CEMEX Construction Materials South, LLC

Balcones Cement Plant

Comal County, Texas

Draft Prevention of Significant Deterioration (PSD) Greenhouse Gas (GHG) Permit, Statement of Basis, GHG PSD Permit Application, and Cultural Resource Report

Public Notice Begins November 17, 2013

Comment Period Ends December 17, 2013

United States Environmental Protection Agency

CEMEX Construction Materials South, LLC

Balcones Cement Plant

Proposed PSD GHG Permit Related Documents

for Permit PSD-TX-74-GHG

Public Comment Period: November 17, 2013 thru December 17, 2013

Table of Contents

Document Description	Tab Number
Proposed Draft Permit Statement of Basis	1
Proposed Draft Permit	2
Permit Application Final Completeness Determination Letter	3
CEMEX Cultural Resources Report August 30, 2013Update	4
Permit Application Revision Dated August 26, 2013	5
CEMEX February 6, 2013 Response to EPA Request for Additional Information	6
CEMEX November 16, 2012 Response to Information Request	7
EPA Request for Additional Information September 20, 2012	8
CEMEX Initial Cultural Resources Report November 2012	9
CEMEX Initial Permit Application July 2012	10

*****PUBLIC NOTICE*****

CEMEX Construction Materials South, LLC
Balcones Cement Plant
New Braunfels, Comal County, Texas

ANNOUNCEMENT OF PROPOSED PERMIT AND PUBLIC HEARING, AND REQUEST FOR PUBLIC COMMENT OF PROPOSED CLEAN AIR ACT GREENHOUSE GAS PREVENTION OF SIGNIFICANT DETERIORATION PRECONSTRUCTION PERMIT

Public Comment Period November 17, 2013 to December 17, 2013

The United States Environmental Protection Agency (EPA) provides notice of and requests public comments on the EPA's proposed action relating to the Prevention of Significant Deterioration (PSD) permit application for the CEMEX Construction Materials South, LLC Balcones Cement Plant. If finalized, the permit would regulate greenhouse gas (GHG) pollutant emissions associated with the project to modify an existing cement manufacturing complex in accordance with the PSD regulation (40 CFR 52.21). The proposed modifications are to take place at 2580 Wald Road, New Braunfels, TX 78132 at the following coordinates: 29° 40' 22" N and 98° 10' 56" W.

EPA concludes that the CEMEX – Balcones Cement Plant is subject to PSD review for the pollutant GHGs, as the project will result in increased greenhouse gas emissions for a facility described at 40 CFR 52.21(b)(49)(iv). The proposed project consists of the increase in production of cement clinker associated with Kiln No. 2 and installation of new multi channel burners in the kilns of both existing cement kilns at the site. EPA Region 6 implements a Greenhouse Gas (GHG) PSD Federal Implementation Plan (FIP) for Texas under the provisions of 40 CFR 52.21 (except paragraph (a)(1)). *See 40 CFR 52.2305*.

Any interested individual may submit written comments on EPA's proposed PSD permit for the Balcones Cement Plant. All comments must be received in writing or be postmarked by December 17, 2013. Direct the comments to Mr. Brad Toups at one of the following addresses:

EPA Contact: Brad Toups

Phone Number: (214) 665-7258

E-mail: Toups.Brad@epa.gov

U.S. Mail: Brad Toups
Air Permits Section (6PD-R)
U.S. EPA, Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202

EPA will consider and respond to all comments in making the final decision regarding the issuing of the permit. Similar comments may be grouped together in the response, and the EPA will not respond to individual commenters directly.

Additionally, all comments will be included in the administrative record without change, and may be made available to the public, including any personal information provided, unless the comments includes Confidential Business Information (CBI) or other information whose disclosure is restricted by statue. Thus, CBI or other protected information should be clearly identified as such, and should not be submitted through email. Emails sent directly to the EPA will capture your email address automatically and will be included as part of the public comment. *Please note that an email or postal address must be provided with your comments if you wish to receive responses to comments submitted during the public comment period and direct notification of EPA's final decision regarding the permit.*

An extension of the 30-day comment period may be granted if the request for an extension adequately demonstrates why additional time is required to prepare comments.

Public Hearing: If EPA determines that there is a significant degree of public interest in the draft permit, the EPA has the right to hold a public hearing. Any request for a public hearing must be received by the EPA either by email or U.S. mail by December 17, 2013, and must state the nature of the issues proposed to be raised in the hearing. Attendance at the public hearing is not required in order to submit written comments. ***If the EPA determines that there is significant public interest***, a public hearing will be held on January 7, 2014 from 6:00 p.m. to 8:00 p.m. at the following location:

New Braunfels Public Library
Public Meeting Room
700 Commons St
New Braunfels, TX 78130
(830) 221-4300

If a public hearing is held, the public comment period shall automatically be extended to the close of the public hearing. The EPA maintains the right to cancel a public hearing if no request for a public hearing is received by December 17, 2013, or the EPA determines that there is not significant interest. ***If the public hearing is cancelled,*** notification of the cancellation will be posted by December 20, 2013 on the EPA's Website http://yosemite.epa.gov/r6/Apermit.nsf/AirP. Individuals may also call the EPA at the contact number listed above to determine if the public hearing has been cancelled.

Permit Documents: EPA's draft permit, EPA's preliminary determination and statement of basis, CEMEX- Balcones Cement Plant's permit application and supporting documentation, and comments received from the public, other government agencies, and the applicant during the public comment period become part of the administrative record for the permit. In addition, all data submitted by the applicant is available as a part of the administrative record. The public can access the administrative record at the following locations (Please call in advance for available viewing times):

New Braunfels Public Library
700 Commons St
New Braunfels, TX 78130
(830) 221-4300

EPA Region 6 Office
1445 Ross Avenue, Suite 1200
Dallas, TX 75202
Phone: (214) 665-7200

Final Determination: A final decision to issue a permit or to deny the application for the permit shall be made after all comments have been considered. Notice of the final decision shall be sent to each person who has submitted written comments or requested notice of the final permit decision, provided the EPA has adequate contact information.

Statement of Basis

Proposed Draft Greenhouse Gas Prevention of Significant Deterioration Preconstruction Permit for the CEMEX Construction Materials South, LLC, CEMEX- Balcones Cement Plant

Proposed Draft Permit Number: PSD-TX-74-GHG

This document serves as the statement of basis (SOB) for the above-referenced draft permit, as required by 40 CFR §124.7. This document sets forth the legal and factual basis for the draft permit conditions and provides references to the statutory or regulatory provisions, including provisions in 40 CFR §52.21, that would apply if the permit is finalized. This document is intended for use by all parties interested in the permit.

I. Executive Summary

On July 11, 2012, CEMEX Construction Materials South, LLC (CEMEX) submitted to EPA Region 6 a Prevention of Significant Deterioration (PSD) permit application for greenhouse gas (GHG) emissions from a proposed modification to a cement production plant in New Braunfels, Texas. The application was revised on February 6, 2013 and again on August 26, 2013 (hereinafter, referred to as "the application"). In connection with the same proposed project, CEMEX submitted a PSD New Source Review permit applications for non-GHG pollutants to the Texas Commission on Environmental Quality (TCEQ) dated December 29, 2011 and the non-GHG PSD permit (PSD-TX-74M2) was issued by the TCEQ on October 8, 2013.

The draft GHG permit would authorize a modification and increased GHG emissions at an existing major source (for PSD purposes and for pollutants other than GHGs). More specifically, the permit would authorize increased GHG emissions for both the kiln line No. 1 and kiln line No. 2. Each of these lines is comprised of an in-line raw mill, blending silos, preheaters, precalciners, a rotary kiln, a clinker cooler, and in-line solid fuel mills. Additional equipment at the site includes raw material handling systems, finish milling equipment, baghouses to capture product and to control particulate emissions, ancillary equipment and processes at the site including shipping systems, gaseous pollutant control systems and alternative fuel receiving, handling, and preparation systems, but none of the other systems result in the emission of GHG pollutants.

This project includes two distinct modifications at the site. The first change affects kiln line No.2 only, and authorizes increased emissions to raise an existing production limitation from 3,600 to 3,960 tons of clinker per day (30-day rolling average). Clinker production from the kiln No.1 system remains unchanged at 3,250 tons of clinker per day (30-day rolling average). The kiln No.2 production rate of 3,960 ton per 30- day rolling average requires no physical change to the kiln system to achieve but rather can be derived from the system as it was constructed in 2008.

The second change at the site addressed by this permit includes GHG emissions from the effect of upgrades to the main kiln burners in kiln line No. 1 and kiln line No. 2 systems to multipath adjustable units. The burner upgrades will not increase the maximum fuel firing rate for either kiln but will increase flexibility in the amount and kind of fuels (the fuel mix) that can be burned in the main kiln and result in potential energy efficiency improvements. The list of authorized fuels can be found in permit PSD-TX-74M1. That permit authorized the firing of natural gas, coal, and petroleum coke (pet coke) as primary fuels and also authorized multiple, specifically identified alternative fuels including wood products, carpet fibers, shingles, oil filter fluff, rice husks, and cotton gin residue. PSD-TX-74M2, among other things continues to govern the authorized and unchanged list of fuels that may be fired in either kiln line.

This SOB provides the information and analysis used to support EPA’s decisions in drafting the air permit. It includes a description of the facility and proposed modification, the air permit requirements based on BACT analyses conducted on the proposed modified units, and the compliance terms of the permit.

EPA Region 6 concludes that CEMEX’s application is complete and provides the necessary information to demonstrate that the proposed project meets the applicable air permit regulations. EPA's conclusions rely upon information provided in the permit application, supplemental information provided by CEMEX at EPA’s request, and EPA's own technical analysis. EPA is making this information available as part of the public record.

II. Applicant

CEMEX Construction Materials South, LLC
CEMEX – Balcones Cement Plant
2580 Wald Road
New Braunfels, TX 78132

Physical Address:
2580 Wald Road
New Braunfels, TX 78132

Contact:
Jimmy Rabon
2580 Wald Road
New Braunfels, TX 78132
(210) 250-4009

III. Permitting Authority

On May 3, 2011, EPA published a federal implementation plan (FIP) that made EPA Region 6 the PSD permitting authority for the pollutant GHGs. See 75 FR 25178 (promulgating 40 CFR §52.2305).

The GHG PSD Permitting Authority for the State of Texas is:

EPA, Region 6
1445 Ross Avenue
Dallas, TX 75202

The EPA Region 6 Permit Writer is:
Brad Toups
Air Permitting Section (6PD-R)
(214) 665-7258

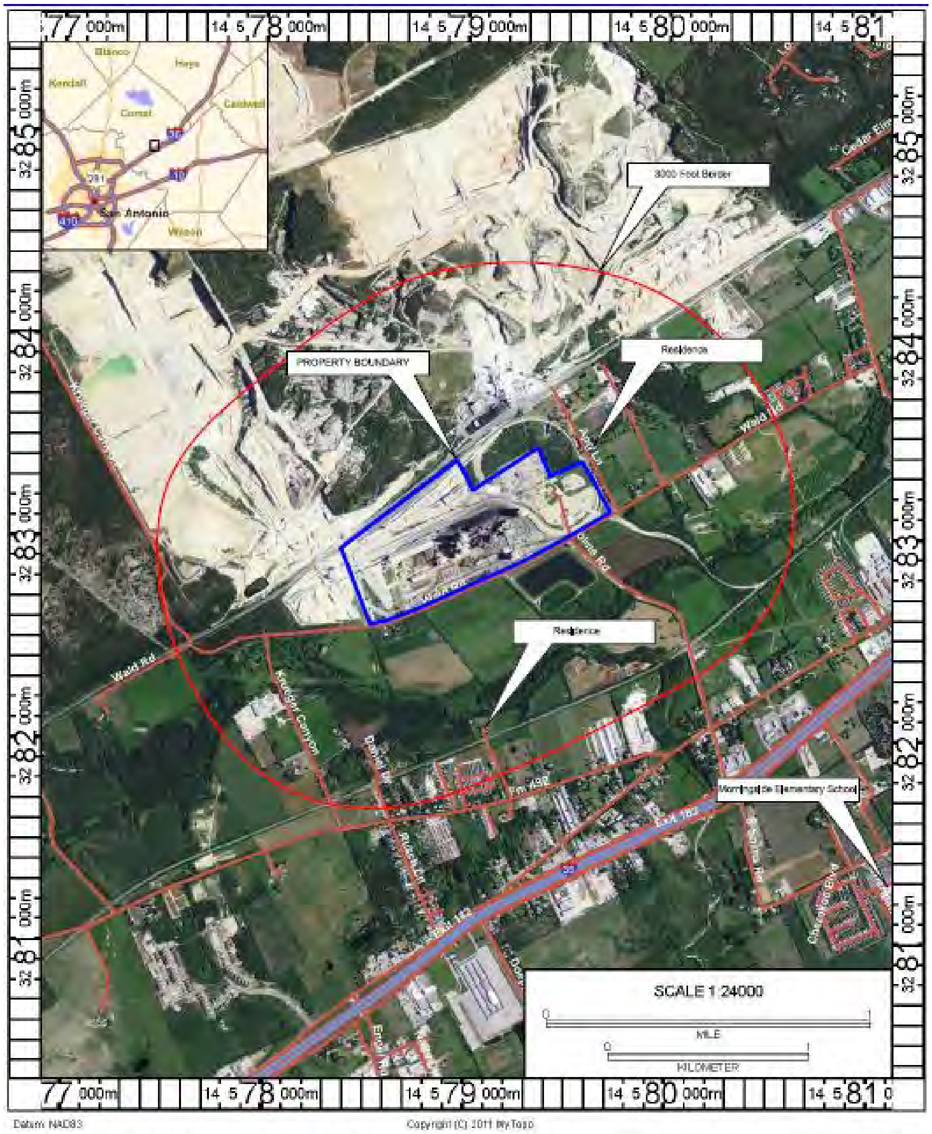
IV. Facility Location

The CEMEX- Balcones Cement Plant is located in Comal County, Texas, which is currently designated attainment/unclassified for all NAAQS pollutants. The nearest Class 1 areas are the Guadalupe Mountains National Park, Texas which is located over 400 miles west and Breton Sound Wildlife Refuge, Louisiana, located over 500 miles east of the site. The geographic coordinates for this facility are as follows:

Latitude: 29º 40' 22" North
Longitude: - 99º 10' 56" West

Below, Figure 1 illustrates the facility location for this draft permit.

Figure 1. CEMEX- Balcones Cement Plant, New Braunfels, Tx Plant Location



V. Applicability of Prevention of Significant Deterioration (PSD) Regulations

EPA concludes that CEMEX's application is subject to PSD review for GHGs because the project would lead to a net emissions increase of GHGs for a facility as described at 40 CFR § 52.21(b)(23) and (49)(iv). Under the project, GHG emissions are calculated to increase over zero tpy on a mass basis and to exceed the applicability threshold of 75,000 tpy CO_2e (CEMEX calculates an increase of 841,250 tpy CO_2e). EPA Region 6 implements a GHG PSD FIP for Texas under the provisions of 40 CFR § 52.21 (except paragraph (a)(1)). See 40 CFR § 52.2305.

As the permitting authority for regulated NSR pollutants other than GHGs, TCEQ has determined that the modification to an existing major source is subject to PSD review for CO. Accordingly, under the circumstances of the project, the State will issue the non-GHG portion of the PSD permit, and EPA will issue the GHG portion.TCEQ issued the required PSD permit – PSD-TX-72M2- on October 8, 2013for this proposed modification.[1]

EPA Region 6 applies the policies and practices reflected in the EPA document entitled "PSD and Title V Permitting Guidance for Greenhouse Gases"[2]. Consistent with this guidance, we have not required the applicant to model or conduct ambient monitoring for GHGs, and we have not required any assessment of impacts of GHGs in the context of the additional impacts analysis or Class I area provisions of 40 CFR § 52.21(o) and (p), respectively. Instead, EPA has determined that compliance with the selected Best Available Control Technology (BACT) is the best technique that can be employed at present to satisfy the additional impacts analysis and Class I area requirements of the rules with respect to emissions of GHGs. We note again, however, that the project has triggered review for regulated NSR pollutants that are non-GHG pollutants under the PSD permit amendment sought from TCEQ.

VI. Project Description

The process of cement making involves three basic steps: raw material grinding and mixing to produce a raw meal, pyroprocessing of the raw meal to produce cement clinker, and then grinding the clinker together with other additives to produce powdered cement. Over 75% of the raw material is limestone, typically mined on site to minimize transportation costs. The other raw materials include sand, clay, and other minerals.

This project's physical changes and the change in method of operation (increased production from kiln line No. 2) directly affects only the pyroprocessing step of cement production- the two kiln lines at the site where the production of clinker occurs. While there will be increased raw material fed to kiln line 2 and more clinker that will need grinding and processing downstream, the only source of GHG emissions at this site are located in the pyroprocessing step and involve the kiln lines.

Within the kiln lines, the process of making cement clinker may be subdivided into three successive phases. In the first phase, the raw meal is heated to about 1112° F. (600° C) in order to dehydrate the meal. The second process phase is supplying the additional heat energy needed to calcine the limestone component (calcium carbonate, $CaCO_3$) of the dried raw meal. Calcining, or deacidification, of limestone results when limestone is heated sufficiently to

[1] *See* EPA, Question and Answer Document: Issuing Permits for Sources with Dual PSD Permitting Authorities, April 19, 2011, http://www.epa.gov/nsr/ghgdocs/ghgissuedualpermitting.pdf
[2] EPA, *PSD and Title V Permitting Guidance for Greenhouse Gases* EPA-457/B-11-001, March 2011

efficiently chemically change the $CaCO_3$ into lime (CaO) and liberate CO_2 in the process, which takes place within the kiln line at temperatures typically between 1200 to 1742°F (650 to 950° C) The third process phase comprises further heating of the material within the main kiln to sintering temperature when 'clinker' formation occurs, usually from 2500 to 3000°F (1370 to 1650° C). Immediately after the clinker exits the kiln, the clinker is rapidly cooled to optimize clinker quality using ambient air passing thru the clinker as it traverses a reciprocating grate cooler.

GHG are generated from cement production from two sources within the kiln lines: from the calcination of limestone which forms lime and liberates CO_2 and from combustion of the various fuels needed for the energy intensive clinker production process. Minimizing the amount of fuel needed to efficiently produce quality clinker in the kiln lines while maximizing the utilization of combustion derived energy are the keys to reducing GHG in cement clinker production. Making the best use of the fuel derived heat energy means that the clinker cooler heated air is used to dry the coal (or coke) prior to firing and to pre-heat combustion air used in the preheater/precalciner. It also means making use of the kiln exhaust stream to dry the raw meal prior to entering the main kiln proper. Other design and process methods, such as the use of energy efficient motors, material handling methods and variable frequency fans are additional methods of increasing energy efficiency and result in less electricity use, thus lowering GHG emissions associated with cement production.

The primary fuels used in clinker production typically include coal and petroleum coke due to the cost effectiveness and stable supply stream of these fuels, and to a lesser extent, natural gas. Alternative fuels are many, and often include various materials ranging from tires to carpenter shop wood waste, to just about any cost effective material with adequate heating value. The solid fossil fuels are typically dried with a slip stream of air heated in the clinker cooler and ground in a coal mill. The dried and ground fuel can be introduced into the main kiln burner or at the pre-heater or pre-heater/pre-calciner. The primary combustion air to the kiln is ambient air while secondary combustion air is supplied from the clinker cooler. Exhaust gases from fuel combustion in the kiln and pre-heater (or pre-heater/pre-calciner) are used in the raw mill for heating and drying the material. All products of combustion are eventually exhausted to atmosphere at the main kiln baghouse (Emission Point Numbers, EPNs, PS-16 for kiln line 1 and PS-77 for kiln line 2).

This project includes two modifications to the existing facility, as follows:

Modification 1: Kiln line 2 production increase. In this change in the method of operation, the kiln will not require any equipment modifications in order to increase the production to the proposed rate of 3,960 tons of clinker per day (30-day average) and 1,386,000 tons of clinker per year. This kiln has been in operation for less than five years and has demonstrated an ability to reach a higher production capacity than what was originally estimated and permitted. Increasing the existing federally enforceable limitation to the production capacity constitutes a change in the method of operation.

Modification 2: Upgrades to the burners on kiln 1 and kiln 2. CEMEX is proposing to upgrade both kiln line kiln burners to multichannel adjustable units. This upgrade will allow for better flame control, reduce primary air by up to 12% and handle authorized alternative fuels in distinct and separate fuel lines. This change constitutes a physical change to both kiln lines.

Overall, the project will increase kiln line 2's nominal clinker production capacity from 1.260 MM tons clinker per year to 1.3860 MM tons clinker/year, a 10% increase in total annual clinker production. from kiln line 2, while the production rate of kiln line 1 remains unchanged at 1.1375MM tons clinker per year.

Project subject to PSD review Because of the physical changes and the changes in method of operation that result in a mass emissions rate increase above 0 tpy and a significant net increase in CO_2e emissions above 75,000 tpy, this project constitutes a major modification as defined in 40 CFR§52.21b(2)(i), and thus triggers PSD review for GHG. It should be noted that this same project was evaluated for PSD applicability by the TCEQ, who determined that the project is also subject to PSD review as a major modification for the criteria pollutant CO. The TCEQ reviewed the project and issued permit PSD-TX-72M2 to authorize the changes for criteria pollutants.

Both kiln lines combust solid fossil fuels and natural gas as primary fuels and a wide variety of alternative fuels as well. Both kiln lines are equipped with various design and process operating practices to maximize energy efficiency while producing the needed quality and quantity of clinker, and add-on controls to reduce particulate and criteria pollutant and HAP emissions.

The kiln lines are equipped with automated kiln control systems help maximize energy efficiency. Low NO_x, burners, and selective non catalytic reduction (SNCR) systems are in place to control NO_x emissions. SO_2 emissions are limited by the inherently low sulfur content of the limestone raw material. The list of control requirements to assure compliance with the NAAQS and other criteria and HAP pollutant limitations are listed in the state issued PSD permit for the site. Both kiln systems are fitted with continuous monitoring systems for CO_2 (required by 40 CFR 98 Subpart C), NO_x, SO_2, and opacity as required by state authorizations for the source.

VII. General Format of the BACT Analysis

The BACT analyses for this draft permit were conducted in accordance with EPA's *PSD and Title V Permitting Guidance for Greenhouse Gases* (March 2011), which outlines the steps for conducting a "top-down" BACT analysis. Those steps are listed below.

Step 1 Identify all potentially available control options.
Step 2 Eliminate technically infeasible control options.
Step 3 Rank remaining control options.
Step 4 Evaluate the most effective controls and document the results.
Step 5 Select BACT.

As part of the PSD review, CEMEX provided in their GHG permit application a 5-step top-down BACT analysis for the project's emission units and processes that are subject to PSD review for GHG emissions. EPA has reviewed CEMEX's BACT analysis for the kiln lines, which has been incorporated into this Statement of Basis. CEMEX relied upon the 2010 published EPA document entitled "Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Portland Cement Industry"[3] [*hereinafter*, "CI GHG Control White Paper" or "White Paper"] which provides GHG BACT guidance specific to the industry as there are only three other cement kiln projects that have completed GHG PSD review to date in the United States. Consequently, all of the recommended relevant control techniques for the scope of this

---

[3] EPA 2010, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From the Portland Cement Industry*, http://www.epa.gov/nsr/ghgpermitting.html Accessed July 29, 2013.

project covered in the white paper and measures to mitigate greenhouse gas emissions have been incorporated into this review.

VIII. Applicable Emission Units for BACT

The CEMEX Balcones Cement Plant modification involves installing multipath burners on each of the two kilns. Further, kiln 2 clinker production capacity is being increased by 10% over the existing PSD permit authorized levels being accomplished without further physical modifications to kiln line 2.

With this project, the projected actual emissions of GHG will increase over baseline actual emissions (accounting for emissions that could have been accommodated) by approximately 841,295 short tons CO_2e/year to a total sitewide annual allowable emissions of 2,397,328 short tons of GHGs (as CO_2e) . Approximately 45% of the GHG emissions are from the operation of kiln line 1 and 55% from kiln line 2.

As previously stated, GHG emissions originate from two distinct chemical processes that take place in each kiln line: calcination process CO_2 and fuel combustion CO_2, CH_4, and N_2O emissions,[4] Process related GHG emissions account for 57% of the CO_2e GHG emissions at the site. This source of CO_2 emissions is dependent upon the raw material used, which is obtained from the nearby limestone quarry at the site. The remaining 43% of the CO_2e GHG emissions originate from combustion of fuels as the heat source needed by pyroprocessing to produce clinker from the limestone and other raw materials. The site has some *de minimis* fugitive emissions from piping components associated with the existing and unmodified natural gas supply to the kilns, one of the authorized fuels for use in both kiln lines. Nitrous oxide (N_2O) and methane (CH_4) emissions from fuel combustion within each kiln line contribute a combined 0.7% of the total annual GHG CO_2e emissions at the site. Therefore, the scope of the BACT analysis is limited to the two kiln lines, in accordance with the control technology review requirements of 40 CFR§52.21(j)(3). These two lines are:

- Kiln Line 1 (EPN: PS-16)
- Kiln Line 2 (EPN: PS-77)

[4] Based on 2001 US cement industry data, Hanle, *et. al*, reported that calcining process CO_2 emissions accounted for approximately 54% of the CO_2 emissions from cement production while the remaining 46% was from fuel firing. Hanle, L. and K. Jayaraman *CO_2 Emissions profile of the U.S. Cement Industry*, paper presented at the13th International Emission Inventory Conference "Working for Clean Air in Clearwater", Clearwater, FL, June 8 - 10, 2004

IX. BACT Analysis for the kiln lines (EPNs: PS-16 and PS-77)

Potential control technologies relevant to the kiln lines fall into three categories: 1) kiln line energy efficiency measures, 2) the use of low emitting GHG fuels, and 3) add-on control measures. This analysis has identified 16 kiln line efficiency measures that could be employed in the project, an evaluation of fuels that might be used to reduce GHG emissions, and an evaluation of 4 means of CO_2 capture for subsequent sequestration and an evaluation of transportation and sequestration of the captured CO_2. These measures (some of which are already implemented or present in existing operations) are discussed below.

A. BACT Analysis Step 1 -Identification of Potential Control Technologies for GHGs

Efficiency Measures

Kiln Line Energy Efficiency Measure 1: Process control and management systems
The CI GHG Control White Paper recommends using automated control systems to maintain operating conditions in the kiln at optimum levels. The Balcones plant has automated control systems for both kiln 1 and kiln 2 which are integrated into a central control room. The kilns have an indirect firing system with the main characteristics of low amount of primary air, flame adjustment control and fuel rate control by the dosing equipment. Process gas analyzers are used by control room operators to monitor CO and O_2 levels to insure efficient combustion. The calciner fuel rate is automatically controlled based on the temperature of the gasses immediately prior to the partially calcined raw material entering the kiln, and the kiln main burner is adjusted by the operator depending of the oxygen levels, kiln burning zone temperature and clinker quality.

Kiln Line Energy Efficiency Measure 2: Kiln seal maintenance program. The CI GHG Control White Paper recommends that all facilities should have a regular maintenance plan for the kiln seals. Leaking seals can result in increased heat loss which increases fuel use. The CEMEX Balcones Plant has a maintenance routine to inspect the kiln seals weekly and during the major outages. Components of the kiln seals are replaced as needed based on inspections during kiln stops.

Kiln Line Energy Efficiency Measure 3: Kiln combustion system optimization. The CI GHG ControlWhite Paper recommends incorporating available technologies to optimize kiln combustion into kiln designs. Incomplete fuel burning, poor mixing of fuel with combustion air, and poorly adjusted firing can lead to increased fuel usage (as well as increased NOx and CO emissions).

The combustion system process for kilns 1 and 2 are designed to provide for efficient use of fuel. Kilns 1 and 2 have an indirect firing system with the main characteristics of low amount of primary air, flame adjustment control, and fuel rate control by the dosing equipment. The primary air accounts for 10 to 40% of the total air needed depending on the type of firing system. The additional 90 or 60% of the air is called secondary air and consists of hot air from the clinker cooler. The higher the secondary air the more efficient the combustion system.

Precalciner kilns like the Balcones Kiln 1 and Kiln 2 are designed to maximize the heat input to the calciner and typically 60% of fuel is fed to the calciner. Most of the air required by the combustion at the calciner is hot air from the clinker cooler. This air is known as tertiary air.

Mixing and heat transfer at the calciner has proven calcination levels above 90% and significantly reduces the thermal load at the kiln.

Kiln Line Energy Efficiency Measure 4: Use of fluxes and mineralizers to reduce energy demand. The CI GHG ControlWhite Paper recommends considering the use of fluxes and mineralizers to reduce the temperature at which the clinker melt begins to form in the kiln, promote formation of clinker compounds, and reduce the lower temperature limit of the tricalcium silicate stability range. The White Paper (pg. 20) states: "Fluorides are often used as a mineralizer and can reduce the sintering temperature by 190°F. Although there is a fuel savings, that savings may be offset by the high cost of the fluxing agent or mineralizer. CEMEX conducted a test using fluoride in a kiln at one of its other U.S. cement plants. Based on the test results, CEMEX evaluated the use of fluoride in kilns and determined the benefit in fuel savings does not offset the cost of the fluoride. There were also negative effects in quality of cement and concrete physical properties that prohibited the use at some plants. Therefore, CEMEX does not use fluxes and mineralizers in Kilns 1 and 2.

Kiln Line Energy Efficiency Measure 5: Kiln/preheater insulation inspection program. The CI GHG Control White Paper recommends proper insulation to keep heat loss through the kiln shell at a minimum. Kilns 1 and 2 are insulated with refractory brick and the preheaters are insulated with a combination of brick and castable over a light-weight insulating material. The kiln refractory is inspected during every major outage and portions of the refractory are replaced, as needed, depending on the condition.

Kiln Line Energy Efficiency Measure 6: Refractory material selection that maximizes long life and insulation efficiency. The CI GHG Control White Paper states: "The refractory bricks lining the combustion zone of the kiln protect the outer shell from the high combustion temperatures, as well as chemical and mechanical stresses. Although the choice of refractory materials is highly dependent on fuels, raw materials, and operating conditions, consideration should be given to refractory materials that provide the highest insulating capacity and have the longest life."

The kiln refractory for Kilns 1 and 2 is very standard for the cement industry and was selected based on the conditions of each zone (mainly thermal and chemical conditions). The refractory is inspected every major outage and it is replaced depending on the condition.

Kiln Line Energy Efficiency Measure 7: Grate cooler conversion. The CI GHG ControlWhite Paper recommends replacing planetary and travelling grate coolers with a more energy efficient reciprocating grate coolers as an option for improving energy efficiency. Kilns 1 and 2 are equipped with reciprocating grate coolers which recuperate heat back to the kiln. The secondary air coming from the coolers provide oxygen for combustion and heat recuperated from the clinker improving the overall kiln energy efficiency.

Kiln Line Energy Efficiency Measure 8: Heat recovery from kiln and clinker cooler exhausts. The CI GHG Control White Paper states: "There are several exhaust streams in the cement manufacturing operation that contain significant amounts of heat energy, including the clinker cooler exhause, and kiln preheater and precalciner exhaust. Generally only long dry kilns produce exhaust gases with temperatures high enough to make heat recovery for power economical….Heat recovery for power may not be possible at facilities with in-line raw mills where the waste heat is used to extensively dry the raw materials…" Kilns 1 and 2 have in-line raw mills, where the waste heat from the kiln and precalciners are used to dry and preheat the raw materials. The exhaust from the clinker coolers is used partly as secondary air which provide oxygen and heat to the kilns and also to provide heat for drying the coal and petroleum coke.

Kiln Line Energy Efficiency Measure 9: Suspension preheater low pressure drop cyclones. The CI GHG Control White Paper recommends the use of low pressure drop cyclones as a method of improving energy efficiency. The preheater cyclones and duct areas associated with Kilns 1 and 2 are designed to minimize pressure drop and to minimize the dust lost in the preheater. These cyclones are used to allow intimate contact between hot kiln exhaust gases and the raw material passing thru the cyclones, thus efficiently preheating and calcining the raw meal prior to entering the kiln.

Kiln Line Energy Efficiency Measure 10: Multistage preheater. The CI GHG Control White Paper recommends converting to multistage preheaters to allow higher energy transfer efficiency and lower fuel requirements. Kiln lines 1 and 2 are equipped with multi-stage preheaters consisting of several cyclones in suspension. The material is fed at the top of the preheater and exchange heat with hot gases from the kiln as they pass thru the various stages and cyclones. The intimate contact between the material and the hot gas in each cyclone allows for efficient heat exchange between materials.

Kiln Line Energy Efficiency Measure 11: Conversion of long dry kiln to preheater/precalciner kiln. The CI GHG Control White Paper recommends reducing energy consumption by converting a long dry kiln to a preheater/precalciner kiln. The CEMEX Kkilns 1 and 2 are both preheater/precalciner kilns.

Kiln Line Energy Efficiency Measure 12: Kiln drive efficiency. The CI GHG Control White Paper recommends using high efficiency motors to rotate the kiln. The Balcones Kiln 1 has a direct current adjustable speed drive and Kiln 2 has an alternating current adjustable speed drive. The variable frequency/speed drives installed at both kilns provides high energy efficiency motor control. Both kilns have a single pinion drive with a direct coupled gear coupling.

Kiln Line Energy Efficiency Measure 13: Adjustable speed drive for kiln fan. The CI GHG Control White Paper recommends installing adjustable speed drives on kiln fans for increased energy efficiency. Kilns 1 and 2 use variable frequency drives which allow for high efficiency of the kiln fans. The fan efficiency is maintained in different speeds using variable frequency drive instead of the damper operation where the fan efficiency is reduced while the damper is closing.

Kiln Line Energy Efficiency Measure 14: Mid kiln firing. The CI GHG Control White Paper states that: "Mid kiln firing, which is the practice of adding fuel (often scrap tires) at a point near the middle of the kiln, can result in reduced fuel usage thereby potentially reducing overall CO_2 emissions. This practice is most often used with long wet or long dry kilns." Mid-kiln firing is proven for long dry kilns but results are not the same for calciner kilns. In a long, dry kiln with mid-kiln firing, the combustion efficiency increases for two reasons: (1) the fuel at the main burner is reduced and (2) hot flame at mid-kiln firing will destroy and ensure complete combustion of the main fuel. The kiln in a calciner system is shorter than long dry or wet kilns and therefore do not have the adequate conditions for mid-kiln firing. Both kilns at Balcones are preheater/precalciner kilns.

Kiln Line Energy Efficiency Measure 15: Air mixing technology. The CI GHG Control White Paper states that: "Mixing air is the practice of injecting a high pressure air stream into a kiln to break up and mix stratified layers of gases within the kiln. Mixing the air improves the combustion efficiency. Due to the increased efficiency, less fuel is required, leading to lower CO_2 emissions." The type of mixing air technology discussed in the CI GHG Control White Paper is only needed if there is poor mixing at the burner pipe. CEMEX Kilns 1 and 2 have multichannel burners that allow for necessary mixing of fuel and air to complete combustion. Multichannel burners allow for adjustment of multiple streams of mixing air to complete combustion.

Kiln Line Energy Efficiency Measure 16: Preheater riser duct fuel firing. The CI GHG Control White Paper states that: "The operation of cement manufacturing operations that include a preheater prior to the kiln can be improved by firing a portion of the fuel in the riser duct to increase the degree of calcination in the preheater." In the CEMEX Kilns 1 and 2, a portion of the fuel is fired in the riser duct to increase the degree of calcinations in the preheater. Firing at the riser serves two functions: (1) more mixing and longer residence time for the fuel to complete combustion and (2) generate enough CO to destroy NO_x from the kiln by the reaction $NO + CO \rightarrow N_2 + CO_2$. This reaction has been reported to be catalyzed by limestone present in the hot meal.

Lower GHG emitting Fuels

Kilns 1 and 2 were previously authorized by TCEQ Air Permit 6048/PSD-TX-74M1 to fire the following fuels in the kiln/preheater system: coal, petroleum coke, natural gas, wood, tire derived fuel, other rubber products, and other alternative fuels including carpet products, non-asbestos containing shingles, construction and demolition waste, oil filter fluff, oily rags, oily wood, paper, cardboard, rick husks, and cotton gin residue. Fuel costs, fuel availability, and fuel reliability have primarily dictated the fuel mix used in the kilns but the permit, when originally issued, contained a special provision stating, in part that fuels other than coal and petroleum coke may make up a substantial portion of heat input. For example, Special Condition No. 4 states in part "… Alternate fuels shall at no time comprise more than 70 percent of the energy required to fire either kiln, including the preheater."[5]

The EPA PSD and Title V Permitting Guidance for Greenhouse Gases[6] states that "…permitting authorities might determine that, with respect to the biomass component of a facility's fuel stream, certain types of biomass by themselves are BACT for GHGs." This is based on the premise that CO_2 emissions from burning biomass are the result of carbon that has relatively recently been removed from the atmosphere through uptake by plants and thus does not have the global warming impact that burning fossil fuel has. Potential types of biomass that can be burned in the Balcones cement kilns already include:

- Wood
- Paper
- Cardboard
- Rice Husks,
- Pecan shells, and

[5] See Special Condition No 4 of TCEQ issued permit PSD-TX-74M1, issued February 6, 2010
[6] EPA. *PSD and Title V Permitting Guideance for Greenhouse Gases,* p10. EPA-457/B-11-001. March 2011. U.S. Environmental Protection Agency

- Cotton gin residue.

