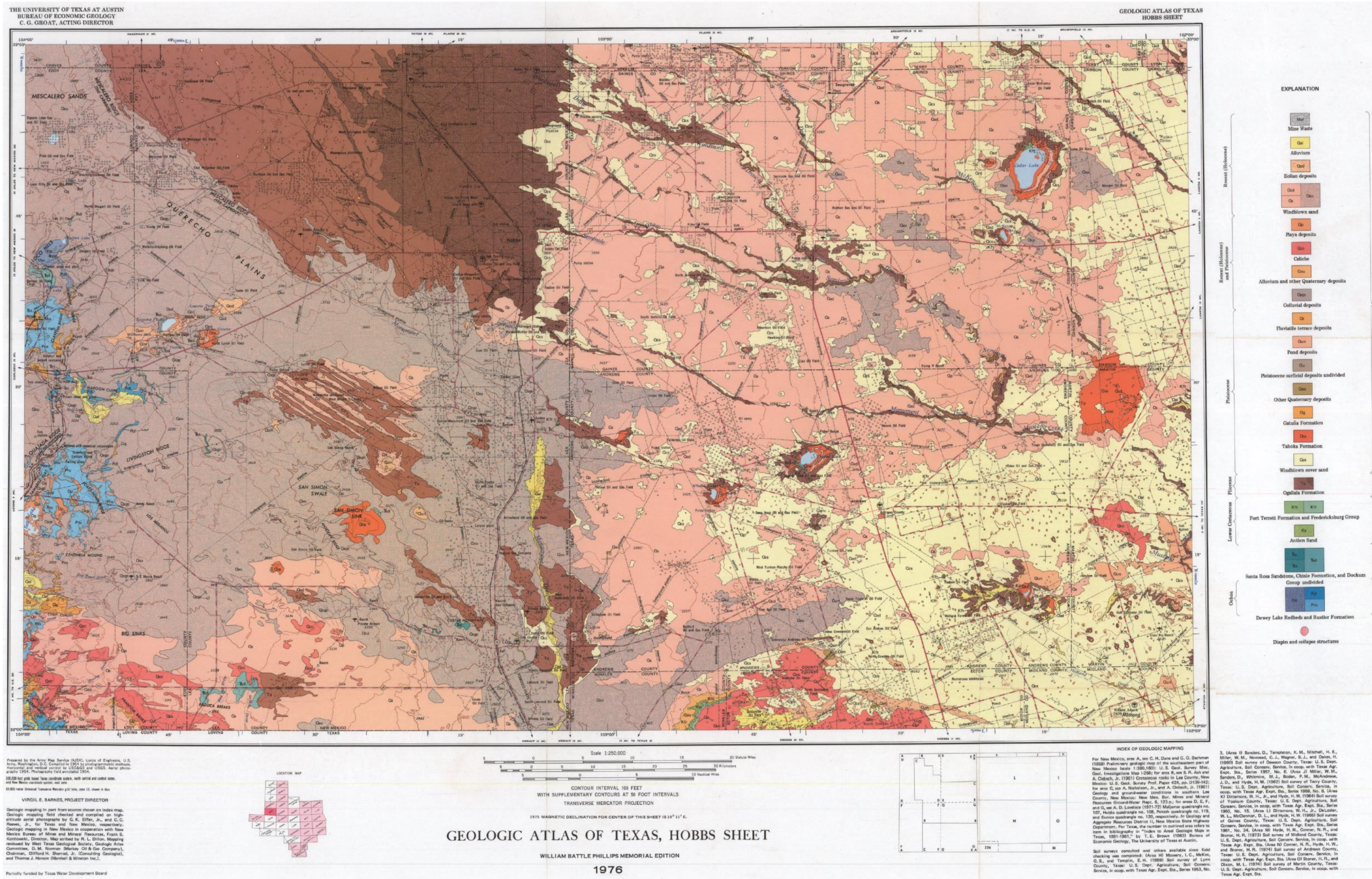

Figure 2-14
Geologic Atlas of Texas, Hobbs Sheet
(7 Pages)

THE UNIVERSITY OF TEXAS AT AUSTIN
BUREAU OF ECONOMIC GEOLOGY

TO ACCOMPANY MAP—HOBBS SHEET
GEOLOGIC ATLAS OF TEXAS

GEOLOGIC ATLAS OF TEXAS

HOBBS SHEET

WILLIAM BATTLE PHILLIPS MEMORIAL EDITION

VIRGIL E. BARNES, Project Director
1976

Figure 2-14
Geologic Atlas of Texas, Hobbs Sheet
(7 Pages)

EXPLANATION

QUATERNARY

Recent (Holocene)

MW

Mine Waste

Dumps and storage areas for waste materials produced during recovery of potash minerals; confined to New Mexico

Qal

Alluvium

Floodplain and pediment deposits; includes low terrace deposits along streams, and bedrock locally in stream channels; pediment deposits of sandy silt locally modified by sheetwash action

Qcd

Eolian deposits

Sand, calcareous, mainly brown to grayish brown; mostly derived from and rests on lacustrine deposits; confined to New Mexico

Qsd | Qs | Qsu

Windblown sand

Sand and silt in sheets, Qs, locally includes cover sand; dunes and dune ridges, Qsd, dark brown to grayish brown, derived from lacustrine, fluviatile, and eolian deposits, mostly rests on lacustrine deposits; and sand sheets, dunes, and dune ridges undivided, Qsu, light brown to reddish, overlies windblown cover sand, Qcs, in much of western part of area, mostly derived from Gatuña Formation in western area; thickness 5 to 10 feet

Recent Holocene and Pleistocene

Qp

Playa deposits

Clay and silt, sandy, light to dark gray, in shallow depressions; those of Wisconsinan age usually covered by thin deposit of Recent sediment

NOTE: Water in depressions not shown

Qcc

Caliche

Caliche stripped of covering materials mapped separately; thickness up to 10 feet

Figure 2-14
Geologic Atlas of Texas, Hobbs Sheet
(7 Pages)

QUATERNARY

Recent (Holocene) and Pleistocene

Qau

Alluvium and other Quaternary deposits

Intimately associated alluvium and Qao deposits undivided, in dissected areas in Texas

Qsgc

Colluvial deposits

Sand, silt, and gravel deposited by slopewash, and talus from Ogallala, red to gray; in part calichified, caliche 1 to 20 feet thick; may include weathered Gatuña Formation locally; rests mainly on Triassic and Permian rocks

Pleistocene

Qt

Fluviatile terrace deposits

Gravel, sand, and silt; commonly with pebbles and cobbles of limestone, sandstone, and chert

Qun

Pond deposits

Gastropod-bearing sandy silt and silty clay, gray to light gray, deposited in ponds and shallow swales, locally may include upper part of Tahoka deposits

Qu

Pleistocene surficial deposits undivided

Brown and grayish-brown silty sand and sandy silt deposited mainly by sheetwash action as broad, gently sloping sheets; one outcrop on eastern border of sheet

Qao

Other Quaternary deposits

Mostly boulders, cobbles, and pebbles of Cretaceous limestone and chert, locally overlain by brown silt; probably equivalent to "Qs3" of Seymour Formation of Big Spring Sheet; confined to Texas

Qg

Gatuña Formation

Mostly sand, fine, friable, yellowish to reddish orange, red; some conglomerate, gypsum, limestone, and siltstone, gray, purplish, red, and shale, greenish; upper few feet calichified; may exceed 300 feet in thickness at head of Cedar Canyon, in many places only a few feet thick. (Probably underlies part of the Querecho Plains, Mescalero Sands, San Simon Swale, and Monument Draw); confined to New Mexico

Figure 2-14
Geologic Atlas of Texas, Hobbs Sheet
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QUATERNARY

Pleistocene

Qta

Tahoka Formation

Lacustrine clay, silt, sand, and gravel, locally calcareous, selenitic. Clay and silt, sandy, indistinctly bedded to massive, weakly coherent, various shades of light gray and bluish gray. Sand, fine- to coarse-grained quartz, indistinctly bedded to massive, friable, gray, grades to gravel at margins of deposits. Molluscan and vertebrate fossils (Wisconsinan)

Qcs

Windblown cover sand

Fine- to medium-grained quartz, silty, calcareous, caliche nodules common, massive, grayish red; distinct soil profile; thickness up to 10 feet, feathers out locally (mostly Illinoian, may include younger deposits)

TERTIARY

Pliocene

To

Ogallala Formation

Fluviatile sand, silt, clay, and gravel capped by caliche. Sand, fine- to medium-grained quartz, in part silty and calcareous, clay balls common, clayey in upper part, indistinctly bedded to massive, crossbedded, unconsolidated to weakly cohesive, local quartzite lenses, various shades of gray, red. Silt and clay with caliche nodules, reddish brown, dusky red, pink. Gravel, not everywhere present, mostly quartz, some quartzite, sandstone, limestone, chert, igneous rock, metamorphic rock, and worn *Gryphaea* in intraformational channel deposits and in basal conglomerate. Caliche, sandy, pisolitic at top, hard, produces caprock along Mescalero Ridge, may have formed since the Pliocene. Fossil plants and vertebrates scarce. Maximum thickness up to 100 feet

CRETACEOUS

Lower Cretaceous

Kft | Kfr

Fort Terrett Formation and Fredericksburg Group

Fort Terrett Formation, Kft, limestone and shale; limestone, mostly fine grained, argillaceous, thin to thick bedded and massive, in part nodular, grayish yellow, light gray; shale, calcareous, thinly laminated, dusky yellow, yellowish gray, light olive-gray, dark gray; marine megafossils abundant in some beds; outcrop thickness of 53 feet measured at northwestern margin of McKenzie Lake

Fredericksburg Group undivided, Kfr, limestone, dolomite, chert, and minor marl; limestone, nodular, aphanitic, marly, gray, yellow, white, pink; dolomite, fine grained, gray; chert, in thin layers and nodules; marl, locally gypsiferous, gray, yellowish gray; abundant *Exogyra texana*, some beds made almost entirely of *Gryphaea* sp.; exposed thickness 50 feet

Ka

Antlers Sand

Medium grained, in part loosely consolidated, in part cemented by opal, in part ferruginous, massive, lenses of quartz gravel common, grayish pink to moderate reddish brown; outcrop thickness of 6 feet at Whalen Lake and 10 feet at Shafter Lake

Figure 2-14
Geologic Atlas of Texas, Hobbs Sheet
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TRIASSIC

Santa Rosa Sandstone, Chinle Formation, and Dockum Group undivided

In New Mexico, Chinle Formation, TRc, in eastern part, Santa Rosa Sandstone, TRs, in western part, and Dockum Group undivided, TRd, in southern part as well as in Texas

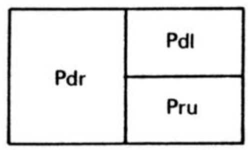
Chinle Formation, TRc, claystone, micaceous, greenish, red with reduction spots, interbedded with sandstone, fine grained, in thin beds; thickness up to 300 feet

Santa Rosa Sandstone, TRs, mostly crossbedded sandstone, conglomerate, some clay, claystone, and siltstone, pale red to reddish brown; thickness 50 to 70 feet

Dockum Group undivided, TRd, shale, sandstone, siltstone, limestone, and gravel; mostly shale, micaceous, thin bedded, variegated; thickness up to 300 feet

PERMIAN

Ochoa

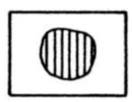


Dewey Lake Redbeds and Rustler Formation

Dewey Lake Redbeds, Pdl, Rustler Formation, Pru, and Dewey Lake Redbeds and Rustler Formation undivided, Pdr

Dewey Lake Redbeds, Pdl, siltstone and fine-grained quartz sandstone, laminated, locally crossbedded, reddish orange, reddish brown, brownish yellow, greenish-gray reduction spots up to an inch in size common; thickness 200 to 250 feet

Rustler Formation, Pru, limestone, siltstone, sandstone, gypsum, marl, and clay. Upper part—limestone and dolomitic limestone; thickness 50+ feet. Middle part—siltstone and sandstone, yellowish gray; thickness 50 to 70 feet. Lower part—siltstone and fine-grained sandstone, thin to medium bedded, red, interbeds of earthy to sparry red gypsum, a few beds of red and greenish-gray marl and clay; thickness 50+ feet



Diapirs and collapse structures

Small circular structures in potash-mining area attributed to upward movement of salt, followed in some structures by solution and collapse

VIRGIL E. BARNES, PROJECT DIRECTOR

Geologic mapping in part from sources shown on index map. Geologic mapping field checked and compiled on high-altitude aerial photographs by G. K. Eifler, Jr., and C. C. Reeves, Jr., for Texas and New Mexico, respectively. Geologic mapping in New Mexico in cooperation with New Mexico Bureau of Mines and Mineral Resources, Frank E. Kottlowski, Director. Map scribed by R. L. Dillon. Mapping reviewed by West Texas Geological Society, Geologic Atlas Committee, D. M. Norman (Markay Oil & Gas Company), Chairman, Clifford H. Sherrod, Jr. (Consulting Geologist), and Thomas J. Hansen (Marshall & Winston Inc.)