Globally, the 2011 average percent of thermal energy from fossil fuels (primarily coal and petroleum coke) used in grey clinker production was about 86.7% while in the United States, from 1990 to 2011, the average percentage use of those fossil fuels has dropped from 95.9 to 84.1%. [7] Cemex reported that their world wide average alternative fuel use was 27% in 2012, with a target of 35% for 2015. [8] While the Balcones facility has used fuels other than petroleum coke and coal in the fuel mix in the past, the burner modifications undertaken in this project will enable the better and more controlled use of fuels other than petroleum coke and coal in the two kilns.

Add-On Controls

Methods for CO_2 Capture for Subsequent Sequestration 1: The Calera Process. The Calera process captures carbon dioxide from flue gas and converts the gas to stable solid minerals. The process employs a scrubber with high pH water containing calcium, magnesium, sodium, and chloride as the scrubbing liquid. The CO_2 is absorbed by the water, converting it to a dissolved carbonic acid species. Pilot plant testing has only been in relation to the electric utility industry so the technology may be transferable to cement clinker production.

Methods for CO_2 Capture for Subsequent Sequestration 2: Membrane technology. The CI GHG Control White Paper indicates that membrane technology is being researched as a means to separate or adsorb CO_2 in the kiln exhaust. The captured CO_2 would then be purified and compressed for transport.

Methods for CO_2 Capture for Subsequent Sequestration 3: Superheated calcium oxide. The CI GHG Control White Paper noted that a superheated Calcium Oxide (CaO) process has also been identified as potential CO_2 control technology. The superheated CaO process separates the calcination and combustion reactions into independent chambers. The heat necessary to run the calciner is provided by circulating a stream of superheated CaO particles between a fluidized bed combustor and a fluidized bed calciner. Retrofits of an existing kiln would involve removal of existing preheaters and precalciners, construction of the fluidized beds, cyclones, heat exchangers, and compressors associated with the process.

Methods for CO_2 Capture for Subsequent Sequestration 4: Amine absorbtion. Of the emerging CO_2 capture technologies that have been identified, only amine absorption (post-combustion solvent capture and stripping) is currently commercially used for state-of-the- art CO_2 separation processes. Amine absorption has been applied to processes in the petroleum refining and natural gas processing industries and for exhausts from gas-fired industrial boilers but there has been little work discussing its feasibility at cement plants.

Transportation and Sequestration of Captured CO_2 emissions. If CO_2 capture can be achieved at a cement plant at full scale, it would need to be routed to a geologic formation capable of long-term storage. Due to volume, transportation of CO_2 would be most efficient

[7] World Business Council for Sustainable Development. Cement Sustainability Initiative, "*Global cement database on CO_2 and energy information*," Available at http://wbcsdcement.org, Last accessed September 6, 2013.
[8] CEMEX Corporation Annual Report for 2012 available at http://www.cemex.com/CEMEX_AR2012/eng/OurDNA.html. Last accessed September 6 2013.

via pipeline with the CO_2 being transported in the supercritical fluid state. The long-term storage potential for a geological storage formation is a function of the volumetric capacity of a geologic formation and CO_2 trapping mechanisms within the formation, including dissolution in brine, reactions with minerals to form solid carbonates, and/or adsorption in porous rock. The U.S. Department of Energy's National Energy Technology Laboratory (DOE-NETL) describes the geologic formations that could potentially serve as CO_2 storage sites as follows:

"Geologic carbon dioxide (CO_2) storage involves the injection of supercritical CO_2 into deep geologic formations (injection zones) overlain by competent sealing formations and geologic traps that will prevent the CO_2 from escaping. Current research and field studies are focused on developing better understanding of 11 major types of geologic storage reservoir classes, each having their own unique opportunities and challenges. Understanding these different storage classes provides insight into how the systems influence fluids flow within these systems today, and how CO_2 in geologic storage would be anticipated to flow in the future. The different storage formation classes include: deltaic, coal/shale, fluvial, alluvial, strandplain, turbidite, eolian, lacustrine, clastic shelf, carbonate shallow shelf, and reef. Basaltic interflow zones are also being considered as potential reservoirs. These storage reservoirs contain fluids that may include natural gas, oil, or saline water; any of which may impact CO_2 storage differently…"[9]

B. BACT Analysis Step 2: Eliminate Technically Infeasible Options

Of the 16 identified control methods addressing energy efficiency and kiln design options, 2 have been eliminated due to being technically infeasible. The control options so eliminated are as follows:

Kiln Line Energy Efficiency Measure 4: Use of fluxes and mineralizers to reduce energy demand. CEMEX conducted a test using fluoride in a kiln at one of its other U.S. cement plants. Based on the test results, CEMEX evaluated the use of fluoride in kilns and determined the benefit in fuel savings does not offset the cost of the fluoride. There were also negative effects in quality of cement and concrete physical properties that prohibited the use at some plants. Therefore, CEMEX considers and the EPA agrees that the use of flues and mineralizers is technically and economically infeasible at this facility.

Kiln Line Energy Efficiency Measure 14: Mid kiln firing. The kilns are preheater/precalciner design which are physically shorter than long dry or wet kilns and therefore do not have the adequate conditions for mid-kiln firing. EPA concludes that this control technology is technically infeasible for this existing facility.

EPA has concluded that none of the 4 potential methods to capture CO_2 from clinker production are technically feasible. The reasons include:

The Calera Process. This technology has not been implemented on a full scale basis and pilot plant testing has only been in relation to the electric utility industry.

---

[9] DOE-NETL, *Carbon Sequestration: Geologic Storage Focus Area*, http://www.netl.doe.gov/technologies/carbon_seq/corerd/storage.html (last visited August 1, 2013)

Membrane Technology. According to the 2010 CI GHG Control White Paper, this technology is still primarily in the research stage, with industrial application at least 10 years away. There are significant problems to overcome designing membrane reactors large enough to handle the kiln exhaust.

Superheated Calcium Oxide. Superheated CaO simulations have shown that the superheated CaO process is theoretically feasible; however, the system remains theoretical with no systems yet built according to the CI GHG Control White Paper.

Amine Absorber. Amine absorption has been applied to processes in the petroleum refining and natural gas processing industries and for exhausts from gas-fired industrial boilers but there has been little work discussing its feasibility at cement plants. The CI GHG ControlWhite Paper listed the following technical issues associated with using post-combustion amine scrubbing at a cement kiln:

- Additional Steam Requirements. One of the major issues with using MEA CO_2 capture is the large steam requirement for solvent regeneration. The CEMEX Balcones plant currently does not have steam generation capabilities.
- Sulfur Dioxide (SO_2). The concentration of SO_2 in the flue gas from the cement process is important for post-combustion capture with amines because amines react with acidic compounds to form salts that will not dissociate in the amine stripping system.
- Nitrogen Dioxide (NO_2). NO_x within the flue gas is problematic for MEA absorption as this results in solvent degradation.
- Dust. The presence of dust reduces the efficiency of the amine absorption process. The dust level must be kept below 15 mg/Nm^3.
- Reducing Conditions. The clinker must not be generated in reducing conditions and an excess of oxygen must be maintained in the process.
- Heat Reduction for MEA Absorption. The flue gas must be cooled from about 110°C to about 50°C to meet the ideal temperature for CO_2 absorption with MEA.
- Other Gases. The presence of any acidic components will reduce the efficiency of the MEA absorption process.

Notwithstanding that the above technology may be transferrable to the cement industry, there are no installations where amine absorption has been implemented at a cement clinker production facility to date.

CO_2 Transportation and Sequestration. Even if it is assumed that CO_2 capture and compression could feasibly be achieved for the proposed project, the high-volume CO_2 stream generated would need to be transported to a facility capable of storing it. Potential geologic storage sites for CO_2 sequestration in Texas, Louisiana, and Mississippi to which CO_2 could be transported if a pipeline was constructed are delineated in Figure 2 at the end of this document.[10] The potential length of such a CO_2 transport pipeline is uncertain due to

[10] Susan Hovorka, University of Texas at Austin, Bureau of Economic Geology, Gulf Coast Carbon Center, *New Developments: Solved and Unsolved Questions Regarding Geologic Sequestration of CO2 as a Greenhouse Gas*

the uncertainty of identifying a site(s) that is definitively suitable for large-scale, long-term CO_2 storage. The hypothetical minimum length required for any such pipeline(s) will be the distance to the closest site with recognized potential for some geological storage of CO_2, storage in saline formations, or use in enhanced oil recovery (EOR) operations.

While the potential exists for long-term CO_2 storage in saline formations along the Texas Gulf Coast, none are currently being utilized for CO_2 storage. In comparison, the closest site that is currently being field-tested to demonstrate its capacity for large-scale geological storage of CO_2 is the Southeast Regional Carbon Sequestration Partnership's (SECARB) Cranfield test site, which is located in Adams and Franklin Counties, Mississippi over 400 miles away (see location map at Figure 2 at the end of this document for the SECARB site location). Therefore, to access this potentially large-scale storage capacity site, assuming that it is eventually demonstrated to indefinitely store a substantial portion of the large volume of CO_2 generated by the proposed project, a very long and sizable pipeline would need to be constructed to transport the large volume of high-pressure CO_2 from the plant to the storage facility

The suitability of potential storage sites is a function of volumetric capacity of their geologic formations, CO_2 trapping mechanisms within formations (including dissolution in brine, reactions with minerals to form solid carbonates, and/or adsorption in porous rock), and potential environmental impacts resulting from injection of CO_2 into the formations. Potential environmental impacts resulting from CO_2 injection that still require assessment before Carbon Capture and Sequestration/Storage (CCS) technology can be considered feasible include:

- Uncertainty concerning the significance of dissolution of CO_2 into brine,
- Risks of brine displacement resulting from large-scale CO_2 injection, including a pressure leakage risk for brine into underground drinking water sources and/or surface water,
- Risks to fresh water as a result of leakage of CO_2, including the possibility for damage to the biosphere, underground drinking water sources, and/or surface water,12 and
- Potential effects on wildlife.

Potentially suitable storage sites, including EOR sites and saline formations, exist in Texas, Louisiana, and Mississippi. The closest EOR sites with such recognized potential for some geological storage of CO_2 are located within 50 miles of the proposed project, but such nearby sites have not yet been technically demonstrated with respect to all of the suitability factors described above. The closest active CO_2 pipeline and EOR area is Denbury's Green Pipline which runs to the Hastings oil field south/southeast of Houston, Texas which is approximately 175 miles from Cemex. In comparison, the closest site that is currently being field-tested to demonstrate its capacity for geological storage of the volume of CO_2 that is currently being generated and which would see increased GHG emissions with this cement clinker project, is the previously mentioned SECARB's Cranfield test site located in western Mississippi, over 400 miles away. It should be

Reduction Method (GCCC Digital Publication #08-13) at slide 4 (Apr. 2008), available at: http://www.beg.utexas.edu/gccc/forum/codexdownloadpdf.php?ID=100(last visited Aug. 8, 2011).

noted that, based on the suitability factors described above, the suitability of the Cranfield site or any other test site to store a substantial portion of the large volume of CO_2 generated by the proposed project has yet to be fully demonstrated. Consequently, CCS is considered not technically feasible at the present time.

C. BACT Analysis Step 3: Rank Remaining Control Technologies

As documented above, EPA has determined that that implementation of CCS technology is currently infeasible, leaving energy efficiency measures and the use of lower GHG generating fuels (biomass, etc) as the only technically feasible emission reduction options. As all of the remaining technically feasible energy efficiency related processes, practices, and designs discussed above are being proposed for this project, as is the use, at least in part of lower GHG intensive fuels, a ranking of the control technologies is not necessary for this application.

D. BACT Analysis Step 4: Evaluate Most Effective Controls and Document Results

While CCS technology was eliminated in Step 2 above as being technically infeasible, the economics of implementation are also here considered to reflect a more thorough evaluation of the option and to discuss an additional basis for its elimination. The relative costs of implementing a CCS solution is provided here.

The International Energy Agency (IEA) Greenhouse Gas R&D Programme conducted a study to assess the technologies that could be used to capture CO_2 in cement production and their associated performance and costs.[11] The technical and economic assessments were based on a new preheater/precalciner cement plant in the United Kingdom producing 1 million tonnes/year of cement (910,000 ton/yr of cement).

The post combustion CO_2 capture technology chosen for the study was CO_2 absorption using monoethynolamine (MEA). The study listed the main additions to the plant for post combustion CO_2 capture as: a CO_2 capture plant including a solvent scrubber and regenerator; a compressor to increase the pressure of the CO_2 product for transport by pipeline; high efficiency flue gas desulfurization and de-NO_x to satisfy the flue gas purity requirements of the CO_2 capture process; and a plant to provide the steam required for regeneration of the CO_2 capture solvent. The initial capital cost for a CO_2 capture system was estimated to be $295 €/tonne cement ($401.44/ton cement at the 1.5 $/€ exchange rate used in the study). The average annual cost per tonne of CO_2 emissions avoided in the IEA study for CO_2 capture and compression was calculated to be 118.15 €/tonne ($146.15/ton at the 1.5 $/€ exchange rate used in the study).

Scaling the results of the study to fit the characteristics of the CEMEX facility, the projected costs for installation of CO_2 capture equipment for the Balcones Kiln 1 and 2 would be $1,013,000,000. For comparison purposes, the estimated capital cost for the upgrades to the main kiln burners in Kiln No. 1 and Kiln No. 2 to multipath adjustable units is $750,000. Implementation of post combustion carbon capture system alone for Kilns 1 and 2 would

[11] IEA Greenhouse Gas R&D Programme (IEA GHG), *CO2 Capture in the Cement Industry*, Final Report, July 2008

result in initial capital costs of approximately 1,350 times higher than the projected project costs.

Transportation of supercritical CO_2 by pipeline is technically feasible but expensive. Based on recent studies reported in the "Report of the Interagency Task Force on Carbon Capture and Storage"[12], pipeline transport costs for a 100 kilometer (62 mile) pipeline transporting 5 million tonnes per year range from approximately $1 per tonne to $3 per tonne ($0.91 per ton to $2.72 per ton). The distance from the CEMEX Balcones Plant to the nearest existing oil recovery site with a recognized potential for some geological storage of CO_2 is 170 miles, while the distance to the nearest potential unproven enhanced oil recovery site in Karnes County is 50 miles. Conservatively assuming that the pipeline cost is linear, the estimate average annual cost for just CO_2 transport would be $1.46/ton CO_2 avoided if a EOR were currently available in Karnes County.

It was also reported in "Report of the Interagency Task Force on Carbon Capture and Storage"[13] that the costs associated with CO_2 storage have been estimated to be approximately $0.4 – 20/tonne plus $0.16 – 0.30/tonne CO_2 stored for monitoring. The average annual cost on a $/ton CO2 storage basis for storage and monitoring would be $9.33/ton. A summary of the calculated annual costs associated with a CCS system is shown in the following table. This is a very high annual cost and would make the proposed project economically nonviable if selected.

Table 2. Annual Cost Analysis for CEMEX Balcones Cement Plant CCS

Activity	Cost /ton CO_2 Avoided	Potential Tons of CO_2 Avoided Per Year	Total Projected Annual Operating Cost (Million $ per Year)
Capture and Compression	$146.15	2,157,593	$315.33
Transport	$1.46	2,157,593	$3.15
Storage and Monitoring	$9.33	2,157,593	$20.13
Total CCS System Cost	$156.94		$338.61

E. BACT Analysis Step 5: Select BACT

The following system design elements which have already been implemented at the site are BACT requirements:

- Kiln refractory material selection that maximizes long life and insulation efficiency
- Use of reciprocating grate clinker coolers
- Use of in-line raw mills which recover heat from the kiln exhausts

[12] *Report of the Interagency Task Force on Carbon Capture and Storage*, p. 37 (Aug. 2010) (http://www.epa.gov/climatechange/policy/ccs_task_force.html)

[13] *Ibid.*, p. 44 (Aug. 2010)

- Use of clinker cooler exhaust as secondary air to provide oxygen and heat to the kilns
- Use of suspension preheater low pressure drop cyclones
- Use of preheater/precalciner kilns
- Use of efficient, variable frequency drives for kilns
- Use of efficient, variable frequency drives for kiln fans

The following energy efficiency process controls and workpractices are BACT for the project:

- Kiln process control and management system
- Kiln seal maintenance program
- Kiln combustion system optimization
- Kiln/preheater insulation inspection program
- Use of multichannel kiln burners that allow for necessary mixing of fuel and air to complete combustion
- Firing a portion of the fuel in the preheater riser duct
- Use of Lower GHG emitting fuels including natural gas and biomass. As stated previously, the implementation of multichannel burners will not only result in more efficient combustion of primary fuels, it will make possible the more efficient use of lower GHG emitting fuels, that is, fuels other than coal and petroleum coke. However, the use of biomass is limited by cost, availability, and kiln process variables including high moisture or high chlorides content. Because biomass wastes have heating values that are typically lower than heating values for coal and petroleum coke, more biomass is needed to provide the same heating value as a given weight of coal or petroleum coke. Higher chlorides contents of fuels can negatively affect the quality of the cement product from the kiln. Therefore the exact mix of fuels to be used is based on a mix of fuel availability, quality, quantity, cost, and effect on product; nevertheless, lower GHG emitting fuels (fuels other than coal and petroleum coke) must make up a technically feasible and economically reasonable percentage of all fuel used, up to 35%, on a mmBTU basis, the total heat input annually for both kilns combined. The exact minimum percentage of heat input required will the lesser of 35% or the maximum sustainable value based on the results of a study to be undertaken in the first 24 months of permit issuance, and during the study, a minimum percentage of 10% is required.

The following emissions limits are the proposed BACT limits for Kiln line 1 and Kiln line 2, which are in units of tons of CO_2e per rolling 12-month average values:

- 0.41 tons CO_2e per ton of clinker attributable to kiln fuel combustion; and,
- 0.54 tons CO_2e per ton of clinker attributable to process (calcining) emissions; and,
- 0.95 tons CO_2e per ton of clinker attributable to combined fuel firing and process emissions.

Demonstration of compliance with the energy efficiency, workpractice, and kiln design BACT limits shall be demonstrated by implementing the following:

- For system design BACT elements, design elements already implemented will be tracked via a GHG monitoring plan, which includes the documentation of all maintenance or corrective actions taken.

- For energy efficiency and process controls and workpractice BACT elements, documentation of the methods used and actions taken shall be documented as part of the GHG monitoring plan.
- For heat input and CO_2e emission limitation (ton/yr and ton CO_2e/ton clinker) BACT requirements:
- Fuel use shall be monitored and calorific value determined on a frequency appropriate for the fuel type to assure that the rolling 12-month total heat input per kiln and the heat input from coal and petroleum coke and other fuels are met (mmBTU basis). Values are calculated monthly.
- Emissions of CO_2 shall be continuously monitored for each kiln to allow for daily calculation of the 30-day rolling average related limitations on clinker CO_2e .
  - Emissions of N_2O and CH_4 shall be determined by calculation based on fuel fired daily for compliance with the various pollutant specific and CO_2e limitation determinations needed.
  - Determination of clinker emissions factor and kiln dust emissions factors monthly to assure compliance with the per ton clinker based emissions limits.

BACT Analysis Discussion – Comparison with recently issued cement production PSD permits.

CEMEX performed a search of the EPA's RACT/BACT/LAER Clearinghouse for Portland cement kilns and found no entries which address BACT for GHG emissions at the time of their permit application. EPA subsequently performed a search and found only one entry reglated to Portland cement manufacturing, that of Universal Cement in Chicago, Ill. Although not listed in the RACT/BACT/LAER Clearinghouse, a GHG BACT analysis was performed by the following Portland Cement Plants: LaFarge Building Materials, Inc., Town of Coeymans, New York (commonly known as the Ravena Plant), Carolinas Cement Company in Castle Hayne, North Carolina, and . A discussion of EPA's BACT as compared to those projects is provided below:

LaFarge Ravena Plant

The proposed LaFarge project would replace the existing "wet" cement-making process at the Ravena Plant with a preheater/precalciner "dry" cement-making process. The proposed capacity of the modified plant was 2.81 million tons of clinker per year. The kiln system was designed to fire coal, petroleum coke, oil, and tire derived fuel. PSD Permit 4-0124-00001/00112 was issued on July 19, 2011. The permit included a GHG emission limit for the kiln system of 1900 pounds (0.95 tons) of CO_2e per ton of clinker, rolling 12-month average.

Universal Cement

Universal Cement proposed construction of a new preheater/precalciner kiln system capable of producing about 1 million tons per year of clinker. The clinker production train consists of an in-line raw mill, a blending silo, kiln system (preheat tower, precalciner, rotary kiln), clinker cooler and a solid fuel mill. Other equipment in the project includes clinker storage silos, a finish mill, and the associated raw material, solid fuel and finished product handling equipment. The kiln system was designed to fire coal and petroleum coke in the kiln and the precalciner; scrap tires, as available, in the precalciner; and natural gas or propane during kiln startup. Permit 031600GVX was issued by the Illinois Environmental Protection Agency on December 20, 2011. The permit included a GHG emission limit for the kiln system of 1860 pounds (0.93 tons) of CO_2 equivalent per ton of clinker, rolling 12-month average.

Carolinas Cement Company

Carolinas Cement Company proposed to construct a new Portland cement manufacturing facility at the site of an existing cement storage terminal near Castle Hayne, North Carolina. The proposed plant consisted of a multistage preheater/precalciner kiln with an in-line raw mill, coal mill, alkali bypass and clinker cooler venting through the main stack. Production was proposed to be 6000 tons per day (tons/day) and 2,190,000 tons per year (tons/yr) of clinker. Fuels included coal, petroleum coke, biomass fuels (organic material that is available on a renewable or recurring basis), and distillate fuel oil. Coal and petroleum coke was proposed as the primary fuels. Biomass was proposed to be utilized to the extent practical depending on performance, availability, and economic viability. Fuel oil was proposed to be used mainly for kiln startup. Permit O7300R09 was issued by the North Carolina Department of Environment and Natural Resources on February 29, 2012. The permit included a GHG emission limit for the kiln system of 0.91 tons of CO_2 equivalent per ton of clinker, rolling 12-month average, determined with procedures used for reporting GHG emissions pursuant to 40 CFR Part 98.

GCC Rio Grande, Inc Pueblo Cement Plant

GCC Rio Grande, Inc. (GCC) was authorized on July 9, 2012 by the Colorado Department of Public Healther and Environment in Permit 98PB0893 (Modification No. 5) to increase clinker production and to incorporate the use of tire derived fuels at their Pueblo Colorado cement manufacturing facility. The review included triggering PSD review for several criteria pollutants and for GHG. The GHG controls selected for the project as BACT included the following:

- Continued use of the modern, high efficiency preheater/precalciner kiln process.
- Continued use of all the latest high-efficiency equipment systems installed throughout the facility.
- Continued implementation of a sustainability program to reduce overall GHG emissions from the Facility. This program will continue evaluating the use of new additives, raw materials, and fuels consistent with the availability and cost of materials while continuing to maintain the quality of the cement product, and continuing to utilize the high-efficiency, pyro-processing design in place.

The BACT limit was set at 0.95 tons of carbon dioxide equivalent (CO_2e) per ton of clinker.

CEMEX Balcones Cement Plant

EPA agrees that the CEMEX' proposed BACT limit of 0.95 ton CO_2e/ton clinker per kiln line is equivalent to the BACT limit for the Ravena Plant modification but slightly higher than the BACT limit for the new Universal Cement Plant and the new Carolinas Cement Company Plant. The new, greenfield facilities can take advantage of original design of more stages in the preheater tower and better and more energy efficient material handling equipment than is within the scope of the CEMEX modification. However, the CEMEX facility, as an existing facility, is the only facility of the four being compared here with known kiln specific CO_2e/ton clinker process and fuel firing emissions rates. While the Ravena site is not undergoing major renovations for the existing material handling systems, they are changing the main kiln design and installing a new preheater tower and precalciner, thereby affording them the opportunity to make better use of the more energy efficient stages of preheat than is proposed for the CEMEX project. Process emissions are a major portion of the CO_2 emissions from cement clinker manufacturing, and the fact that the CEMEX process based CO_2 emissions are larger than the 2001 US average (57% vs 54%,)[14] and are known based on current process data at this existing facility, the BACT limitation of 0.95 ton CO_2e/ton clinker together with the limitations on annual fuel heat input and the imposed limits for CO_2 emissions per ton of clinker between fuel (0.41 ton CO_2e/ton clinker) and process (0.54 ton CO_2e/ton clinker) is reasonable and appropriate as BACT for this project.

[14] See discussion on page 8 above.

X. Endangered Species Act

Pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) (16 U.S.C. 1536) and its implementing regulations at 50 CFR Part 402, EPA is required to insure that any action authorized, funded, or carried out by EPA is not likely to jeopardize the continued existence of any federally-listed endangered or threatened species or result in the destruction or adverse modification of such species' designated critical habitat.

To meet the requirements of Section 7, EPA is relying on a Biological Assessment (BA) prepared by the applicant, CEMEX Construction Materials South, LLC ("CEMEX"), and its consultant, Zephyr Environmental Corporation, ("Zephyr"), and adopted by EPA.

A draft BA has identified thirteen (13) species listed as federally endangered or threatened in Comal County, Texas:

Federally Listed Species for Comal County by the U.S. Fish and Wildlife Service (USFWS) and the Texas Parks and Wildlife Department (TPWD)	**Scientific Name**
Plant	
Texas wild-rice	*Zizania texana*
Birds	
Black-capped vireo Golden-cheeked warbler Whooping Crane	*Verio atricapilla* *Setophaga chrysoparia* *Grus americana*
Fish	
Fountain darter	*Etheostoma fonticola*
Crustacean	
Peck's cave amphipod	*Stygobromus pecki*
Mammals	
Black Bear Jaguarundi Red Wolf	*Ursus americanus* *Herpailurus yaguarondi* *Canis rufus*
Insects	
Comal Springs riffle beetle Comal Springs dryopid beetle	*Comaldessus stygius* *Stygoparnus comalensis*
Amphibians	
San Marcos salamander Texas blind salamander	*Eurycea nana* *Typhlomolge rathbuni*

EPA has determined that issuance of the proposed permit will have no effect on any of the thirteen listed species, as there are no records of occurrence, no designated critical habitat, nor potential suitable habitat for any of these species within the action area.

Because of EPA's "no effect" determination, no further consultation with the USFWS is needed.

Any interested party is welcome to bring particular concerns or information to our attention regarding this project's potential effect on listed species. The final draft biological assessment can be found at EPA's Region 6 Air Permits website at http://yosemite.epa.gov/r6/Apermit.nsf/AirP.

XI. National Historic Preservation Act (NHPA)

Section 106 of the NHPA requires EPA to consider the effects of this permit action on properties eligible for inclusion in the National Register of Historic Places. To make this determination, EPA relied on and adopted a cultural resource report prepared by Horizon Environmental Services, Inc. ("Horizon") on behalf of Zephyr submitted on August 30, 2013.

For purposes of the NHPA review, the Area of Potential Effect (APE) was determined to be location of the two existing cement kilns within the existing cement production facility. Horizon conducted a desktop review within a 1.0-mile radius area of potential effect (APE). The desktop review included an archaeological background and historical records review using the Texas Historical Commission's online Texas Archaeological Site Atlas (TASA) and the National Park Service's National Register of Historic Places (NRHP). Based on the desktop review, one cultural resources survey, that included a field survey, was previously performed in 1978 with an APE that includes the current APE of this project. No cultural resources were recorded at the location of the kilns during this prior survey. Based on the desktop review, two previously recorded archaeological sites were identified within 1-mile of the APE; however, neither site was recommended to be eligible for listing on the Nation Register.

EPA Region 6 determines that because no historic properties are located within the APE and that a potential for the location of archaeological resources within the construction footprint itself is low, issuance of the permit to CEMEX will not affect properties potentially eligible for listing on the National Register.

On September 10, 2013, EPA sent letters to Indian tribes identified by the Texas Historical Commission as having historical interests in Texas to inquire if any of the tribes have historical interest in the particular location of the project and to inquire whether any of the tribes wished to consult with EPA in the Section 106 process. EPA received no requests from any tribe to consult on this proposed permit. EPA will provide a copy of the report to the State Historic Preservation Officer for consultation and concurrence with its determination. Any interested party is welcome to bring particular concerns or information to our attention regarding this project's potential effect on historic properties. A copy of the report may be found at http://yosemite.epa.gov/r6/Apermit.nsf/AirP.

XII. Environmental Justice (EJ)

Executive Order (EO) 12898 (59 FR 7629 (Feb. 16, 1994)) establishes federal executive branch policy on environmental justice. Based on this EO, the EPA's Environmental Appeals Board (EAB) has held that environmental justice issues must be considered in connection with the issuance of federal PSD permits issued by EPA Regional Offices [See, e.g., *In re Prairie State Generating Company*, 13 E.A.D. 1, 123 (EAB 2006); *In re Knauf Fiber Glass,* Gmbh, 8 E.A.D. 121, 174-75 (EAB 1999)]. This permitting action, if finalized, authorizes emissions of GHG controlled by what we have determined is BACT for those emissions. It does not select environmental controls for any other pollutants. Unlike the criteria pollutants for which EPA has historically issued PSD permits, there is no NAAQS for GHGs. The global climate-change inducing effects of GHG emissions, according to the "Endangerment and Cause or Contribute Finding", are far-reaching and multi-dimensional (75 FR 66497). Climate change modeling and evaluations of risks and impacts are typically conducted for changes in emissions that are orders of magnitude larger than the emissions from individual projects that might be analyzed in PSD permit reviews. Quantifying the exact impacts attributable to a specific GHG source obtaining a permit in specific places and points would not be possible [PSD and Title V Permitting Guidance for GHGS at 48]. Thus, we conclude it would not be meaningful to evaluate impacts of GHG emissions on a local community in the context of a single permit. Accordingly, we have determined an environmental justice analysis is not necessary for the permitting record.

XIII. Conclusion and Proposed Action

Based on the information supplied by CEMEX, our review of the analyses contained in the TCEQ PSD Permit Application and Permit and the GHG PSD Permit Application, and our independent evaluation of the information contained in our Administrative Record, it is our determination that the proposed conditions in the draft permit represent BACT for GHGs. Therefore, EPA is proposing to issue CEMEX a PSD permit for GHGs for the facility, subject to the PSD permit conditions specified therein. This permit is subject to review and comments. A final decision on issuance of the permit will be made by EPA after considering comments received during the public comment period.

APPENDIX: Annual Facility Emission Limits

Table 1. Maximum annual heat input, clincker production, emissions limitations, and BACT limitations for kiln lines 1 and 2.

FIN	EPN	Description	Maximum Heat Input Limitation[1]		GHG Mass Basis Limitation[1]		CO_2e Limitation[1]	BACT Limitation
			MMBtu/year		GHG[2]	TPY[2]	TPY[2]	Rolling 12-month average
KF13	PS-16	Kiln Line No. 1 used to produce cement clinker.	4,102,239		CO_2	463,088	463,088	0.41 ton CO_2e /ton clinker from fuel firing
					CH_4	49.74	1,045	
					N_2O	7.24	2,244	
					Total	--	466,377	
KILN2	PS-77	Kiln Line No. 2 used to produce cement clinker.	4,998,420		CO_2	564,254	564,254	0.41 ton CO_2e /ton clinker from fuel firing
					CH_4	60.61	1,273	
					N_2O	8.82	2,734	
					Total	--	568,261	
FIN	**EPN**	**Description**	**Maximum Clinker Production Limitation[1]**		**GHG Mass Basis Limitation[1]**		**CO_2e Limitation[1]**	**BACT Limitation**
			Tons/day 30-day rolling average	**Tons/yr 12-month rolling total**	**GHG[2]**	**TPY[2]**	**TPY[2]**	**Rolling 12-month average**
KF13	PS-16	Kiln Line No. 1	3,250	1,137,500	CO_2	614,250	614,250	0.54 ton CO_2e/ton clinker from raw material calcinations
KILN2	PS-77	Kiln Line No. 2	3,960	1,386,000	CO_2	748,440	748,440	0.54 ton CO_2e/ton clinker from raw material calcination
Both Kiln Systems Total (fuel firing and calcination)					**CO_2**	**2,390,032**	**2,397,328**	**0.95 tonCO_2e / ton clinker for each kiln system**
					CH_4	**110.35**		
					N_2O	**16.06**		

1. All annual limitations are based on a rolling 12- month period unless otherwise noted. Maximum heat input limitation is based on all fuels combined total heat input (million BTUs per year) in a rolling 12-month total. The fuel firing, production, emissions and BACT limitations specified in this table are not to be exceeded for this facility and include emissions from the facility during all operations, including maintenance, startup, and shutdown activities.
2. GHG= Greenhouse Gas. TPY=total tons per year, based a 12-month rolling total. CO_2e values calculated by multiplying the TPY mass basis limitation value by the Global Warming Potentials (GWP): CO^2=1, CH_4 = 21, N_2O = 310. Note that numbers may not add exactly due to rounding.

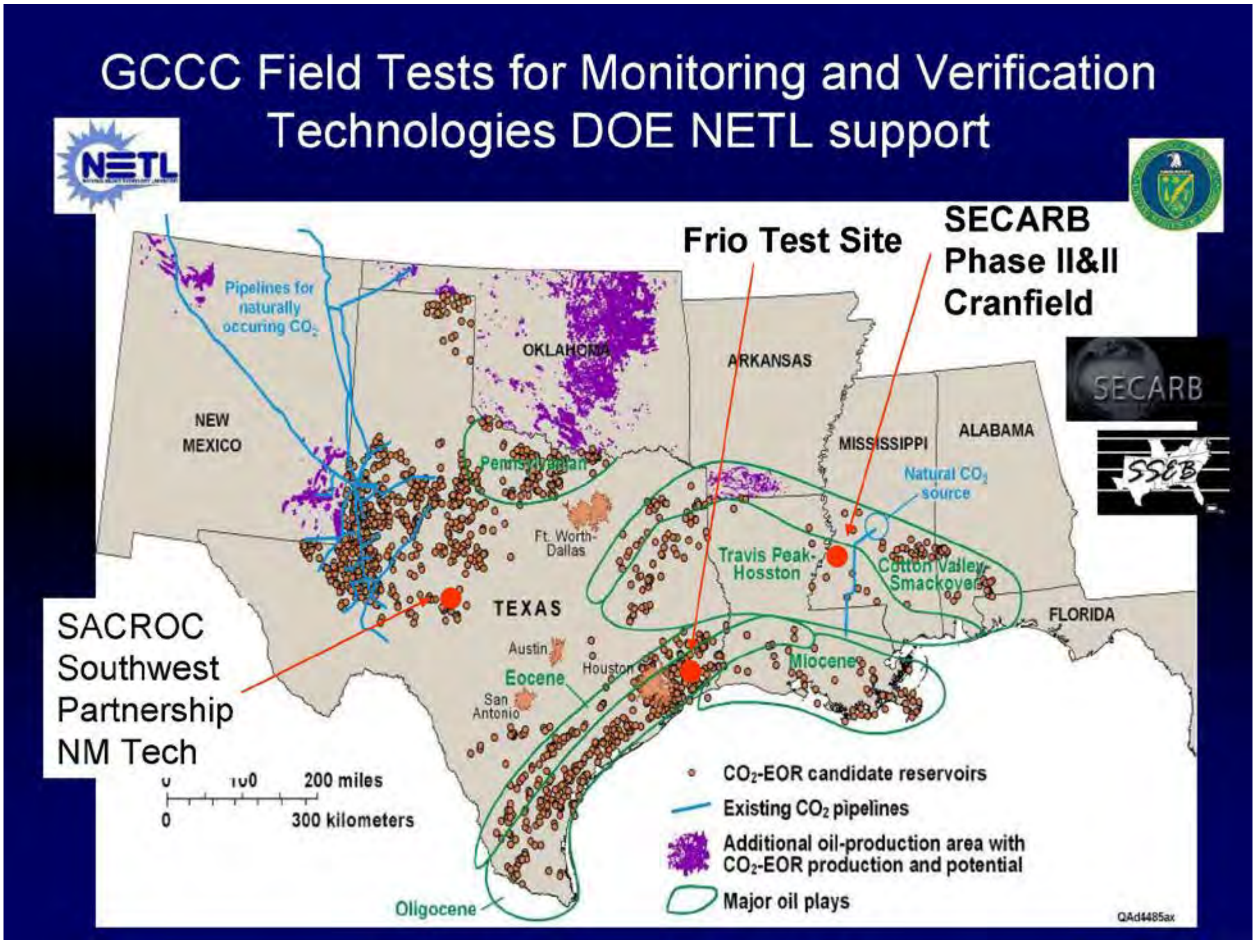


Figure 2. Location of potential CO_2 sequestration sites.

PREVENTION OF SIGNIFICANT DETERIORATION PERMIT FOR GREENHOUSE GAS EMISSIONS ISSUED PURSUANT TO THE REQUIREMENTS AT 40 CFR § 52.21

U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 6

PROPOSED DRAFT PSD PERMIT NUMBER:	**PSD-TX-74-GHG**
PERMITTEE:	CEMEX Construction Materials South, LLC
FACILITY NAME:	CEMEX – Balcones Cement Plant
FACILITY LOCATION:	2580 Wald Road New Braunfels, TX 78132

Pursuant to the provisions of the Clean Air Act (CAA), Subchapter I, Part C (42 U.S.C. Section 7470, *et. Seq.*), and the Code of Federal Regulations (CFR) Title 40, Section 52.21, and the Federal Implementation Plan at 40 CFR § 52.2305 (effective May 1, 2011 and published at 76 FR 25178), the U.S. Environmental Protection Agency, Region 6 is issuing a *Prevention of Significant Deterioration* (PSD) permit to CEMEX Construction Materials South, LLC Balcones Cement Plant (CEMEX) for Greenhouse Gas (GHG) emissions. Emissions of all non GHG pollutants are not addressed in or governed by this authorization.