Figure 2-14
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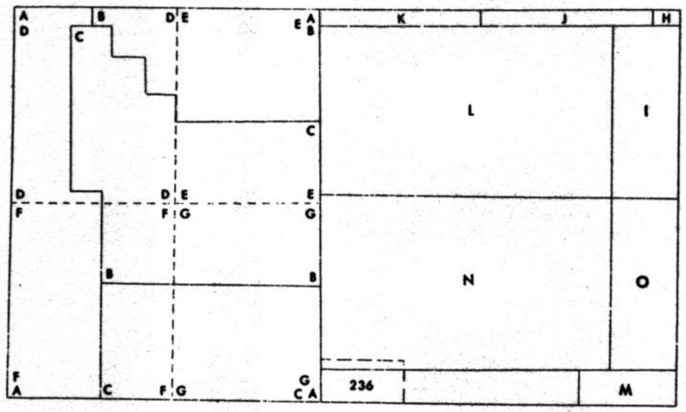

INDEX OF GEOLOGIC MAPPING

For New Mexico, area A, see C. H. Dane and G. O. Bachman (1958) Preliminary geologic map of the southeastern part of New Mexico (scale 1:380,160): U. S. Geol. Survey Misc. Geol. Investigations Map I-256; for area B, see S. R. Ash and A. Clebsch, Jr. (1961) Cretaceous rocks in Lea County, New Mexico: U. S. Geol. Survey Prof. Paper 424, pp. D139-142; for area C, see A. Nicholson, Jr., and A. Clebsch, Jr. (1961) Geology and ground-water conditions in southern Lea County, New Mexico: New Mex. Bur. Mines and Mineral Resources Ground-Water Rept. 6, 123 p.; for areas D, E, F, and G, see A. D. Lovelace (1971-72) Maljamar quadrangle no. 107, Hobbs quadrangle no. 108, Potash quadrangle no. 119, and Eunice quadrangle no. 120, respectively. *In* Geology and Aggregate Resources District II, New Mexico State Highway Department. For Texas, the numbers in outlined areas refer to items in bibliography in "Index to Areal Geologic Maps in Texas, 1891-1961," by T. E. Brown (1963) Bureau of Economic Geology, The University of Texas at Austin.

Soil surveys consulted and others available since field checking was completed: (Area H) Mowery, I. C., McKee, G. S., and Templin, E. H. (1959) Soil survey of Lynn County, Texas: U. S. Dept. Agriculture, Soil Conserv. Service, in coop. with Texas Agr. Expt. Sta., Series 1953, No. 3. (Area I) Sanders, D., Templeton, K. M., Mitchell, H. E., Miller, W. M., Novosad, C. J., Wagner, B. J., and Oakes, H. (1960) Soil survey of Dawson County, Texas: U. S. Dept. Agriculture, Soil Conserv. Service, in coop. with Texas Agr. Expt. Sta., Series 1957, No. 6. (Area J) Miller, W. M., Sanders, D., Whitmire, M. J., Boden, P. M., McAndrews, J. D., and Hyde, H. W. (1962) Soil survey of Terry County, Texas: U. S. Dept. Agriculture, Soil Conserv. Service, in coop. with Texas Agr. Expt. Sta., Series 1959, No. 6. (Area K) Dittemore, W. H., Jr., and Hyde, H. W. (1964) Soil survey of Yoakum County, Texas: U. S. Dept. Agriculture, Soil Conserv. Service, in coop. with Texas Agr. Expt. Sta., Series 1960, No. 15. (Area L) Dittemore, W. H., Jr., DeLozier, W. L., McClennon, D. L., and Hyde, H. W. (1965) Soil survey of Gaines County, Texas: U. S. Dept. Agriculture, Soil Conserv. Service, in coop. with Texas Agr. Expt. Sta., Series 1961, No. 34. (Area M) Hyde, H. W., Conner, N. R., and Stoner, H. R. (1973) Soil survey of Midland County, Texas: U. S. Dept. Agriculture, Soil Conserv. Service, in coop. with Texas Agr. Expt. Sta. (Area N) Conner, N. R., Hyde, H. W., and Stoner, H. R. (1974) Soil survey of Andrews County, Texas: U. S. Dept. Agriculture, Soil Conserv. Service, in coop. with Texas Agr. Expt. Sta. (Area O) Stoner, H. R., and Dixon, M. L. (1974) Soil survey of Martin County, Texas: U. S. Dept. Agriculture, Soil Conserv. Service, in coop. with Texas Agr. Expt. Sta.

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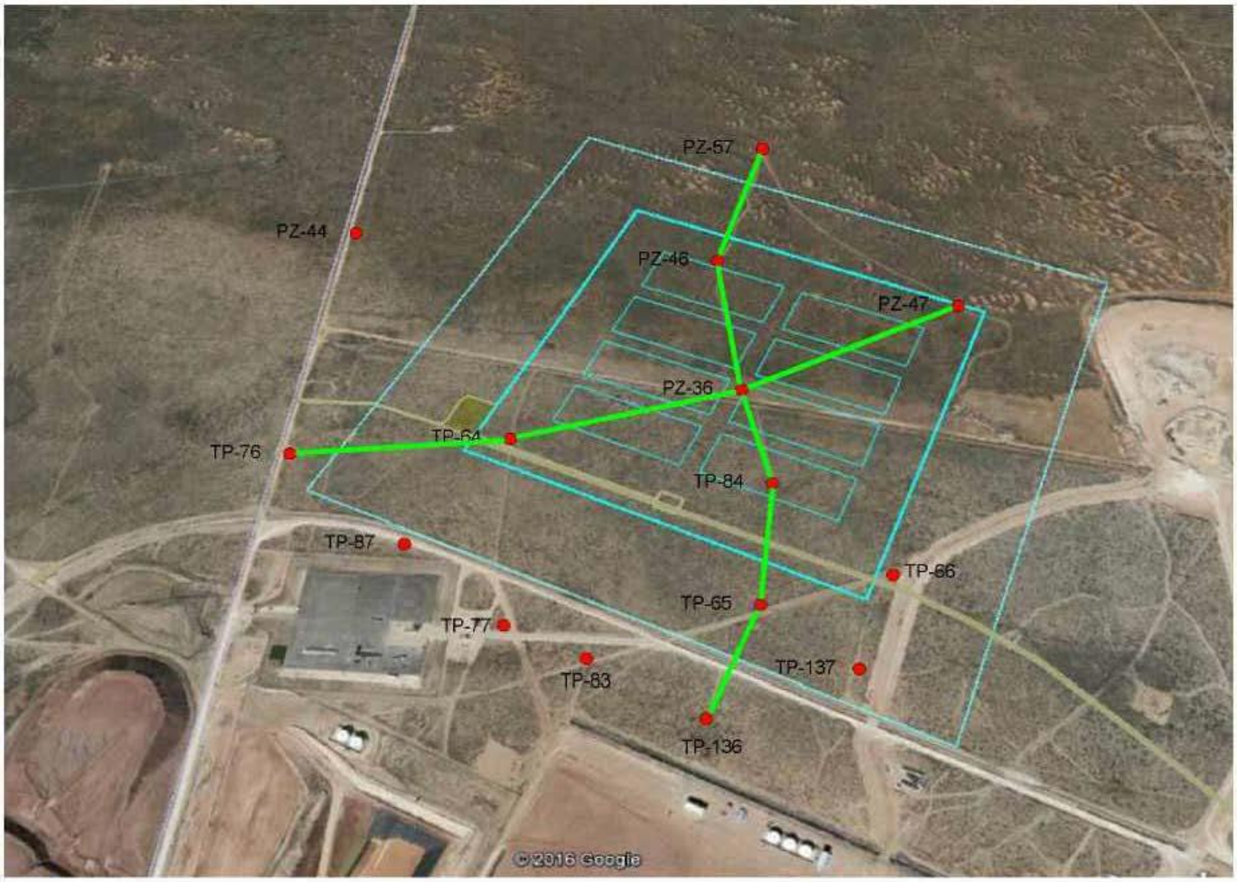

Monitoring Well/ Piezometer Name	Date Drilled/ Completed	Total Depth Well (ft btoc)	Bottom of Well Elevation (ft msl)	Ground Elevation (ft msl)	Top of Casing Elevation (ft msl)	Depth to Top of Red Beds (ft bgs)	Top of Red Bed Elevation (ft msl)
PZ-36	7/20/05	78.98	3419.51	3494.79	3498.49	75.0	3419.79
PZ-44	1/22/08	82.98	3416.90	3496.59	3499.88	77.1	3419.49
PZ-46	1/23/08	93.83	3412.04	3502.38	3505.87	87.4	3414.98
PZ-47	1/24/08	92.22	3411.56	3500.60	3503.78	87.0	3413.60
PZ-57	1/23/08	99.56	3415.44	3511.79	3515.00	93.5	3418.29
TP-64	1/11/08	70.81	3433.99	3502.08	3504.80	65.3	3436.78
TP-65	1/11/08	57.68	3436.07	3490.40	3493.75	52.5	3437.90
TP-66	1/10/08	57.78	3430.88	3485.45	3488.66	51.0	3434.45
TP-76	2/7/08	53.42	3436.78	3487.06	3490.20	47.1	3439.96
TP-77	2/7/08	51.30	3436.09	3484.19	3487.39	45.4	3438.79
TP-83	2/11/08	55.55	3435.60	3487.77	3491.15	49.8	3437.97
TP-84	2/12/08	65.24	3429.59	3491.56	3494.83	58.7	3432.86
TP-87	3/15/08	49.02	3438.47	3484.17	3487.49	43.3	3440.87
TP-136	3/20/09	55.21	3438.01	3490.17	3493.22	50.5	3439.67
TP-137	3/20/09	56.46	3434.68	3488.00	3491.14	51.5	3436.50