CEMEX is authorized to increase clinker production from kiln line No. 2 to 3960 tons per day (30-day average) and upgrade the existing burners to multichannel adjustable burners in both the No. 1 and No. 2 kilns in accordance with the permit application (and plans submitted with the permit application), the federal PSD regulations at 40 CFR § 52.21, and other terms and conditions set forth in this PSD permit in conjunction with the corresponding Texas Commission on Environmental Quality (TCEQ) PSD Permit No. 6048/PSD-TX-74M2.

Failure to comply with any condition or term set forth in this PSD permit may result in enforcement action pursuant to Section 113 of the Clean Air Act (CAA). This PSD permit does not relieve CEMEX of the responsibility to comply with any other applicable provisions of the CAA (including applicable implementing regulations in 40 CFR Parts 51, 52, 60, 61, 72 through 75, and 98) or other federal and state requirements (including the state PSD program that remains under approval at 40 CFR § 52.2303).

In accordance with 40 CFR §124.15(b), this PSD Permit becomes effective 30 days after the service of notice of this final decision unless review is requested on the permit pursuant to 40 CFR §124.19.

_______________________________ _______________________

Wren Stenger, Director
Multimedia Planning and Permitting Division

Date

CEMEX – Balcones Cement Plant (PSD-TX-74-GHG)
Prevention of Significant Deterioration Permit
For Greenhouse Gas EmissionsP
Proposed Draft Permit Conditions

PROJECT DESCRIPTION

The basic steps in cement production include the milling of various raw materials, over 75% of which is limestone, combing those finely ground raw materials to form a meal that is then fed into a kiln (comprised of fired preheaters/precalciners, a fired rotating kiln, and forced draft clinker cooler), progressively heating the material to drive off moisture, to calcine the carbonate bearing materials (limestone, marl), and ultimately to fuse the various materials at very high temperatures (>2500° F) in the rotating portion of the kiln system to form molten clinker. The molten clinker forms clinker nodules as it is rapidly cooled using a clinker cooler and then ground together with other additives in the finish mills to form cement. The finely ground cement is then shipped by bulk rail or truck. GHG emissions are generated in cement production from two distinct sources: so called 'process' related emissions which are those from the calcining of limestone or marl to form lime, which liberates CO_2 in the process and from the combustion of the various fuels in the preheaters/precalciners and in the rotating kiln itself where the various raw materials are fused by high temperature to form cement clinker.

This permit authorizes GHG emissions for both the kiln line No. 1 and kiln line No. 2. Each of these lines is comprised of an in-line raw mill, raw material blending silos, preheaters, precalciners, a rotary kiln, clinker cooler, and solid fuel mills. Additional equipment at the site includes raw material handling systems, finish milling equipment, baghouses to capture product and to control particulate emissions, ancillary equipment and processes at the site including shipping systems, gaseous pollutant control systems and alternative fuel receiving, handling, and preparation systems, but none of the other systems result in GHG emissions.

This project includes two distinct changes to the kiln lines at the site. The first change affects kiln line No.2 only, and authorizes increased emissions to raise an existing production limitation from 3,600 to 3,960 tons of clinker per day (30-day rolling average). Clinker production from the kiln line No.1 remains unchanged at 3,250 tons of clinker per day (30-day rolling average). The kiln line No.2 production rate of 3,960 ton per 30- day rolling average requires no physical change to the kiln line to achieve but rather can be derived from the system as it was constructed in 2008.

The second change at the site addressed by this permit includes GHG emissions from the effect of upgrades to the main kiln burners in both kilns to multichannel adjustable units. The upgrades consist of adding a channel to allow the use of alternative fuels such as biomass and refuse derived fuel in the main kiln burners, fuels which were previously authorized in permit PSD-TX-74M1. The burner upgrades will not increase the maximum fuel firing rate for either kiln but will increase flexibility in the amount and kind of fuels (the fuel mix) that can be burned in the main kiln and result in potential energy efficiency improvements. The list of authorized fuels can be found in permit PSD-TX-74M1. That permit authorized the firing of natural gas, coal, and petroleum coke (pet coke) as primary fuels and also authorized multiple, specifically identified alternative fuels including wood products, carpet fibers, shingles, oil filter fluff, rice husks, and cotton gin residue. PSD-TX-74M2, among other things continues to govern the authorized and unchanged list of fuels that may be fired in either kiln line.

EQUIPMENT LIST

The following processes (identified by Facility Information Numbers (FIN) and Emission Point Number (EPN) are subject to this GHG PSD permit.

FIN	EPN	Description
KF13	PS-16	Kiln line No. 1 is used to produce cement clinker. The line includes kiln No. 1, the associated clinker cooler, preheated air from the clinker cooler being routed to the coal mill to dry the solid fossil fuel, preheater/precalciners with their fuel firing capacity and kiln fuel firing emissions which are routed through the inline raw mill when needed to dry the raw feed and then through the kiln No.1 main baghouse prior to discharge at EPN PS-16.
KILN2	PS-77	Kiln line No. 2 is used to produce cement clinker. The line includes kiln No. 2, the associated clinker cooler, preheated air from the clinker cooler being routed to the coal mill to dry the solid fossil fuel, preheater/precalciners with their fuel firing capacity and kiln fuel firing emissions which are routed through the inline raw mill when needed to dry the raw feed and then through the kiln No.2 main baghouse prior to discharge at EPN PS-77.

I. GENERAL PERMIT CONDITIONS

A. Permit Expiration

1. As provided in 40 CFR §52.21(r), this PSD Permit shall become invalid if construction:
    a. is not commenced (as defined in 40 CFR §52.21(b)(9)) within 18 months after the approval takes effect; or
    b. is discontinued for a period of 18 months or more; or
    c. is not completed within a reasonable time.
2. Pursuant to 40 CFR §52.21(r), EPA may extend the 18-month period upon a written satisfactory showing that an extension is justified.

B. Permit Notification Requirements

1. Permittee shall notify EPA Region 6 in writing and by electronic mail of the:
    a. date construction is commenced, postmarked within 30 days of such date;
    b. actual date of initial startup, as defined in 40 CFR §60.2, postmarked within 15 days of such date. The notice shall include a description of how the energy efficiency system design elements identified in Special Condition No. II.B.3 have been implemented at the site;
    c. date upon which initial performance tests will commence, in accordance with the provisions of Special Condition No.II.D, postmarked not less than 30 days prior to such date. Notification may be provided with the submittal of the performance test protocol required pursuant to Special Condition No.II.D.2.

C. Facility Operations

At all times, including periods of startup, shutdown, and maintenance, Permittee shall, to the extent practicable, maintain and operate the facility including associated air pollution control equipment in a manner consistent with good air pollution control practice for minimizing emissions. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the EPA, which may include, but is not limited to, monitoring results, review of operating maintenance procedures and inspection of the facility.

D. Malfunction Reporting

1. Permittee shall notify EPA by mail within 48 hours following the discovery of any failure of air pollution control equipment, process equipment, or of a process to operate in a normal manner, which results in an increase in GHG emissions above the allowable emission limits stated in Section II of this permit.
2. Within 10 days of the restoration of normal operations after any failure described in General Condition I.D.1 of this permit, Permittee shall provide a written supplement to the initial notification that includes a description of the malfunctioning equipment or abnormal operation, the date of the initial malfunction, the period of time over which emissions were increased due to the failure, the cause of the failure, the estimated resultant emissions in excess of those allowed in Section II, the methods utilized to mitigate emissions and the date normal operations were restored.
3. Compliance with this malfunction notification provision shall not excuse or otherwise constitute a defense to any violation of this permit or any law or regulation such malfunction may cause.

E. Right of Entry

1. EPA authorized representatives, or representatives of any air pollution control program with jurisdiction, upon the presentation of credentials, shall be permitted:
    a. to enter the premises where the facility is located or where any records are required to be kept under the terms and conditions of this PSD Permit;
    b. during normal business hours, to have access to and to copy any records required to be kept under the terms and conditions of this PSD Permit;
    c. to inspect any equipment, operation, or method subject to requirements in this PSD Permit; and,
    d. to sample materials and emissions from the source(s).

F. Transfer of Ownership

In the event of any changes in control or ownership of the facilities to be constructed, this PSD Permit shall be binding on all subsequent owners and operators. Permittee shall notify the succeeding owner and operator of the existence of the PSD permit and its conditions by letter; a copy of the letter shall be forwarded to EPA Region 6 within thirty days of the letter signature.

G. Severability

The provisions of this PSD Permit are severable, and, if any provision of the PSD Permit is held invalid, the remainder of this PSD Permit shall not be affected.

H. Adherence to Application and Compliance with Other Environmental Laws

Permittee shall construct and operate this project in compliance with this PSD Permit, the application on which this permit is based, TCEQ PSD Permit PSD-TX-74M2 and all other applicable federal, state, and local air quality regulations. This PSD permit does not release the Permittee from any liability for compliance with other applicable federal, state and local environmental laws and regulations, including the Clean Air Act.

I. Acronyms and Abbreviations

AVO	Auditory, Visual, and Olfactory
BACT	Best Available Control Technology
CAA	Clean Air Act
CC	Carbon Content
CCS	Carbon Capture and Sequestration
CEMS	Continuous Emissions Monitoring System
CFR	Code of Federal Regulations
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
dscf	Dry Standard Cubic Foot
EF	Emission Factor
EPN	Emission Point Number
FIN	Facility Identification Number
FR	Federal Register
GCV	Gross Calorific Value
GHG	Greenhouse Gas
gr	Grains
GWP	Global Warming Potential
HHV	High Heating Value
hr	Hour
HRSG	Heat Recovery Steam Generating
LAER	Lowest Achievable Emission Rate
lb	Pound
LDAR	Leak Detection and Repair
MAPD	Methyl Acetylene Propadiene
mmBtu	Million British Thermal Units
MSS	Maintenance, Start-up and Shutdown
NAAQS	National Ambient Air Quality Standards
NNSR	Nonattainment New Source Review
N2O	Nitrous Oxides
NSPS	New Source Performance Standards
PSD	Prevention of Significant Deterioration
QA/QC	Quality Assurance and/or Quality Control
SCFH	Standard Cubic Feet per Hour
SCR	Selective Catalytic Reduction
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TOC	Total Organic Carbon
TPY	Tons per Year
USC	United States Code
VDU	Vapor Destruction Unit
VHP	Very High Pressure
VOC	Volatile Organic Compound

II. PERMIT SPECIAL CONDITIONS

A. Fuel Firing, Clinker Production, GHG emissions, and BACT Limitations

Fuel firing, clinker production, GHG emissions, and BACT limitations for the facility are listed in Table 1 and may not be exceeded.

Table 1. Maximum annual heat input, clincker production, emissions limitations, and BACT limitations for kiln lines 1 and 2.

FIN	EPN	Description	Maximum Heat Input Limitation[1] MMBtu/year	GHG Mass Basis Limitation[1] GHG[2]	GHG Mass Basis Limitation[1] TPY[2]	CO_2e Limitation[1] TPY[2]	BACT Limitation Rolling 12-month average
KF13	PS-16	Kiln line No. 1 used to produce cement clinker.	4,102,239	CO_2	463,088	463,088	0.41 ton CO_2e /ton clinker from fuel firing
				CH_4	49.74	1,045	
				N_2O	7.24	2,244	
				Total	--	466,377	
KILN2	PS-77	Kiln line No. 2 used to produce cement clinker.	4,998,420	CO_2	564,254	564,254	0.41 ton CO_2e /ton clinker from fuel firing
				CH_4	60.61	1,273	
				N_2O	8.82	2,734	
				Total	--	568,261	

FIN	EPN	Description	Maximum Clinker Production Limitation[1] Tons/day 30-day rolling average	Maximum Clinker Production Limitation[1] Tons/yr 12-month rolling total	GHG Mass Basis Limitation[1] GHG[2]	GHG Mass Basis Limitation[1] TPY[2]	CO_2e Limitation[1] TPY[2]	BACT Limitation Rolling 12-month average
KF13	PS-16	Kiln line No. 1	3,250	1,137,500	CO_2	614,250	614,250	0.54 ton CO_2e/ton clinker from raw material calcinations
KILN2	PS-77	Kiln line No. 2	3,960	1,386,000	CO_2	748,440	748,440	0.54 ton CO_2e/ton clinker from raw material calcination
Both Kiln Systems Total (fuel firing and calcination)					**CO_2**	**2,390,032**	**2,397,328**	**0.95 tonCO_2e / ton clinker for each kiln system**
					CH_4	**110.35**		
					N_2O	**16.06**		

1. All annual limitations are based on a rolling 12- month period unless otherwise noted. Maximum heat input limitation is based on all fuels combined total heat input (million BTUs per year) in a rolling 12-month total. The fuel firing, production, emissions and BACT limitations specified in this table are not to be exceeded for this facility and include emissions from the facility during all operations, including maintenance, startup, and shutdown activities.
2. GHG= Greenhouse Gas. TPY=total short tons per year, based a 12-month rolling total. CO_2e values calculated by multiplying the TPY mass basis limitation value by the Global Warming Potentials (GWP): CO^2=1, CH_4 = 21, N_2O = 310.

B. Workpractices and Operational Limitations

1. Fuel Firing

a. Maximum annual fuel firing (mmBtu/yr) in each respective kiln line is not to exceed the values in Table 1 of this permit.

b. Fuel types authorized for firing and limitations placed on fuel used in either kiln line shall be limited as follows:

(1) natural gas;

(2) coal;

(3) petroleum coke (pet coke); and

(4) non-hazardous alternate fuels, engineered fuels, or fuel blends consisting of the following:

(i) biomass, including, but not limited to: rice husks, agricultural residues, grasses, stover, straw, chaff, hulls, and cotton gin residue;

(ii) oil containing materials, including, but not limited to: on-site and off-site generated oil filter fluff, oily rags, oily wood, carbon black, absorbents, and grease;

(iii)plastics: post industrial packaging film, plastic labels, and shredded plastic;

(iv)tire derived fuel (TDF) and rubber products, including, but not limited to: tubes, plugs, seals, and tire manufacturer trimmings, in shredded or whole form;

(v) wood, including, but not limited to: sawdust, woodchips, pallets, crates, carpenter shop waste, brush, bark, seed shells, seeds, dyed pallets, creosote treated wood (including utility poles and railroad ties), and untreated and unpainted wood; and,

(vi)others: biosolids, cardboard, carpet products, construction and demolition waste, geotextile fabric, hydrocarbon liquids, label waste, non-asbestos shingles, paper, post-industrial personal care material, printed paper, and wax.

c. Cemex shall incorporate lower GHG emitting fuels than coal and petroleum coke into the mix of fuels fired in the kiln lines such that in any rolling 12 month period, the combined contribution (heat input, mmBTU basis) of fuels other than coal and petroleum coke must be the lesser of 35% of the total sitewide kiln heat input or an amount found through engineering studies completed within the first 24 months of operation after startup to be technically and economically sustainable, as follows:

(1) Within 60 days of issuance of this permit, submit for approval a written plan to determine a technologically and economically sustainable fraction of heat input into the kilns from authorized fuels other than coal and petroleum coke to the Air Permits program of EPA Region 6. The written test plan shall not contain confidential information.

(2) For the first 24 months after the start of operation of the kilns being fitted with the

multichannel burners, utilize fuels other than coal and petroleum coke for a minimum of 10% of the heat input to the kilns on a 12-month rolling average heat input basis.

(3) Within 180 days of issuance of this permit, initiate the evaluation plan approved in paragraph (1) of this provision. The evaluation program will end after 12 months or earlier with written approval from either the EPA or from the TCEQ, if a SIP approved TCEQ GHG permitting program is in place in Texas.

(4) Within three months of completing the evaluation program, submit a report, detailing the results of the evaluation containing at least the most recent 24 months of fuel fired data, by date, fuel type and location, along with daily clinker production data, and projections of future fuel availability by type. The report is to be submitted to the Air Permits section at the address listed in Section III of this permit. The report will be used to determine the appropriate technologically and economically sustainable minimum 12-month average percentage heat input for fuels other than coal and petroleum coke based on the approved test plan results. The 12-month rolling average minimum percentage non coal and petroleum coke heat input percentage is considered to be the maximum annual percentage heat input attributable to all fuels other than coal or petroleum coke achievable and sustainable if demonstrated to be viable for at least 3 months during the test period, considering fuel supply adequacy, and impacts to product quality and cement manufacturing operations.

(5). Beginning no later than 24 months from the date of this permit issuance the minimum 12-month average heat input to all kiln systems from all fuels other than petroleum coke and coal shall be the lesser of 35% or that value determined in subparagraph (4) of this paragraph.

2. Clinker Production

   a. Maximum annual clinker production (12-month rolling total) and daily average (30-day rolling average) clinker production is limited for each respective kiln line not to exceed the values in Table 1 of this permit.

   b. The BACT limitations for each kiln line as listed in Table 1 shall not be exceeded for each kiln line.

3. Kiln line equipment design, operation, and workpractices

   a. Burners for use in both kilns shall be multichannel adjustable burners.

   b. The fuel supply system shall be capable of monitoring and metering the fuel flow for any authorized fuel type.

   b. The combustion systems for both kiln lines, including the multichannel adjustable burners, indirect fired systems, and balance of fuel firing in the various kiln and preheater riser ducts, preheaters and precalciners shall be optimized, operated, and maintained in a manner consistent with the representations made in the permit application dated July 11, 2012 as updated as of August 26, 2013.

   c. Kiln refractory, insulation, seals, and kiln line ductwork shall be maintained in good condition and subject to a written maintenance plan that requires inspection of the seals and ductwork weekly and inspection of all other components at least as frequently as each major outage, but no less frequently than annually.

d. Cooling air exhaust from the clinker coolers shall be routed thru the appropriate kiln line components, including the solid fuel driers to maximize heat utilization prior to being discharged to atmosphere through the EPN of the respective kiln line. Except for periods of time when avoidance of severe equipment damage or personnel safety dictates otherwise, kiln exhaust shall be routed thru the low pressure drop cyclones in the multistage preheaters/precalciners so as to maximize heat utilization by the raw materials prior to being exhausted to atmosphere at the EPN of the respective kiln line.

e. Kiln drive motors and kiln line fans shall include variable speed/variable frequency drive devices and operated so as to maximize energy efficiency. Kiln drive ID fan motors may have the ability to operate with damper controls when necessary.

C. Monitoring and Recordkeeping

1. GHG Operations and Monitoring plan (GHG O&M plan). The permittee must create and maintain, and make available upon request by the EPA or any air pollution control program with jurisdiction, a GHG operations and monitoring plan that is consistent with the requirements of 40 CFR §98.3(g). Such a plan shall include but is not limited to:

a. information for all systems used to monitor and track raw material usage, fuel characterization (higher heating value, and other relevant fuel analyses), fuel usage by specific fuel and firing location, clinker production, kiln dust production, kiln dust recirculation or alkali bypass, GHG gas monitoring from both fuel firing and calcination processes and all associated data acquisition, reduction, and archiving processes related to GHG emissions or energy usage of the kiln lines.

b. Permittee shall calibrate, operate, maintain, and take corrective action to restore to proper operations the various instruments used to validly monitor fuel flow, clinker production, and any other instrumental measuring devices in accordance with manufacturers' recommendations. For such equipment with no manufacturers recommendations, such calibrations shall be performed no less frequently than annually. Results of any such checks, corrective action taken, and dates of same shall be documented and retained for 5 years from last use.

c. All data collected, example calculations, and calculated values shall be retained for a minimum of 5 years from its last use.

d. Permittee shall ensure that all required continuous emissions, continuous volumetric flow rate, and continuous stack moisture monitoring systems (if any), and associated data acquisition and storage systems and equipment are installed and all certification tests are completed on or before the earlier of 90 unit operating days or 180 calendar days after the date the unit commences operation. Such systems testing shall include those testing and certifications required in 40 CFR§98.34(c).

e. Maintenance activities and any corrective action taken on each systems or element of the kiln lines referenced in Special Condition No II.B.3 shall be documented at the time of the maintenance activities. Repairs and maintenance activities shall include the cause of the activity, the date the activity was undertaken and completed, the person responsible for the activity and maintenance performed or corrective actions taken, if any.

2. Fuel Firing

a. For each location in each kiln line that fuel is fired, and for each fuel type fired, fuel usage shall be determined as follows:

(1) Continuously monitor and record the fuel usage with an operational non-resettable elapsed flow meter suitable for use for each fuel type or fuel blend being introduced into any point of each kiln line. Valid, quality assured data of fuel usage must be collected for any hour or portion of hour that fuel is fired in any portion of the kiln line. The method of fuel usage data collection, methods and equipment used, method and equipment calibration and associated QA/QC requirements for determining fuel usage shall be documented in the GHG O&M plan required in Special Condition No. II.C.1 of this permit. If any fuel firing data are missing, then follow the procedures of 40 CFR §98.35 to estimate fuel firing for the hour or portion of the hour for which data are missing. Fuel use records for each fuel for each usage location for each hour shall include an indicator if the fuel usage value was derived by missing value procedures.

(2) Total fuel usage, by fuel type and firing location, shall be summed and recorded hourly for each clock hour. In addition, concurrent kiln operational status (startup, shutdown, or kiln operating with raw mill on, kiln operating with raw mill off, or kiln line down) shall be identified for each hour fuel is fired for each kiln line. Only those clock hours where no fuel is introduced to any portion of the kiln line for the entire hour may be characterized as kiln line down operational status for the kiln line.

(3) Total fuel usage by fuel type, firing location, and kiln line shall be summed for each day and for each month and recorded monthly. Percent of fuel fired by type for each firing location and kiln line shall be calculated and recorded each month.

b. The annual high heating value (HHV) of each fuel or fuel blend must be determined for each fuel or fuel blend fired, using either a fuel default HHV or by fuel sampling as follows:

(1) For fuels listed in Table C-1 of 40 CFR 98 Subpart C, the default annual HHV for the fuel referenced in that table may be used.

(2) For any fuel or fuel blend that is not so listed, or for any fuel that the permittee does not wish to use the annual default HHV value found in Table C-1, the procedures listed in 40 CFR §98.33(a)(2)(ii) shall be used to determine the annual HHV for the fuel or fuel blend.

(i) The sampling procedures used to collect the samples, the frequency of sampling, and the analytical methods used to conduct the analysis of the samples to determine the annual HHV of the fuel or fuel blend shall be done in accordance with the procedures found in 40 CFR §98.34(a),

(ii) The procedures for estimating missing data for any HHV sample outlined in

40 CFR §98.35 shall be followed to supply required but missing HHV sample data.

(iii)The details of the actual sampling, analysis, analytical QA/QC methods, and data collection and reduction for each fuel annual HHV determination shall be documented in the GHG O&M plan required under Special Condition II.C.1 of this permit.

(iv)Records related to HHV determinations shall be created and maintained in accordance with the requirements of 40 CFR §98.3(g) except that the records retention listed in 40 CFR§98.3(g) shall be maintained for 5 years rather than 3 years.

c. The annual HHV for each fuel or fuel blend shall be calculated monthly for any fuel or fuel blend used in the preceding 12 months based on the data collected in Special Condition II.B.2.b, above. The annual value shall be calculated in accordance with Equation C-2b of 40 CFR§98.34(a)(2).

d. The 12-month rolling total heat input, in mmBtu/yr shall be calculated monthly for the preceeding 12-month rolling period for each kiln line as follows:

(1) For each fuel type and fuel firing point, multiply the total fuel used in the relevant 12 months at the point, as derived in Special Condition No. II.C.2.a.(3) of this permit with the annual HHV for the respective fuel type, as derived in Special Condition No. II.C.2.c of this permit.

(2) Sum the heat input totals (mmBtu/yr heat input) across all fuel usage points by fuel types for each kiln line for the relevant 12-month period. Use these values to demonstrate compliance both with the kiln line specific annual heat input limitations found in Table 1 of Special Condition No II.A. and with the percent heat input attributable to firing coal and petroleum coke combined and percent heat input for all other fuels combined limits found in Special Condition No. II.B.1.c.

e. Upon request, permittee shall provide a sample and/or analysis of the fuel that is fired in any unit covered by this permit at the time of the request, or shall allow a sample to be taken for analysis by EPA or any air permitting authority with jurisdiction.

f. Create and maintain all records to support the heat input evaluation program required in Special Condition No. 2.B.C, a copy of the test plan, all data used in the plan execution, and plan report from that study.

3. Clinker Production

a. Maximum annual clinker production and daily average (30-day rolling average) clinker production is limited for each respective kiln line not to exceed the values in Table 1.

(1) Daily clinker production (in short tons) shall be determined by direct weight measurement of raw kiln feed and application of a kiln specific clinker factor using the same plant techniques used for accounting purposes, consistent with the requirements found in 40 CFR§98.84(d) for each day of production. Production data are to be recorded daily for each kiln line. Daily totals shall be summed and recorded monthly to derive the monthly clinker production total weight in short tons.

(2) Annual clinker production shall be calculated and recorded monthly on a 12-month rolling total basis using the data collected in Special Condition No II.C.3.a(1) of this permit. Compliance with the production limitation in Table 1 shall be determined using this data.

b. Clinker production for each kiln line shall be determined by direct weight measurement of raw kiln feed and application of a kiln specific clinker factor using the same plant techniques used for accounting purposes in accordance with the requirements found in 40 CFR §98.84(d) using the monitoring and QA/QC requirements found in 40 CFR §98.84. Total clinker production in short tons must be determined for each month the kiln line operates for any period of time during the month. When quality assured clinker production weight data are not available, supply missing data in accordance with the requirements found in 40 CFR §98.85(c).

c. Determine on a monthly basis the kiln specific clinker emission factor for each kiln line at the facility in accordance with the requirements of 40 CFR §98.83(d)(2)(i), following the relevant requirements of 40 CFR §98.84 for data collection and QA/QC requirements and 40 CFR §98.85 for missing data procedures.

d. Determine the kiln specific clinker kiln dust emission factor monthly in accordance with the provisions of 40 CFR §98.83(d)(2)(ii) and the CO_2 emissions from raw materials in accordance with the method listed in 40 CFR§98.83(d)(3), reporting the CO_2 emissions from raw materials on a short ton basis. Determination of these two parameters shall be accomplished following the relevant requirement of 40 CFR §98.84 for data collection, monitoring, and QA/QC requirements The clinker dust emissions factor shall be calculated monthly and be based on data gathered in the preceding 3 calendar months.

4. Determining CO_2 emissions attributable to processing from each kiln line.

a. Determine and record monthly the CO_2 mass emission rate in short tons per month attributable to process emissions for each kiln using the data collected in Special Condition No. II.C.3 of this permit, making the calculations in a manner consistent with the requirements of 40 CFR§98.33(d)(2), in units of short tons.

b. Calculate and record each month the annual 12-month rolling total CO_2 emissions attributable to process emissions for each kiln.

5. Monitoring total GHG emissions from each kiln line.

   a. Determine hourly average CO_2 mass emissions rate, in short tons, from each kiln line by using continuous monitoring systems (CMS) in accordance with the requirements of Tier 4 calculation methodology found in 40 CFR§98.33(a)(4) and all associated requirements for Tier 4 calculations in 40 CFR 98 Subpart C (General Stationary Fuel Combustion Sources), including monitoring and QA/QC requirements of 40 CFR§98.34 and the missing data procedures of 40 CFR §98.35. The valid CMS generated data are to be used to determine the hourly average CO_2 mass emissions rate, in short tons, for each hour fuel is fired for any amount of time in any part of a kiln system. In addition, to recording the kiln line CO_2 emissions rate, concurrent indication of kiln line operational status (normal operations, startup, shutdown, normal operations, in-line mill on or off) for each clock hour shall also be recorded. The methods used must be documented in the GHG O&M plan as required in Special Condition No. II.C.1 of this permit.

   b. The procedures found in 40 CFR§98.33(c) shall be used to calculate rolling 12-month total annual mass emissions rate for CH_4 and N_2O emissions, in short tons, from each kiln line. Calculations shall be made based on the total fuel firing and HHV by fuel type or blend for each kiln as derived in Special Condition No. II.C.2. of this permit. Report the emissions in short tons. Calculate and record the emissions by contaminant and fuel type for each kiln line for each month. Sum across all fuel types for each kiln to derive a total mass emissions by contaminant for the month for each kiln. Using the global warming potential values found in footnote 2 in Table 1 of this permit to calculate and record the CO_2e emissions rates for each contaminant per month for each kiln.

   c. Total daily and monthly CO_2 and CO_2e emissions for each fuel type for each kiln line are to be calculated and recorded monthly. Monthly totals are to be used to calculate and record each month the rolling 12-month total emissions rate of CO_2 and CO_2e.

6. Compliance with 12-month rolling total mass emissions, 12-month rolling total CO_2e emissions limitations and BACT limitations for each kiln line.

   a. The BACT limitation for each kiln line as listed in Table 1 shall not be exceeded for each kiln line or for the site as a whole.

   b. Use the data collected in Special Condition No. II.C.5 of this permit to demonstrate compliance with the annual CO_2 and CO_2e emissions limits found in Table 1.

   c. Calculate the tons CO_2e per ton clinker for each month for each kiln line, by dividing the the total CO_2e emissions for each kiln line by the total clinker production for the kiln line for month. Calculate and record the 12-month rolling average CO_2e per ton clinker each month, using this data to demonstrate compliance with the ton CO_2e per ton clinker BACT limitation of Table 1.

   d. Calculate and report the BACT limitations of CO_2e per ton clinker attributable to fuel combustion by subtracting the total tons CO_2 per month attributable to process emissions as determined in Special Condition No. II.C.4 of this permit from the total CO_2e emissions per kiln as determined by Special Condition No. II.C.5 of this permit.

   e. Calculate and record percent of total fuel related CO_2e attributable to each fuel type for each kiln each month, and for each rolling 12-month period. Use this data to demonstrate, in part, compliance with Special Condition No. II.B.1.c of this permit.

7. Additional Recordkeeping Requirements

   a. Permittee shall maintain a file of all records, data, measurements, reports, and documents related to the operation of the facilities authorized by this permit at the site, including, but not limited to, the following: all records or reports pertaining to significant maintenance performed on any system or device at the kiln lines; duration of startup, shutdown; the initial startup period for the emission units; pollution control units; malfunctions; all records relating to performance tests, calibrations, checks, and monitoring of combustion equipment; duration of an inoperative monitoring device and emission units with the required corresponding emission data; and all other information required by this permit recorded in a permanent form suitable for inspection. The file shall be retained for not less than five years following the date such measurements, maintenance, reports, and/or records are required to be used.

   b. Permittee shall maintain records and submit a written report of deviations from permit requirements, including all excess emissions events, to EPA semi-annually except when more frequent reporting is specifically required by an applicable subpart, or the Administrator or authorized representative, on a case-by-case basis, determines that more frequent reporting is necessary to accurately assess the compliance status of the source. The report is due on the 30th day following the end of each semi-annual period and shall include the following:

      (1) Time intervals, the nature of the deviation or excess emissions event, the data and magnitude of the excess emissions, the nature and cause (if known) of corrective actions taken and preventive measures adopted;

      (2) Applicable time and date of each period during which the monitoring equipment was inoperative (monitoring down-time);

      (3) A statement in the report of a negative declaration; that is; a statement when no deviations have occurred or any excess emissions occurred or when the monitoring equipment has not been inoperative, repaired or adjusted;

      (4) Any failure to conduct any required source testing, monitoring, or other compliance activities; and

      (5) Any violation of limitations on operation.

   c. Excess emissions shall be defined as any period in which the facility emissions exceed an emission limit set forth in this permit or a malfunction occurs causing such an emissions exceedance. Deviations are instances where compliance with a permit term or condition, or of a permit application representation upon which permit limitations have been based that and that may result in unauthorized emissions or practically render ineffective the ability to determine compliance with any term or condition of the permit.

   d. Excess emissions indicated by GHG emission source certification testing or compliance monitoring shall be considered violations of the applicable emission limit for the purpose of this permit.

   e. Unless otherwise noted, instruments and monitoring systems required by this PSD permit shall have a 95% on-stream time on an annual basis.

D. Initial Performance Testing Requirements:

1. The Permittee shall perform stack sampling and other testing to establish the actual pattern and quantities of air contaminants (as listed in paragraph 3 below) being emitted into the atmosphere from the stacks of kiln line 1 and kiln line 2 (EPNs: PS-16 and PS-77, respectively) to determine the initial compliance with the GHG mass emissions limits established in this permit. Initial performance testing shall be conducted in accordance with 40 CFR§60.8. The holder of this permit is responsible for providing sampling and testing facilities and conducting the sampling and testing operations at his expense. The following methods, found in 40 CFR Part 60 Appendix A unless otherwise noted, shall be used:

    a. Method 1—Sample and Velocity Traverses for Stationary Sources.

    b. Method 2—Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube).

    c. Method 3C—Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen From Stationary Sources.

    d. Method 4—Determination of Moisture Content in Stack Gases. Sampling shall be conducted in accordance with 40 CFR § 60.8 and EPA Method 3a or 3b for the concentration of CO_2.

    e. Method 320 – Measurement of vapor phase organic and inorganic emissions by extractive Fourier transform infrared (FTIR) Spectroscopy.

2. The EPA Region 6 shall be notified in writing as soon as testing is scheduled but not less than 45 days prior to sampling to afford the EPA the opportunity to schedule a pretest meeting. The notice shall include:

    a. proposed date for pretest meeting.

    b. Date sampling will occur.

    c. Name of firm conducting sampling.

    d. Type of sampling equipment to be used.

    e. Method or procedure to be used in sampling.

    The purpose of the pretest meeting is to review the necessary sampling and testing procedures, to provide the proper data forms for recording pertinent data, and to review the format procedures for submitting the test reports.

    A written proposed description of any deviation from sampling procedures specified in permit conditions or TCEQ or the U.S. Environmental Protection Agency sampling procedures shall be made available to the EPA prior to the pretest meeting. The EPA Region 6 shall approve or disapprove of any deviation from specified sampling procedures.

    Requests to waive testing for any pollutant specified in paragraph 1 of this condition shall be submitted to the EPA Region 6 Air Permits Division.

3. Air contaminants to be tested for include (but are not limited to) CO_2, CH_4, and N_2O.

Determination of CO2e emissions shall be made by calculation based on the specific GHG contaminants measured and the global warming potential values found in Table 1 footnote 2 of this permit.

4. Sampling shall occur within 60 days of startup after the modifications are complete and at such other times as may be required by the EPA Region 6 or any pollution control program with jurisdiction. Requests for additional time to perform sampling shall be submitted to the EPA Region 6 office.

5. Testing shall be performed when the feedstock input rate for each unit is at the maximum usable rate for achieving the quality specifications of the clinker being produced at the time.

   a. The production rate of clinker shall be monitored and recorded during the test, as well as the fuel type firing and firing rate at each fuel firing location in the kiln lines being tested.

   b. Initial performance testing shall be comprised of at least 3, 1-hr runs, averaged to derive the hourly rate and shall be conducted at or near full production operations. Future operations may not operate in excess of the tested production rate without first establishing the emissions rate through stack testing of higher production limits. The test derived hourly emission rates will be scaled up to 8760 hrs to produce an annualized emissions rate to compare projected compliance with Table 1.

   c. If the calculated annualized CO_2 emissions rate exceeds 95% of the Table 1 limitation for any given GHG pollutant or for all pollutants combined (CO_2e), then the company shall produce a report along with the required test report identifying how they will operate in order to stay within the limitations of Table 1, and report on progress monthly, including in the report the calculated 12-month rolling total GHG mass emissions rate and CO_2e emissions rate, clinker production, kiln specific clinker emissions factor, for each kiln line for the first 24 months of operation. If the above calculated CO_2 emission total exceeds 90% of the annual limitation listed in Table 1, then performance tests will be required annually, otherwise performance testing shall be repeated at least once every 3 years for each kiln line.This information, together with the sampling results, shall be used to determine hourly emission rates for each GHG and all GHG combined (CO_2e), which will be scaled up by 8760 hrs to produce emissions in short tons per year. This analysis shall appear in the sampling report.

   d. A copy of the final sampling report shall be forwarded to EPA Region 6 within 60 days after sampling is completed. If reports are required under sub paragraph c of this paragraph, then those reports are due within 60 days of the end of each calendar month.

6. Permittee shall provide, or cause to be provided at permittees expense, performance testing facilities as follows:

   a. Sampling ports adequate for test methods applicable to this facility,

   b. Safe sampling platform(s),

   c. Safe access to sampling platform(s), and

   d. Utilities for sampling and testing equipment.