Figure 2-15
Boring Locations in the Vicinity of the WCS CISF

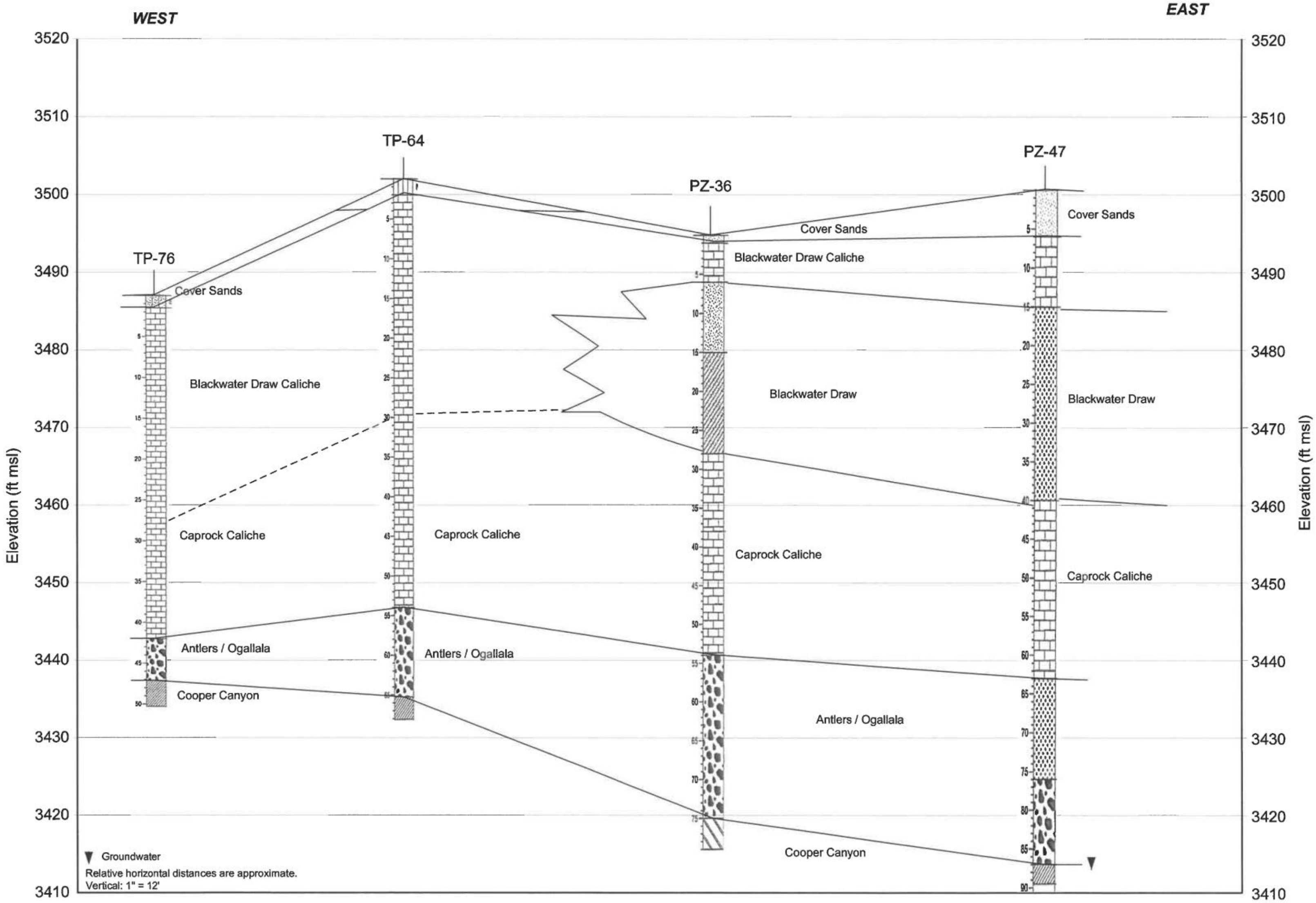

Figure 2-16
WCS CISF Cross Section West-East

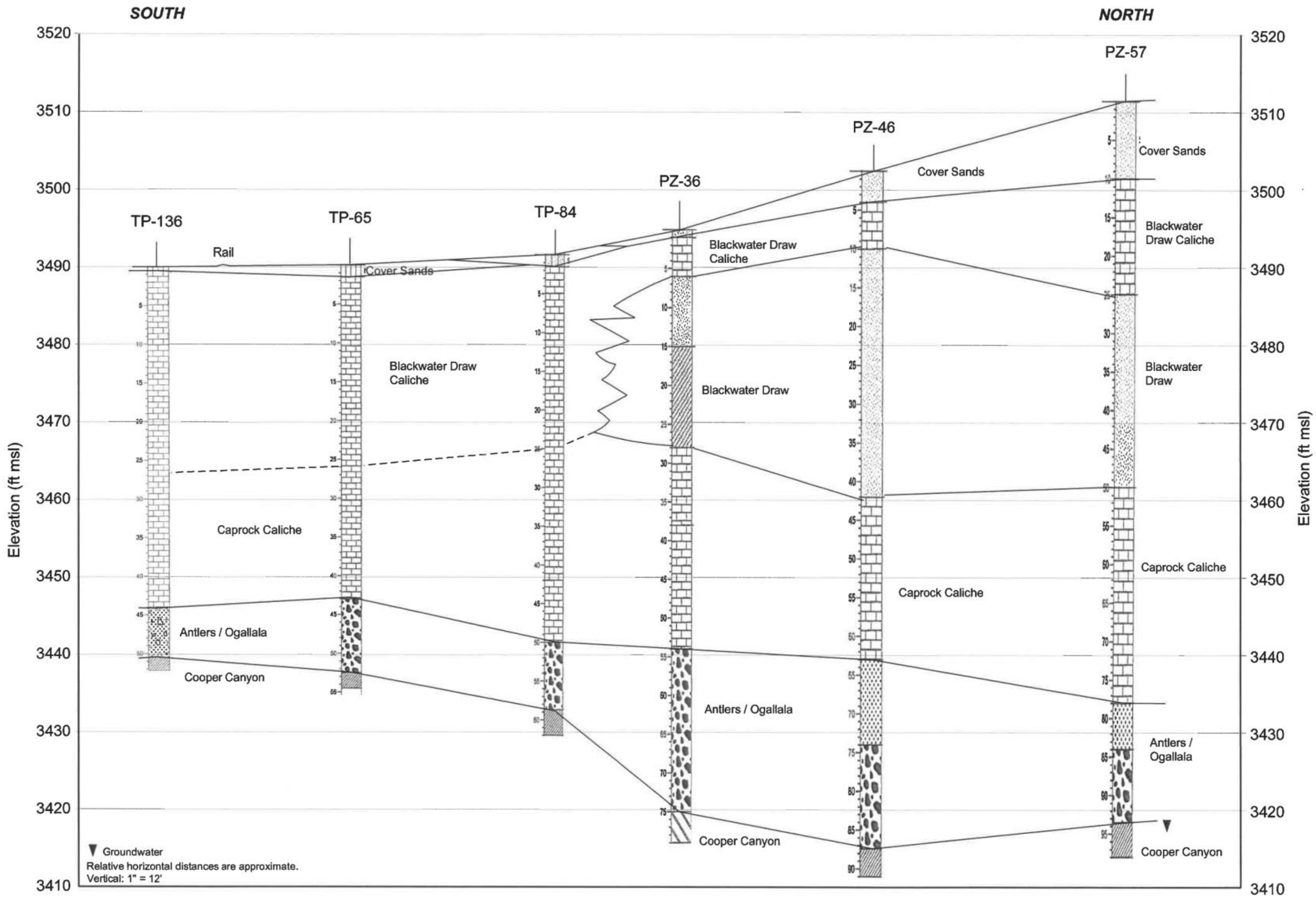

Figure 2-17
WCS CISF Cross Section South-North

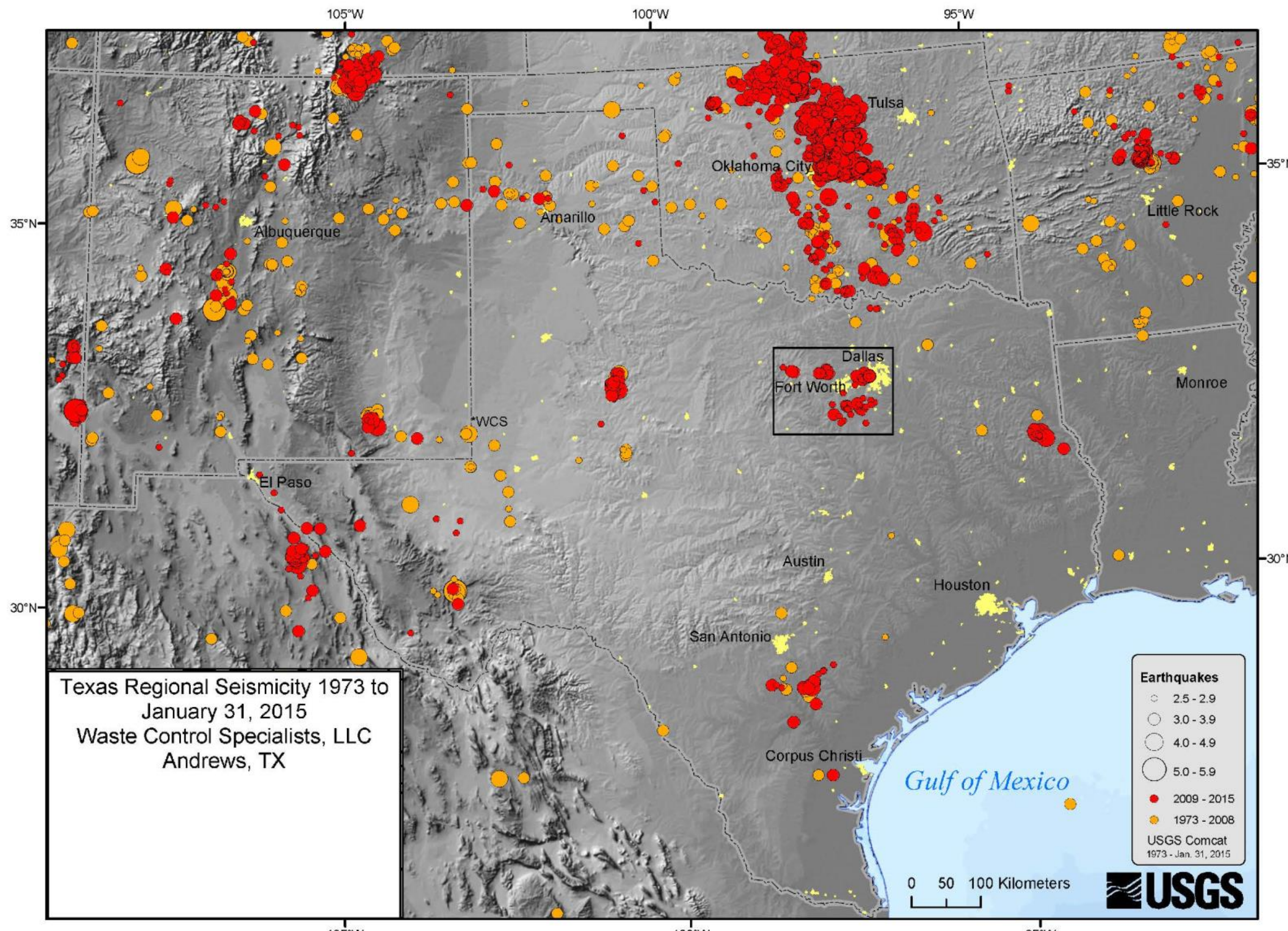

Figure 2-18
Texas Regional Seismicity 1973 to January 31, 2015

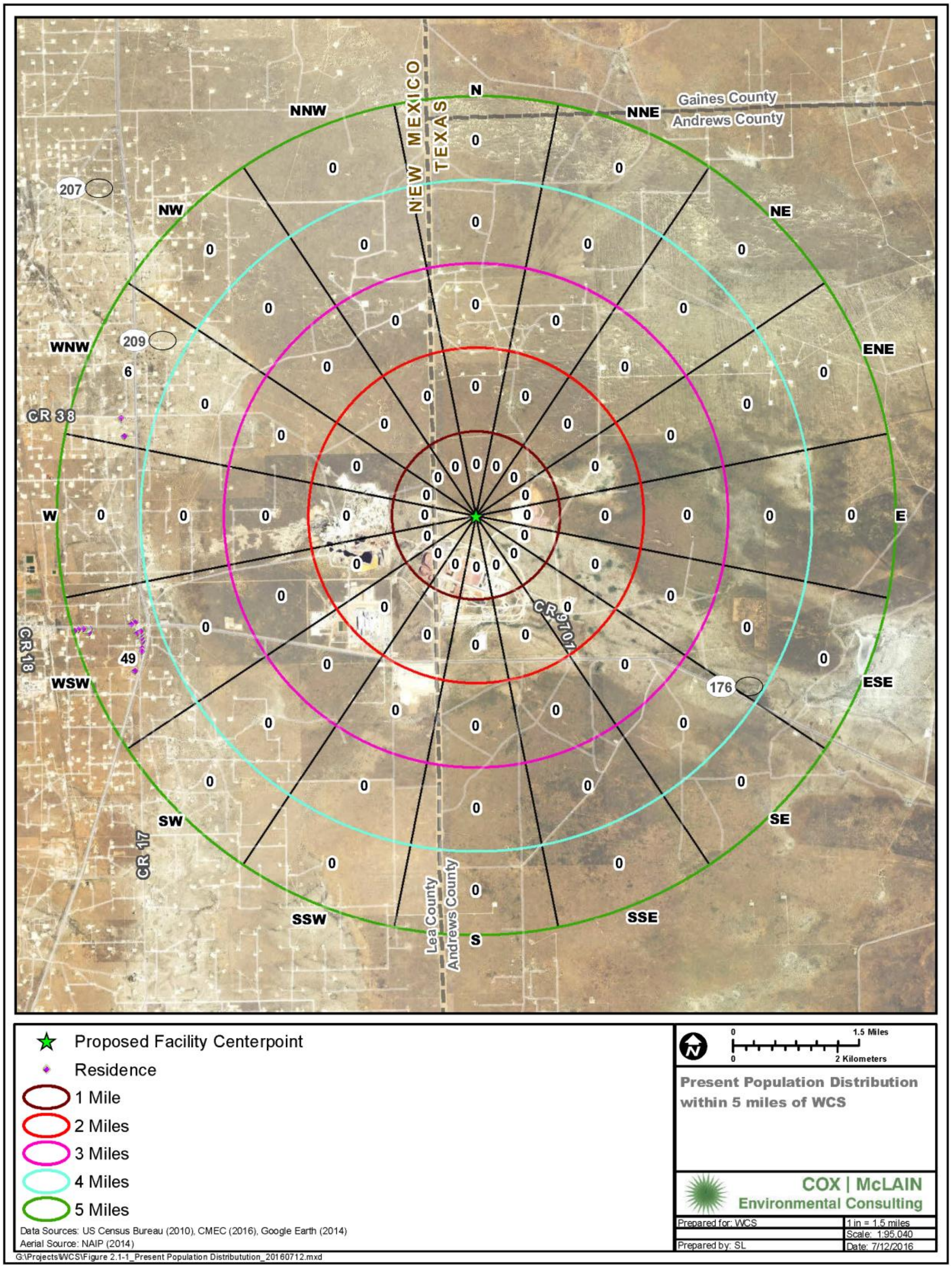

Figure 2-19
Present Population Distribution within 5 Miles of the WCS CISF

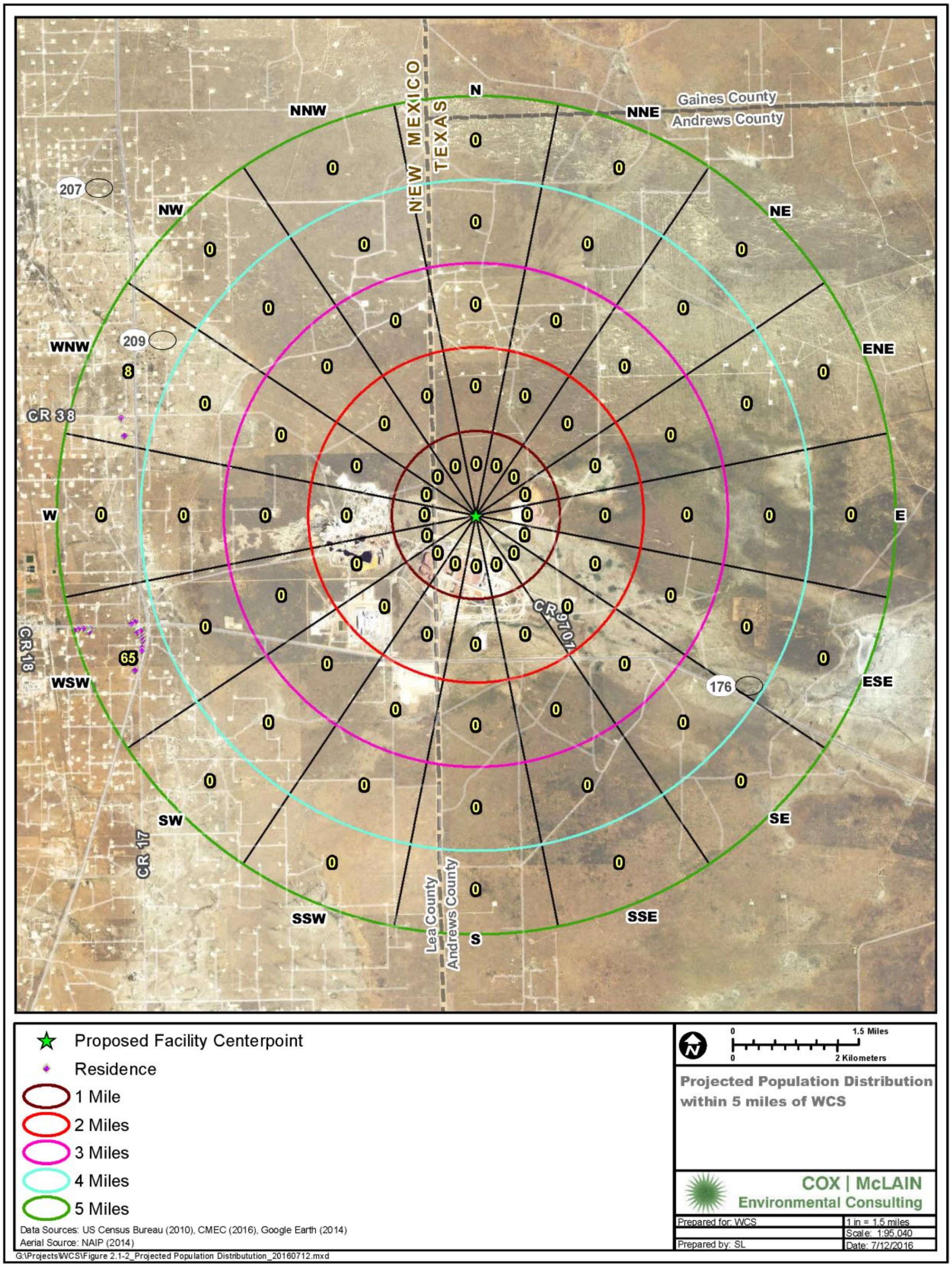

Figure 2-20
Projected Population Distribution within 5 Miles of the WCS CISF

Figure 2-21
Tower 1 Located South of the Waste Control Specialists Guard House

Figure 2-22
ER Tower Located on the North Side of the Waste Control Specialists Federal Waste Facility

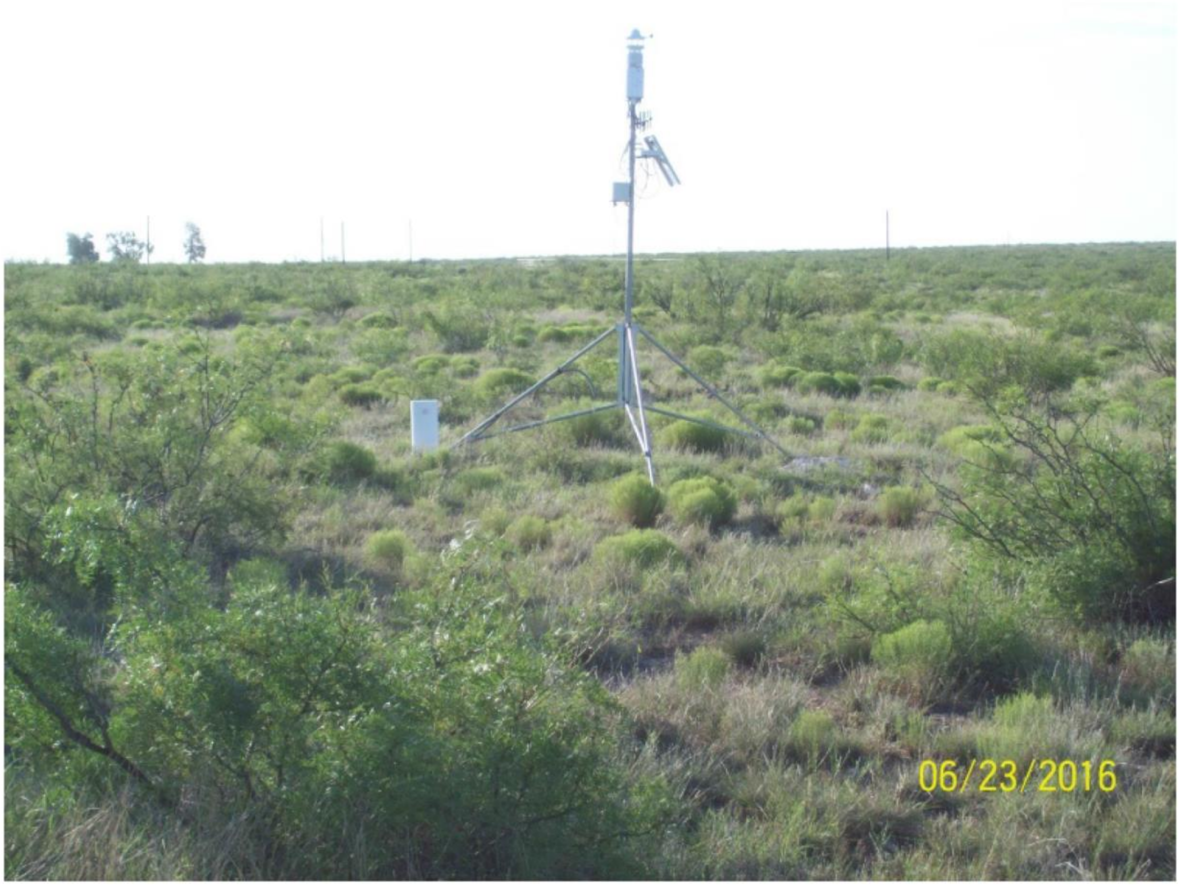

Figure 2-23
WeatherHawk East Located on the East Side of the Permitted Area for Waste Control Specialists (North of the Rail Loop)

Figure 2-24
WeatherHawk West Located West of the Waste Control Specialists LSA Pad Next to State Line Road