III. AGENCY NOTIFICATIONS

Permittee shall submit GHG permit applications, permit amendments, and other applicable permit information to:

Multimedia Planning and Permitting Division
Air Permits Section
EPA Region 6
1445 Ross Avenue (6 PD-R)
Dallas, TX 75202
Email: Group R6AirPermits@EPA.gov

Permittee shall submit a copy of all compliance and enforcement correspondence as required by this Approval to Construct to:

Compliance Assurance and Enforcement Division
EPA Region 6
1445 Ross Avenue (6EN)
Dallas, TX 75202

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS TX 75202-2733

NOV 08 2013

Mr. Jimmy Rabon
Plant Manager
CEMEX – Balcones Cement Plant
2580 Wald Road
New Braunfels, TX 78132

Re: GHG PSD Permit Application Completeness Determination

Dear Mr. Rabon:

We are writing in response to your Greenhouse Gas Prevention of Significant Deterioration permit application received by the Environmental Protection Agency on July 16, 2012. After our initial review of your application, we determined additional information was needed for the application to be considered complete. An incompleteness letter was sent on September 20, 2012 requesting additional information. Based on our review of the additional information and revised application you provided in response to that request on February 6, 2013 and on your revised permit application dated August 26, 2013, we have determined your application is complete. Please note that even though your application is deemed complete, in the course of our review, we may identify further information that may be essential for the EPA to continue processing your application and make a permit decision, including information that may be needed in response to public comments.

A proposed permit determination is being drafted and when we issue our proposed decision, the EPA will publish a public notice of the permitting action and allow for at a minimum a 30 day public comment period. In addition, the documents will be made available for review by the public during the public comment period. The EPA will consider and respond to all significant comments in making the final decision on the draft permit and keep a record of the persons commenting and the issues being raised during the public participation process. As we develop our preliminary determination, it may be necessary for the EPA to request additional clarifying or supporting information. If the supporting information substantially changes the original scope of the permit application, an amendment or new application may be required.

Although not required as a part of our completeness determination, the EPA may not issue a final permit without determining its action will have no effect on threatened or endangered species and their designated critical habitat or until it has completed consultation under Section 7 of the Endangered Species Act (16 USC 1536). In addition, the EPA must undergo consultation pursuant to Section 106 of the National Historic Preservation Act (16 USC 470f). We appreciate your cooperation in conducing and documenting your Biological Assessment and a cultural resources report covering the project and action area to the EPA.

If you have any questions regarding the review of your permit application, please contact Brad Toups of my staff at (214) 665-7558 or toups.brad@epa.gov.

Sincerely yours,

Wren Stenger
Director
Multimedia Planning and
Permitting Division

cc: Mr. Mike Wilson, P.E., Director
Air Permits Division
Texas Commission on Environmental Quality

Proposed Clinker Production Increase at the CEMEX Construction Materials South, LLC, Balcones Cement Plant, Comal County, Texas

Cultural Resources Review

Prepared for:

Zephyr Environmental Corporation
11200 Westheimer Road, Suite 600
Houston, Texas 77042

Prepared by:

Horizon Environmental Services, Inc.
1507 South IH 35
Austin, Texas 78741

HJN 080122.39 AR

August 2013

ABSTRACT

Horizon Environmental Services, Inc. (Horizon), has been contracted to provide a cultural resources background review for the proposed upgrade of the existing Balcones Cement Plant located at 2580 Wald Road, New Braunfels, Comal County, Texas, 78132. The Balcones Cement Plant is owned and operated by CEMEX Construction Materials South, LLC (CEMEX), and the existing CEMEX facility consists of 2 cement kilns, raw and finish mills, clinker coolers, and ancillary material transfer equipment. CEMEX is proposing to authorize the use of additional alternate fuels for both cement kilns (Kiln Nos. 1 and 2), including engineered "Sharps" (including plastic) and rubberized asphalt; to increase Kiln No. 2 clinker production; and to authorize upgrades to the main kiln burners in Kiln Nos. 1 and 2 to multipath adjustable units. The production upgrades would improve kiln fuel efficiency; however, CEMEX is not proposing a production increase related to this upgrade, no physical changes to the existing kiln system would be required, and no ground disturbance would be required to install the upgrades to the existing kilns.

As the proposed upgrades would require a Prevention of Significant Deterioration (PSD) permit issued by the US Environmental Protection Agency (EPA), the undertaking falls under the regulations of Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, which is invoked when federal funds are utilized or when federal permitting is required for a proposed project. The NHPA states that the Advisory Council for Historic Preservation (ACHP) and the Texas Historical Commission (THC), which serves as the State Historic Preservation Office (SHPO) for the state of Texas, must be afforded the opportunity to comment when any cultural resources potentially eligible for inclusion in the National Register of Historic Places (NRHP) are present in a project area affected by federal agency actions or covered under federal permits or funding.

In November 2012, Horizon conducted a cultural resources background review for the proposed project. The background review examined an area extending 1.0 mile from the proposed kiln site. Two previously recorded archeological sites, 41CM107 and 41CM332, are located within the 1.0-mile review radius; however, both of these sites are located outside the proposed kiln upgrade location. Both sites were recommended as ineligible for listing on the NRHP and/or for designation as State Archeological Landmarks (SAL) when they were originally recorded in 1978 and 2011, respectively, and both sites have been either largely or entirely destroyed from prior industrial development. Neither site would be affected by the

proposed undertaking. No cemeteries, listed NRHP properties or districts, or SALs were identified within the 1.0-mile review radius or at the location of the proposed kiln upgrades.

Furthermore, the location of the 2 existing cement kilns on the Balcones Cement Plant was surveyed for cultural resources in 1978 prior to construction of the cement plant. No cultural resources were recorded at the location of the kilns during this prior survey.

Based on the extent of prior disturbances on the proposed project site resulting from construction of the existing Balcones Cement Plant and its ancillary facilities and the limited scope of the proposed upgrades to the 2 existing cement kilns, the proposed undertaking would have no potential to adversely affect any significant cultural resources. The portion of the Balcones Cement Plant in which the 2 existing cement kilns are located was surveyed for cultural resources in 1978 prior to construction of the plant, and no cultural resource sites were recorded at this location. It is Horizon's opinion that the proposed project site does not require any further cultural resources investigations and that no archeological or historic properties that are listed on, eligible for, or potentially eligible for inclusion in the NRHP would be adversely affected.

TABLE OF CONTENTS

Chapter		Page
	ABSTRACT	i
1.0	INTRODUCTION	1
2.0	ENVIRONMENTAL SETTING	5
	2.1 Physiography and Hydrology	5
	2.2 Geology and Geomorphology	5
	2.3 Climate	5
	2.4 Flora and Fauna	6
3.0	CULTURAL BACKGROUND	7
	3.1 PaleoIndian Period (ca. 12,000 to 8500 B.P.)	7
	3.2 Archaic Period (ca. 8500 to 1200 B.P.)	8
	3.3 Late Prehistoric Period (ca. 1200 to 350 B.P.)	8
	3.4 Historic Period (ca. 350 B.P. to Present)	8
4.0	ARCHIVAL RESEARCH	13
5.0	SUMMARY AND RECOMMENDATIONS	15
	5.1 Eligibility Criteria for Inclusion in the National Register of Historic Places	15
	5.2 Summary and Recommendations	17
6.0	REFERENCES CITED	19

APPENDIX A: Project Area Overview Photographs
APPENDIX B: Resume of Principal Investigator
APPENDIX C: Copy of Howry (1978) Cultural Resources Survey Report
APPENDIX D: Copies of References Cited

LIST OF FIGURES

Page

Figure 1. Location of Project Area on USGS Topographic Quadrangle 2
Figure 2. Location of Project Area on Aerial Photograph 3

LIST OF TABLES

Page

Table 1. Summary of Documented Cultural Resources within 1.0 Mile of Project Site.............14

1.0 INTRODUCTION

Horizon Environmental Services, Inc. (Horizon), has been contracted to provide a cultural resources background review for the proposed upgrade of the existing Balcones Cement Plant located at 2580 Wald Road, New Braunfels, Comal County, Texas, 78132. The Balcones Cement Plant is owned and operated by CEMEX Construction Materials South, LLC (CEMEX), and the existing CEMEX facility consists of 2 cement kilns, raw and finish mills, clinker coolers, and ancillary material transfer equipment. CEMEX is proposing to authorize the use of additional alternate fuels for both cement kilns (Kiln Nos. 1 and 2), including engineered ―Sharps" (including plastic) and rubberized asphalt; to increase Kiln No. 2 clinker production; and to authorize upgrades to the main kiln burners in Kiln Nos. 1 and 2 to multipath adjustable units. The production upgrades would improve kiln fuel efficiency; however, CEMEX is not proposing a production increase related to this upgrade, no physical changes to the existing kiln system would be required, and no ground disturbance would be required to install the upgrades to the existing kilns (Figures 1 and 2).

As the proposed upgrades would require a Prevention of Significant Deterioration (PSD) permit issued by the US Environmental Protection Agency (EPA), the undertaking falls under the regulations of Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, which is invoked when federal funds are utilized or when federal permitting is required for a proposed project. The NHPA states that the Advisory Council for Historic Preservation (ACHP) and the Texas Historical Commission (THC), which serves as the State Historic Preservation Office (SHPO) for the state of Texas, must be afforded the opportunity to comment when any cultural resources potentially eligible for inclusion in the National Register of Historic Places (NRHP) are present in a project area affected by federal agency actions or covered under federal permits or funding.

In November 2012, Horizon conducted a cultural resources background review for the proposed project. The background review examined an area extending 1.0 mile from the proposed kiln site. Two previously recorded archeological sites, 41CM107 and 41CM332, are located within the 1.0-mile review radius; however, both of these sites are located outside the proposed kiln upgrade location. Both sites were recommended as ineligible for listing on the NRHP and/or for designation as State Archeological Landmarks (SAL) when they were originally recorded in 1978 and 2011, respectively, and both sites have been either largely or entirely destroyed from prior industrial development. Neither site would be affected by the

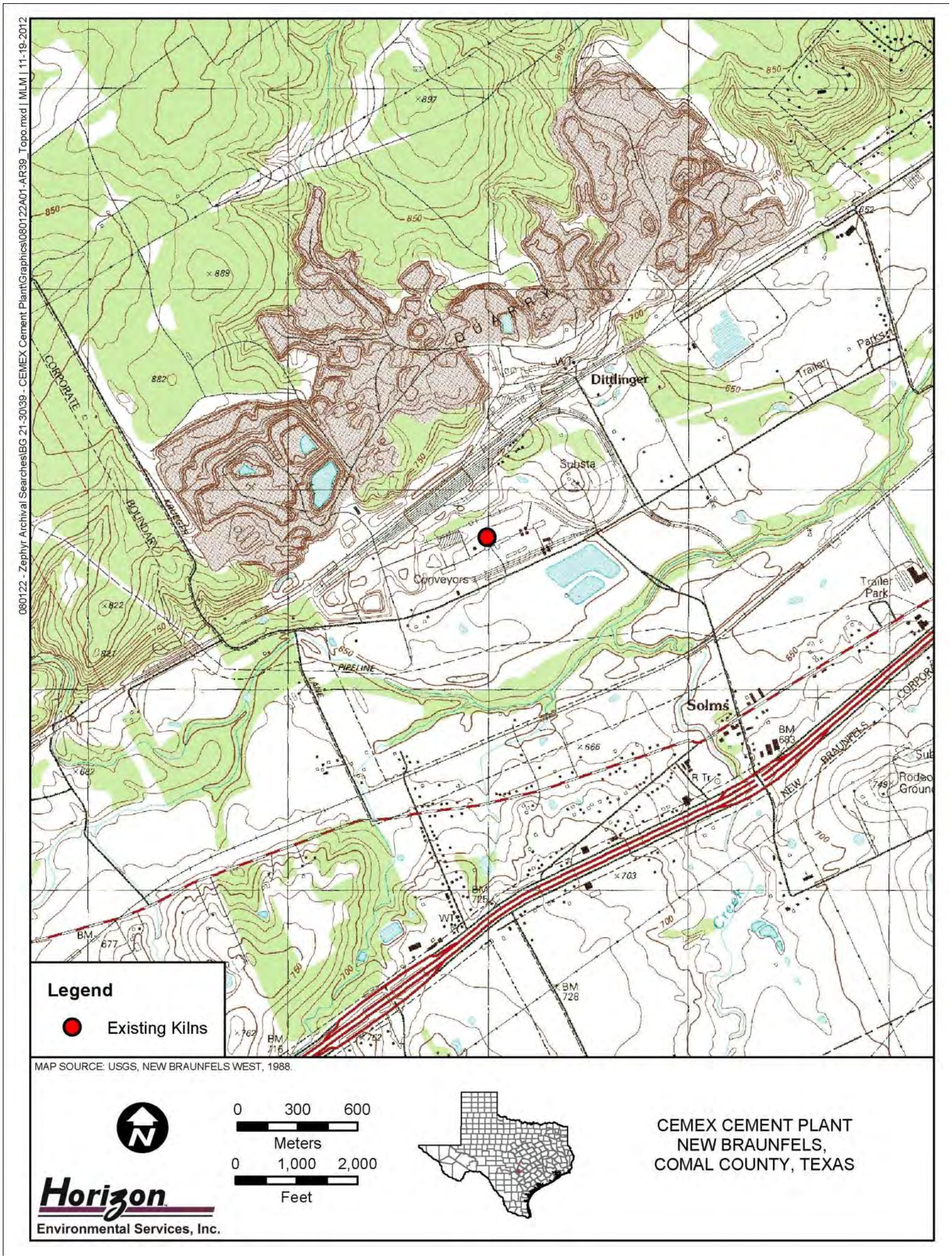


Figure 1. Location of Project Area on USGS Topographic Quadrangle

Figure 2. Location of Project Area on Aerial Photograph

proposed undertaking. No cemeteries, listed NRHP properties or districts, or SALs were identified within the 1.0-mile review radius or at the location of the proposed kiln upgrades.

Furthermore, the location of the 2 existing cement kilns on the Balcones Cement Plant was surveyed for cultural resources in 1978 in connection with a US EPA undertaking prior to construction of the existing facility. No cultural resources were recorded at the location of the kilns during this prior survey.

Based on the extent of prior disturbances on the proposed project site resulting from construction of the existing Balcones Cement Plant and its ancillary facilities and the limited scope of the proposed upgrades to the 2 existing cement kilns, the proposed undertaking would have no potential to adversely affect any significant cultural resources. The portion of the Balcones Cement Plant in which the 2 existing cement kilns are located was surveyed for cultural resources in 1978 prior to construction of the plant, and no cultural resource sites were recorded at this location. It is Horizon's opinion that the proposed project site does not require any further cultural resources investigations and that no archeological or historic properties that are listed on, eligible for, or potentially eligible for inclusion in the NRHP would be adversely affected.

This document presents the results of Horizon's cultural resources background review of the proposed project site. Following this introductory chapter, Chapters 2.0 and 3.0 present the environmental and cultural backgrounds of the project area, respectively. Chapter 4.0 presents the results of the background review, and Chapter 5.0 summarizes the results of the background review and presents management recommendations for the proposed undertaking. Chapter 6.0 lists the references cited in the document. Appendix A provides representative overview photographs of the existing plant facility and the proposed project area; Appendix B includes the resume of Jesse Owens, Horizon senior staff archeologist, who served as Principal Investigator for this project; Appendix C provides a copy of a prior cultural resources survey report that included the current project area; and Appendix D consists of a CD-ROM that contains copies of references cited in this report.

2.0 ENVIRONMENTAL SETTING

2.1 PHYSIOGRAPHY AND HYDROLOGY

The existing Balcones Cement Plant is located in southwestern New Braunfels in southeastern Comal County in Central Texas. The project site is located on an old alluvial terrace remnant along the northern margins of the Dry Comal Creek floodplain. The project site is situated within an existing industrial cement plant. The landscape within the existing industrial facility has been artificially leveled via prior construction of the plant, and the elevation of the project site is 660 feet above mean sea level. Hydrologically, the project area is situated within the Dry Comal Creek basin, which drains into the Guadalupe River on the eastern side of New Braunfels. The Guadalupe River, in turn, flows southeastward before ultimately discharging into the Gulf of Mexico near Port Lavaca. The project site is drained to the south toward Dry Comal Creek.

2.2 GEOLOGY AND GEOMORPHOLOGY

Comal County is underlain by a relatively thick sequence of Cretaceous-age, sedimentary rock strata. These strata are composed of 3 formations, including the Anachaco Limestone, Pecan Gap Chalk, and Austin Chalk formations (Fisher 1976). These formations range in depth from 30 to 152 meters (m) (100 to 500 feet [ft]) and are composed of limestone and marl, chalk and chalky marl, and chalk and marl, respectively. Specifically, the project site is situated on the Early Pleistocene Leona Formation, which consists of fine calcareous silt grading down into course gravels.

Specifically, the project area is underlain by Branyon clay, 1 to 3% slopes (ByB), which consists of clayey alluvium of Quaternary age derived from mixed sources found on stream terraces (NRCS 2012). A typical profile of this soil type consists of deep, undifferentiated deposits of clay extending to depths of more than 80 inches below surface. This soil is moderately well drained.

2.3 CLIMATE

The modern climate in Comal County is typically dry to subhumid with long, hot summers and short, mild winters. The climate is influenced primarily by tropical maritime air masses from the Gulf of Mexico, but it is modified by polar air masses. Tropical maritime air masses predominate throughout spring, summer, and fall. Modified polar air masses are dominant in winter and provide a continental climate characterized by considerable variations in temperature.

In winter, the average temperature is 52 degrees Fahrenheit (°F); however, during winter the temperature tends to fluctuate greatly as air masses move in and out of the area. These air masses can produce light rain and drizzle, and conditions can become cloudy. Spring is relatively dry, with some thunderstorms and cool spells. Summer temperatures are high, with the daily maximum temperature often reaching or exceeding 90°F. Fall is warm, dry, and pleasant, with increasing cold spells.

The average precipitation within the region is 33 inches. The majority of this precipitation occurs as rain that falls between April and September. The growing season is approximately 265 days long.

2.4 Flora and Fauna

The project area is situated in the southwestern portion of the Texan biotic province (Blair 1950), an intermediate zone between the forests of the Austroriparian and Carolinian provinces and the grasslands of the Kansan, Balconian, and Tamaulipan provinces (Dice 1943). Some species reach the limits of their ecological range within the Texan province. Rainfall in the Texan province is barely in excess of water need, and the region is classified by Thornwaite (1948) as a C_2 (moist subhumid) climate with a moisture surplus index of from 0 to 20%.

Edaphic controls on vegetation types are important in the Texan biotic province, which is located near the border between moisture surplus and moisture deficiency. Sandy soils support oak-hickory forests dominated by post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*), and hickory (*Carya buckleyi*). Clay soils originally supported a tall-grass prairie, but much of this soil type has been placed under cultivation. Dominant tall-grass prairie species include western wheatgrass (*Agrophyron smithii*), silver beardgrass (*Andropogon saccharoides*), little bluestem (*Andropogon scoparius*), and Texas wintergrass (*Stipa leucotricha*). Major areas of oak-hickory forest include the Eastern and Western Cross Timbers, and major tall-grass prairie areas include the Blackland, Grand, and Coastal prairies. Some characteristic associations of the Austroriparian province occur locally in the Texan province, such as a mixed stand of loblolly pine (*Pinus taeda*) and blackjack and post oak in Bastrop County and a series of peat and bog marshes distributed in a line extending from Leon to Gonzales counties.

3.0 CULTURAL BACKGROUND

The project site is located within Prewitt's (1981, 1985) Central Texas Archeological Region. The indigenous human inhabitants of Central Texas practiced a generally nomadic hunting and gathering lifestyle throughout all of prehistory, and, in contrast to much of the rest of North America, mobility and settlement patterns do not appear to have changed markedly through time in this region.

3.1 PALEOINDIAN PERIOD (CA. 12,000 TO 8500 B.P.)

The initial human occupations in the New World can now be confidently extended back before 12,000 B.P. (Dincauze 1984; Haynes et al. 1984; Kelly and Todd 1988; Lynch 1990; Meltzer 1989). Evidence from Meadowcroft Rockshelter in Pennsylvania suggests that humans were present in Eastern North America as early as 14,000 to 16,000 years ago (Adovasio et al. 1990), while more recent discoveries at Monte Verde in Chile provide unequivocal evidence for human occupation in South America by at least 12,500 years ago (Dillehay 1989, 1997; Meltzer et al. 1997). Most archeologists presently discount claims of much earlier human occupation during the Pleistocene glacial period (cf. Butzer 1988).

The earliest generalized evidence for human activities in Central Texas is represented by the PaleoIndian period (12,000 to 8500 B.P.) (Collins 1995). This stage coincided with ameliorating climatic conditions following the close of the Pleistocene epoch that witnessed the extinction of herds of mammoth, horse, camel, and bison. Cultures representing various periods within this stage are characterized by series of distinctive, relatively large, often fluted, lanceolate projectile points. These points are frequently associated with spurred end scrapers, gravers, and bone foreshafts. PaleoIndian groups are often inferred to have been organized into egalitarian bands consisting of a few dozen individuals that practiced a fully nomadic subsistence and settlement pattern. Due to poor preservation of floral materials, subsistence patterns in Central Texas are known primarily through the study of faunal remains. Subsistence focused on the exploitation of plants, small animals, fish, and shellfish, even during the PaleoIndian period. There is little evidence in this region for hunting of extinct megafauna, as has been documented elsewhere in North America. Rather, a broad-based subsistence pattern appears to have been practiced throughout all prehistoric time periods. In Central Texas, the PaleoIndian stage is divided into 2 periods based on recognizable differences in projectile point styles. These include the Early PaleoIndian period, which is recognized based on large, fluted projectile points (i.e., Clovis, Folsom, Dalton, San Patrice, and Big Sandy), and the Late

PaleoIndian period, which is characterized by unfluted lanceolate points (i.e., Plainview, Scottsbluff, Meserve, and Angostura).

3.2 ARCHAIC PERIOD (CA. 8500 TO 1200 B.P.)

The onset of the Hypsithermal drying trend marks the beginning of the Archaic period (8500 to 1200 B.P.) (Collins 1995). This climatic trend marked the beginning of a significant reorientation of lifestyle throughout most of North America, but this change was far less pronounced in Central Texas. Elsewhere, the changing climatic conditions and corresponding decrease in the big game populations forced people to rely more heavily upon a diversified resource base composed of smaller game and wild plants. In Central Texas, however, this hunting and gathering pattern is characteristic of most of prehistory. The appearance of a more diversified tool kit, the development of an expanded groundstone assemblage, and a general decrease in the size of projectile points are hallmarks of this cultural stage. Material culture shows greater diversity during this broad cultural period, especially in the application of groundstone technology.

Traditionally, the Archaic period is subdivided into Early, Middle, and Late subperiods. Changes in projectile point morphology are often used as markers differentiating these 3 subperiods, though other changes in material culture occurred as well. Perhaps most markedly, burned rock middens appear during the Middle Archaic subperiod, continuing into the Late Archaic subperiod, and large cemeteries appear during the Late Archaic subperiod. In addition, the increasing density of prehistoric sites through time is often considered to constitute evidence of population growth, though differential preservation probably at least partially accounts for the lower numbers of older sites.

3.3 LATE PREHISTORIC PERIOD (CA. 1200 TO 350 B.P.)

The onset of the Late Prehistoric period (1200 to 350 B.P.) (Collins 1995) is defined by the appearance of the bow and arrow. In Central Texas, pottery also appears during the Late Prehistoric period (though ceramics appear earlier in Southeast Texas). Use of the atlatl (i.e., spearthrower) and spear was generally discontinued during the Late Prehistoric period, though they continued to be used in the inland subregion of Southeast Texas along with the bow and arrow through the Late Prehistoric period (Patterson 1980, 1995; Wheat 1953). In Texas, unifacial arrow points appear to be associated with a small prismatic blade technology. The Late Prehistoric period is generally divided into 2 phases, the Austin and Toyah phases. Austin phase sites occur earliest to the north, which has led some researchers (e.g., Prewitt 1985) to suggest that the Austin-phase populations of Central Texas were migrants from the north, and lack the ceramic industry of the later Toyah phase.

3.4 HISTORIC PERIOD (CA. 350 B.P. TO PRESENT)

The first European incursion into what is now known as Texas was in 1519, when Álvarez de Pineda explored the northern shores of the Gulf of Mexico. In 1528, Cabeza de Vaca crossed South Texas after being shipwrecked along the Texas Coast near Galveston Bay. However, European settlement did not seriously disrupt native ways of life until after 1700. The first half of the 18th century was the period in which the fur trade and mission system, as well as the first effects of epidemic diseases, began to seriously disrupt the native culture and social systems. This process is clearly discernable at the Mitchell Ridge site, where burial data suggest population declines and group mergers (Ricklis 1994) as well as increased participation on the part of the Native American population in the fur trade. By the time that heavy settlement of Texas began in the early 1800s by Anglo-Americans, the indigenous Indian population was greatly diminished.

Spanish explorers were familiar with the Comal Springs area but showed little interest in settling the region.[1] After the expedition of Domingo Terán de los Ríos of 1691, the Old San Antonio Road crossed the Guadalupe River near the future site of New Braunfels. Subsequent French and Spanish expeditions, including those of the Marqués de Aguayo and Louis Juchereau de St. Denis, commonly passed through what later became southeastern Comal County. In 1756, Comal Springs became the site of the short-lived Nuestra Senora de Guadalupe Mission, but, rather than fortify the mission against anticipated Comanche depredations, Spanish authorities closed it in 1758. Nearly a century passed before settlement became permanent, although a Mexican land grant of 1825 gave title of the area around the springs to Juan M. Veramendi. During the 18th century, the springs and river (which had been called Las Fontanas and the Little Guadalupe, respectively) took the name Comal, Spanish for "flat dish." It is thought that the name was suggested to the Spanish by the numerous small islands in the river or by the shallow basin through which the river runs.

The inhabitants of the region on the eve of settlement were primarily Tonkawa and Waco Indians, although Lipan Apaches and Karankawas also roamed the area. Early settlers' contacts with the indigenous populations were generally uneventful. Nomadic Wacos camped at springs north of New Braunfels moved their camp west within a year of the founding of the settlement, and a village of some 500 Tonkawas on the Guadalupe River above New Braunfels initially welcomed German visitors. Notwithstanding the rapid influx of settlers in the 1840s and 1850s and isolated incidents of violence, county fathers and Indian leaders generally maintained peaceful relations.

Permanent settlement of the area began in 1845, when Prince Carl of Solms-Braunfels secured title to 1,265 acres of the Veramendi grant, including the Comal springs and river, for the Adelsverein. In succeeding years, thousands of Germans and Americans were attracted to the rich farm and ranch land around New Braunfels. Settlement progressed rapidly; in March 1846 the Texas legislature formed Comal County from the Eighth Precinct of Bexar County and made New Braunfels the county seat. The final boundary determination was made in 1858 with the separation of part of western Comal County to Blanco and Kendall counties. The first county elections were held on 13 July 1846. In 1854, the county commissioners divided the county into 8 public school districts, and, in 1858, long before they were required by law to do so, New Braunfels citizens voted to collect a tax for support of public schools. The population of

[1] The following historical summary has been adapted from TSHA (2012).

the county grew 133% between 1850 and 1860, and numbered more than 4,000 on the eve of the Civil War.

Comal County was exceptional among the largely German counties of southern and western Central Texas in the strength of its 1861 vote in favor of secession. The county contributed 3 all-German volunteer companies—2 cavalry and 1 infantry—to the Confederate cause. There is little to suggest that the county's support for the Confederacy reflected enthusiasm for slavery. Free labor predominated over slave labor in all counties with large German populations; a survey of 130 German farms in Comal and 2 other counties in 1850 revealed no slave laborers. By 1860, as Anglo-Americans settled alongside the German pioneers, blacks still made up less than 5% of county residents, and the family remained the primary source of labor. Comal County residents seem to have embraced the Southern cause because of their support of the larger cause of states' rights. There is no record in the county of the violence between Unionists and Confederates that broke out in German counties to the northwest.

From the early years of its settlement, Comal County supported diversified farming and ranching industries. Corn was almost universally cultivated by pioneers and quickly became a staple both of the German diet and of the local economy as a cash crop. It declined in importance relative to other crops and to livestock, however, during and after the Civil War as county ranchers and farmers began to produce commercially significant amounts of cotton, wheat, oats, wool, dairy products, and beef.

As farming and ranching spread beyond the environs of New Braunfels into the Hill Country, the county seat developed as an important supply and processing center for products of the expanding agricultural frontier. Many immigrants brought manufacturing experience and commercial acumen to their new home and applied these skills to the products of local agriculture. Comal County never developed as a major cotton-producing area, but the crop played an important role in the local economy. Production rose from 1,220 bales in 1860 to a peak of more than 16,000 bales in 1900. Perhaps more significant, however, was early interest in cotton processing. The first cotton gin in the county was built in the mid-1850s, and there were 20 gins by 1885. During the Civil War, John F. Torrey imported machinery and looms to manufacture cotton textiles and laid the foundation of the Comal County cotton industry of the 20th century. At almost the same time, another New Braunfels industrialist, George Weber, established the first cottonseed press in the state. Local businessmen also moved rapidly from sheep herding to woolen textiles. Production of raw wool expanded from 621 pounds in 1850 to 72,000 pounds in 1890, and a company was organized in New Braunfels in 1867 for the manufacture of woolen products.

After World War I, Comal County farming declined relative to ranching. As the diversified farms and ranches of the original Comal County agriculturalists gave way to the livestock economy of the 20th century, local industrialists were increasing the scope and the scale of county manufactures. By 1982, 50 manufacturers, employing almost 30% of the county labor force, had a gross product of more than $188 million. The production of such construction materials as gravel, sand, limestone, crushed stone, and concrete, in addition to the manufacture of textiles and clothing and the milling of wheat and corn, were still the mainstays of the industrial sector and accounted for much of its expansion. Metal and wood work and food processing also became important industries.

The county grew rapidly after World War II and boomed after 1970. From 16,357 residents in 1950, the population expanded by 21% in the subsequent decade and by the same amount in the 1960s, reaching 24,165 by 1970. In 1980, the figure was 36,446, a 50% increase from the previous census.

The emergence of tourism as a primary industry, as well as attendant increases in retail and service employment, explains much of the population growth. The county is located in the ―corridor" along Interstate Highway 35 between San Antonio and Austin; in 1973, it was included in the San Antonio Metropolitan Statistical Area. Between 1970 and 1984, the number of residents employed in trade nearly doubled, to 2,287; the number of jobs in service industries increased more than 600% to 1,977; and employment in financial, insurance, and real estate businesses rose 400%.

4.0 ARCHIVAL RESEARCH

Project maps showing the location of the 2 existing kilns that are proposed for upgrades at the Balcones Cement Plant, located at 2580 Wald Road, New Braunfels, Comal County, Texas, 78132, are presented in Appendix A.

Background archival research conducted via the Internet at the THC's online *Texas Archeological Sites Atlas* (Atlas) restricted-access database indicated that the presence of 2 previously recorded archeological sites within a 1.0-mile radius of the project site (Table 1) (THC 2012), while a review of the National Park Service's (NPS) NRHP Google Earth map layer indicated the presence of no historic properties listed on the NRHP within the review area (NPS 2012).

Site 41CM107 was originally recorded in 1978 in connection with a survey conducted for General Portland, Inc. (GPI) prior to construction of the cement plant (Howry 1978), a copy of which is provided in Appendix C. Site 41CM107 was recorded as a surficial scatter of aboriginal lithic artifacts in what was then a plowed agricultural field. A temporally diagnostic projectile point associated with the Middle to Late Archaic periods was observed among the artifacts on the site. Cultural materials were observed only on the surface of the plowed field, though the site form does not specify whether or not any subsurface investigations were undertaken, so the depth of cultural deposits is unknown. The site was recommended as ineligible for inclusion in the NRHP. While the mapped location of site 41CM107 places it approximately 100 feet southwest of the location of the existing cement kilns that are being proposed for upgrades, this site was recorded prior to construction of the Balcones Cement Plant. Prior construction of the plant would have destroyed any vestiges of this ephemeral prehistoric site.

Site 41CM332 represents the remnants of the mid-20th-century company town of Dittlinger, also known locally as The Village, or alternately the USG Village (for the US Gypsum Company). Site 41CM332 was recorded in 2011 during a cultural resources survey conducted by the Lower Colorado River Authority (LCRA) for a New Braunfels Utilities transmission line project (Malof et al. 2012). Dittlinger was established between 1917 and 1936, though probably closer to 1936, to provide housing and community services for the workers of the nearby US Gypsum mines. By 1951, Dittlinger consisted of approximately 30 individual homes situated on 50-foot lots that ran along APG Lane. The town was officially closed in 1968 over a labor dispute. A few of the residents purchased their homes and continued to live in them, but

Table 1. Summary of Documented Cultural Resources within 1.0 Mile of Project Site

Site No.	Site Type	NRHP/SAL Eligibility	Distance/Direction from Project Area	Potential to be Impacted by Project?
41CM107	Middle to Late Archaic aboriginal lithic scatter	Recommended ineligible	100 feet southwest	No
41CM332	Mid-20th century company town (Dittlinger)	Recommended ineligible	1,075 feet northeast	No

km Kilometer
NRHP National Register of Historic Places
SAL State Archeological Landmark

the rest were demolished. Based on the extent of prior disturbance observed when the former community of Dittlinger was recorded as an archeological site in 2011, the site was recommended as being ineligible for designation as an SAL under the Antiquities Code of Texas, and no further investigations were recommended.

Both sites 41CM107 and 41CM332 were recommended as ineligible for listing on the NRHP and/or for designation as State Archeological Landmarks (SAL) when they were originally recorded in 1978 and 2011, respectively, and both sites have been either largely or entirely destroyed from prior industrial development. Neither site would be affected by the proposed undertaking. No cemeteries, listed NRHP properties or districts, or SALs were identified within the 1.0-mile review radius or at the location of the proposed kiln upgrades.

Furthermore, the location of the 2 existing cement kilns on the Balcones Cement Plant was surveyed for cultural resources in 1978 in connection with a US EPA undertaking prior to construction of the existing facility (Howry 1978). No cultural resources were recorded at the location of the 2 cement kilns that are proposed for upgrades in connection with the current project during this prior survey.

Based on the extent of prior disturbances on the proposed project site resulting from construction of the existing Balcones Cement Plant and its ancillary facilities and the limited scope of the proposed upgrades to the 2 existing cement kilns, the proposed undertaking would have no potential to adversely affect any significant cultural resources. The portion of the Balcones Cement Plant in which the 2 existing cement kilns are located was surveyed for cultural resources in 1978 prior to construction of the plant, and no cultural resource sites were recorded at this location. It is Horizon's opinion that the proposed project site does not require any further cultural resources investigations and that no archeological or historic properties that are listed on, eligible for, or potentially eligible for inclusion in the NRHP would be adversely affected.

5.0 SUMMARY AND RECOMMENDATIONS

5.1 ELIGIBILITY CRITERIA FOR INCLUSION IN THE NATIONAL REGISTER OF HISTORIC PLACES

Determinations of eligibility for inclusion in the NRHP are based on the criteria presented in the Code of Federal Regulations (CFR) in 36 CFR §60.4(a-d). The 4 criteria of eligibility are applied following the identification of relevant historical themes and related research questions:

> The quality of significance in American history, architecture, archeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:
>
> a. [T]hat are associated with events that have made a significant contribution to the broad patterns of our history; or,
>
> b. [T]hat are associated with the lives of persons significant in our past; or,
>
> c. [T]hat embody the distinctive characteristics of a type, period, or method of construction, or that represent a significant and distinguishable entity whose components may lack individual distinction; or,
>
> d. [T]hat have yielded, or may be likely to yield, information important in prehistory or history.

The first step in the evaluation process is to define the significance of the property by identifying the particular aspect of history or prehistory to be addressed and the reasons why information on that topic is important. The second step is to define the kinds of evidence or the data requirements that the property must exhibit to provide significant information. These data requirements in turn indicate the kind of integrity that the site must possess to be significant. This concept of integrity relates both to the contextual integrity of such entities as structures, districts, or archeological deposits and to the applicability of the potential database to pertinent research questions. Without such integrity, the significance of a resource is very limited.

For an archeological resource to be eligible for inclusion in the NRHP, it must meet legal standards of eligibility that are determined by 3 requirements: (1) properties must possess significance, (2) the significance must satisfy at least 1 of the 4 criteria for eligibility listed above, and (3) significance should be derived from an understanding of historic context. As discussed here, historic context refers to the organization of information concerning prehistory and history according to various periods of development in various times and at various places. Thus, the significance of a property can best be understood through knowledge of historic development and the relationship of the resource to other, similar properties within a particular period of development. Most prehistoric sites are usually only eligible for inclusion in the NRHP under Criterion D, which considers their potential to contribute data important to an understanding of prehistory. All 4 criteria employed for determining NRHP eligibility potentially can be brought to bear for historic sites.

Criterion A—Events

To be considered for listing under Criterion A, a property must be associated with 1 or more events important in the defined historic context. Criterion A recognizes resources associated with single events, such as the founding of a town, or with a pattern of events, repeated activities, or historic trends, such as the gradual rise of a port city's prominence in trade and commerce. The event or trends, however, must clearly be important within the associated context of settlement, in the case of the town, or development of a maritime economy, in the case of the port city. Moreover, the property must have an important association with the event or historic trends, and it must retain historic integrity.

Criterion B—Persons

Criterion B applies to resources associated with individuals whose specific contributions to history can be identified and documented. Persons ―significant in our past" refers to individuals whose activities are demonstrably important within a local, state, or national historic context. The criterion is generally restricted to those resources that illustrate (rather than commemorate) a person's important achievements.

Criterion C—Design or Construction

This criterion applies to resources significant for their physical design or construction, including such elements as architecture, landscape architecture, engineering, and artwork. To be eligible under this criterion, a property must meet *at least one* of the following requirements—embody distinctive characteristics of a type, period, or method of construction; represent the work of a master; possess high artistic value; or represent a significant and distinguishable entity whose components may lack individual distinction.