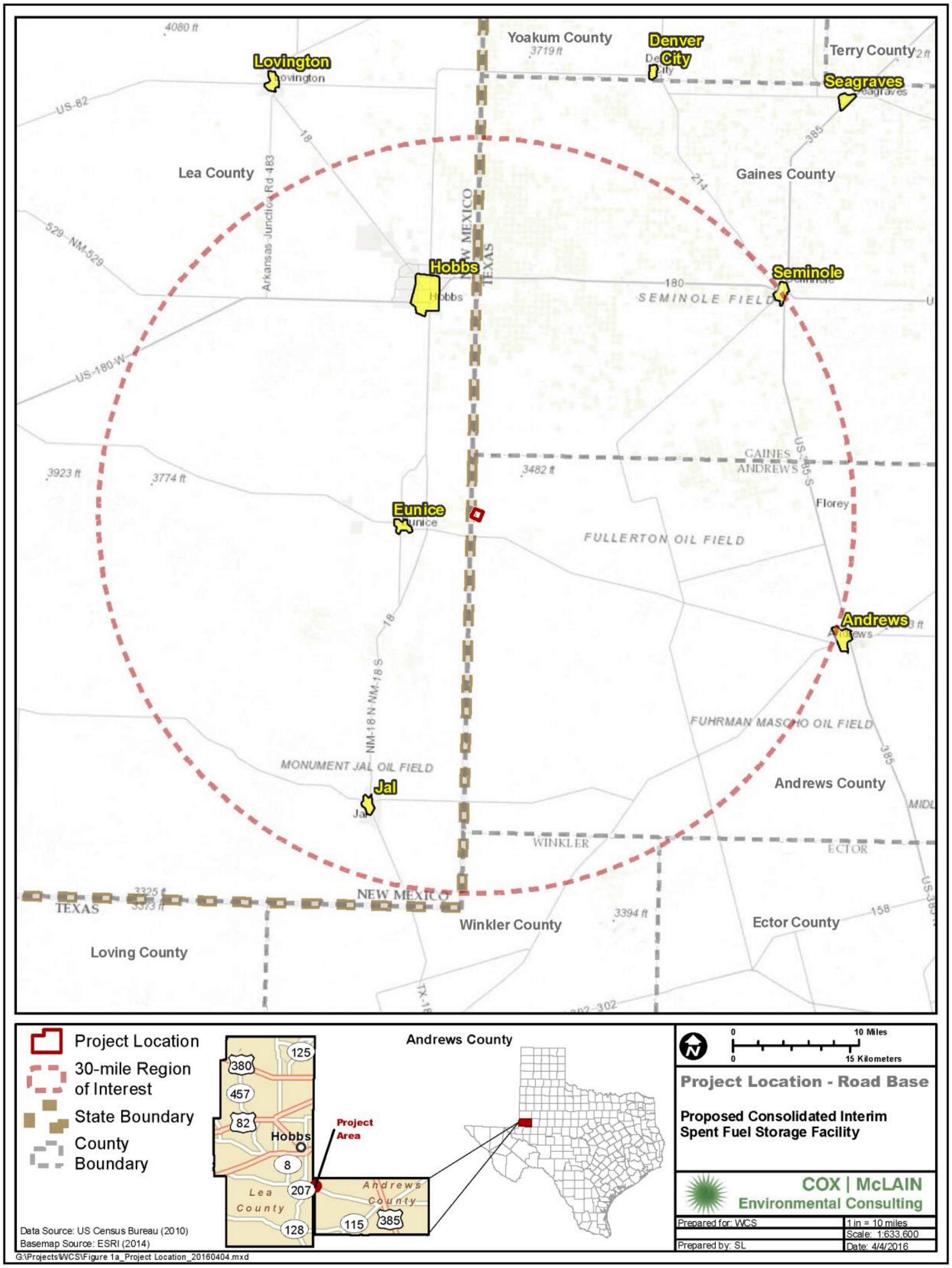

Figure 2-25
Project Location-Road Base

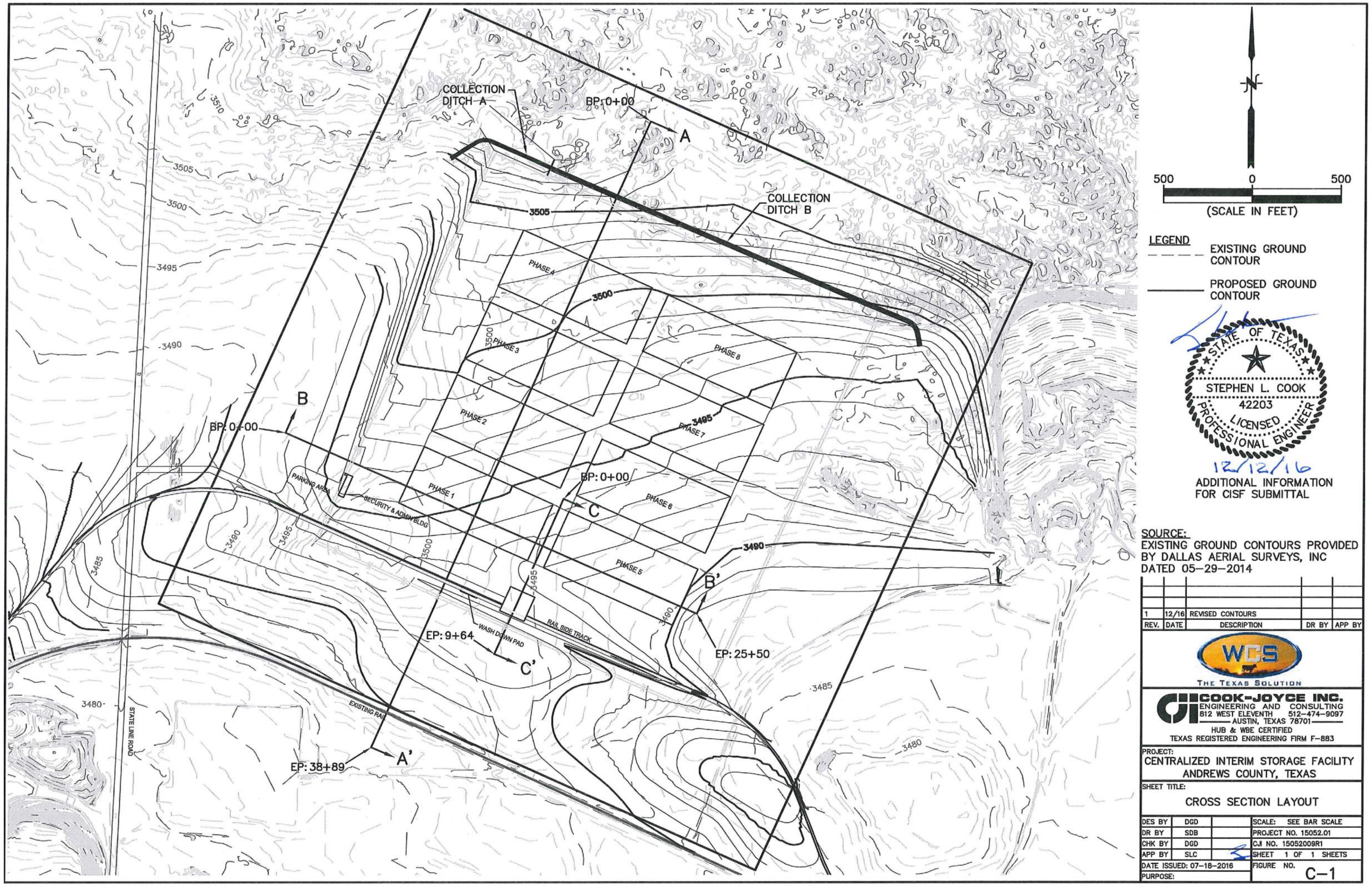

Figure 2-26
CJI C-1 Cross Section Layout

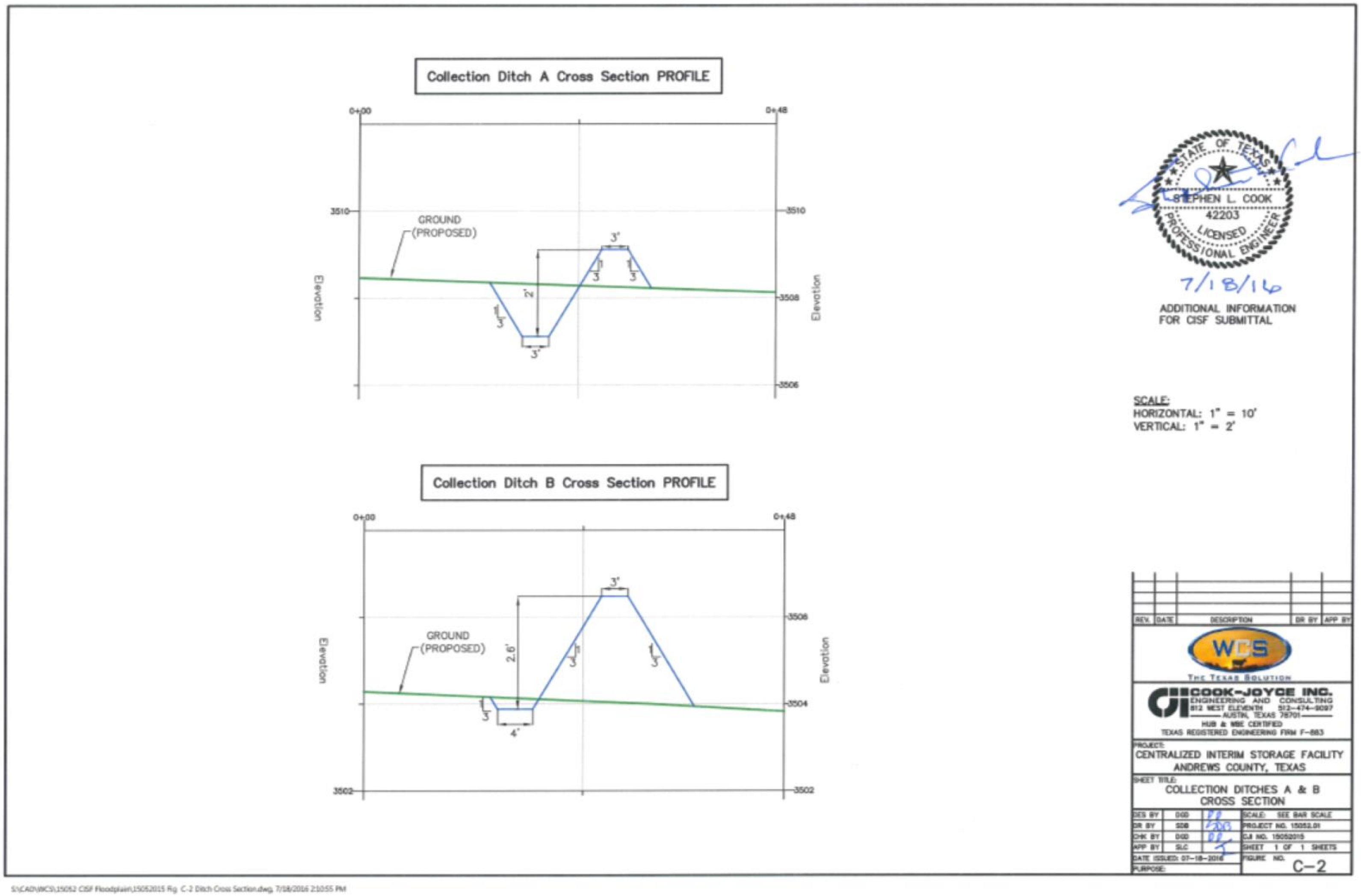

Figure 2-27
CJI C-2 Collection Ditches A &B Cross Section

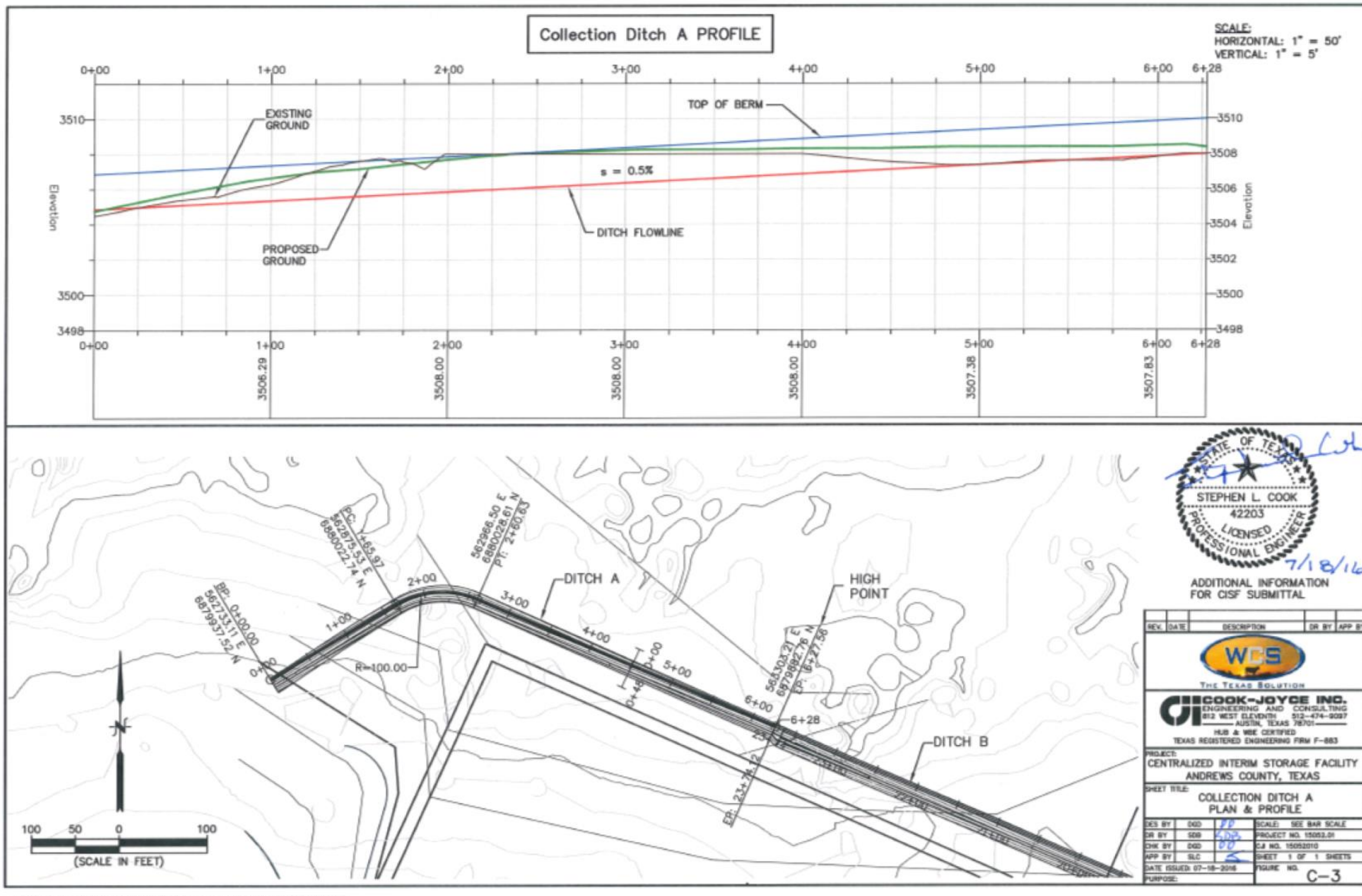

Figure 2-28
CJI C-3 Collection Ditch A Plan & Profile

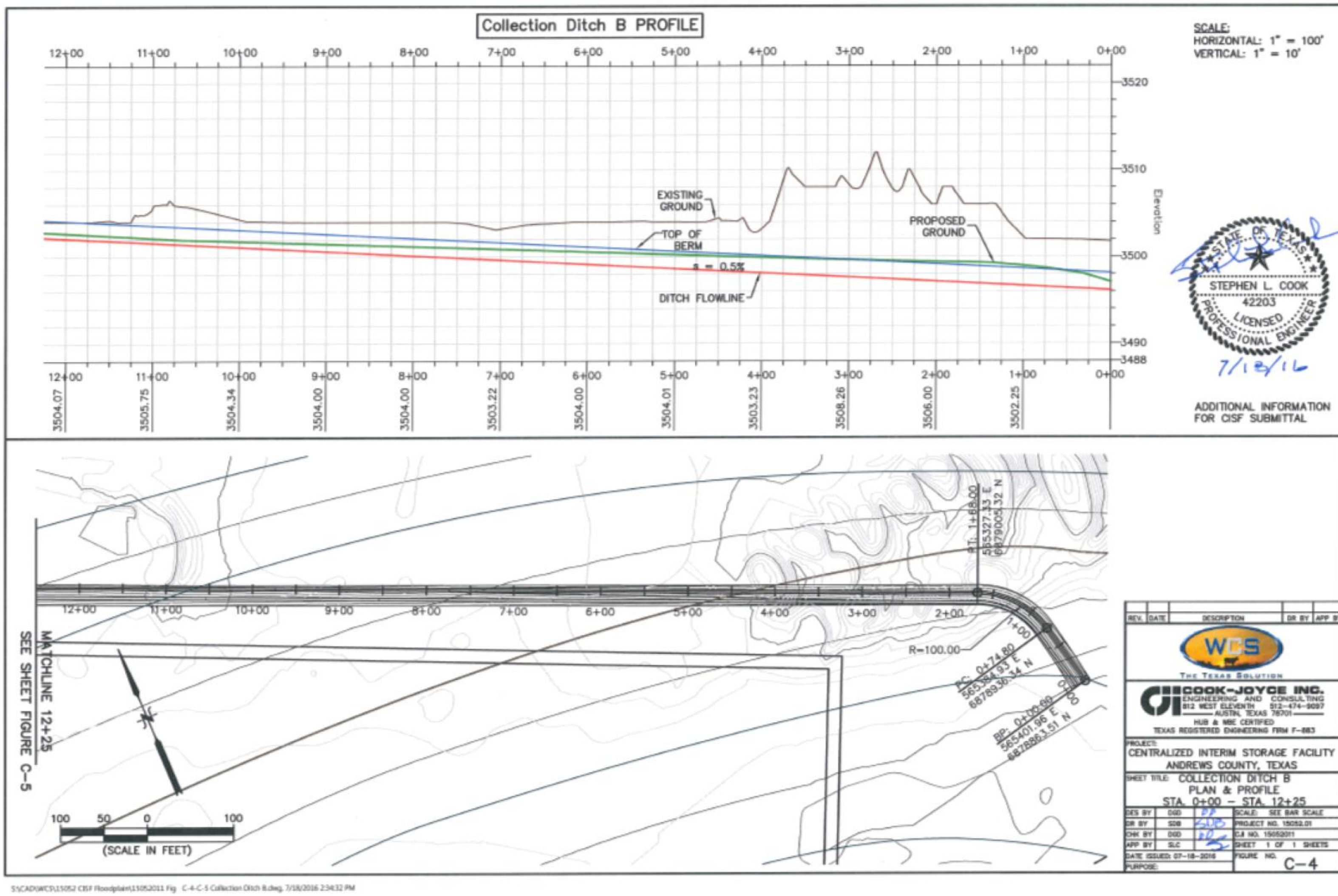

Figure 2-29
CJI C-4 Collection Ditch B Plan & Profile STA. 0+00 – STA. 12+25

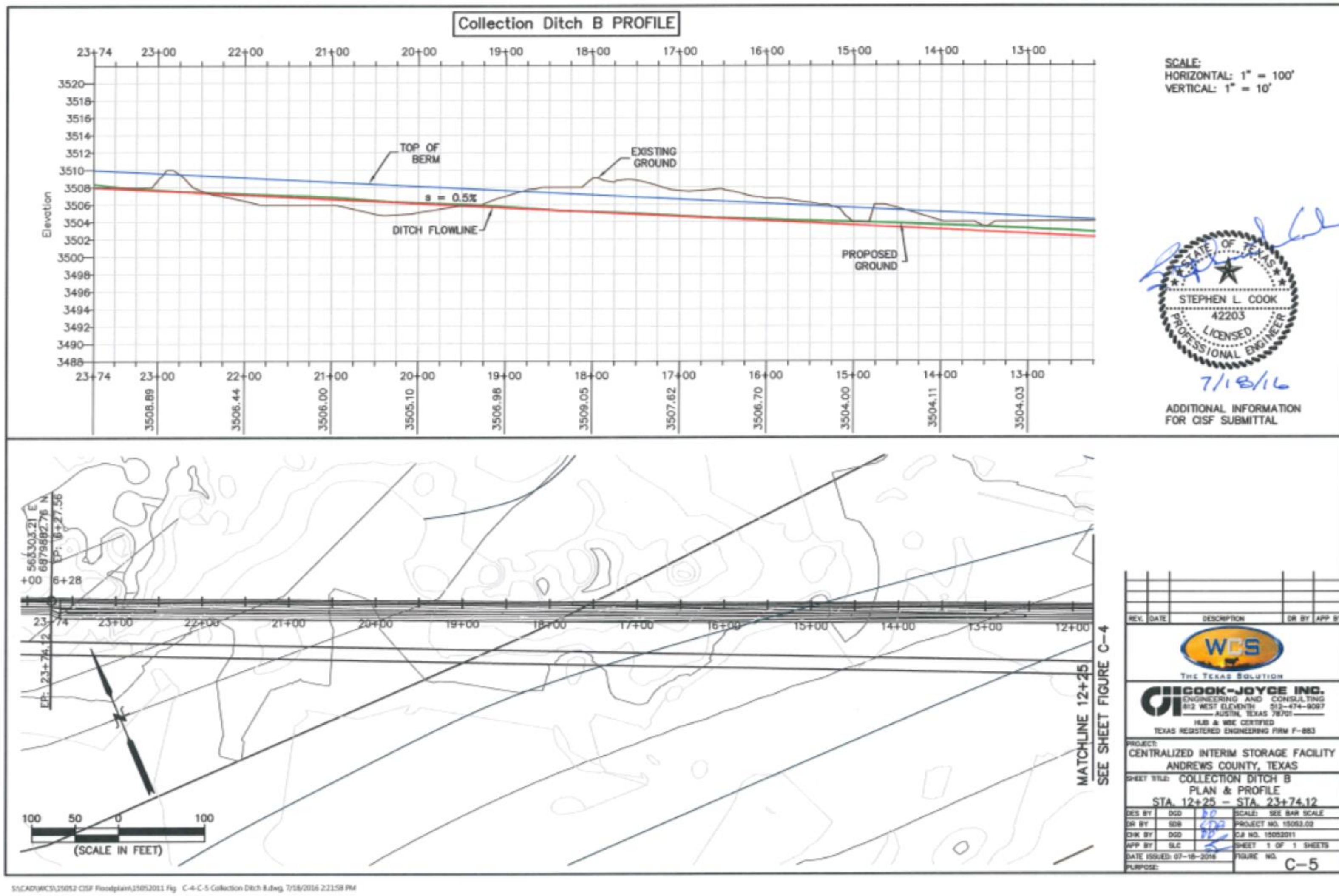

Figure 2-30
CJI C-5 Collection Ditch B Plan & Profile STA. 12+25 – STA 23+74.12

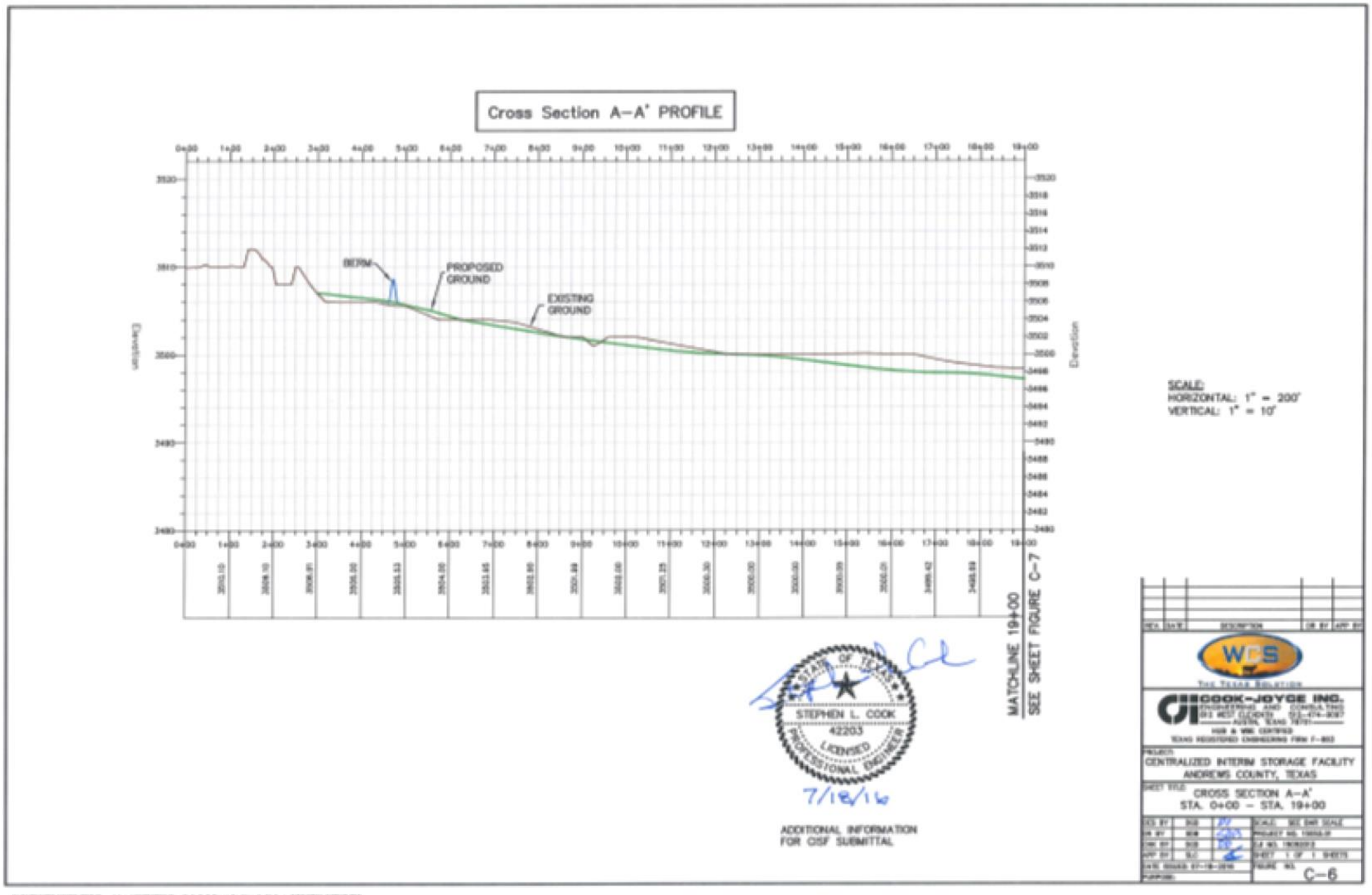

Figure 2-31
CJI C-6 Cross Section A-A' STA. 0+00 – STA. 19+00

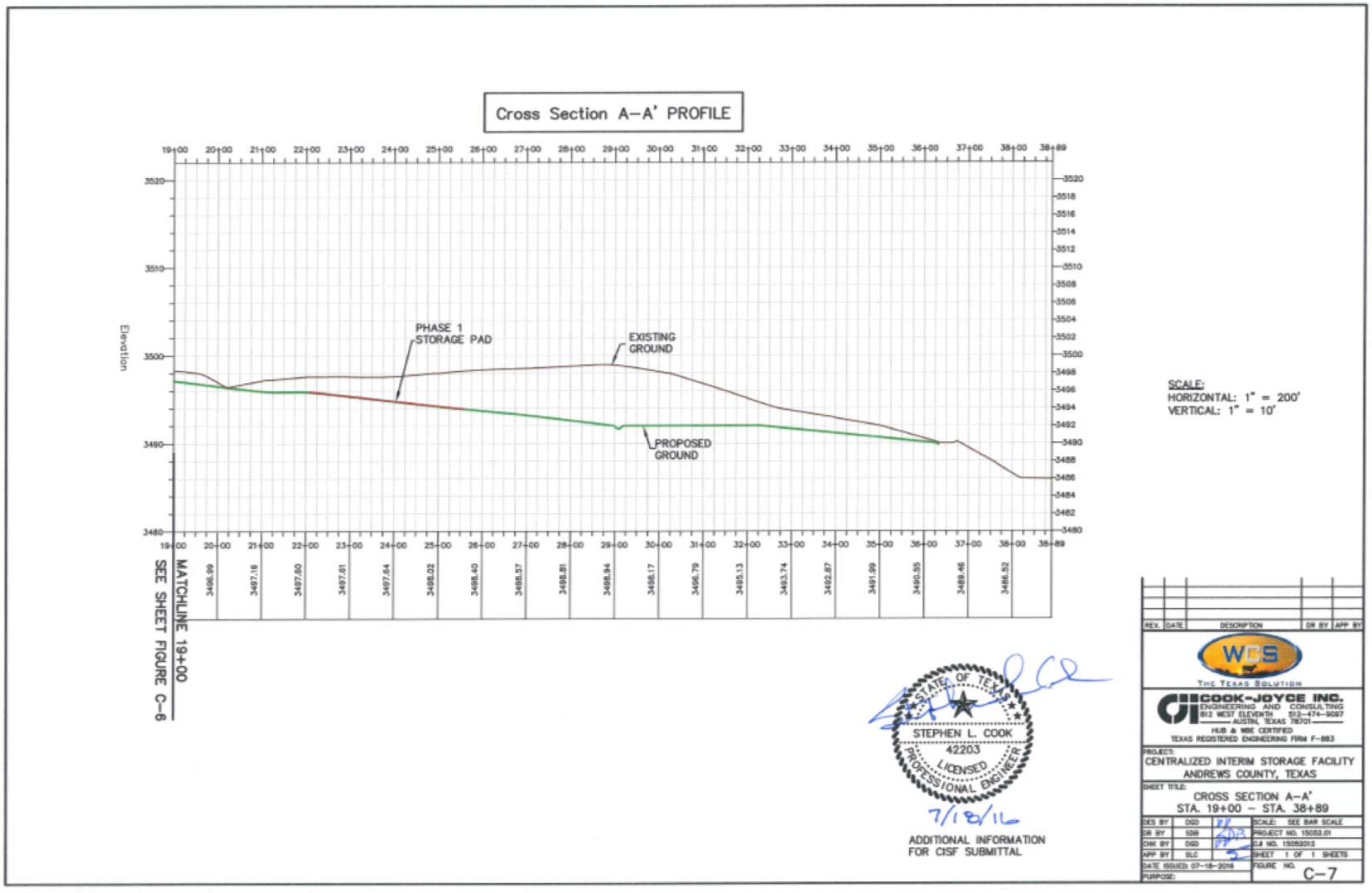

Figure 2-32
CJI C-7 Cross Section A-A' STA. 19+00 – STA. 38+39

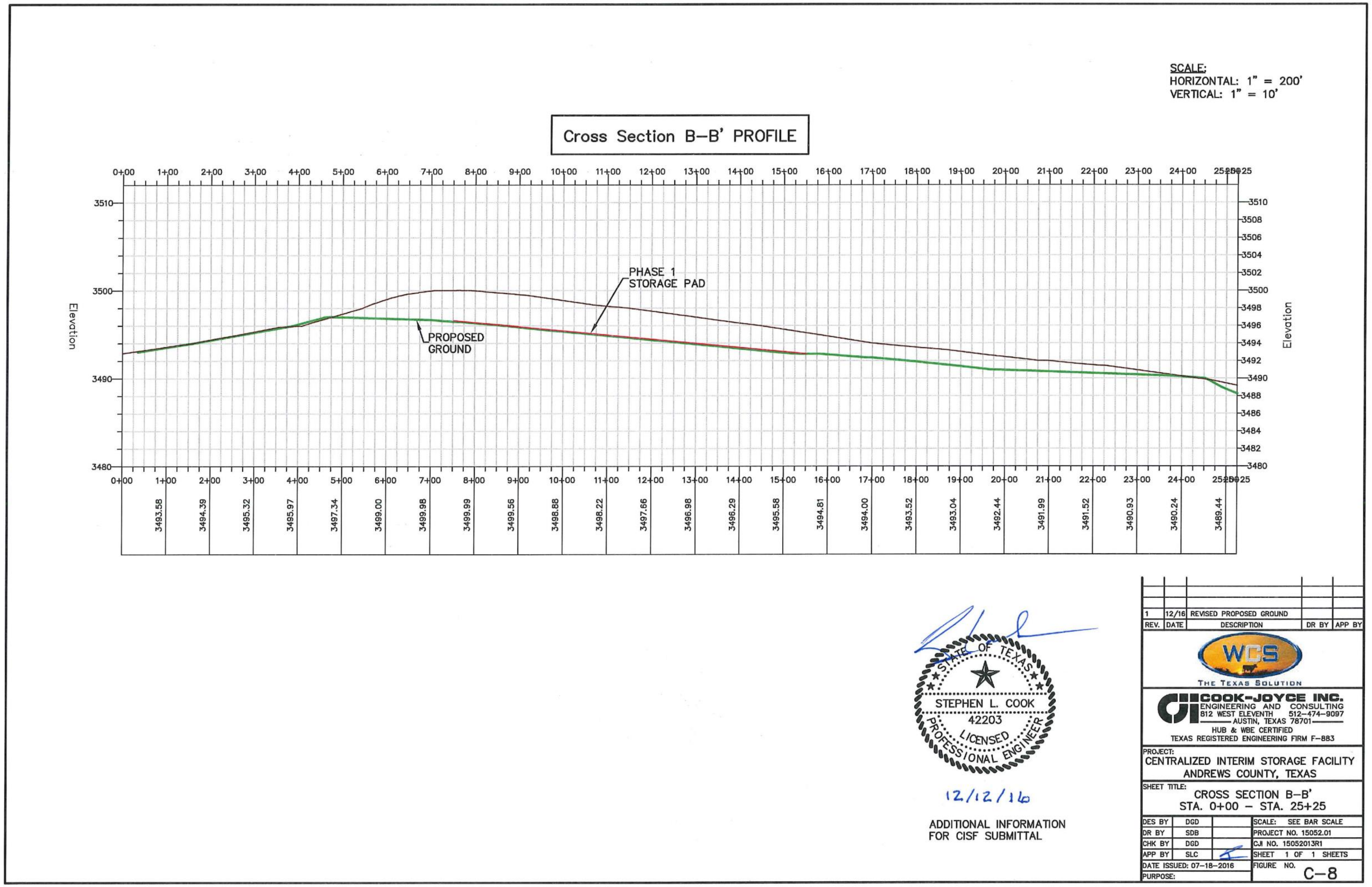

Figure 2-33
CJI C-8 Cross Section B-B' STA. 0+00 – STA.25+25

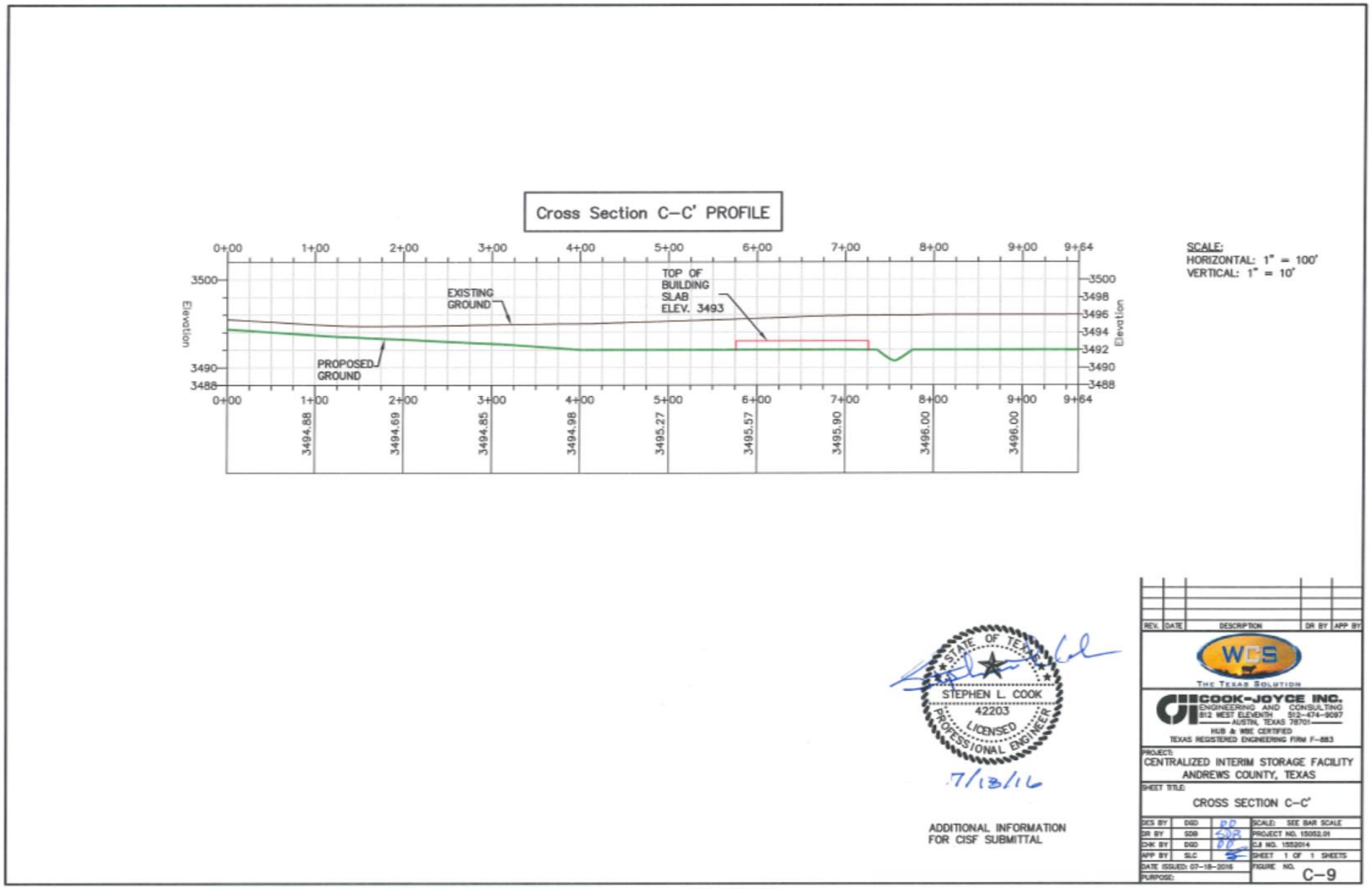

Figure 2-34
CJI C9 Cross Section C-C

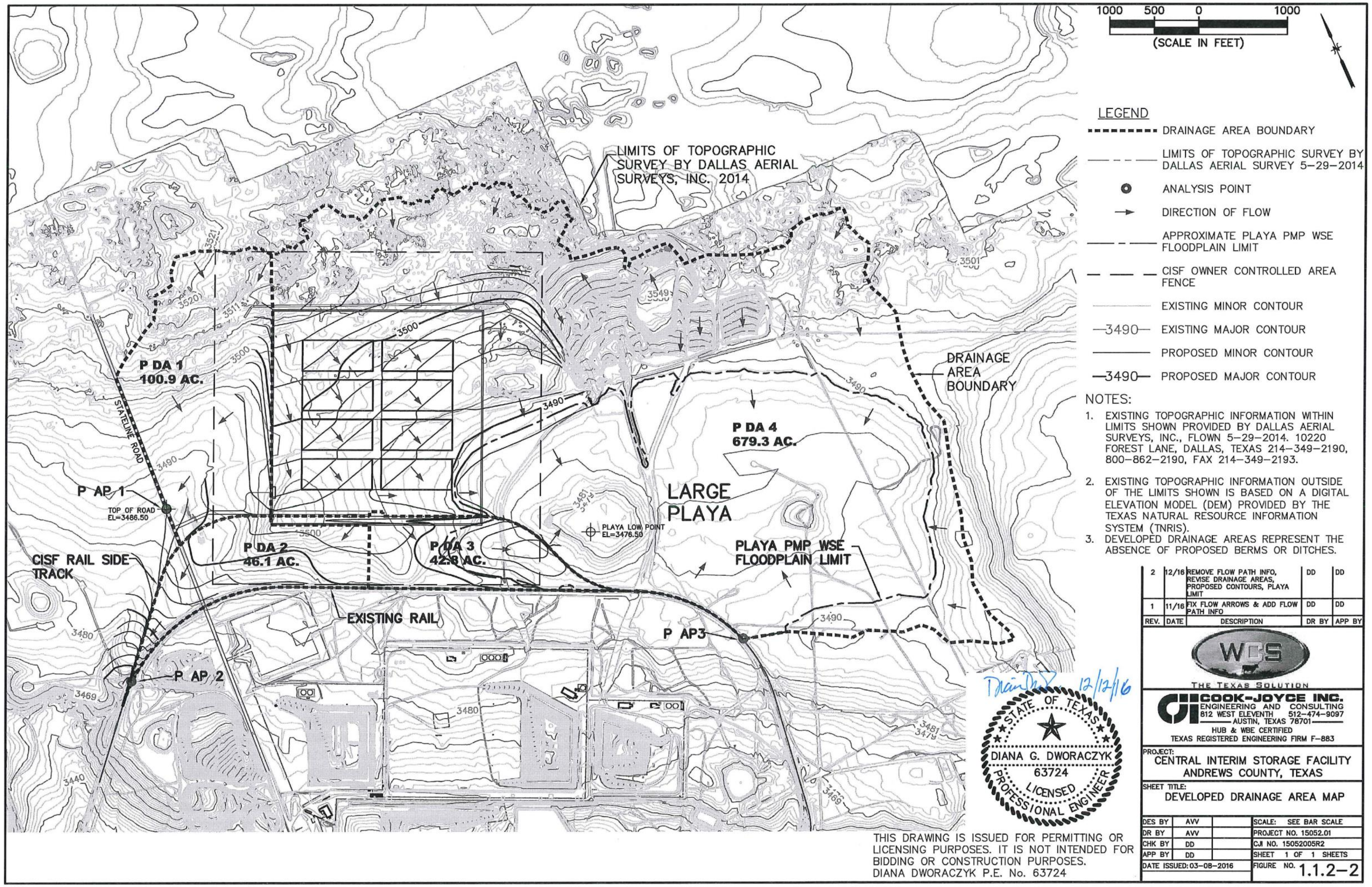

Figure 2-35
Developed Drainage Area Map

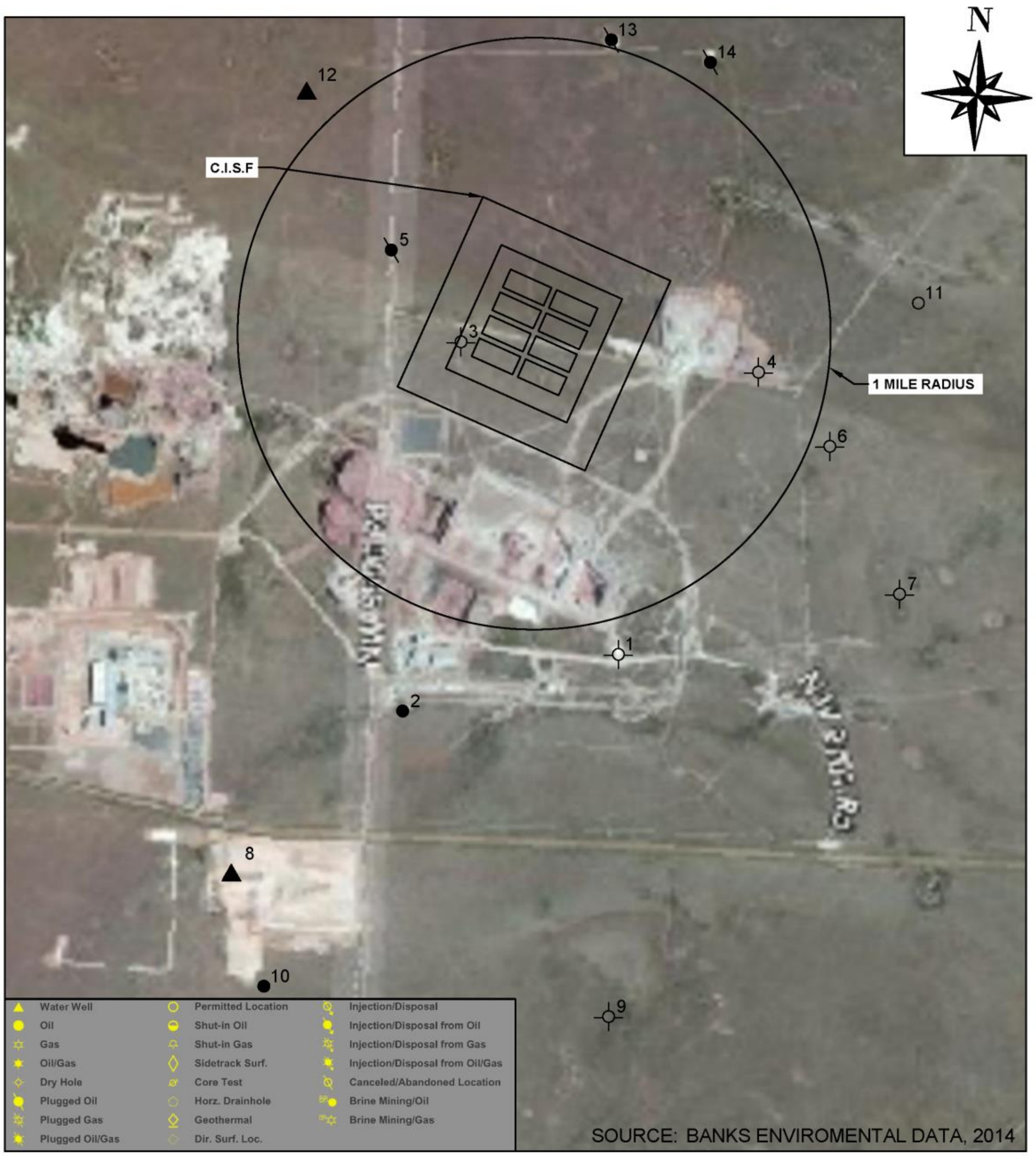

Figure 2-36
CISF 1-Mile Radius Oil and Gas Activity

Years BP (millions)	ERA	PERIOD	FORMATION	THICKNESS	USCS	LITHOLOGY
0.01	CENOZOIC	QUATERNARY	COVER SANDS	1'-10'	SP	SAND, FINE GRAINED, WELL SORTED, **UNCONSOLIDATED**, LOOSE, ORANGE TO TAN, **DRY**
			CALICHE	4'-28'	NA	CALICHE WITH SAND MATRIX, **CONSOLIDATED**, FIRM TO MODERATELY HARD, WHITE TO TAN, **DRY**