Criterion D—Information Potential

Certain important research questions about human history can only be answered by the actual physical material of cultural resources. Criterion D encompasses the resources that have the potential to answer, in whole or in part, those types of research questions. The most common type of property nominated under this Criterion is the archeological site (or a district composed of archeological sites). Buildings, objects, and structures (or districts composed of these property types), however, can also be eligible for their information potential. Criterion D has 2 requirements, which must *both* be met for a property to qualify—the property must have, or have had, information to contribute to our understanding of human history or prehistory, and the information must be considered important.

5.2 SUMMARY AND RECOMMENDATIONS

Based on the results of the background Atlas review, inspection of current maps and aerial photographs, and inspection of site photographs provided by Zephyr, the proposed project site area is the site of an existing industrial cement plant with no low potential to contain intact cultural resources that would meet the criteria for significance for inclusion in the NRHP. Two previously recorded archeological sites, 41CM107 and 41CM332, are located within the 1.0-mile review radius; however, both of these sites are located outside the proposed kiln upgrade location. Both sites were recommended as ineligible for listing on the NRHP and/or for designation as State Archeological Landmarks (SAL) when they were originally recorded in 1978 and 2011, respectively, and both sites have been either largely or entirely destroyed from prior industrial development. Neither site would be affected by the proposed undertaking. No cemeteries, listed NRHP properties or districts, or SALs were identified within the 1.0-mile review radius or at the location of the proposed kiln upgrades.

Furthermore, the location of the 2 existing cement kilns on the Balcones Cement Plant was surveyed for cultural resources in 1978 prior to construction of the cement plant. No cultural resources were recorded at the location of the kilns during this prior survey.

Based on the extent of prior disturbances on the proposed project site resulting from construction of the existing Balcones Cement Plant and its ancillary facilities and the limited scope of the proposed upgrades to the 2 existing cement kilns, the proposed undertaking would have no potential to adversely affect any significant cultural resources. The portion of the Balcones Cement Plant in which the 2 existing cement kilns are located was surveyed for cultural resources in 1978 prior to construction of the plant, and no cultural resource sites were recorded at this location. It is Horizon’s opinion that the proposed project site does not require any further cultural resources investigations and that no archeological or historic properties that are listed on, eligible for, or potentially eligible for inclusion in the NRHP would be adversely affected.

6.0 REFERENCES CITED

Adovasio, J.M., J. Donahue, and R. Stuckenrath
1990 The Meadowcroft Rockshelter Chronology 1975-1990. *American Antiquity* 55:348-354.

Blair, W. F.
1950 The Biotic Provinces of Texas. *Texas Journal of Science* 2:93-117.

Butzer, K.W.
1988 A Marginality Model to Explain Major Spatial and Temporal Gaps in the Old and New World Pleistocene Settlement Records. *Geoarcheology* 3:193-203.

Collins, M.B.
1995 Forty Years of Archeology in Central Texas. *Bulletin of the Texas Archeological Society* 66:361-400.

Dice, L.R.
1943 *The Biotic Provinces of North America*. University of Michigan Press, Ann Arbor.

Dillehay, T.D.
1989 *Monte Verde: A Late Pleistocene Settlement in Chile—Paleoenvironment and Site Context*, Vol. 1. Smithsonian Institution Press: Washington, D.C.

1997 *Monte Verde: A Late Pleistocene Settlement in Chile—The Archaeological Context*, Vol. 2. Smithsonian Institution Press: Washington, D.C.

Dincauze, D.F.
1984 An Archaeo-Logical Evaluation of the Case for Pre-Clovis Occupations. *Advances in World Archaeology* 3:275-323. Academic Press, New York.

Fisher, W.L.
1976 *Geologic Atlas of Texas—San Antonio Sheet*. Bureau of Economic Geology, The University of Texas at Austin.

Haynes, C.V., Jr., D.J. Donahue, A.J. T. Hull, and T.H. Zabel
1984 Application of Accelerator Dating to Fluted Point Paleoindian Sites. *Archaeology of Eastern North America* 12:184-191.

Howry, J.

1978 *Cultural Resources Survey for GPI Properties in Comal and Guadalupe Counties, Texas*. Environmental Research & Technology, Inc., Concord, Massachusetts.

Ily, R.L., and L.C. Todd

1988 Coming into the Country: Early Paleo-Indian Hunting and Mobility. *American Antiquity* 53:231-244.

Lynch, T.F.

1990 Glacial-Age Man in South America?: A Critical Review. *American Antiquity* 55(1):12-36.

Malof, A.F., C.A. Hixson, and D.J. Prikryl

2012 *Intensive Cultural Resource Investigations of New Braunfels Utilities Proposed T-336, GPI Switch to Loop 337 Tie and T-586, E.C. Mornhinweg to GPI Switch Transmission Line Project, Comal County, Texas*. Cultural Resource Report No. 16, Cultural Resource Services, Lower Colorado River Authority. Austin, Texas.

Meltzer, D.J.

1989 Why Don't We Know When the First People Came to America? *American Antiquity* 54(3):471-490.

Meltzer, D.J., D.K. Grayson, G. Ardila, A.W. Barker, D.F. Dincauze, C.V. Haynes, F. Mena, L. Nuñez, and D.J. Stanford

1997 On the Pleistocene Antiquity of Monte Verde, Southern Chile. *American Antiquity* 62(4):659-663.

National Park Service (NPS)

2012 National Park Service National Register of Historic Places Google Earth Map Layer – South Region. <http://nrhp.focus.nps.gov/natreg/docs/Google_Earth_Layers.html>. Accessed November 20, 2012.

Natural Resources Conservation Service (NRCS)

2012 Web Soil Survey. <http://websoilsurvey.nrcs.usda.gov/app/>. Accessed November 20, 2012.

Patterson, L.W.

1980 *The Owen Site, 41HR315: A Long Occupation Sequence in Harris County, Texas*. Houston Archeological Society, Report No. 3.

1995 The Archeology of Southeast Texas. *Bulletin of the Texas Archeological Society* 66:239-264

Prewitt, E.

1981 Cultural Chronology in Central Texas. In *Bulletin of the Texas Archeological Society* 52:65-90.

1985 From Circleville to Toyah: Comments on Central Texas Chronology. *Bulletin of the Texas Archeological Society* 53:201-238.

Ricklis, R.A.

1994 Toyah Components: Evidence for Occupation in the Project Area During the Latter Part of the Late Prehistoric Period. In *Archaic and Late Prehistoric Human Ecology in the Middle Onion Creek Valley, Hays County, Texas*, by R.A. Ricklis and M.B. Collins, pp. 207-316. Studies in Archeology, No. 19. Texas Archeological Research Laboratory, The University of Texas at Austin.

Texas Historical Commission (THC)

2012 *Texas Archeological Sites Atlas Restricted Database*. <http://www.nueces.thc.state.tx.us/>. Accessed November 20, 2012.

Texas State Historical Association (TSHA)

2012 Comal County. *The Handbook of Texas Online: A Digital Gateway to Texas History*. <http://www.tshaonline.org/handbook/online/articles/hcc19>. Accessed November 20, 2012.

Thornwaite, C.W.

1948 An Approach Toward a Rational Classification of Climate. *Geographical Review* 38:55-94.

US Geological Survey (USGS)

1988 7.5-minute series topographic maps, New Braunfels West, Texas, quadrangle.

Wheat, J.B.

1953 *The Addicks Dam Site*. Bulletin 154:143-252. Bureau of American Ethnology, US Government Printing Office, Washington, D.C.

APPENDIX A:

Project Area Overview Photographs

(Provided by Zephyr Environmental Corporation)

CEMEX entry

Front of CEMEX Facility looking north

Front of CEMEX Facility looking southwest

Front of CEMEX Facility looking west

Inside facility looking northwest

Aerial view of facility looking north

Aerial view of the facility looking north

Aerial view of facility looking northeast settling ponds

Aerial view of the facility looking west

Aerial view of facility looking east

APPENDIX B:

Resume of Principal Investigator

Horizon Environmental Services, Inc.

Jeffrey D. Owens, M.A., R.P.A.

Archeological Principal Investigator/Project Manager

EXPERTISE

- Prehistoric Archeology
- Historic Archeology

RESEARCH AREAS

- Eastern North America (esp. Midwest, Southeast)
- Great Plains
- American Southwest

AREAS OF EXPERTISE

- Project Management
- Archival and Historical Research
- Archeological Survey, Testing, and Data Recovery
- National Register of Historic Places (NRHP) Evaluations
- Section 106 of the National Historic Preservation Act (NHPA)
- Antiquities Code of Texas (ACT)
- Native American Graves Protection and Repatriation Act (NAGPRA)
- Lithic and Ceramic Analysis
- Technical Writing and Editing
- Quality Assurance/ Quality Control

EDUCATION

- A.B.D., Anthropology, Southern Methodist University, 1997
- M.A., Anthropology, New York University, 1995
- B.A., Anthropology, New York University, 1991

Mr. Owens is an accomplished cultural resources professional with more than 23 years of experience in archeological fieldwork, research and analysis, and cultural resources management (CRM). He is an adept principal investigator and project manager, proficient at managing suites of turnkey, fast-turnaround projects as well as long-term, multidisciplinary research projects. He is fully versed in historic and environmental preservation laws, assessing the National Register of Historic Places (NRHP) eligibility of cultural resources, and developing management plans for historic properties that ensure compliance with applicable federal, state, and local laws while ensuring projects meet construction schedules and adhere to budgetary constraints.

Mr. Owens has planned, implemented, and successfully completed cultural resources survey, testing, and data recovery projects in Arizona, Arkansas, Illinois, Louisiana, Mississippi, Missouri, New Jersey, New Mexico, New York, Oklahoma, Pennsylvania, and Texas. He has completed hundreds of projects for a broad range of clients in the public and private sectors, including oil and gas exploration, development, and transportation; ethanol and petrochemical production; coastal and inland residential, commercial, and industrial land development; solid waste landfills; dredging activities; municipal planning; reservoir development; coastal port and channel improvements; transportation infrastructure; water and wastewater transportation and treatment; electricity generation and transportation; military reservations; and university research.

Mr. Owens also regularly contributes cultural resources oversight to the preparation of environmental regulatory documents, including Environmental Assessments (EA), Environmental Impact Statements (EIS), Biological Assessments (BA), and Categorical Exclusions (CE) for National Environmental Policy Act (NEPA) compliance projects.

Mr. Owens' project management style incorporates innovative leadership skills, resourcefulness, versatility, swift adaptability, and attention to the bottom line. His success is due in part to his thorough familiarity with federal, state, and local historic preservation laws and long-standing personal relationships with regulatory agency reviewers.

CERTIFICATIONS/QUALIFICATIONS

- Meets all Secretary of the Interior's standards for performing cultural resources investigations
- Permittable to perform cultural resource investigations on federal and state projects
- Listed on qualified cultural resource consultant lists in numerous states
- Pre-certified by TxDOT for Service 2.10.1 (Archeological Surveys, Documentation, Excavations, Testing, Reports, and Data Recovery Plans) and Service 2.11.1 (Historical and Archival Research)

PROFESSIONAL AFFILIATIONS

- Register of Professional Archaeologists (RPA)
- Council of Texas Archeologists (CTA)
- Texas Archeological Society (TAS)

PROFESSIONAL EXPERIENCE

Archaeological Principal Investigator/Project Manager Jan 2005 Present
Horizon Environmental Services, Inc.
1507 South IH-35
Austin, Texas 78741
(512) 328-2430

Project Archaeologist/Managing Editor Mar 2002 – Jan 2005
TRC Environmental Corporation
505 East Huntland Drive, Suite 250
Austin, Texas 78752
(512) 454-8716

Senior Editor Oct 1999 – Aug 2001
Consulting Partners (now part of Beeline Learning Solutions)
14911 Quorum Drive, Suite 120
Dallas, Texas 75254
(972) 813-0465

Project Archaeologist Aug 1997 – Oct 1999
Geo-Marine, Inc.
2201 K Avenue, Suite A2
Plano, Texas 75074
(972) 423-5480

Departmental/Teaching Assistant Sep 1995 – Jun 1997
Southern Methodist University
Department of Anthropology
3225 Daniel Avenue, Room 208
Dallas, Texas 75205
(214) 768-2684

Project Archaeologist Oct 1994 – Sep 1995
Soil Systems, Inc. (now part of PaleoWest)
1121 North 2nd Street
Phoenix, Arizona 85004
(602) 261-7253

Archeological Field Technician Jun 1994 – Oct 1994
John Milner Associates, Inc. Nov 1993 – Dec 1993
535 North Church Street
West Chester, Pennsylvania 19380
(610) 436-9000

Departmental Assistant Aug 1991 – Jun 1994
New York University
Department of Anthropology
25 Waverly Place, Rufus D. Smith Hall
New York, New York 10003
(212) 998-8550

Field Technician Dec 1993
Institute for Long Island Archaeology
State University of New York – Stonybrook
Department of Anthropology
Circle Road, Social & Behavioral Sciences Buildings, 5th Floor
Stonybrook, New York 11794
(631) 632-7620

Crew Chief Sep 1993 – Nov 1993
Greenhouse Consultants, Inc.
32 Park Place
Newark, New Jersey 07102
(973) 623-9091

Research Associate May 1993 – Sep 1993
AquaTerra Environmental Services Corporation
(now AquaTerra Environmental Solutions, Inc.)
[New York office no longer in business]
New York, New York

Crew Chief Jun 1992 – Jul 1992
New York University Jun 1990 – Jul 1990
Department of Anthropology
25 Waverly Place, Rufus D. Smith Hall
New York, New York 10003
(212) 998-8550

Archaeological Consultant Nov 1991 – Dec 1991
TAMS Consultants, Inc.
300 Broadacres Drive
Bloomfield, New Jersey 07003
(973) 338-6680

TECHNICAL PUBLICATIONS

n.d. *Archeological and Historical Investigations for the Proposed Dell Medical School Phase 1 Project, Austin, Travis County, Texas*. HJN 130112. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Proposed Alpha Olefin Chemical Company, LLC, Alpha Olefins Plant, Freeport, Brazoria County, Texas—Cultural Resources Assessment*. HJN 110012.21. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey of the Proposed 0.67-acre Lindshire Lane Wastewater System Improvements Project, Austin, Travis County, Texas*. HJN 130138. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Archeological and Geoarcheological Investigations, M&G Resins USA, LLC/ChemTex International, Inc., Proposed Jumbo Project, Corpus Christi, Nueces County, Texas* (with Charles D. Frederick). HJN 080122.56. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey of Segments of Browder Loop Road, Eldridge Lane, and North Butch Arthur Road, San Jacinto County, Texas*. HJN 130103. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey of the Proposed Enterprise Mont Belvieu Complex Fractionation Units 9 and 10 Project, Chambers County, Texas*. HJN 110012.17. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey of 5.9 Miles of Proposed Subsurface Utility Relocations, FM 1637 Expansion Project, Waco, McLennan County, Texas*. HJN 130031. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Proposed Victoria Power Station Expansion Project, Victoria, Victoria County, Texas—Cultural Resources Review*. HJN 110012.11. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey for the Proposed INVENERGY Energy Center, Ector County, Texas*. HJN 080122.54. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey for the Proposed Kansas City Southern K478.0 Bridge Construction and Railroad Alignment Project, Little River County, Arkansas*. HJN 130023. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey for the Proposed Southern Company Natural Gas Plant, Trinidad, Henderson County, Texas*. HJN 080122.53. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey of Proposed Yoakum Cryogenic Gas Processing Plant Expansion Areas, Lavaca County, Texas*. HJN 110012.15. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey of Proposed INVISTA Victoria Plant Improvements, Victoria County, Texas*. HJN 130035. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Proposed Equistar Chemicals, L.P., Corpus Christi Complex Expansion Project, Corpus Christi, Nueces County, Texas—Cultural Resources Assessment*. HJN 110012.13. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey of the Proposed 78-Acre La Paloma Energy Center Tract, Harlingen, Cameron County, Texas*. HJN 080122.31. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Proposed Clinker Production Increase at the CEMEX Construction Materials South, LLC, Balcones Cement Plant, Comal County, Texas—Cultural Resources Review*. HJN 080122.39. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey of the Proposed 77-Acre Pinecrest Energy Center Tract, Lufkin, Angelina County, Texas*. HJN 080122.40. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Proposed Guadalupe Generating Station Expansion Project, Marion, Guadalupe County, Texas—Cultural Resources Review*. HJN 130016. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey of the Proposed 181-Acre Enterprise Mont Belvieu Complex Propane Dehydrogenation Unit Project, Chambers County, Texas*. HJN 110012.12. Horizon Environmental Services, Inc., Austin, Texas.

n.d. *Intensive Cultural Resources Survey of a Proposed 20-Acre Expansion Tract Adjacent to an Existing PL Propylene, LLC, Facility, Houston, Harris County, Texas*. HJN 080122.30. Horizon Environmental Services, Inc., Austin, Texas.

2013 *Intensive Cultural Resources Survey of 4 USACE Jurisdictional Areas on Chesapeake Energy Corporation's Proposed JEA West Lateral Pipeline Right-of-Way, Dimmit County, Texas* (with R.K. Brownlow). HJN 130087.04. Horizon Environmental Services, Inc., Austin, Texas.

2013 *Intensive Cultural Resources Survey of Chesapeake Energy Corporation's Proposed Sugarland DIM H Well Pad and Access Road, Dimmit County, Texas* (with R.K. Brownlow). HJN 130087.03. Horizon Environmental Services, Inc., Austin, Texas.

2013 *A Cultural Resources Assessment of the USACE Jurisdictional Areas along BridgeTex Pipeline Company, LLC's, Proposed BridgeTex North Pipeline ROW* (with R.K. Brownlow and J.L. Cochran). HJN 120166 AR. Horizon Environmental Services, Inc., Austin, Texas.

2013 *Intensive Cultural Resources Survey of the Proposed 545-Acre Kansas City Southern Railroad Wylie Intermodal Facility, Wylie, Collin County, Texas*. HJN 130042. Horizon Environmental Services, Inc., Austin, Texas.

2013 *Intensive Cultural Resources Survey of a USACE Jurisdictional Area on a Proposed 4.6-Acre HEB Grocery Store Expansion Tract, Georgetown, Williamson County, Texas*. HJN 120085. Horizon Environmental Services, Inc., Austin, Texas.

2013 *Cultural Resources Investigations along the Proposed Lone Star Competitive Renewable Energy Zone (CREZ) 345-kV Transmission Line Right-of-Way in North-Central Texas*, Vols. I and II (with Jennifer L. Cochran, Russell K. Brownlow, and Raymundo Chapa). HJN 100137. Horizon Environmental Services, Inc., Austin, Texas.

2013 *Intensive Cultural Resources Survey of the San Antonio River Outfall Project, San Antonio, Bexar County, Texas*. HJN 120150. Horizon Environmental Services, Inc., Austin, Texas.

2012 *Intensive Archeological Survey for the Proposed Brushy Creek Regional Trail Gap Project, Round Rock, Williamson County, Texas*. HJN 080151. Horizon Environmental Services, Inc., Austin, Texas.

2012 *Intensive Archeological Survey for the Proposed San Gabriel River Trail Extension Project, Georgetown, Williamson County, Texas*. HJN 120057. Horizon Environmental Services, Inc., Austin, Texas.

2012 *Intensive Cultural Resources Survey of the 1,102-Acre Creekside Park West Tract, Harris County, Texas* (with Raymundo Chapa). HJN 100142. Horizon Environmental Services, Inc., Austin, Texas.

2012 *Intensive Cultural Resources Survey of Two 0.9-Acre HDD Locations on the Trinity River, Madison and Houston Counties, Texas*. HJN 120009.14. Horizon Environmental Services, Inc., Austin, Texas.

2012 *Intensive Cultural Resources Survey of a USACE Jurisdictional Area on the Proposed 18.5-Acre Esperanza Crossing Tract, Austin, Travis County, Texas*. HJN 120052. Horizon Environmental Services, Inc., Austin, Texas.

2012 *Intensive Cultural Resources Survey, One USACE Jurisdictional Area, Existing East Red Segment 1 Pipeline Maintenance Activities, Clay County, Missouri*. HJN 120075. Horizon Environmental Services, Inc., Austin, Texas.

2012 *Intensive Cultural Resources Survey, Two USACE Jurisdictional Area Dig Sites (#253 and #261) on the Existing Eskridge to Kearney Pipeline Maintenance Activities, Clay County, Missouri*. HJN 120075. Horizon Environmental Services, Inc., Austin, Texas.

2012 *Intensive Cultural Resources Survey for the Penn City Coal Expansion Project, Houston, Harris County, Texas*. HJN 110097. Horizon Environmental Services, Inc., Austin, Texas.

2012 *Intensive Cultural Resources Survey for the Lake Anahuac East Levee Project, Anahuac, Chambers County, Texas* (with Sally Victor). HJN 120004. Horizon Environmental Services, Inc., Austin, Texas.

2012 *Intensive Cultural Resources Survey, One USACE Jurisdictional Area on the Existing Eskridge to Kearney Pipeline Right-of-Way, Platte County, Missouri*. HJN 120075. Horizon Environmental Services, Inc., Austin, Texas.

2012 *Intensive Cultural Resources Survey of the Proposed 0.6-Mile-Long Rattler Road Extension Project, San Marcos, Hays County, Texas*. HJN 120036. Horizon Environmental Services, Inc., Austin, Texas.

2011 *Intensive Cultural Resources Survey of 6 Jurisdictional Stream Crossings for the City of Hamshire Water System Improvements Project, Hamshire, Jefferson County, Texas*. HJN 110070. Horizon Environmental Services, Inc., Austin, Texas.

2011 *Cultural Resources Investigations on the Proposed Waller Creekside Apartments Tract, Austin, Travis County, Texas*. HJN 110116. Horizon Environmental Services, Inc., Austin, Texas.

2011 *Intensive Cultural Resources Survey of the Woodland Oaks Wastewater Treatment Plant Proposed 1.3-Acre Expansion Tract, Houston, Harris County, Texas*. HJN 100024. Horizon Environmental Services, Inc., Austin, Texas.

2011 *Intensive Archeological Survey of the Farm-to-Market Road 1660 Realignment Project, Hutto, Williamson County, Texas*. HJN 090047. Horizon Environmental Services, Inc., Austin, Texas.

2011 *Intensive Archeological Survey of a 3.7-Acre Tract in San Marcos, Hays County, Texas*. HJN 110124. Horizon Environmental Services, Inc., Austin, Texas.

2011 *Intensive Cultural Resources Survey of USACE Jurisdictional Areas on the Proposed Whispering Pines Par 3 Golf Course Tract, Trinity County, Texas*. HJN 110031. Horizon Environmental Services, Inc., Austin, Texas.

2011 *Archeological Avoidance Plan for the Proposed Washburn 3D Seismic Survey Project, Houston, Harris County, Texas*. HJN 110122. Horizon Environmental Services, Inc., Austin, Texas.

2011 *Intensive Cultural Resources Survey of the Orange County Sewer and Natural Gas Infrastructure Improvements Project, Orange County, Texas*. HJN 110121. Horizon Environmental Services, Inc., Austin, Texas.

2011 *Intensive cultural Resources Survey for the McInnish Park Water System Improvements Project, Carrollton, Dallas County, Texas*. HJN 110135. Horizon Environmental Services, Inc., Austin, Texas.

2011 *Intensive Cultural Resources Survey for the City of Liberty Wastewater System Improvement Project, Liberty County, Texas*. HJN 110005. Horizon Environmental Services, Inc., Austin, Texas.

2011 *Cultural Resource Investigations to Offset Mechanical Impacts to the Clear Creek Golf Course Site (41CV413), Fort Hood, Texas* (with J. Michael Quigg, Christopher Lintz, Grant D.

Smith, and David DeMar). TRC Technical Report No. 02353. ARM Series, Research Report No. 60. TRC Environmental Corporation, Austin, Texas.

2011 *Archeological Avoidance Plan for the Proposed North Clinton Dome 3D Seismic Survey Project, Houston, Harris County, Texas*. HJN 110011. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Cultural Resources Survey Activities for the Shelby East 3D Seismic Survey Project, Areas 1 and 2, Sabine National Forest, San Augustine and Shelby Counties, Texas*. HJN 090017. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Cultural Resources Survey Activities for the Shelby East 3D Seismic Survey Project, Areas 1 and 2, Sabine National Forest, San Augustine and Shelby Counties, Texas. Addendum #1—Access Routes*. HJN 090017. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Intensive Cultural Resources Survey of the 10.6-Acre Helbig Road Tract, Beaumont, Jefferson County, Texas*. HJN 100099. Horizon Environmental Services, Inc., Austin, Texas

2010 *Intensive Cultural Resources Survey of the 44-Acre Creekside Park, Section 18, Tract, The Woodlands, Harris County, Texas*. HJN 100079. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Intensive Cultural Resources Survey of the 66-Acre Royal Shores Tract, Kingwood, Harris County, Texas*. HJN 100005. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Intensive Cultural Resources Survey of the Proposed 74 Ranch Pittman 1-H Well Pad, Campbellton, Atascosa County, Texas*. HJN 100093.001. Horizon Environmental Services, Inc., Austin, Texas

2010 *Intensive Cultural Resources Survey of the Proposed 74 Ranch Axis 1-H Well Pad, Campbellton, Atascosa County, Texas*. HJN 100093.002. Horizon Environmental Services, Inc., Austin, Texas

2010 *An Intensive Cultural Resources Survey of a Proposed HDD Location Under an Abandoned Tram Road in Nacogdoches County, Texas*. HJN 100019. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Intensive Cultural Resources Survey for the Green Valley Special Utility District's Water Supply Improvement Project, Guadalupe County, Texas*. HJN 090102. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Intensive and Reconnaissance Survey of the Proposed Lake Halbert Water Treatment Plant Expansion Project, Corsicana, Navarro County, Texas*. HJN 100015. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Intensive Cultural Resources Survey of a Proposed 2.9-Mile-Long Force Main Right-of-Way, Houston, Harris County, Texas*. HJN 100051. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Intensive Cultural Resources Survey of a 13.9-Acre Tract for the Proposed Fort Bend County MUD No. 116 Wastewater Treatment Plant Project, Richmond, Fort Bend County, Texas*. HJN 100047. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Intensive Cultural Resources Survey of a Proposed 3,100-Foot-Long Erosion-Control Bulkhead on the T-BAR-O Ranch, Llano County, Texas*. HJN 100075. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Intensive Cultural Resources Survey of the 21.6-Acre Kalentari Tract, San Marcos, Hays County, Texas*. HJN 100055. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Intensive Cultural Resource Survey of a 14.8-Acre Tract on Williams Gully in Houston, Harris County, Texas*. HJN 090127. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Intensive Cultural Resources Survey of the Proposed Crossroad Exhibit Hall Expansion, Fort Griffin State Historic Site, Shackelford County, Texas*. HJN 090019. Horizon Environmental Services, Inc., Austin, Texas.

2010 *Intensive Phase I Cultural Resources Survey of 3.5 Miles of M2 LGS, LLC's, Proposed Natural Gas Pipeline Right-of-Way on the Mansfield Battlefield, DeSoto Parish, Louisiana*. HJN 090055.025. Horizon Environmental Services, Inc., Austin, Texas.

2009 *Intensive Archeological Survey of the US Highway 69 Expressway and Reliever Route, Jacksonville, Cherokee County, Texas*. HJN 080173. Horizon Environmental Services, Inc., Austin, Texas.

2009 *Intensive Cultural Resource Survey of the Proposed 5.4-Acre Floral Gardens Senior Living Apartments Tract, Houston, Harris County, Texas*. HJN 090129. Horizon Environmental Services, Inc. Austin, Texas.

2009 *Intensive Cultural Resource Survey, PEC Marshall Ford to Buttercup Substations Transmission Line Rebuild Project, Travis and Williamson County, Texas*. HJN 090096. Horizon Environmental Services, Inc. Austin, Texas.

2009 *Intensive Cultural Resources Survey of the Possum Kingdom Lake Hike and Bike Trail, Phase III, Palo Pinto County, Texas*. HJN 090053. Horizon Environmental Services, Inc., Austin, Texas.

2009 *Intensive Cultural Resource Survey of the Proposed 2.2-Acre Junker-Spencer Well No. 69, Fannett, Jefferson County, Texas*. HJN 090079. Horizon Environmental Services, Inc., Austin, Texas.

2009 *Cultural Resource Survey of the Proposed 60-Acre Harrison Ranch Park, Dripping Springs, Hays County, Texas*. HJN 090080. Horizon Environmental Services, Inc. Austin, Texas.

2009 *Intensive Cultural Resource Survey of the Tyrrell Park Storm Water Detention Pond Project, Beaumont, Jefferson County, Texas*. HJN 090042. Horizon Environmental Services, Inc. Austin, Texas.

2009 *Intensive Cultural Resource Survey of 7 Miles of Proposed Dredge Disposal Areas along Green Pond Gully, Beaumont, Jefferson County, Texas*. HJN 090041. Horizon Environmental Services, Inc. Austin, Texas.

2009 *Intensive Cultural Resource Survey of for the Lumberton Lift Station Rehabilitation Project, Loeb, Hardin County, Texas*. HJN 080008. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of the Port of Houston Authority's 43-Acre Acryl Tract, Seabrook, Harris County, Texas*. HJN 080163. Horizon Environmental Services, Inc. Austin, Texas.

2009 *Intensive Cultural Resource Survey of 34 Acres of Dredge Disposal Areas along Bayou Din, Beaumont, Jefferson County, Texas*. HJN 090038. Horizon Environmental Services, Inc. Austin, Texas.

2009 *Intensive Cultural Resources Survey of the 2.8-Acre Harris County MUD No. 148 Wastewater Treatment Plant No. 2, Harris County, Texas*. HJN 090048. Horizon Environmental Services, Inc., Austin, Texas.

2009 *Intensive Cultural Resources Survey of the Round Rock ISD 181-Acre Pearson/ England Tract, Round Rock, Williamson County, Texas*. HJN 090027. Horizon Environmental Services, Inc., Austin, Texas.

2009 *Intensive Cultural Resources Survey of the Round Rock ISD 12.8-Acre Stone Oak School Tract, Round Rock, Williamson County, Texas*. HJN 090006. Horizon Environmental Services, Inc., Austin, Texas.

2009 *Intensive Cultural Resources Survey of the 136-Acre Sweetwater Ranch Tract, Travis County, Texas*. HJN 090005. Horizon Environmental Services, Inc., Austin, Texas.

2009 *Intensive Cultural Resources Survey of the Elm Fork Relief Interceptor Segment EF-3 Project, Dallas and Farmers Branch, Dallas County, Texas*. HJN 080185. Horizon Environmental Services, Inc., Austin, Texas.

2009 *Intensive Cultural Resources Survey of Oak Branch Drive at US Highway 290 and Nutty Brown Road, Hays County, Texas*. HJN 080166. Horizon Environmental Services, Inc., Austin, Texas.

2009 *Intensive Cultural Resources Survey of the Bachelor Creek Interceptor Project, Terrell, Kaufman County, Texas*. HJN 080132. Horizon Environmental Services, Inc., Austin, Texas.

2009 *Intensive Cultural Resources Survey of the Washington Street Improvements Project, Sherman, Grayson County, Texas*. HJN 080179. Horizon Environmental Services, Inc., Austin, Texas.

2009 *Intensive Cultural Resources Survey of the Canyon Creek Drive Extension Project, Sherman, Grayson County, Texas*. HJN 080178. Horizon Environmental Services, Inc., Austin, Texas.

2008 *Archeological Surveys and Impact Evaluations in the Texas Department of Transportation's Abilene, Brownwood, Fort Worth, and Waco Districts, 2006-2008*. HJN 080104. Texas Department of Transportation, Environmental Affairs Division, Archeological Studies Program, Report No. 112. Horizon Environmental Services, Inc., Austin, Texas.

2008 *Intensive Cultural Resources Survey of the Wells Ranch Carrizo Groundwater Project, Bexar, Gonzales, and Guadalupe Counties, Texas*. HJN 070157. Horizon Environmental Services, Inc., Austin, Texas.

2008 *Intensive Cultural Resource Survey of the Westwood Water Supply Corporation Water System Improvements Project, Jasper County, Texas*. HJN 080060. Horizon Environmental Services, Inc., Austin, Texas.

2008 *Intensive Cultural Resources Survey of 1,118 Feet of the Bethune Gathering System Pipeline Right-of-Way, Sam Rayburn Reservoir, Nacogdoches County, Texas*. HJN 060042. Horizon Environmental Services, Inc., Austin, Texas.

2008 *Intensive Cultural Resources Survey of 15 Earthen Levee Segments on White's Ranch, Jefferson and Chambers Counties, Texas*. HJN 070196. Horizon Environmental Services, Inc., Austin, Texas.

2008 *Intensive Cultural Resources Survey of the 107-Acre Juno Lake No. 1 Reservoir Project, Trinity and Polk Counties, Texas*. HJN 080034. Horizon Environmental Services, Inc., Austin, Texas.

2008 *Intensive Cultural Resources Survey of a 0.9-Acre Tract Between Broadway and Garfield Streets, Del Rio, Val Verde County, Texas*. HJN 080091. Horizon Environmental Services, Inc., Austin, Texas.

2008 *Intensive Cultural Resource Survey of the Green Acres Storm Water System Project, Fannett, Jefferson County, Texas*. HJN 080068. Horizon Environmental Services, Inc., Austin, Texas.

2008 *Intensive Cultural Resources Survey of USACE Jurisdictional Areas on the Sunchase Tract, Austin, Travis, and Bastrop Counties, Texas*. HJN 080079. Horizon Environmental Services, Inc., Austin, Texas.

2008 *Intensive Cultural Resources Survey of 2 USACE Jurisdictional Areas on the 70-Acre Regal Oaks Tract, Travis County, Texas*. HJN 080041. Horizon Environmental Services, Inc., Austin, Texas.

2008 *Intensive Cultural Resources Survey of the Proposed 10-Acre Mitchell Island Development, The Woodlands, Montgomery County, Texas* (with Russell K. Brownlow). HJN 070193. Horizon Environmental Services, Inc., Austin, Texas.

2008 *The Varga Site: A Multicomponent, Stratified Campsite in the Canyonlands of Edwards County, Texas, Volume I* (with J.M. Quigg, P.M. Matchen, G. Smith, R.A. Ricklis, M.C. Cody, and C.D. Frederick). TRC Technical Report No. 35319. TRC Environmental Corporation, Austin, Texas.

2008 *Phase I Cultural Resource Investigations for the Deer Park LPG Terminal Project in Chambers and Harris Counties, Texas* (with Price Laird, Larissa Thomas, and Paul Matchen). TRC Environmental Corporation, Austin, Texas.

2007 *Intensive Cultural Resources Survey of 5 USACE Jurisdictional Waterway Impact Areas on the 418-Acre Watersedge Tract, Travis County, Texas*. HJN 070011. Horizon Environmental Services, Inc., Austin, Texas.

2007 *Intensive Cultural Resources Survey of the North Brushy Creek Interceptor Extension, Phase 1, Cedar Park, Williamson County, Texas*. HJN 060258. Horizon Environmental Services, Inc., Austin, Texas.

2007 *Cultural Resources Survey of 2.4 Miles of Proposed Pipeline Reroutes, Dripping Springs Wastewater Treatment System, Dripping Springs, Hays County, Texas*. HJN 050073.002. Horizon Environmental Services, Inc., Austin, Texas.

2007 *Intensive Cultural Resources Survey of the Loop 4 Extension Project, Buda, Hays County, Texas*. HJN 070071. Horizon Environmental Services, Inc., Austin, Texas.

2007 *Intensive Archeological Survey of 5.6 Miles of US 290 from US 183 to Gilleland Creek, Travis County, Texas*. HJN 040029.006. Horizon Environmental Services, Inc., Austin, Texas.

2007 *Intensive Cultural Resources Survey of 3,550 Feet of Jurisdictional Waterways on the 112-Acre Brushy Creek Business Park Tract, Williamson County, Texas*. HJN 050006. Horizon Environmental Services, Inc., Austin, Texas.

2007 *Intensive and Reconnaissance Cultural Resources Survey of the Bexar Metropolitan Water District's Trinity Aquifer Water Supply Project, Bexar County, Texas*. HJN 070012. Horizon Environmental Services, Inc., Austin, Texas.

2007 *Intensive Cultural Resources Survey of the 65.5-Acre Southeast Metropolitan Park Expansion and 2.3-Mile Raw Water Pipeline Right-of-Way, Austin, Travis County, Texas*. HJN 070062. Horizon Environmental Services, Inc., Austin, Texas.

2007 *Intensive Cultural Resources Survey of Section 404 Jurisdictional Waterways on the 260-Acre Winding Creek Tract, Williamson County, Texas*. HJN 070032. Horizon Environmental Services, Inc., Austin, Texas.

2007 *An Intensive Cultural Resources Survey and Subsequent NRHP Eligibility Testing of the USACE Jurisdictional Areas within the Proposed 4.5-Mile Townsen Road Right-of-Way, Montgomery and Harris Counties, Texas* (with Abigail Peyton and Russell K. Brownlow). HJN 050161. Horizon Environmental Services, Inc., Austin, Texas.

2007 *Intensive Cultural Resources Survey of 2.0 Miles of the Proposed Grande Avenue Extension Project, New Copeland Road to SH 110, Tyler, Smith County, Texas*. HJN 070066. Horizon Environmental Services, Inc., Austin, Texas.