			BLACKWATER DRAW	14'-38'	SP/SC/SM	SAND, W/SILT & CLAY, FINE GRAINED, WELL SORTED, **UNCONSOLIDATED**, ORANGE TO TAN, **DRY**
2.6		TERTIARY	CALICHE	19'-28'	NA	CALCAREOUS SAND, **CONSOLIDATED**-VERY HARD, LIGHT GRAY TO WHITE, **DRY**
			OGALLALA	35'-51'	SW/GW	SAND WITH GRAVEL GRADING DOWNWARD TO A GRAVEL WITH SAND, UPPER SAND IS WELL GRADE, **UNCONSOLIDATED**, TAN, **DRY**, LOWER GRAVEL WITH SAND MATRIX, POORLY SORTED, WELL TO POORLY CEMENTED, SUBANGULAR TO SUB ROUNDED, **DRY** IN THE SOUTHERN PORTION OF CISF SITE, 1-5 FEET OF GROUNDWATER PRESENT IN THE NORTHERN PORTION OF THE CISF SITE
			ERODED OR NOT DEPOSITED			
66	MESOZOIC	CRETACEOUS				
145		JURASSIC				
201		TRIASSIC	DOCKUM/ COOPER CANYON	~1400'/~500'	CL-CH	CLAY, CLAYSTONE, PLASTIC, STIFF, **CONSOLIDATED** MAROON TO RED, **DRY**