2007 *Intensive and Reconnaissance Cultural Resources Survey of the City of Meridian 14.8-Mile Treated Water Delivery System, Bosque County, Texas*. HJN 050182. Horizon Environmental Services, Inc., Austin, Texas.

2007 *An Intensive Cultural Resource Survey of the USACE Jurisdictional Areas within the Proposed 6-Mile Loco Bayou Pipeline Right-of-Way, Angelina and Nacogdoches Counties, Texas* (with Pollyanna Held and Russell K. Brownlow). HJN 060053. Horizon Environmental Services, Inc., Austin, Texas.

2007 *Intensive Cultural Resources Survey of the Possum Kingdom Lake Hike and Bike Trail, Phase II, Palo Pinto County, Texas*. HJN 070148. Horizon Environmental Services, Inc., Austin, Texas.

2007 *Cultural Resource Survey of 3.1 Miles of the US Highway 69 Expressway and Reliever Route, Jacksonville, Cherokee County, Texas* (with contributions by Abigail Weinstein). HJN 050093. Horizon Environmental Services, Inc., Austin, Texas.

2006 *Archeological Surveys in the Texas Department of Transportation's Abilene, Brownwood, Fort Worth, and Waco Districts, 2006*. HJN 060170. Texas Department of Transportation, Environmental Affairs Division, Archeological Studies Program, Report No. 90. Horizon Environmental Services, Inc., Austin, Texas.

2006 *Intensive Archeological Survey of Farm-to-Market Road 1460 from Old Settler's Boulevard to Quail Valley Cove, Georgetown, Williamson County, Texas*. HJN 040029.006. Horizon Environmental Services, Inc., Austin, Texas.

2006 *An Intensive Cultural Resources Survey of the Sun 6-Inch-Diameter Pipeline Reroute, Orange County, Texas* (with Abigail Peyton and Russell K. Brownlow). HJN 060123. Horizon Environmental Services, Inc., Austin, Texas.

2006 *Intensive Archeological Survey of 3.9 Acres of New Right-of-Way at the Intersection of FM 3405 and Ronald Reagan Boulevard, Williamson County, Texas*. HJN 060194. Horizon Environmental Services, Inc., Austin, Texas.

2006 *Interim Report: Phase Ia Cultural Resource Inventory Survey, Lake Columbia Water Supply Project, Cherokee and Smith Counties, Texas* (with Terri Myers, Charles D. Frederick, Reign Clark, Abigail Peyton, and A. Elizabeth Butman). HJN 050082. Horizon Environmental Services, Inc., Austin, Texas.

2006 *Intensive Cultural Resources Survey of Two Road Easements in Buescher State Park, Bastrop County, Texas* (with Reign Clark and Marie Archambeault). HJN 060178. Horizon Environmental Services, Inc., Austin, Texas.

2006 *Intensive Cultural Resource Survey of 58.2 Acres of Langham Creek for the Langham Creek Flood Bypass Project, Harris County, Texas* (with Abigail Peyton). HJN 060160. Horizon Environmental Services, Inc., Austin, Texas.

2006 *Cultural Resource Survey of 6,600 Feet of Langham Creek for the Langham Creek Flood Bypass Project, Harris County, Texas*. HJN 060001. Horizon Environmental Services, Inc., Austin, Texas.

2006 *Intensive Cultural Resources Survey of the La Nana Bayou Detention Ponds, Nacogdoches County, Texas* (with Marie J. Archambeault). HJN 060068. Horizon Environmental Services, Inc., Austin, Texas.

2006 *Cultural Resource Survey of the City of Jarrell Wastewater Treatment System, Williamson County, Texas*. HJN 050130. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey of the Farm-to-Market Road 2001 Extension Project, Buda, Hays County, Texas*. HJN 050140. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey of the 46-Acre Arbor Walk Property, Austin, Travis County, Texas*. HJN 040109. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey of Reunion Ranch, a 550-Acre Property in Hays County, Texas*. HJN 040065. Horizon Environmental Services, Inc., Austin, Texas.

2005 *An Intensive Cultural Resources Survey of the Proposed City of Orange Sewer and Water Lines, Orange County, Texas* (with Marie J. Archambeault). HJN 050205. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Constraints Analysis: Farm-to-Market Road 973 Route Study, Manor, Travis County, Texas*. HJN 040029.009. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey of 2.4 Miles of Kuykendahl Road, Harris County, Texas*. HJN 050039. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey of 26-Acre Dredge Disposal and 11-Acre Borrow Areas, Greens Bayou Sediment Remediation Project, Harris County, Texas*. HJN 050135. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey for the Woodlands Waterway West Relocation Project, The Woodlands, Montgomery County, Texas*. HJN 050171. Horizon Environmental Services, Inc., Austin, Texas.

2005 *An Intensive Cultural Resources Survey of the Proposed Lumberton 2.9-Mile Sewer Line, Hardin County, Texas* (with Rebecca Sick and Russell K. Brownlow). HJN 040111. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey of the Proposed Lumberton 2.7-Mile Sewer Line and Lift Station along US Highway 69, Hardin County, Texas* (with Marie J. Archambeault). HJN 040111. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey of the Nacogdoches Wastewater System Improvement Project, Nacogdoches, Texas* (with Marie J. Archambeault). HJN 050115. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey of the 65-Acre Gregg Manor Road Property, Manor, Travis County, Texas*. HJN 040137. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey for County Road 132 Realignment Project, Buda, Hays County, Texas*. HJN 050192. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey of Willow Marsh Bayou Relocation Project, Beaumont, Jefferson County, Texas*. HJN 050080. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey of the Dripping Springs Wastewater Treatment System, Dripping Springs, Hays County, Texas*. HJN 050073. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey of Overpass Road from Interstate 35 Northbound Frontage Road to Farm-to-Market Road 2001, Buda, Hays County, Texas*. HJN 050140. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey of the 148-Acre Comal County Landfill Expansion, Comal and Guadalupe Counties, Texas*. HJN 050078. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Scope of Work: Cultural Resource Survey, Lake Columbia Water Supply Project, Cherokee and Smith Counties, Texas*. HJN 050082. Horizon Environmental Services, Inc., Austin, Texas.

2005 *An Intensive Cultural Resources Survey of US Army Corps of Engineers Jurisdictional Drainages within the Proposed 101-Acre Stone Oak Development Located on US 281 at Stone Oak Parkway, San Antonio, Bexar County, Texas* (with Reign Clark and Russell K. Brownlow). HJN 040133. Horizon Environmental Services, Inc., Austin, Texas.

2005 *An Intensive Cultural Resources Survey of Portions of the Brakes Bayou Flood Mitigation Project, Beaumont, Jefferson County, Texas* (with Russell K. Brownlow). HJN 050149. Horizon Environmental Services, Inc., Austin, Texas.

2005 *An Intensive Cultural Resources Survey of a Proposed 48-Acre Wastewater Treatment Plant Expansion Tract in Lumberton, Hardin County, Texas* (with Rebecca Sick and Russell K. Brownlow). (with Russell K. Brownlow). HJN 040111. Horizon Environmental Services, Inc., Austin, Texas.

2005 *Cultural Resource Survey for the Liberty Hill Regional Wastewater System Project, Williamson County, Texas* (with Marie J. Archambeault). TRC Technical Report No. 44169. TRC Environmental Corporation, Austin, Texas.

2004 *Phase I Cultural Resource Inventory Survey for the Chiles Dome Storage Expansion Project, Atoka, Coal, Latimer, and Pittsburg Counties, Oklahoma* (with Marie J. Archambeault). TRC Technical Report No. 43627. TRC Environmental Corporation, Austin, Texas.

2004 *Cultural Resource Survey of Five Proposed Detention Ponds at the Intersection of State Highway 6 and U.S. 90A, Fort Bend County, Texas*. TRC Technical Report No. 43224. TRC Environmental Corporation, Austin, Texas.

2004 *Cultural Resource Survey of U.S. 75 (Central Expressway Between Spur 399 and State Highway 121, Collin County, Texas*. TRC Technical Report No. 40968. TRC Environmental Corporation, Austin, Texas.

2004 *Cultural Resource Survey of 0.54 Linear Mile of FM 2234 at the SH 122 (Fort Bend Parkway Toll Road) Crossing, Fort Bend County, Texas*. TRC Technical Report No. 40948. TRC Environmental Corporation, Austin, Texas.

2004 *Impact Evaluations of Three TxDOT Bridge Expansion Projects in Collin and Denton Counties, Texas (TxDOT CSJs 0047-09-029; 2980-01-008; 0135-12-025)*. TRC Environmental Corporation, Austin, Texas.

2003 Cultural Resource Survey of 11 Arroyo Crossings for the Laredo Energy Pipeline Project, Zapata County, Texas. TRC Technical Report No. 40959. TRC Environmental Corporation, Austin, Texas.

2003 Cultural Resource Survey of 0.75 Linear Mile of Undeveloped Rangeland for the City of Elgin Water System Project, Bastrop County, Texas. TRC Technical Report No. 40294. TRC Environmental Corporation, Austin, Texas.

2003 Cultural Resource Survey of Two Miles of U.S. Highway 87 at West Rita Blanca Creek on the Rita Blanca National Grasslands, Cibola National Forest, Dallam County, Texas. TRC Technical Report No. 39218. TRC Environmental Corporation, Austin, Texas.

2003 Data Recovery Investigations at the Varga Site (41ED28), Edwards County, Texas: Final Research Design. Research design prepared for the Texas Department of Transportation, Environmental Affairs Division, Archeological Studies Program. TRC Environmental Corporation, Austin, Texas.

2003 Cultural Resource Feasibility Study for the Layne, Texas, Water Transmission Pipeline, Austin to Dallas-Fort Worth, Texas. Feasibility study prepared for Hunter Research, Inc. TRC Environmental Corporation, Austin, Texas.

2002 *Final Data Recovery Phase at the Varga Site (41ED28), Edwards County, Texas: Interim Report* (with J. Michael Quigg and Grant D. Smith). Interim report prepared for the Texas Department of Transportation, Environmental Affairs Division, Archeological Studies Program. TRC Environmental Corporation, Austin, Texas.

2002 *Testing of the Noodle Creek Site (41JS102), Jones County, Texas* (with J. Michael Quigg, Grant D. Smith, and Audrey L. Scott). Texas Department of Transportation, Environmental Affairs Division, Archeological Studies Program, Report No. 48, and TRC Technical Report No. 35398. TRC Environmental Corporation, Austin, Texas.

2000 *Cultural Resources Survey of a Proposed 520.6-Acre Drop Zone Site for Dyess Air Force Base, Runnels County, Texas*. Miscellaneous Reports of Investigations, No. 199. Geo-Marine, Inc., Plano, Texas.

1999 *Cultural Resources Survey of Four DEC Streambank Stabilization Sites in the Black Creek and Batupan Bogue Watersheds in Holmes, Montgomery, and Grenada Counties, Mississippi* (with Doug C. McKay). Geo-Marine, Inc., Plano, Texas.

1999 *Cultural Resources Evaluation and Geoarcheological Investigations of a 6.39-Acre Tract at Stemmons Crossroads, Dallas, Texas*. Miscellaneous Reports of Investigations, No. 191. Geo-Marine, Inc., Plano, Texas.

1999 *Archeological Test Excavations at Five Prehistoric Sites at the Proposed Malden Lake Park Expansion, Wright Patman Lake, Bowie County, Texas* (with Steven M. Hunt). Miscellaneous Reports of Investigations No 189. Geo-Marine, Inc., Plano, Texas.

1999 *Cultural Resources Evaluation and Geoarcheological Investigation of a 12-Acre Tract, Stemmons Crossing, Dallas, Texas*. Miscellaneous Reports of Investigations, No. 183. Geo-Marine, Inc., Plano, Texas.

1999 *Preliminary Cultural Resources Assessment of a 100-Acre Tract in Southwestern Logan County, Oklahoma*. Miscellaneous Reports of Investigations, No. 182. Geo-Marine, Inc., Plano, Texas.

1999 *City of Irving, Lake Chapman Water Supply Project, Cultural Resources Survey and Geoarcheological Investigation of the Proposed Lake Chapman Water Supply Project Phase II Pipeline, Collin and Denton Counties, Texas* (with Brandy Gibson). Miscellaneous Reports of Investigations, No. 181. Geo-Marine, Inc., Plano, Texas.

1999 *Cultural Resources Survey of 398.2 Acres of Proposed Thin-Layer Disposal Areas and Water-Control Structure Locations of the Upper Yazoo Projects, Item 4, LeFlore County, Mississippi*. Miscellaneous Reports of Investigations, No. 174. Geo-Marine, Inc., Plano, Texas.

1998 *Relocation and Reinvestigation of 45 Archeological Sites at Wister Lake, LeFlore County, Oklahoma* (with Floyd B. Largent, Jr., and Margaret J. Guccione). Miscellaneous Reports of Investigations, No. 168. Geo-Marine, Inc., Plano, Texas.

1998 *Cultural Resources Survey of LA 1 Between LA 169 and LA 538, Oil City, Caddo Parish, Louisiana* (with Marsha Prior). Miscellaneous Reports of Investigations, No. 167. Geo-Marine, Inc., Plano, Texas.

1998 *Cultural Resources Survey of 23 Acres North of Del Rio, Val Verde County, Texas*. Miscellaneous Reports of Investigations, No. 165. Geo-Marine, Inc., Plano, Texas.

1998 *Cultural Resources Survey of 10 Acres Northeast of Laredo, Webb County, Texas*. Miscellaneous Reports of Investigations, No. 164. Geo-Marine, Inc., Plano, Texas.

1998 *Cultural Resources Survey for a Joint Task Force Six (JTF-6) Action in Webb, Maverick, and Dimmit Counties, Texas* (with Johnna L. Buysee and Steve Gaither). Miscellaneous Reports of Investigations, No. 158. Geo-Marine, Inc., Plano, Texas.

1998 *Preliminary Results of Relocation and Reinvestigation of 45 Archeological Sites at Wister Lake, LeFlore County, Oklahoma*. Letter Reports, No. 30, submitted to U.S. Army Corps of Engineers, Tulsa District. Geo-Marine, Inc., Plano, Texas.

1998 *Archeological Monitoring of a Joint Task Force Six (JTF-6) Action in Webb and Maverick Counties, Texas*. Letter Reports, No. 29, submitted to U.S. Army Corps of Engineers, Fort Worth District, and Joint Task Force Six. Geo-Marine, Inc., Plano, Texas.

1998 *Potential Hazardous Waste Materials Sites on LA 1 Between LA 169 and LA 538, Oil City, Caddo Parish, Louisiana*. Letter report submitted to Louisiana Department of Transportation and Development. Geo-Marine, Inc., Plano, Texas.

1998 *Management Summary: Phase I Survey of 398.2 Acres of Proposed Thin-Layer Disposal Areas and Flood Control Structure Locations, LeFlore County, Mississippi*. Letter report submitted to U.S. Army Corps of Engineers, Vicksburg District. Geo-Marine, Inc., Plano, Texas.

1995 *A Cultural Resources Survey of 136 Acres (Parcel H) of the Desert Mountain Properties, North Scottsdale, Maricopa County, Arizona*. Soil Systems Technical Report No. 95-24. Soil Systems, Inc., Phoenix, Arizona.

1995 *An Archaeological Assessment of AZ U:5:155 (ASM), a Hohokam Settlement on the DC Ranch Property, North Scottsdale, Maricopa County, Arizona*. Soil Systems Technical Report No. 95-23. Soil Systems, Inc., Phoenix, Arizona.

1995 *A Cultural Resources Survey of Hayden Road Between McKellips Road and the Red Mountain Freeway, Tempe, Maricopa County, Arizona*. Soil Systems Technical Report No. 95-22. Soil Systems, Inc., Phoenix, Arizona.

1995 *Archaeological Test Excavations at AZ U:5:149 (ASM), AZ U:5:150 (ASM), AZ U:5:151 (ASM), and AZ U:5:152 (ASM) on the DC Ranch Property, North Scottsdale, Maricopa County, Arizona*. Soil Systems Technical Report No. 95-21. Soil Systems, Inc., Phoenix, Arizona.

1995 *A Cultural Resources Survey of 14 Acres of Private Land Southeast of Pinnacle Peak and Pima Roads, North Scottsdale, Maricopa County, Arizona*. Soil Systems Technical Report No. 95-20. Soil Systems, Inc., Phoenix, Arizona.

1995 *Archaeological Monitoring of Two Segments of the Santa Fe Pipeline in Pima County, Arizona, and Luna County, New Mexico*. Soil Systems Technical Report No. 95-19. Soil Systems, Inc., Phoenix, Arizona.

1995 *A Cultural Resources Survey of 41 Acres of Private Land Near McKellips Road and Stapley Drive, North Mesa, Maricopa County, Arizona*. Soil Systems Technical Report No. 95-18. Soil Systems, Inc., Phoenix, Arizona.

1995 *A Cultural Resources Survey of 1.4 Miles of State Highway 69, New River and Lake Pleasant Roads, New River, Maricopa County, Arizona*. Soil Systems Technical Report No. 95-15. Soil Systems, Inc., Phoenix, Arizona.

1995 *A Cultural Resources Survey of 1.3 Miles of Forest Road 751 Near Blue Ridge Reservoir, Coconino National Forest, Coconino County, Arizona*. Soil Systems Technical Report No. 95-13. Soil Systems, Inc., Phoenix, Arizona.

1995 *A Cultural Resources Survey of Sections 29 and 31 of the DC Ranch Property, North Scottsdale, Maricopa County, Arizona*. Soil Systems Technical Report No. 95-12. Soil Systems, Inc., Phoenix, Arizona.

1995 *A Cultural Resources Survey of 59th Avenue Between Southern Avenue and Dobbins Road, Phoenix, Maricopa County, Arizona*. Soil Systems Technical Report No. 95-06. Soil Systems, Inc., Phoenix, Arizona.

1995 *A Cultural Resources Survey of Germann Road Between Arizona Avenue and Cooper Road, Chandler, Maricopa County, Arizona*. Soil Systems Technical Report No. 95-05. Soil Systems, Inc., Phoenix, Arizona.

1995 *A Cultural Resources Survey of Bush Highway and Usery Pass Road, Tonto National Forest, Maricopa County, Arizona* (with Caroline P. Davies). Soil Systems Technical Report No. 95-02. Soil Systems, Inc., Phoenix, Arizona.

1994 *A Cultural Resources Survey of 1.4 Miles of Old U.S. Highway 80 in Arlington, Maricopa County, Arizona*. Soil Systems Technical Report No. 94-47. Soil Systems, Inc., Phoenix, Arizona.

1994 *A Cultural Resources Survey of 91st Avenue Between Interstate Highway 10 and Buckeye Road, Tolleson, Maricopa County, Arizona*. Soil Systems Technical Report No. 94-46. Soil Systems, Inc., Phoenix, Arizona.

1994 *A Cultural Resources Survey of Miller Road at the Roosevelt Canal, Valencia, Maricopa County, Arizona*. Soil Systems Technical Report No. 94-45. Soil Systems, Inc., Phoenix, Arizona.

1994 *A Cultural Resources Survey of 5.9 Miles of Residential Streets in Queen Creek, Maricopa County, Arizona*. Soil Systems Technical Report No. 94-44. Soil Systems, Inc., Phoenix, Arizona.

1994 *A Cultural Resources Survey of Germann Road Between Gilbert and Lindsay Roads, Chandler, Maricopa County, Arizona*. Soil Systems Technical Report No. 94-43. Soil Systems, Inc., Phoenix, Arizona.

1994 *A Cultural Resources Survey of Ellsworth Road Between Warner and Guadalupe Roads, Gilbert, Maricopa County, Arizona* (with Caroline P. Davies). Soil Systems Technical Report No. 94-42. Soil Systems, Inc., Phoenix, Arizona.

1994 *A Cultural Resources Survey of Lindsay Road Between Germann and Williams Field Roads, Chandler, Maricopa County, Arizona* (with Caroline P. Davies). Soil Systems Technical Report No. 94-41. Soil Systems, Inc., Phoenix, Arizona.

ACADEMIC PUBLICATIONS

n.d. "Dimensions of Variability at Baehr-Gust: Framing Hypotheses of Site Structure, Chronology, and Function." In *Papers in Memory of Howard Dalton Winters*, edited by Anne-Marie Cantwell and Lawrence A. Conrad. Center for American Archeology, Kampsville, Illinois (in press).

1995 *Activity Organization and Site Function at a Late Middle Woodland Regional Center in the Lower Illinois Valley: Preliminary Investigations of Variability in Surface Scatters at the Baehr-Gust Site*. M.A. Thesis, Department of Anthropology, New York University

PAPERS PRESENTED AND PUBLIC LECTURES GIVEN AT PROFESSIONAL CONFERENCES

2003 "The Toyah of Southwestern Texas: The View from the Varga Site (41ED28)." Paper presented at the 74th Annual Meeting of the Texas Archeological Society, Fort Worth, Texas, October 24-26, 2003.

1997 "Alternate Hypotheses of Intrasite Chronology at the Baehr-Gust Site: A Factor Analysis of Surface Collections." Paper presented at the 62nd Annual Meeting of the Society for American Archaeology, Nashville, Tennessee, April 2-6, 1997.

1993 "Excavations at the Trinity Church Cemetery Site, Newark, New Jersey." Lecture presented at the 8th Annual Meeting of the Archaeological Society of New Jersey. September 1993.

APPENDIX C:

Copy of Howry (1978) Cultural Resources Survey Report

Document P-3377
June 1978

Prepared for
General Portland Inc.

Cultural resources survey for GPI properties in Comal and Guadalupe Counties, Texas

Prepared by
Jeffrey C. Howry
696 Virginia Road
Concord, Massachusetts 01742

ERT
ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.
CONCORD, MASS. • LOS ANGELES • ATLANTA • SAN JUAN, P.R.
FORT COLLINS, CO. • WASHINGTON, D.C. • HOUSTON • CHICAGO

TABLE OF CONTENTS

PHASE I RECONNAISSANCE SURVEY

	Page
1. INTRODUCTION	1-1
1.1 Study Objectives	1-1
1.2 Project Location and Description	1-1
1.3 Cultural Resource Survey Design	1-6
1.4 Summary of Findings	1-7
2. PREHISTORIC ARCHEOLOGY	2-1
2.1 Regional and Local Prehistory	2-1
2.2 Survey Results - Phase I	2-2
2.2.1 Comal County Property	2-2
2.2.2 Guadalupe County Property	2-7
2.3 Summary and Conclusions concerning Prehistoric Resources	2-12
2.4 Impacts and Recommendations for Prehistoric Archeological Resources	2-13
3. HISTORIC PROPERTIES AND STRUCTURES	3-1
3.1 Comal County	3-1
3.1.1 History of Settlement of the New Braunfels Area	3-1
3.1.2 Historic Stuctures on the Comal County Property	3-1
3.2 Seguin and Guadalupe County	3-9
3.2.1 History of Settlement of Seguin and Guadalupe County	3-9
3.2.2 Historic Properties	3-9
3.3 Summary and Conclusions concerning Historical Properties	3-10
3.3.1 Comal County Property	3-10
3.3.2 Guadalupe County Property	3-11
3.4 Impacts and Recommendations for Historic Resources	3-11
3.4.1 Comal County Property	3-11
3.4.2 Guadalupe County Property	3-13

TABLE OF CONTENTS (Continued)

PHASE II SUPPLEMENTARY SURVEY

	Page
4. INTRODUCTION	4-1
4.1 Purpose and Scope of Work	4-1
4.2 Summary	4-2
4.2.1 Prehistoric Resources	4-2
4.2.2 Historic Resources	4-2
5. PREHISTORY	5-1
5.1 Comal County	5-1
5.2 Guadalupe County	5-4
6. HISTORY	6-1
6.1 Family History and Land Title	6-1
6.2 Homestead Plan and Use	6-2
7. CONCLUSIONS AND RECOMMENDATIONS	7-1
7.1 Prehistoric Resources	7-1
7.1.1 Comal County	7-1
7.1.2 Guadalupe County	7-1
7.2 Historic Resources	7-2
7.2.1 Comal County	7-2
7.2.2 Guadalupe County	7-2

REFERENCES

APPENDIX A PHOTOGRAPHIC INVENTORY

APPENDIX B INVENTORY OF ARTIFACTS

APPENDIX C COPY OF DEED TO FEICK LAND GRANT

APPENDIX D LITHIC ASSEMBLAGE FROM LOCAL COLLECTION IN VICINITY OF FEICK HOMESTEAD FIELDS ALONG DRY COMAL CREEK

1. INTRODUCTION

1.1 Study Objectives

General Portland (GPI) is currently planning to develop a cement manufacturing facility to be located in Comal County, southwest of New Braunfels, Texas. Section 1.2 provides a brief description of this project.

As part of the planning for the project, GPI had requested that Environmental Research & Technology, Inc. (ERT) undertake a cultural resource survey of lands acquired for the project and portions of which that would be developed as part of the construction and operation of the proposed cement manufacturing facility. The objective of the cultural resource survey was to evaluate the potential for impacts of planned development on both known and as yet unreported prehistoric archeological sites and historic properties. This report describes ERT's survey work and provides an assessment of the potential for impact that general site development would have on both archeological and historic resources on and near the GPI properties. Section 1.3 describes the approach or survey design employed by ERT for this work. Sections 2 and 3 provide information on the topics of prehistoric archeological and historical properties, respectively. Each of these sections is divided into subsections that (1) briefly summarize information contained in relevant literature, (2) present field survey results, (3) summarize findings, (4) assess the potential for impacts and (5) make recommendations.

1.2 Project Location and Description

GPI, a Delaware Corporation with headquarters in Dallas, TX, plans to build a new cement manufacturing facility in Comal County, three miles southwest of New Braunfels, TX. Figure 1-1 shows the location of the site, consisting of approximately 130 to 150 acres, both in relation to the six-county region between San Antonio and Austin, and in relation to the local roads, topographic features and other industrial facilities in the vicinity of New Braunfels. This plant site is referred to as the Comal County site in this report.

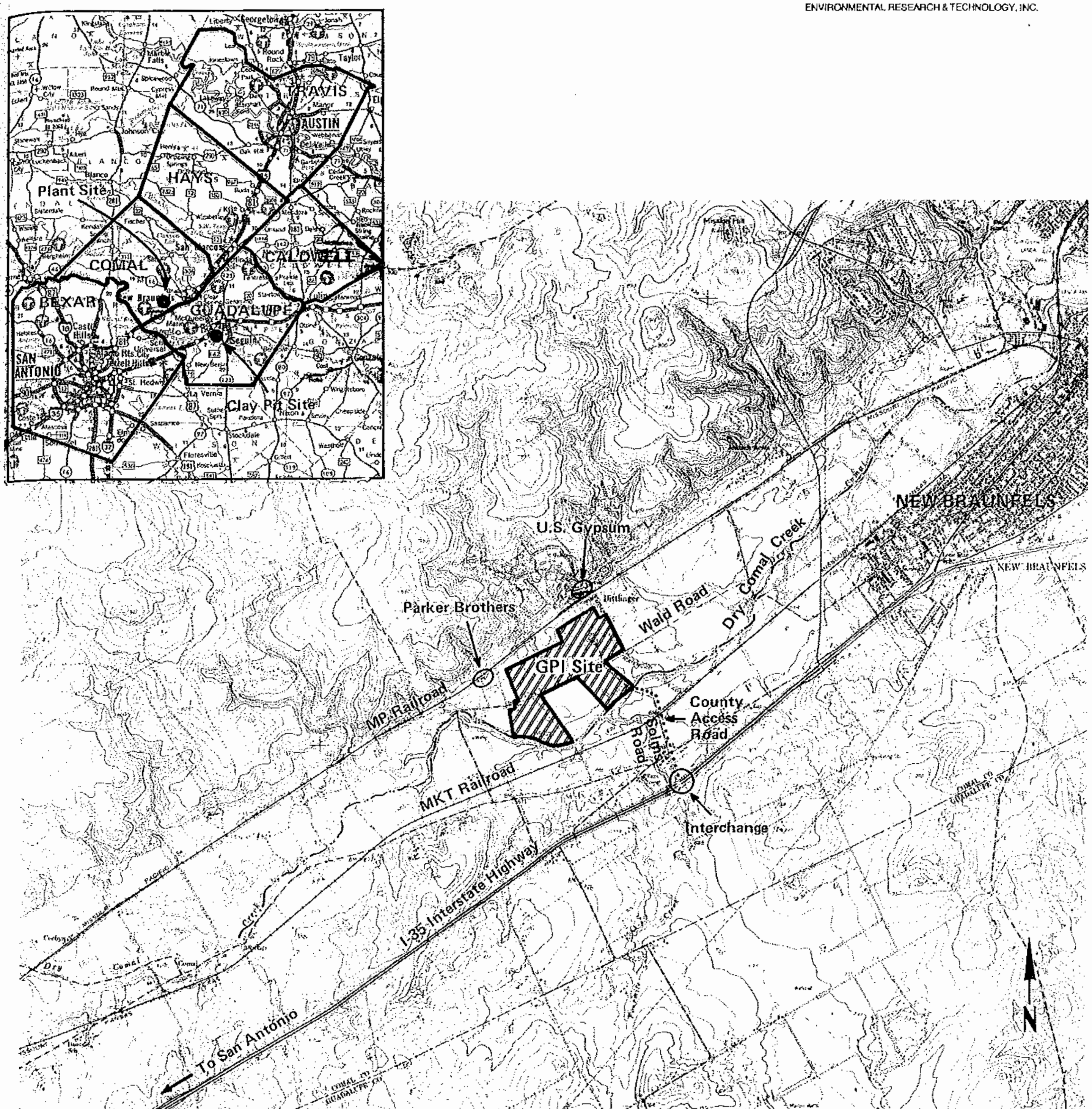


Figure 1-1 Site Location Map

The Comal County site was selected to take advantage of the limestone outcropping of the Balcones fault and the existing quarrying operation run by the Parker Brothers & Company, Inc. of Houston (Parker Brothers). Parker Brothers will supply limestone, the primary raw material, for the GPI cement manufacturing operation. This location will also offer easy access to available highway and railroad transportation systems and an excellent labor market.

The Comal county plant site is located on the edge of the Edwards Plateau along the Balcones fault, between the bluff and Dry Comal Creek. The natural vegetation of the site is a juniper-oak-mesquite savanna, which now contains cedar. Most of the plant site, both cleared and reforested, has been cultivated. The reforested sections are confined to the drainage areas. Site drainage, which runs in a northwest to southeast direction is indicated in Figure 1-2. Dry Comal Creek, which is part of the Dunlap Watershed supplying the Guadalupe River (Braudes and Andrews 1977), provides the major drainage.

The cement facility will be built on part of the GPI site located to the north of Wald Road. An earthen pond, which will catch site runoff and serve as a reservoir for cooling waters, is also planned to be developed on a portion of this site south of Wald Road and near Solms Road and Dry Comal Creek.

As part of this project, GPI will also develop a clay pit to provide clay as a raw material. As shown in Figure 1-1, the clay pit will be located approximately 13 miles southeast of the cement facility site in Guadalupe County. The clay pit site will consist of about 730 acres located approximately two miles south of the I-10/US-90 interchange west of Seguin, TX. All other raw materials will be purchased and brought to the cement facility by truck or rail. The clay pit site is referred to as the Guadalupe County site in this report.

The Guadalupe County site is bordered on the north by Deadman Creek and extends southward to Leissner Road, the east-west county road (Figure 1-3). Nearly all of this land is currently used for livestock grazing purposes. Much of this site has been disturbed by past contour plowing to control erosion. Vegetation consisting largely of live-oak trees currently grows along Deadman Creek and a few of the smaller drainages as indicated in Figure 1-3.

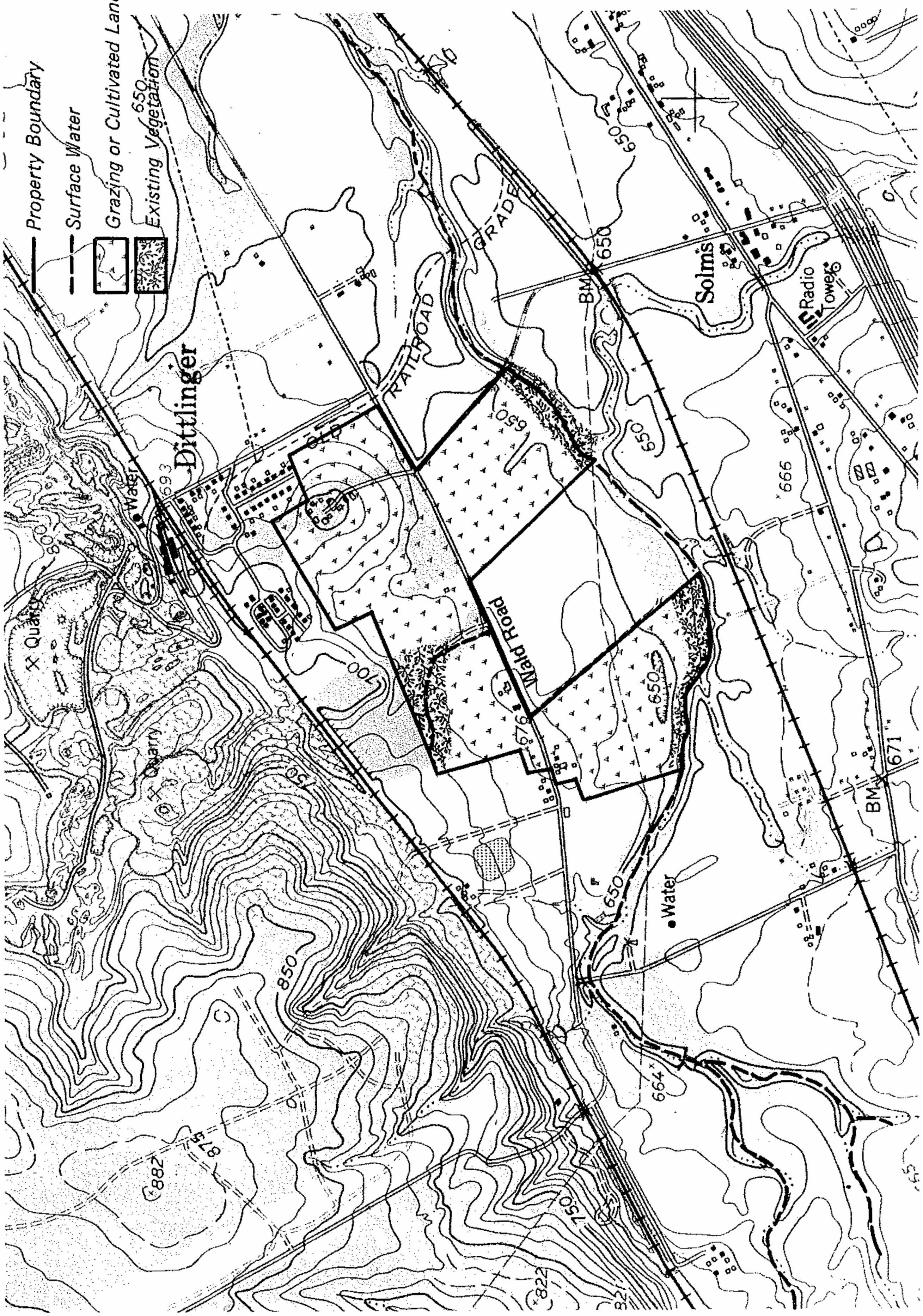


Figure 1-2 Comal County Property and Land Use
New Braunfels West 2998-413

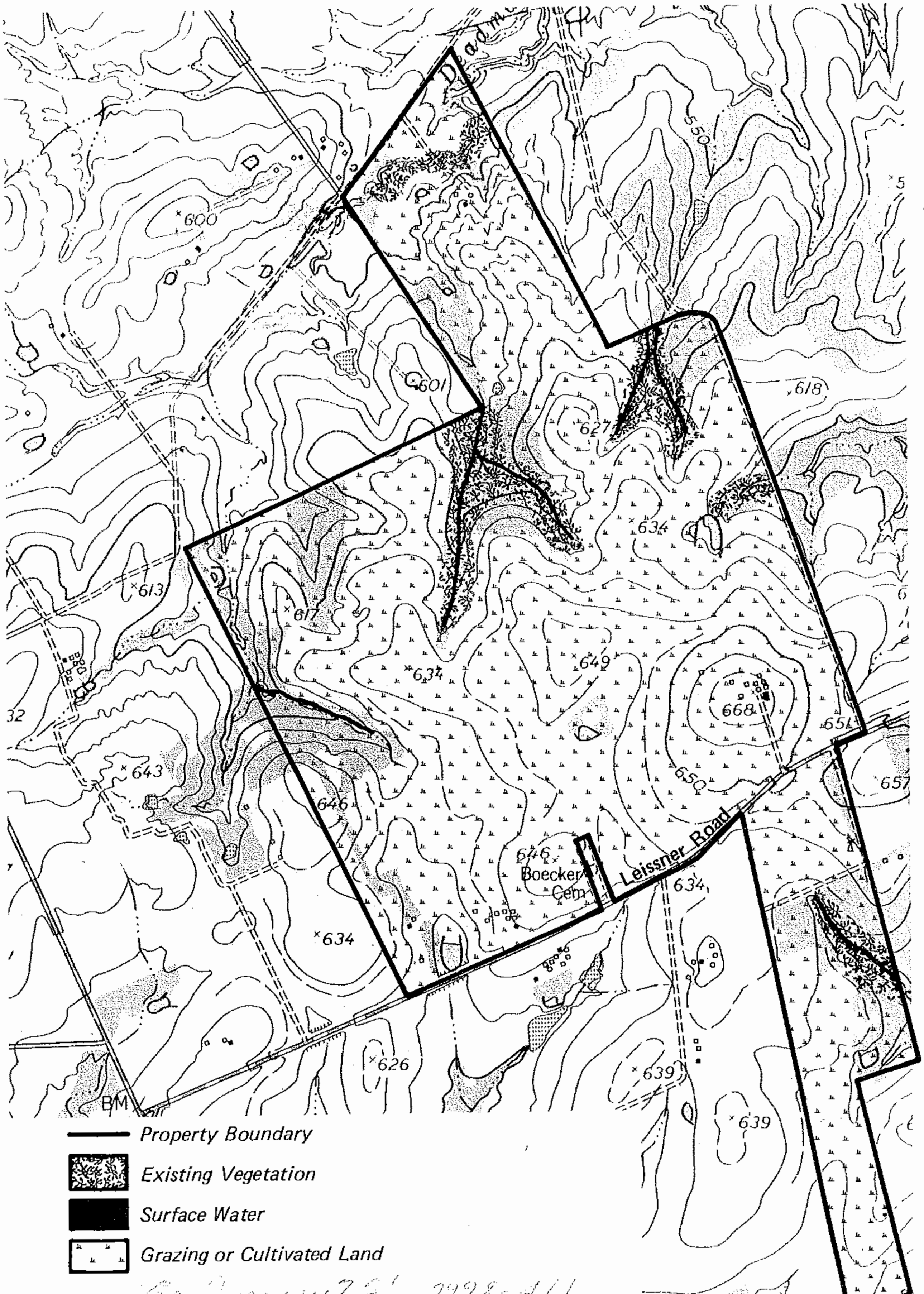


Figure 1-3 Guadalupe County Property and Land Use

Development on this site will begin in the northernmost section, south of Deadman Creek, where the underlying clay will be excavated in an open pit construction. Most of the remaining property will be left unaltered except for continued agricultural activity.

1.3 Cultural Resources Survey Design

All property currently owned or optioned by GPI pertaining to the project was evaluated as part of this cultural resource assessment. Prehistoric resources were evaluated by examining the surface of the GPI sites for artifacts indicating previous occupation. The field survey was conducted along transects parallel to selected drainage and topographic features. The locations of these transects were established after previous cultural resource survey work in the region was reviewed. Thus, particular attention was focused on portions of the GPI sites believed to have the potential for containing yet unidentified cultural resources. Specifically, cultural resource reports available at the Balcones Research Center, University of Texas, Austin, were reviewed as noted in Sections 2.1 and 3.1. Dr. Jeffrey C. Howry, Senior Archeologist at ERT, had overall responsibility for this cultural resource survey program. The field work was undertaken by Dr. Howry with the assistance of Mr. Harvey Smith from the Center for Archeological Research, University of Texas, San Antonio, on 9 and 10 March 1978. Mr. Smith is currently conducting site survey and excavation work in the Comal County region.

Similarly, a limited review of known historic properties in the vicinity of the GPI sites was undertaken before the field survey work. Structures of potential historic significance were visited and photographed. Several local residents believed knowledgeable of the history of the GPI sites were also interviewed (for example, Mr. Felix Kneuper of New Braunfels regarding some of the structures on the Comal County site and Mr. Cox, Leissner Road, regarding some features on the Guadalupe County site). Further background research was conducted at the Baker Library of Texas History, University of Texas, Austin, regarding the general history of the New Braunfels and Seguin because of the relative proximity of these communities to the GPI sites.

Mr. Alton Briggs, archeologist from the Texas Historical Commission, was consulted with respect to possible concerns of the Commission in December 1977 and March 1978. Mr. Briggs' recommendations were incorporated in the subsequent cultural resource survey work.

Figures 1-4 and 1-5 indicate the location of eight areas or zones surveyed within the GPI Comal County and Guadalupe County sites, respectively. Survey Zones I, II and III are included within the Comal County property, while the remaining survey Zones IV through VIII refer to areas within the Guadalupe County site. Survey transect locations are also indicated on these same figures. Information presented in Section 2, Prehistoric Archeology, and Section 3, Historic Properties and Structures, reference eight survey zones.

1.4 Summary of Findings

This section summarizes the major findings of the cultural resources survey. The following conclusions are included in this report:

1) No National Register sites or nominated sites exist on or in close proximity to either of the GPI sites surveyed. No impact on such cultural resources is anticipated.

2) A homestead site associated with the early settlement of New Braunfels exists on a portion of the Comal County property. One of the remaining structures, the main house, may be of some local significance. The structure is situated on a portion of the GPI property that will not be developed, but will remain undisturbed within a "buffer zone." GPI has met with the local historical society in New Braunfels and has offered to donate the main house if sufficient interest in moving it to another location exists. GPI plans to maintain this structure until such time as it is removed. Adverse impact on this possibly locally significant structures is, therefore, also not anticipated.

3) Prehistoric resource materials were found on both the Comal and Guadalupe County sites. However, at no location on either site were artifacts found in sufficient density and variety or in stratigraphic deposits to suggest extended occupation.

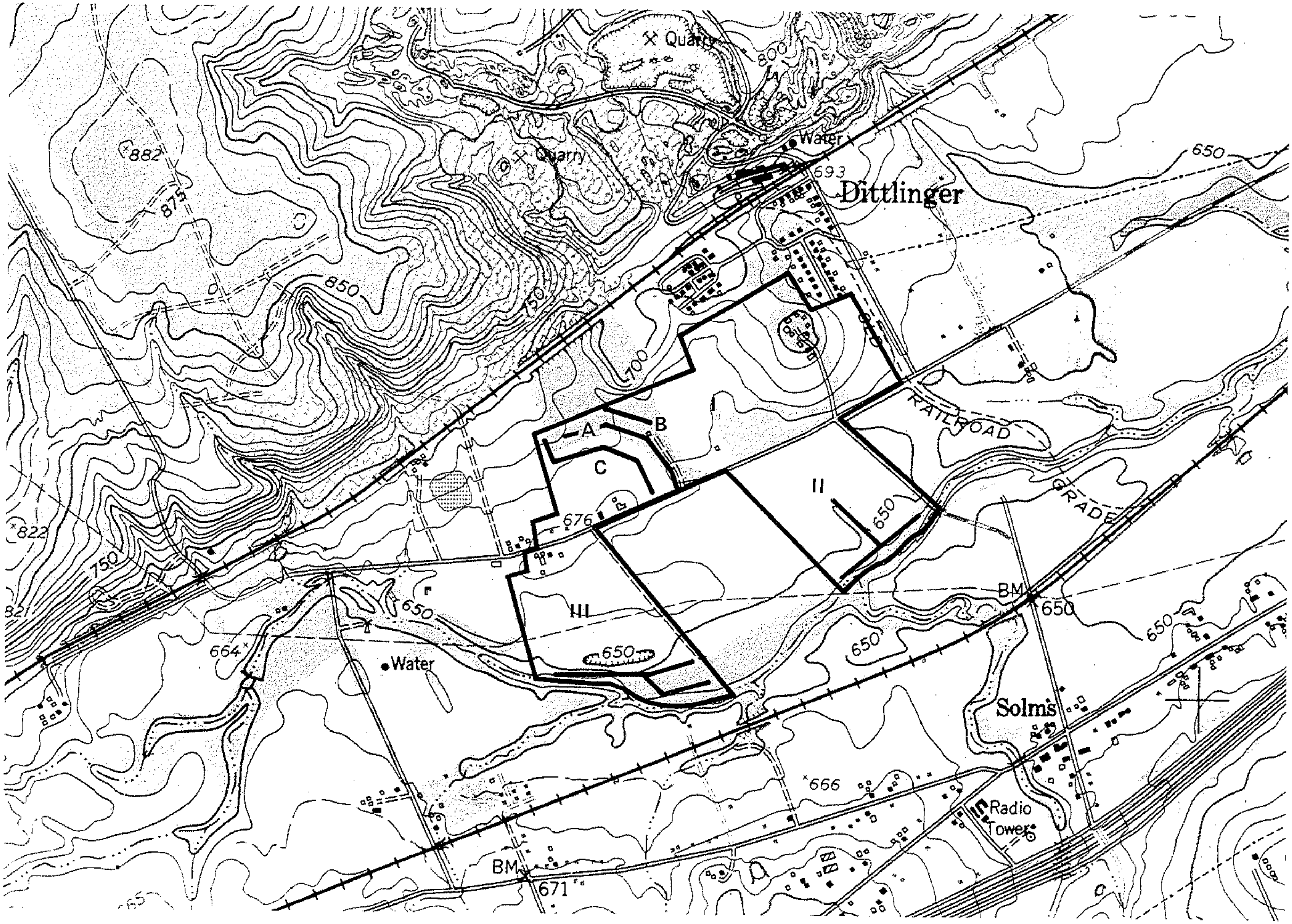


Figure 1-4 Zones of Archeological Survey, Comal County, Texas

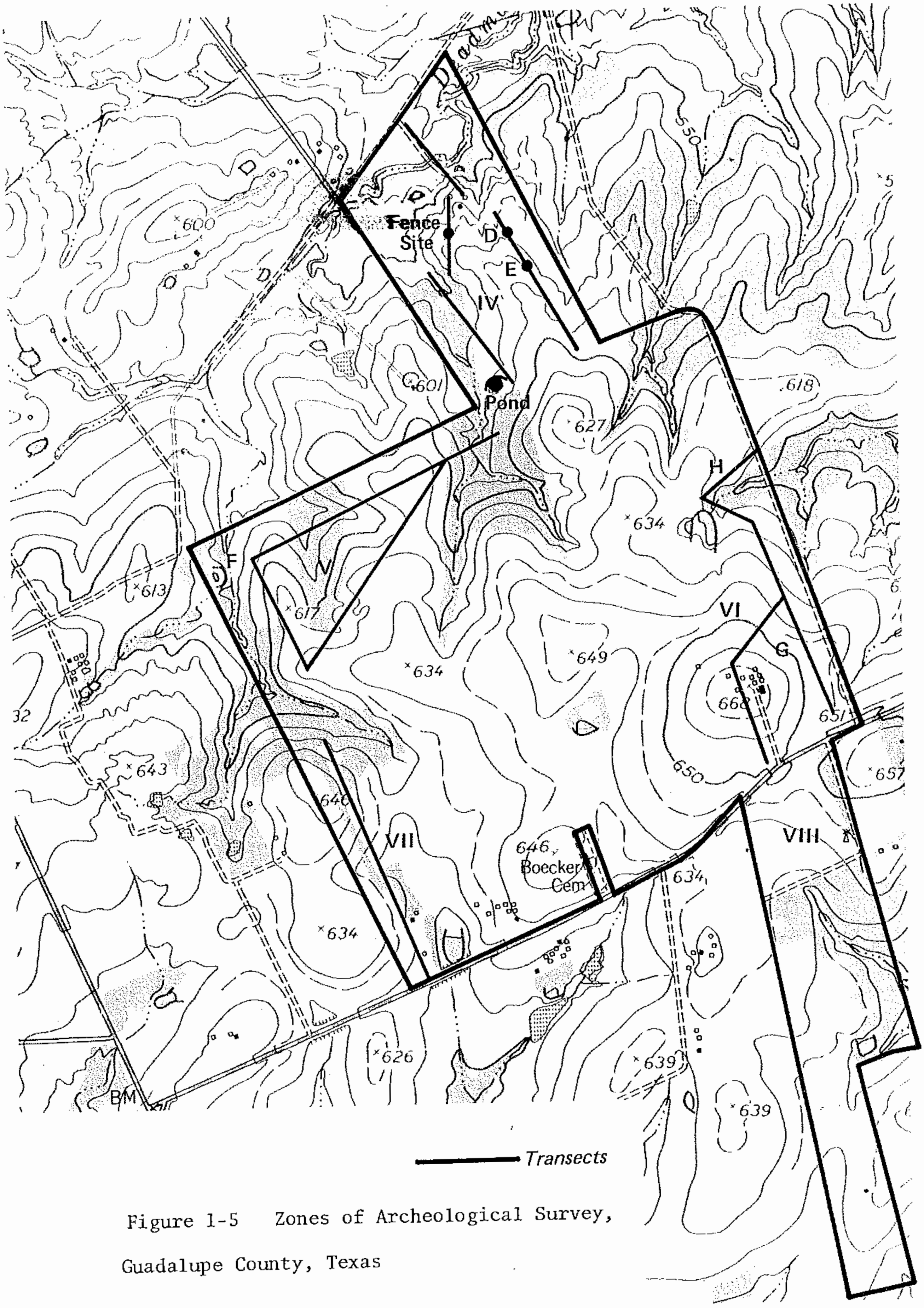


Figure 1-5 Zones of Archeological Survey, Guadalupe County, Texas

It is believed that distribution and location of materials in proximity to seasonal drainages indicates that only temporary camps and hunting activities occurred on various parts of the GPI sites in prehistoric times. The absence of defined prehistoric sites on the Comal County property and the equally light scatter of cultural materials on the Guadalupe County property precludes significant adverse impacts on prehistoric resources.

4) Recommendations regarding prehistoric and historic resources are presented in Sections 2 and 3.

2. PREHISTORIC ARCHEOLOGY

2.1 Regional and Local Prehistory

A review of available literature relevant to the project site areas was undertaken by ERT. Information from this review is briefly summarized below.

The two project sites in Comal and Guadalupe counties represent the separate environmental settings of the Edwards Plateau and coastal plain, respectively. Although ecologically distinct, they share similar prehistoric traditions, which can be broadly characterized as Paleo-Indian, 9200 to 6000 BC, Archaic 6000 BC to 500/1000 AD and Neo-American 500/1000 AD to 1600 AD (Johnson, Suhm and Tunnell 1962, Figure 45). Both project sites are located within the Guadalupe River drainage system. Within this drainage system, five general types of prehistoric sites have been identified as part of other previous research and include:

1) open occupation sites with temporary and repeated occupation,
2) burned rock middens,
3) rock shelters,
4) chert workshops consisting of flint working or surveying stations and
5) burial sites.

In addition to prehistoric occupation, considerable historic Indian settlement in the region occurred and included the Comanche, Tonkawa and Delaware. The Tonkawa are specifically known to have been in the New Braunfels areas (Hester, Bass and Kelly 1975).

Several archeological surveys have been conducted in Comal county, all in the Guadalupe River drainage (Stephenson 1951; Johnson et al. 1962; Hester et al. 1975; Shafer 1963; Kelly and Hester 1975; Kelly and Hester 1976). The most recent investigation by Kelly and Hester focused on the upper portions of Dry Comal Creek as part of a review for a flood control project.

The area covered by this previous survey is located about two miles northwest of the Comal County GPI plant site. Evidence uncovered consists of occupation zones along tributaries running directly off the plateau. Archeological sites identified were near intermittent streams and included extensive lithic scatter, a diversity of tools and burned rock believed to be the remains from campfires by prehistoric inhabitants. Archeological material discovered as part of this work was roughly dated to the Archaic period for both habitation and quarry sites. These sites occurred both adjacent to streams and on terraces on either side of stream drainage.

2.2 Survey Results

A complete inventory of all materials collected is presented in Appendix A. Nomenclature is that used by Kelly and Hester (1976). The technique for survey employed by the field team consisted of walking transects approximately 50 to 100 feet apart in parallel lines, with a random zig-zag along each transect of approximately 20 feet. This technique was modified in Zone I where heavy vegetation necessitated general survey and selected removal of surface litter.

2.2.1 Comal County Property

Zone 1

The cement manufacturing plant will be constructed on part of Zone I. A shallow drainage exists in the central part of Zone I, running roughly northwest to southeast and surrounded by a dense stand of live-oak and cedar. A dirt road runs north from Wald Road, the southern boundary of Zone I, to a barn adjacent to this drainage. The northern Zone I boundary is marked by a cleared fence line separating the GPI property from that of Parker Brothers and U.S. Gypsum.

The areas on both sides of this Zone I drainage were extensively investigated and disclosed a thin scatter of primary and secondary flakes as well as several bifacial tools. Only one diagnostic artifact was found, the corner of a Pedernales Point, along with portions of several other tools that cannot be as specifically dated. Figures 2-1 and 2-2 are photographs of the most significant materials collected in Zone I. The Pedernales Point was recovered in the cleared field west of this drainage and is believed characteristic of the middle to late Archaic period (Suhm and Jelks 1962, page 235) and dates from 4000 BC to 1000 AD. An Archaic time frame is consistent with the other tools collected, including a Clear Fork Gauge and large bifacial hand axes found at Point C (see Figure 1-4). An open field, which has undergone heavy contour plowing, exists on the eastern portion of Zone I on which a large pond has been constructed.

Zone II

Zone II is bounded on the north by Wald Road and the south by Dry Comal Creek. This open field is planted with a thick cover of Bermuda grass. A drainage ditch bisects the southern portion of this field and extends down to the Dry Comal Creek and exposes up to 10 feet of alluvial deposit on the lower portion of the field adjacent to the creek. The eroded bank of the Dry Comal Creek and first terrace was surveyed for evidence of prehistoric habitation, but none was found. A few scattered flint materials, including primary and secondary flakes and one unifacial tool, were collected on the surface of this field (Figure 2-3).

Zone III

Zone III, an agricultural property, includes an old farmstead adjacent to the south side of Wald Road. Dry Comal Creek forms the southern boundary of Zone III, and fence lines form the east and west boundaries. This field, which comprises the majority of land in the zone, is currently covered with grass except for the southern portion adjacent to the creek.

The Dry Comal Creek stream bed and its first terrace were surveyed, but only a few scattered tools were encountered. Figure 2-3 is a photograph of the most significant materials found in Zones II and III adjacent to Dry Comal Creek.

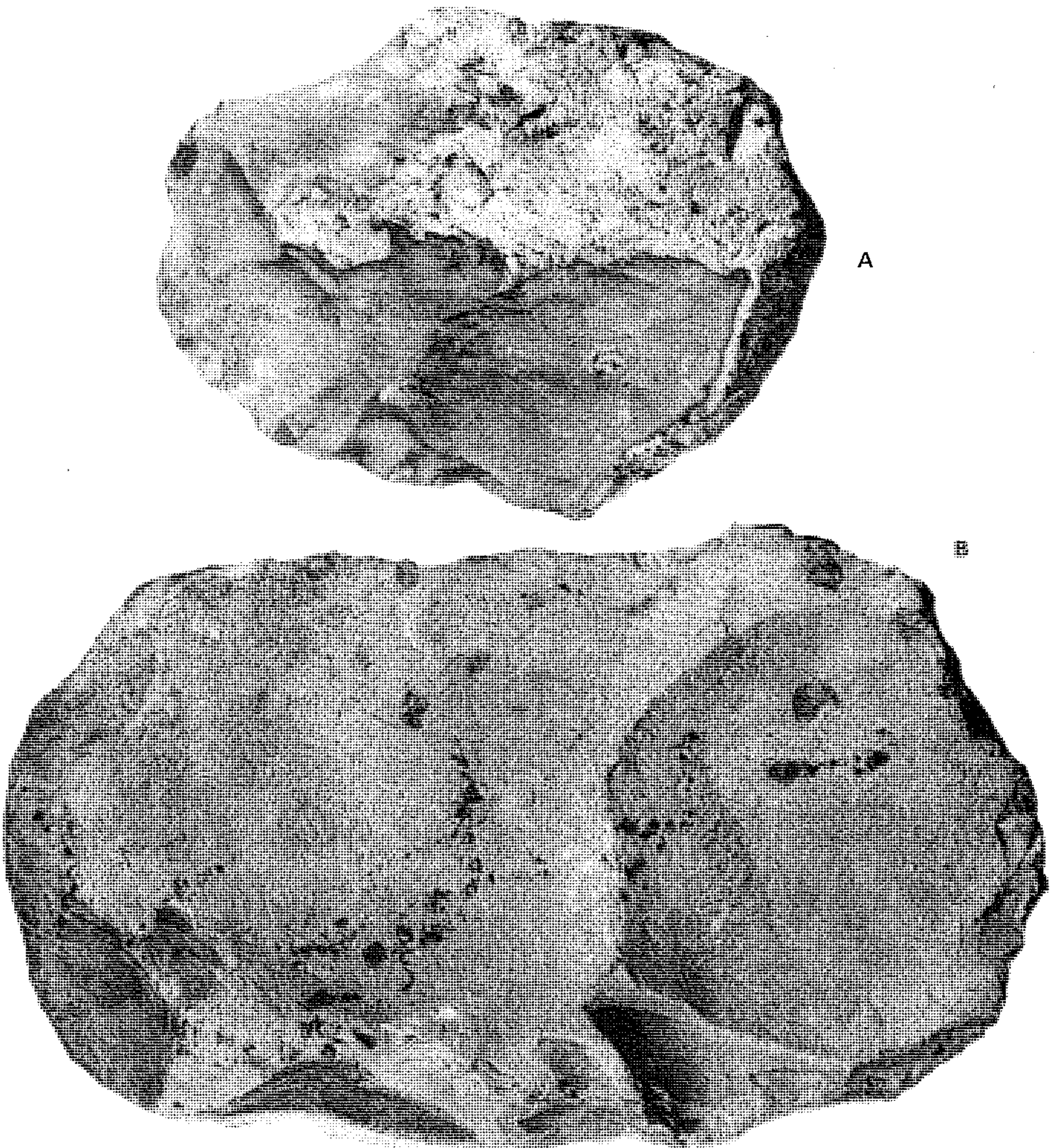


Figure 2-2 Zone I Location C, Comal County
A - Bifacial Tool
B - Bifacial Tool

4617

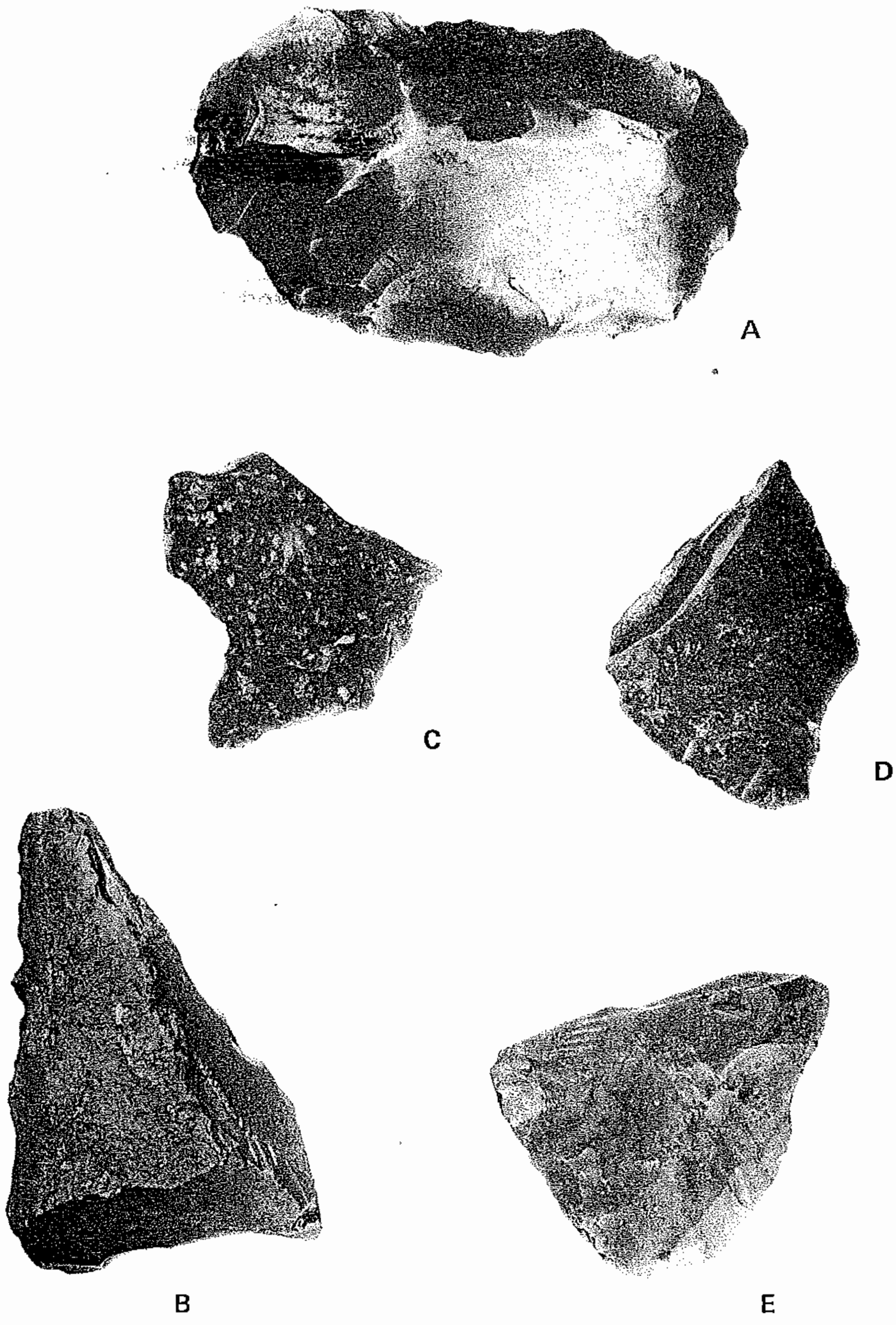


Figure 2-1 Zone I, Comal County
A - Thin Biface, Location A
B - Clear Fork Gauge, Location B
C - Pedernales Point Fragment, Open Field Southwest of A
D - Thin Biface Fragment, Open Field Southwest of A
E - Thin Biface Fragment, Open Field Southwest of A

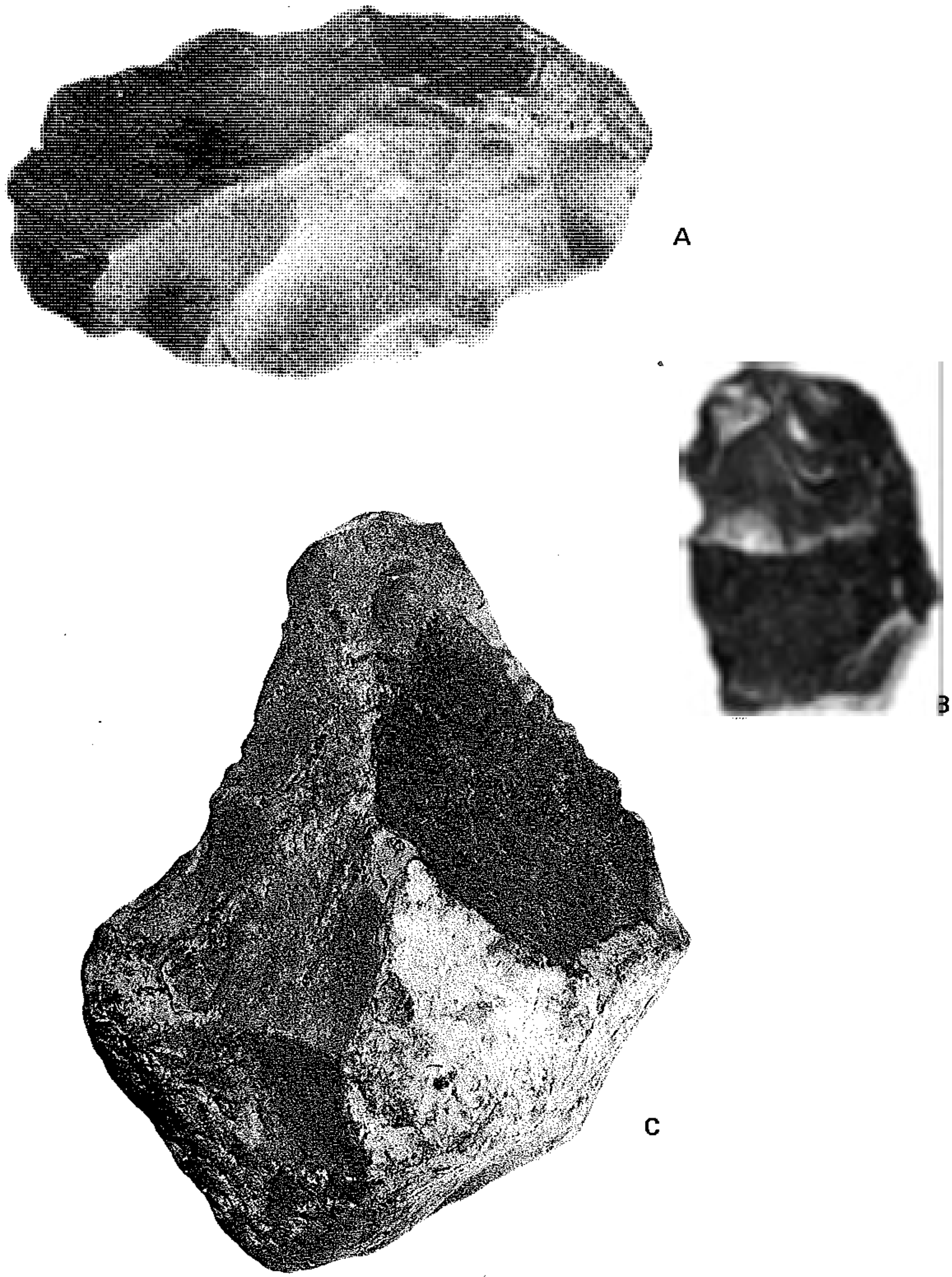


Figure 2-3 Dry Comal Creek Vicinity, Comal County
A Zone II - Bifacial Tool
B Zone III - Thin Biface Fragment
C Zone III - Bifacial Tool

2.2.2 Guadalupe County Property

Zone IV

Only a portion of the Guadalupe County site will be mined for clay. Initial mining will probably take place in the northern part of the Guadalupe County site. As such, much of the GPI site will remain unaltered and continue to be used for agricultural.

Zone IV is crossed in its northern extreme by Deadman Creek, which has a possible flood-prone area extending south to a bluff on which an old farm house is located. No materials were found near Deadman Creek in Zone IV.

South of the old farm house and along a fence line, a concentration of tools was collected in an area approximately 100 feet long and 50 feet wide (see Figure 1-5 for location of the Fence Site). These included an Archaic period point, a gauge, scrapers, bifacial tools and the bases of other tools, possibly knives. Photographs of these materials are included as Figure 2-4. Noteably, only small quantities of debris or debitage of primary or secondary flint flakes were found. No burnt rock and other cultural materials indicative of extended occupation were discovered. This area has been erodedd, exposing the stones that were included in the topsoil and a red subsoil. In summary, this shallow Fence Site appears to have been an area of only limited prehistoric activity.

South of this area, along Zone IV transects, other scattered tools were found. On the east transect, bifacial tools were collected from eroded low ridges (see Locations D and E on Figure 1-5). Upstream (south) from the earthen pond, a few additional tools were also collected. Figures 2-5, 2-6 and 2-7 are photographs of representative material found in the remainder of Zone IV.

Zone V

Zone V is a large field that was recently plowed before this field survey was undertaken. The excellent conditions for surface observation disclosed only a small amount of flint debitage or tools, except at Location F as noted in Figure 1-5, where a few scattered materials were noted.

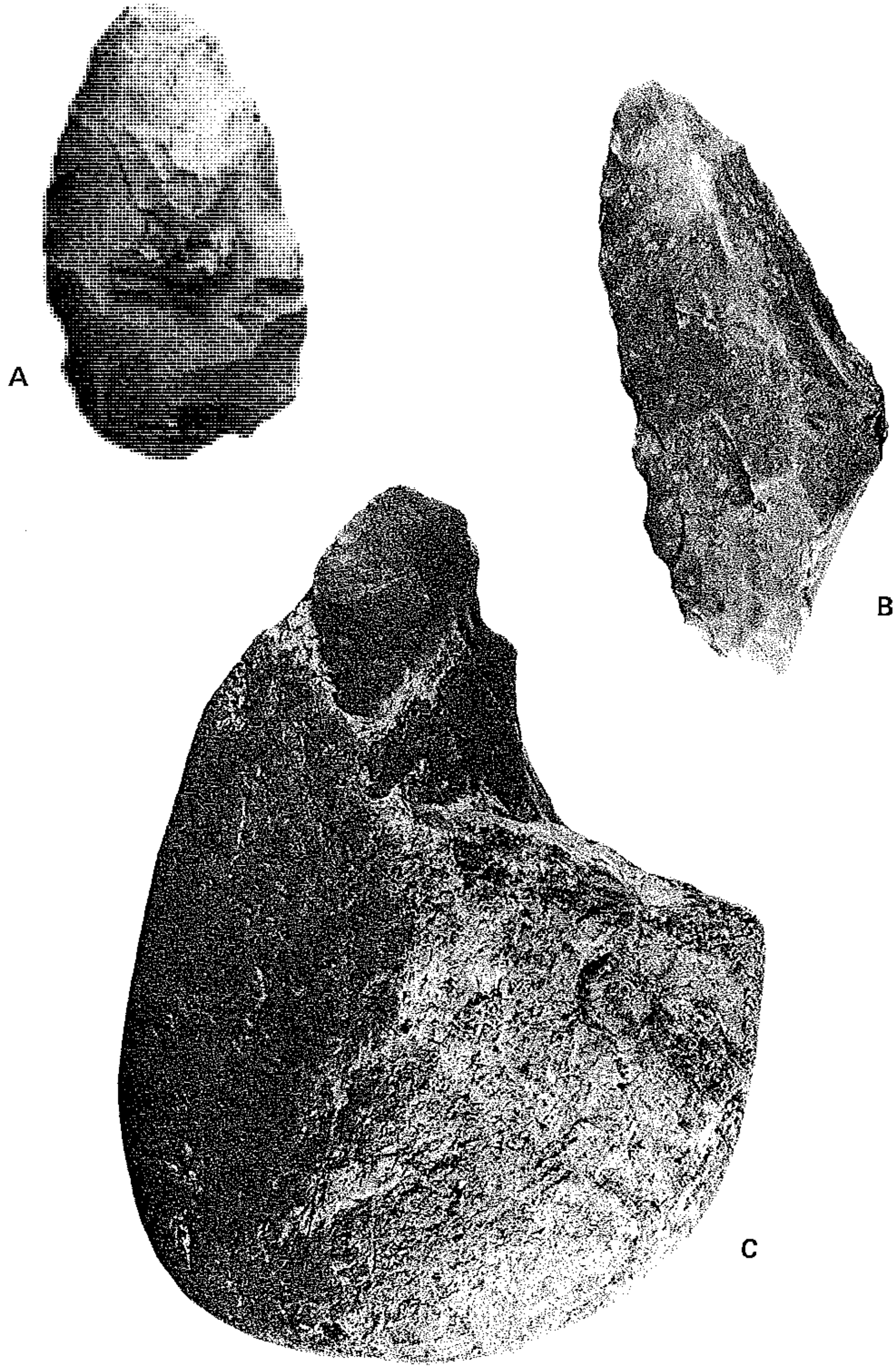


Figure 2-4 Guadalupe County, Fence Site - Zone IV
A - Thin Biface
B - Gourge Fragment
C - Bifacial Tool

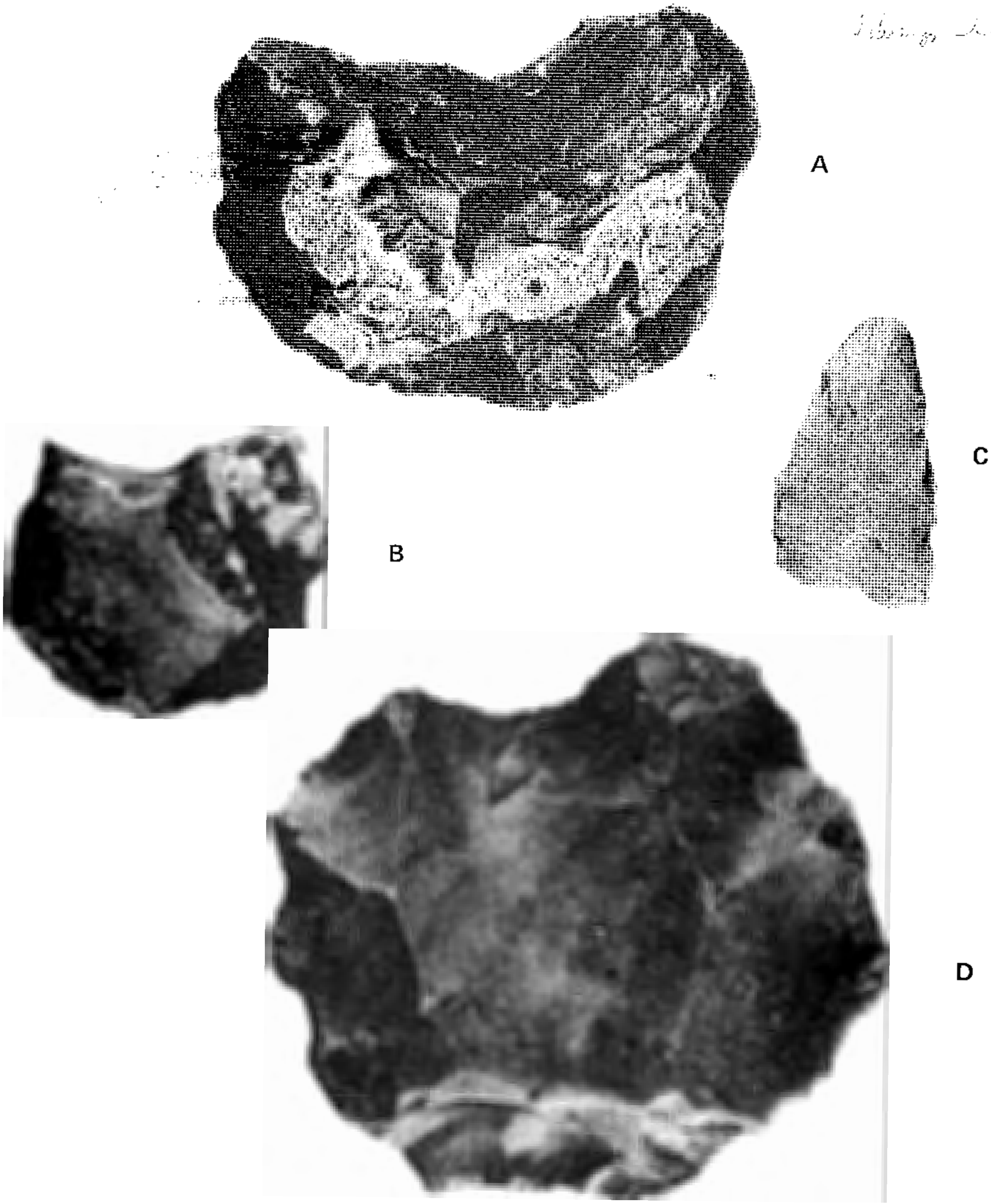


Figure 2-5 Guadalupe County, Fence Site - Zone IV
A - Thin Biface
B - Thin Biface Fragment
C - Point Tip - Archaic
D - Thin Biface