Figure 2-37
Geologic Column of the WCS CISF Area

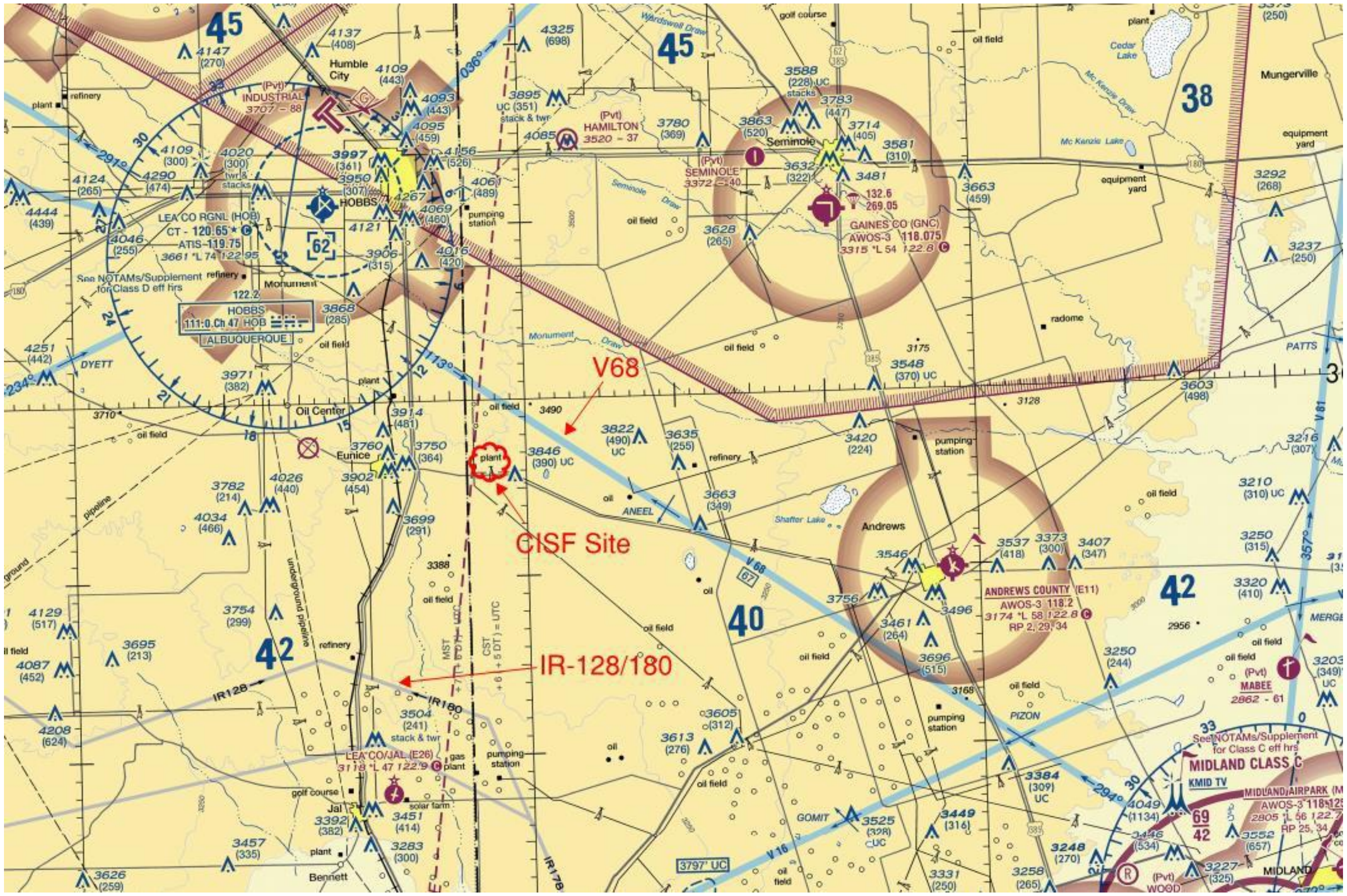

Figure 2-38
Low Altitude Air Routes Passing Near the Site

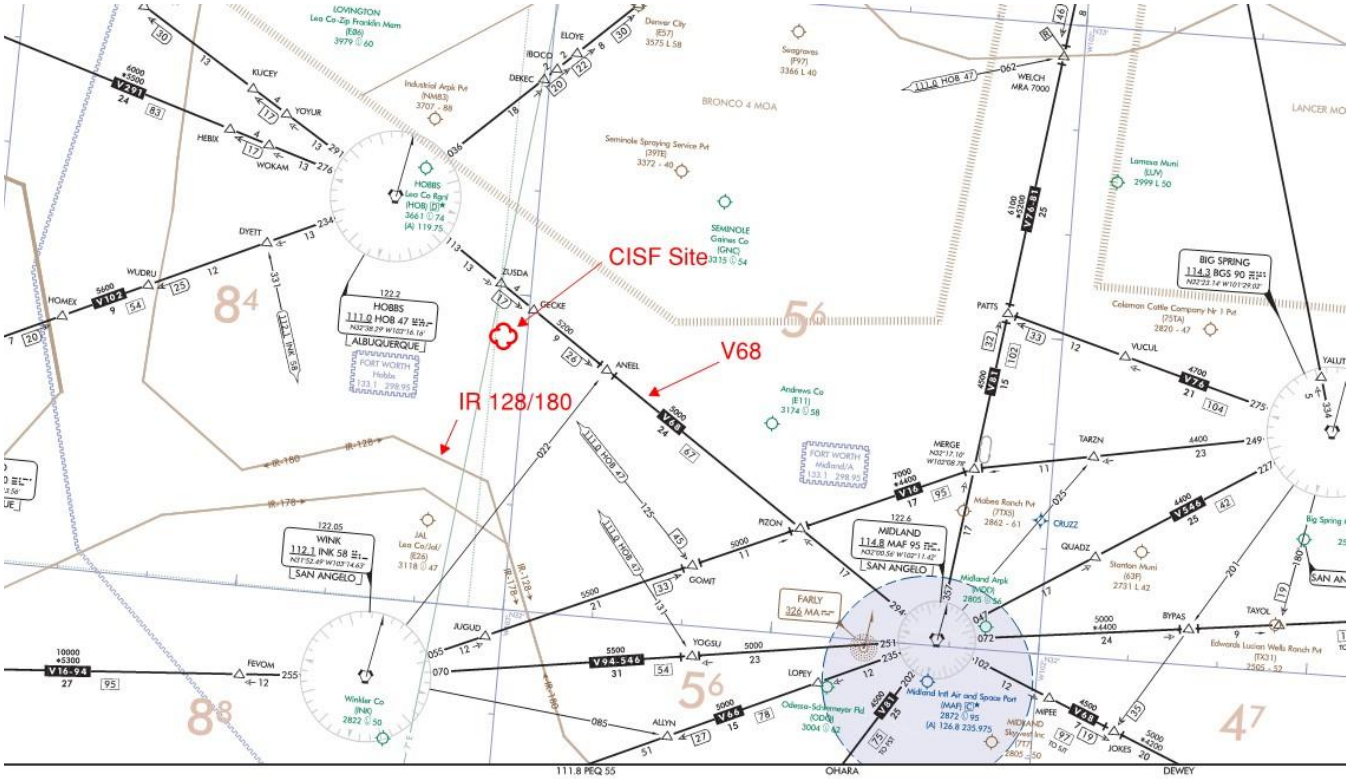

Figure 2-39
Low Altitude Air Routes Passing Near the Site

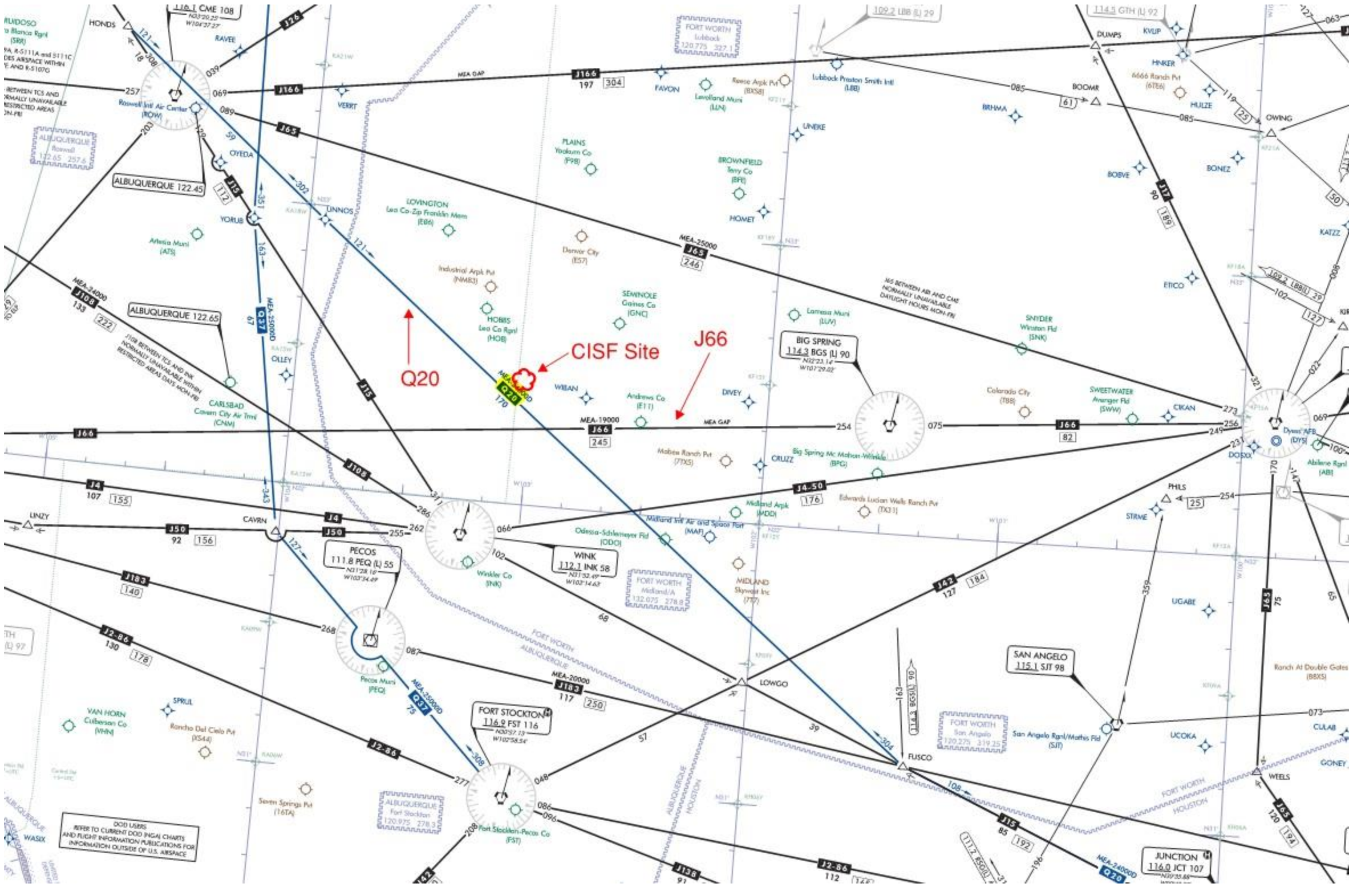

Figure 2-40
High Altitude Air Routes Passing Near the Site