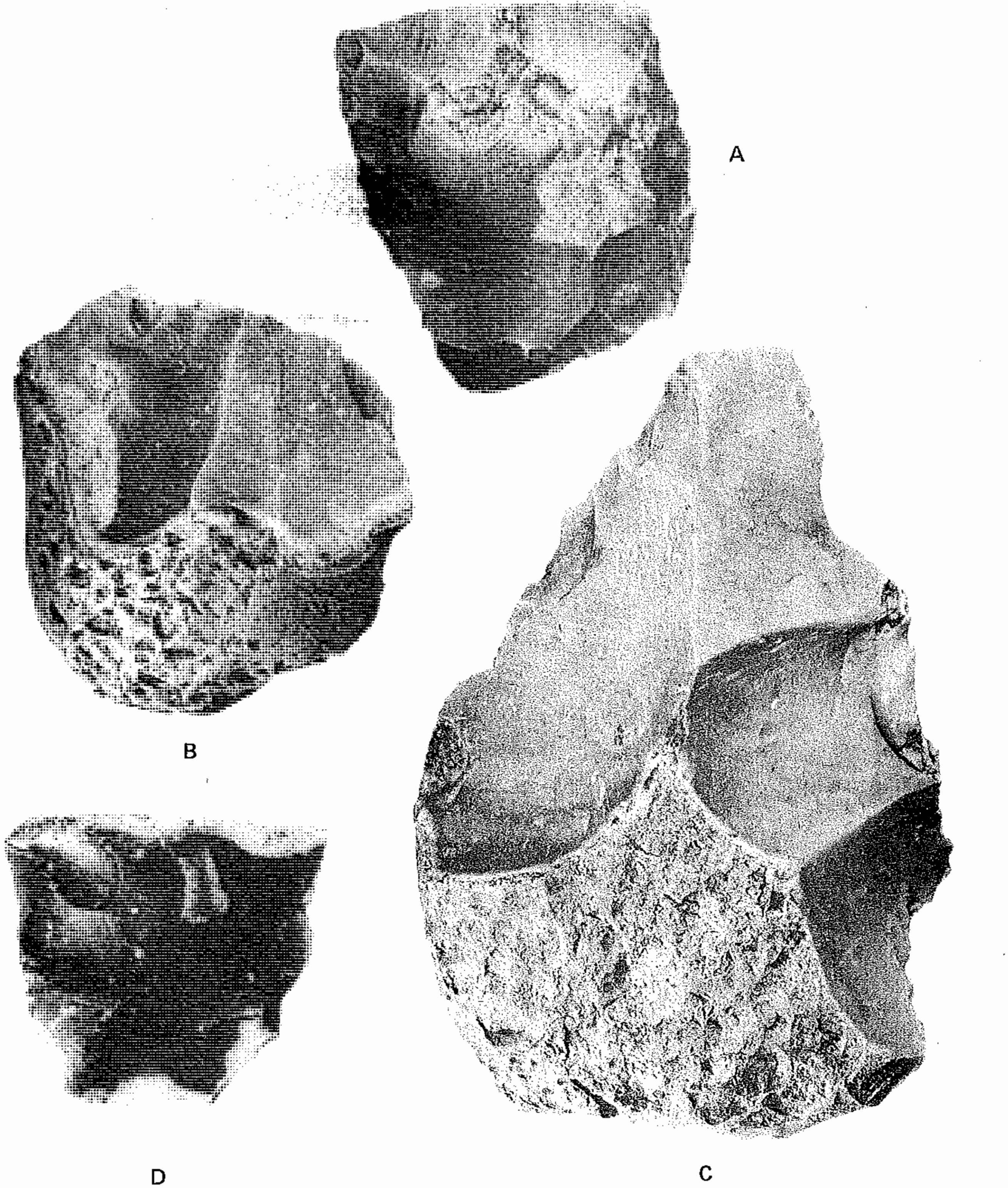


Figure 2-6 Guadalupe County Property
A - Thin Biface Zone IV, Near Pond
B - Thick Bifacial Tool Zone IV, Near Pond
C - Thick Bifacial Tool Zone IV, Location E
D - Thin Biface Zone V, Location F

461-5

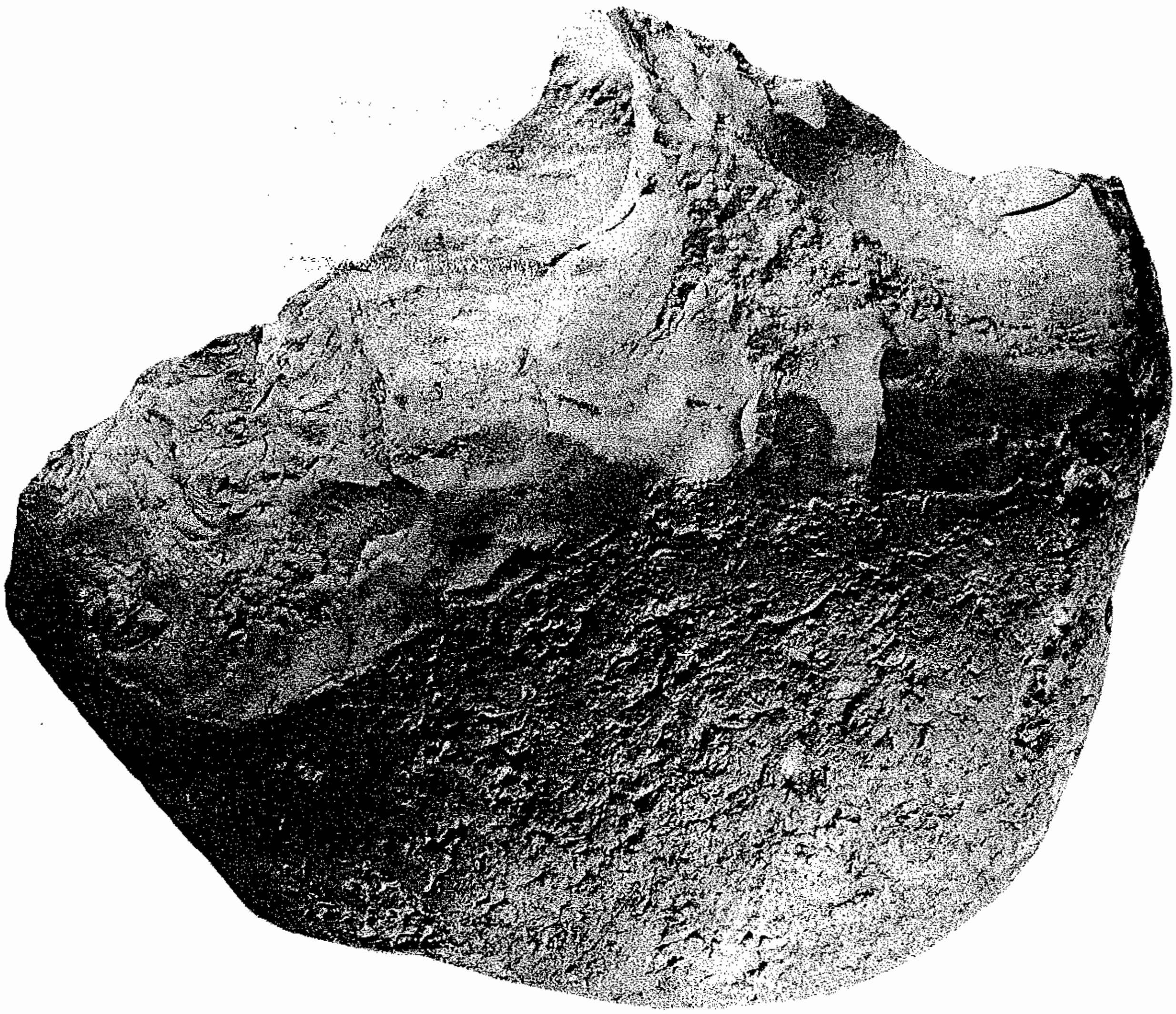


Figure 2-7 Guadalupe County Property
Bifacial Chopper - Zone IV, Location D

461-6

Zone VI

Zone VI includes a farm whose surrounding fields have undergone extensive contour plowing. A minimal amount of material was found in Zone VI. A very few bifacial tools and cores or blanks were found at Locations G and H as noted in Figure 1-5.

Zone VII

Zone VII is another farm area currently used for grazing and undergoing final clearing of a few remaining trees. No artifacts were recovered in Zone VII.

Zone VIII

Zone VIII is a large field used for grazing, the surface of which is covered with a dense grass. This zone is not currently anticipated to be developed as part of the clay pit.

2.3 Summary and Conclusions Concerning Prehistoric Resources

Prehistoric materials recovered from GPI properties in Comal and Guadalupe Counties indicate that prehistoric inhabitants used certain restricted areas within both sites. The materials further indicate that such selected use occurred during what is regionally recognized as the Archaic Period, from 6000 BC to 1000 AD. The few diagnostic artifacts that were found suggest a middle or late Archaic occupation of the area (4000 BC to 1000 AD). At no location on either GPI properties were prehistoric materials found either in sufficient density and variety or in stratigraphic deposits to suggest extended occupation. The distribution and location of materials near seasonal water sources indicate that certain areas were probably the focus of only temporary hunting activities and camps.

Since the majority of both GPI sites have in the past undergone land clearing, cultivation and extensive contouring, the potential for undisturbed prehistoric sites to exist is considered low. Prehistoric occupation may have occurred at early periods along the Dry Comal Creek, but would have been subsequently covered by the creek's alluvium deposits. However, careful examination of the creek's erosional profile revealed no evidence of occupation.

2.4 Impacts and Recommendations for Prehistoric Archeological Resources

No significant adverse impact on archeological resources is anticipated to result from developing the GPI properties, as indicated by the present fieldwork. The absence of defined prehistoric sites on the Comal County property and the equally light scatter of materials in the Guadalupe County property, with the exception of the Fence Site do not represent significant prehistoric resources. However, because materials that indicate prehistoric use of the GPI properties were recovered, the following recommendations are made:

- GPI should undertake additional field work to cover 100% of the Comal and Guadalupe County properties to locate any as yet unidentified prehistoric sites or indications of prehistoric use. This information should be provided to supplement the data presented in this report.
- collected artifacts should be donated to the Center for Archaeological Research, University of Texas, San Antonio, since this institution has conducted other surveys in Dry Comal Creek area and recovered materials might supplement their present collections and
- An archeologist from the Texas Historical Commission should be allowed to observe the site clearing and be permitted to collect any cultural materials that may be unearthed during the plant site development.

3. HISTORIC PROPERTIES AND STRUCTURES

3.1 Comal County

3.1.1 History of Settlement in New Braunfels and Comal County

The European colonization of Comal County is marked by the settlement of New Braunfels by German immigrants in 1845. Under the direction of Prince Carl de-Solms Braunfels, land was purchased at the junction of the Comal and Guadalupe River. The original site of the city consisted of 1,100 acres, with a league of land (4,428.4 acres) eventually constituting the grant. By the end of 1845 more than 980 German immigrants had traveled inland from Matagorda Bay and begun settling in New Braunfels (Haas 1961).

Each settler was provided with a plot of land "in-town" as well as 10 to 15 acres of farm land on the outlying territory. Original house constructions were log cabins made of cedar, with plastered walls and shingle roofs. Comanche Indians lived in the region during this settlement period. However, a peace agreement, which allowed the settlers to remain, was soon made with the council of all Comanche tribes. This treaty encouraged continued immigration of more settlers to the region so that by 1850 New Braunfels was the fourth largest city in Texas.

The available water power on the Guadalupe River encouraged several mills and related industries to be established by the 1860s. Landa Industries, Dittlinger Flour Mills, a woolen textile mill and a brewery were the earliest of these industries. In 1881 the railroad reached New Braunfels, and the Comal and Guadalupe Rivers were crossed by bridges (Rawson 1932).

3.1.2 Historic Structures on the Comal County Properties

The area west of New Braunfels, the site of the GPI property, was used for agriculture throughout the nineteenth century. In 1907, H. Dittlinger constructed a lime kiln on the land adjacent to the Missouri-Pacific Railroad (northeast of the GPI site) utilizing deposits in the Balcones fault. A rock crushing plant was later added to supply road construction materials. A company town, Dittlinger, was established adjacent to the plant site. Low-income housing and a school were built for employees of this plant, who numbered 25 in 1940. Previously, in 1934, the entire facility was sold to the U.S. Gypsum Company (The Handbook of Texas 1952). The location of the former town of Dittlinger is indicated in Figure 3-1A. All housing as indicated on this figure has since been removed with only house foundations remaining.

Existing structures along Wald Road include the Needmore Farm, a nineteenth to twentieth century cluster of structures including a farmhouse and outbuildings (east portion of Zone I). Other, more recently constructed, residences exist further west on Wald Road. A photographic inventory of selected structures on both GPI sites is included in Appendix A. Photographs of buildings along Wald Road are also included in this Appendix.

Along the south side of Wald Road, on the property previously designated as Zone III, is a cluster of four buildings that constitute the remains of the Kasper Feick homestead (1) main house, (2) garage/shed, (3) two-story barn and corn crib, and (4) workshop. Kasper Feick was one of the original settlers of New Braunfels in 1845 and received an initial grant of 15 acres, which is included in the present GPI property. Later, in the 1870s, he purchased additional land to bring his total to approximately 43 acres. Mr. Felix Kneuper, the most recent owner of this property, possesses ownership documents including the original land grant deeds. A copy of this information is included in a separate appendix. Figure 3-1B is a schematic plan indicating the location of existing buildings on the Feick Homestead.

The oldest building formerly existing at the homestead, a one-room log cabin, was probably built at the time of the original land grant. This structure, which was located between the main house and the workshop (see Figure 31B), was recently removed from the property by the former owner to be moved to another site in the nearby Solms for reconstruction and restoration (see Figure 1-2 and Figure 4 in Appendix A).

Within a few years of the original cabin's construction, a larger main house was built. This house forms a portion of the present structure that stands nearest Wald Road. Figure 3-2A is a photograph of the main

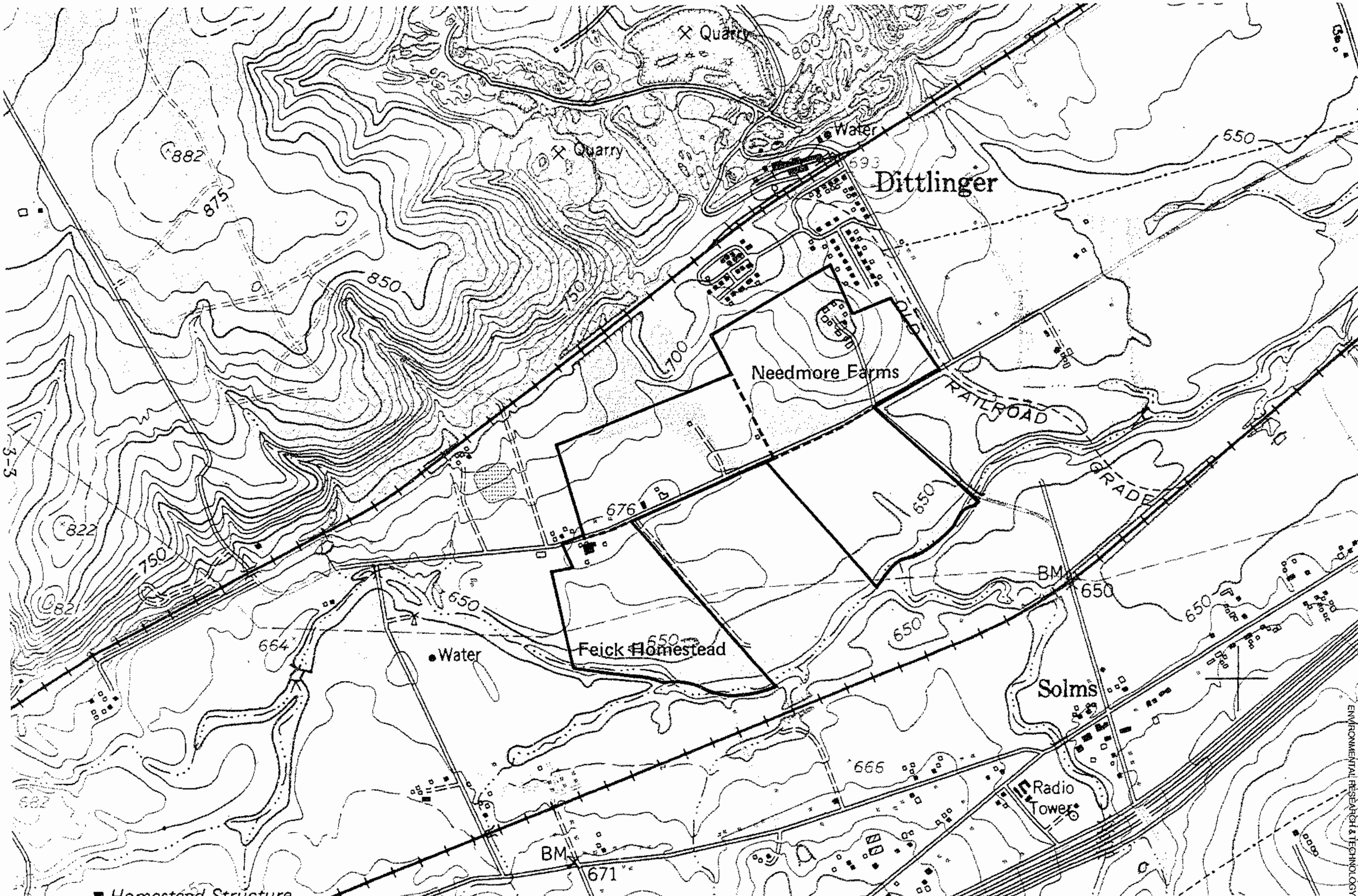


Figure 3-1a   Homesteads -- Comal County

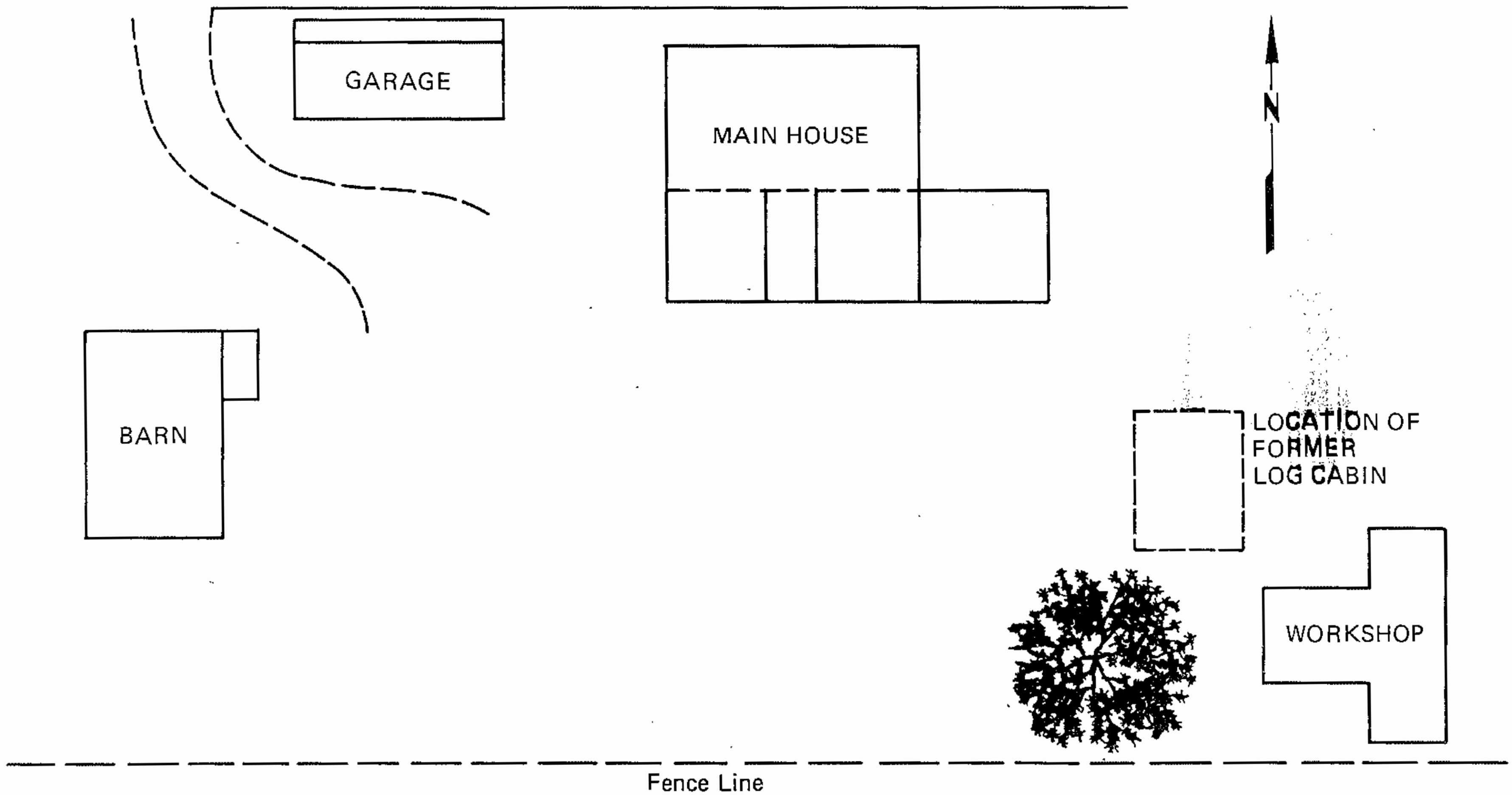


Figure 3-1B Feick Homestead (figure not to scale)

(a) Street View

(b) West View Showing Additions

(c) South View Showing Additions

Figure 3-2 Feick Homestead -- Main House

house from Wald Road. This side of the building, according to the present owner, was originally the back of the house, as the "front" faced the interior yard. The street-facing entrance previously had a double door. The original house portion rests on a stone foundation to create a full cellar. Cedar beams with peg-framing define the walls, which are constructed of sun-dried brick. This construction technique, labeled "fachwerk," is characteristic of the area. The original house previously had a complete chimney of the same brick materials and a central stairway.

Kasper Feick, builder of the two structures previously described, was succeeded by one of his sons, David. Both father and son raised cattle, as well as pursued farming. Kasper Feick's brand (KF) was registered in 1845, the seventeenth brand registered in Comal County. The brand of his son David (D-F) was recorded in 1872. David had two sons, of whom Otto was the last Feick to own the homestead and who sold it to the present owner. Otto's wife, Lotte, continued to live in the main house until 1977. Additions, which included installing clapboard siding to the new portion to conform to the older section, were probably made to the main house at the time of Otto and Lotte's marriage in 1905. This form of exterior treatment is common to many houses in the area built in the early decades of the twentieth century (Figure 3-2B and C).

Typical of early homesteads in the area, several outbuildings were built surrounding the main house. Located west of the main house is a single-story shed structure now used as a garage (Figure 3-3A). A two-story barn (Figure 3-3B), constructed at two separate stages, reveals a north construction of hand-hewn timbers joined to a southern portion by a second story. This upper portion was formerly a corn crib. Between the barn and the road, portions of an earlier barn once existed. The other remaining outbuilding is a workshop located east of the original cabin (Figure 3-4A).

A small parcel of land (1.2 acres) is adjacent to the west side of the Feick homestead. This property is not included as part of the GPI Comal County site. Two structures exist on this property, a cattle barn of relatively recent construction, and an addition to a former structure that once existed on the north side of Wald Road. This addition of Greek Revival design is currently unoccupied and is being stored on temporary foundation pilings. (Figure 3-4B)

(a) Garage

(b) Barn

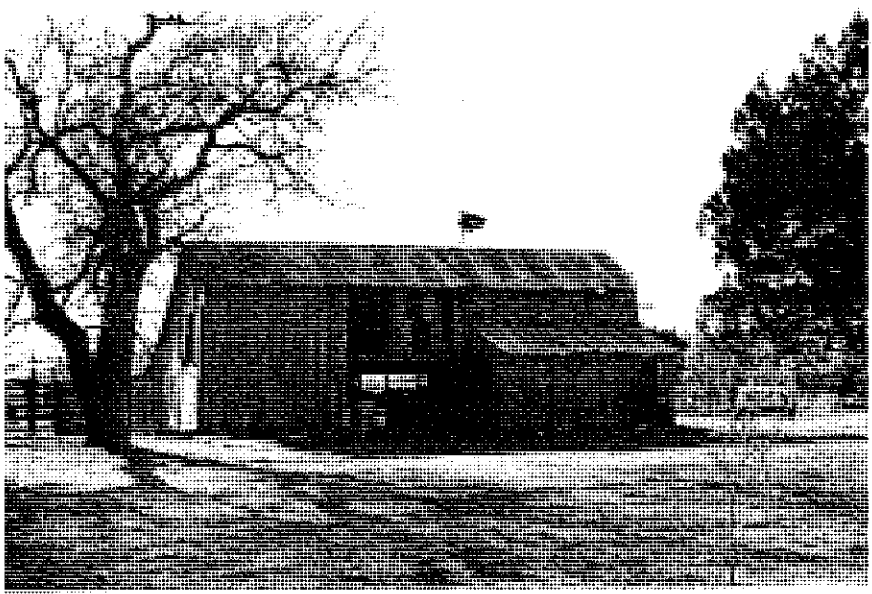


Figure 3-3 Feick Homestead Outbuildings

Figure 3-4A Feick Homestead -- Workshop

Figure 3-4B Barn and Greek Revival Structure
West of Feick Homestead

Further east on Wald Road is Needmore Farms, another nineteenth century homestead, located on the eastern portion of the GPI plant site. The Heitkemp family farmed the surrounding land and continued a dairy farm operation up until the 1930s. There were two log-constructed structures on the property near the location of the most recent house. Approximately five years ago, the New Braunfels Conservation Society obtained these structures and removed them from the property. The other outbuildings, including cattle barns, are of recent construction.

3.2 Seguin and Guadalupe County

3.2.1 History of Settlement in Seguin and Guadalupe County

The history of settlement in the area now called Seguin dates back to at least the 1790s when it was a stop on the Old Spanish Trail. Settlers and commerce passed along this route as the Texan plateau regions became occupied by European immigrants moving north from the Gulf Coast plain and southern Spanish towns.

The town of Seguin was founded in 1838 as a grant to Mathew Caldwell's Gonzales Rangers at a location then named Walnut Springs. A college was founded at Seguin in 1849 as settlers arrived to farm the rich soil of the coastal plain's Blackland Prairie. The region today remains primarily agricultural.

3.2.2 Historic Properties on the Guadalupe County Property

The northernmost part of this GPI property is adjacent to Deadman Creek (previously labeled Zone IV on Figure 1-5). The only structure currently standing is a long-abandoned farmhouse overlooking this creek. The photographic inventory of structures included in Appendix A contains photographs of this building.

Two currently operating farms are located along Leissner Road, the southern boundary of the GPI property. The farms were both part of the Boecker homestead, the original land of which is located in Zones V, VI and VII. The house on the Zone VI property is the earliest. It has a cement foundation and was constructed since the turn of the century.

Its outbuildings include a stock barn, equipment shed and several smaller buildings that were probably farmhand quarters (located behind the main house - see Appendix inventory). Within the past 50 years, a decendent of the Boecker settlers subdivided the property and developed the second farm to the west (Zone VII), into which he moved, leasing or selling the original homestead.

The Boecker cemetery separates the two farms and is located along Leissner Road. The earliest burials in this cemetery date to 1892. The cemetery headstones indicate that a variety of families own plots, with both parents frequently buried together. All persons appear to be of German descent, a few having been among the early settlers to the area.

3.3 Summary and Conclusions concerning Historic Properties

3.3.1 Comal County Property

The GPI site in Comal County is located southwest (three miles) of city of New Braunfels, one of the early and largest settlements of German immigrants to Texas. A land grant to one of the settlers of New Braunfels, Kasper Feick, in 1845, and the one remaining structure he constructed for his homestead (the main house), is contained within the Comal County property of GPI. This property is considered to be of possible local historic significance and is the only historic resource meriting consideration.

GPI has offered to donate the Feick homestead main house to the New Braunfels Conservation Society. Should the society decide to accept the building, it will have the option of moving it to another site at some time in the future. The remaining three structures on the Feick homestead (barn/corn crib, garage, workship) will not be removed from the property. It is believed that these remaining outbuildings are not of particular historic significance. Their importance lies in their spatial context to the residential structure, which will probably be removed from the property. Preservation of these structures by relocation, therefore, does not appear warranted. The Feick homestead portion of the GPI site will not be disrupted, nor will it be part of the proposed construction area. By relocating the Feick homestead's principal component (e.g., the main house), its primary local historic value will be preserved. Therefore, no direct impact on this historic resource is anticipated since structures remaining will be within a buffer zone and not be disturbed by the planned development.

3.3.2 Guadalupe County Property

The property purchased by GPI for clay mining is currently used for two types of agricultural activity, grazing and feed crop cultivation. Most of the property, under the management of two farms along Leissner Road, will be leased back to the original owners for continued agricultural use. Only the northernmost portion of property is currently planned to be used for the clay mining operation. This part of the Guadalupe County site has no historic significance. The remaining structure found in this area does not warrant historic preservation.

The Boecker Cemetery is surrounded by GPI property that will be leased for agricultural use. If, at any time in the future, mining operations are undertaken near the cemetary, a buffer zone of undisturbed land will be preserved around this cemetary. Thus no impact on the Boecker cemetary is anticipated.

No impact on historic resources is anticipated with respect to the Guadalupe County site.

3.4 Impacts and Recommendations concerning Historic Resources

3.4.1 Comal County Property

Of the potentially significant historic sites, only the Feick homestead warrants more detailed consideration. GPI plans do not currently include disruption of any of the Feick homestead structures as part of the cement plant construction or site development program. The land on which these structures are located was purchased as a "buffer area" and will remain in its present condition as open, cleared land. The main house of the Feick homestead will remain occupied with continued maintenance. Under these circumstances, no direct impact on this historic resource is anticipated.

Further, the operation of the facility would not significantly alter the physical environment, resulting in an increase in building deterioration so as to produce an indirect impact on the homestead.

Because of the Feick homestead's potential historic significance, the following recommendations are made.

- Additional information should be assembled to document the homestead's history through a limited review of: (1) available land titles and local historical records, (2) supplementary construction details of the main house and the outbuildings (both on and off the site) should be recorded and include descriptions of building materials, floor plans, foundation structures and other relevent architectual features, (3) limited subsurface testing might also include the identification and extent of homestead refuse or other utilization sites.

- Since certain remaining buildings that form the component parts of the Feick Homestead are on their original sites, it is important to record the relative locations of the buildings to one another. An accurate record of the locations of the structures currently existing and those that were removed in recent years should be undertaken, if such information is not already available, and be included as part of the historic documentation supplement.

- A copy of this report and location records should be provided to the New Braunfels Conservation Society, which has undertaken to preserve other buildings in the area. This report will provide some of the necessary documentation to enable the society or other interested persons to reconstruct the homestead, should they so desire.

Other houses and structures are located on the property owned by GPI in Comal County. However, none of these structures are of historic significance. Therefore, no action is warranted to preserve or protect them. These structures will be removed as part of present site development plans.

3.4.2 Guadalupe County Property

The mining operation planned for the Guadalupe County property will have no impact on historic resources since no significant features exist at the site. The Boecker Cemetary, which is adjacent to south side of the GPI property and more than one-half mile from the initial mining operation, would not be adversely impacted. However, GPI will take measures to provide a buffer zone around the cemetary should at some time in the future mining activities approach the Boecker Cemetary area. No measures to avoid or mitigate impacts on historic resources are necessary.

4. INTRODUCTION

4.1 Purpose and Scope of Work

General Portland Inc. (GPI) requested Environmental Research & Technology, Inc. (ERT) to perform a cultural resource survey for properties it was developing in Comal and Guadalupe Counties, Texas, as part of a cement manufacturing facility. Field work was undertaken in March 1978, and a report was prepared in April. Preliminary review of the survey work by the Texas Historical Commission resulted in recommendations to conduct further work to provide additional documentation. The field work was performed on 26 to 28 April and included both prehistoric and historic resource investigations. The Phase II prehistoric survey was conducted by Dr. Jeffrey C. Howry, Senior Archeologist for ERT and Mr. Fred Valdez of the Center for Archeological Research, University of Texas at San Antonio. In total, 100% of the GPI properties was surveyed. Assistance for the historic documentation was provided by Mr. Harvey Smith, registered architect and staff member of the Center for Archeological Research. Further work including analysis and report preparation was conducted in the weeks following the field work.

The prehistoric component of this study (Section 5) considered portions of the properties not previously surveyed. The investigations of the initial study had focused on those areas of the properties that were believed to have the highest potential for the existence of prehistoric resources. Certain of these areas did disclose limited amounts of materials, although no sites were located that contained diagnostic artifacts or undisturbed deposits. The secondary field investigations covered areas of lower resource potential and resulted in the identification of only two areas of additional prehistoric use. In total, a 100% of the site was surveyed.

The historic component of this study (Section 6) seeks to provide additional documentation on the Feick homestead, a section of property adjacent to the site chosen for the cement manufacturing facility. Included are a more detailed description of property ownership, drawings and photographs of homestead buildings and a description of their construction, a survey of building use, and intensive surface examination with limited test excavations to determine the location of homestead refuse areas.

Conclusions and recommendations resulting from the most recent investigations are given in Section 7 of this report. The following paragraphs summarize the findings.

4.2 Summary of Findings

4.2.1 Prehistoric Resources

The second phase of field survey of the GPI properties in Comal and Guadalupe Counties disclosed only limited prehistoric material. Only on the Comal County property were additional chert tools and debris found in any quantity and within a defined area to suggest limited prehistoric use. As no diagnostic artifacts were collected in these Comal County localities, it is difficult to know the specific time period of occupation. Based on earlier survey work and examination of local collections from the area, it would appear that the artifacts reflect occupation during the Archaic period, and possibly more recently.

4.2.2 Historic Resources

Further investigation of the Feick homestead disclosed the original configuration of the buildings and a history of building construction. Detailed drawings of the main house and outbuildings enabled investigators to enumerate construction techniques and uses. Limited test excavations confirmed that the log cabin had been used both as a residence and, later, as a smokehouse. The blacksmith shop had been the focus of various metal fabrication and repair activities, and the forge was also used for shoeing farm animals.

Over the three generations of single-family ownership, various buildings that increased the homestead's self-sufficiency were added. The homestead represents the full range of activities typical of a family farm as evidenced by the structures and landscape features on the property. As the residence of one of the early German settlers to Comal County, the homestead also represents a particular style of regional adaptation to newly settled lands. However, because the homestead is not situated on land that will be used for the cement plant construction, no impacts will result from planned construction.

5. PREHISTORY

The areas surveyed in the Phase I Reconnaissance Survey and the subsequent Phase II Supplementary Survey are illustrated in Figures 5-1 and 5-2. The survey of both phases constitutes a complete coverage of all properties under consideration by GPI.

5.1 Comal County

The areas encompassed by the proposed cement plant site are Zones I, IX, and X in Figure 5-1. Materials recovered in Zone I were identified as belonging to the Archaic period and are described in Section 2. Zones IX and X, surveyed in Phase II, are similar in terrain but contain less surface water than the adjacent Zone I. Both Zones IX and X are open agricultural fields with a grass cover sparse enough to permit examination of surface conditions.

Zone IX soils contain a significant percentage of natural chert nodules on gently sloping terrain. In the southernmost section, at Location A in Figure 5-1, recognizable as a slight rise of ground level, a roughly oval area within 150 feet of Wald Road was found to contain a scatter of lithic materials that included cores, flakes, and several bifaçial tools. No diagnostic artifacts were recovered, nor were indications of intensive occupation evident. However, intermittent occupation during prehistoric periods seems possible, although extensive collection over many years has reduced the number of diagnostic artifacts to be found.

Zone X, heavily contoured farm pasture, has very dense loamy soil. Surface inspection revealed little chert material of any kind on the property with only one small area, approximately 50 feet long (Location A, Zone X) where slope erosion disclosed one bifacial tool.

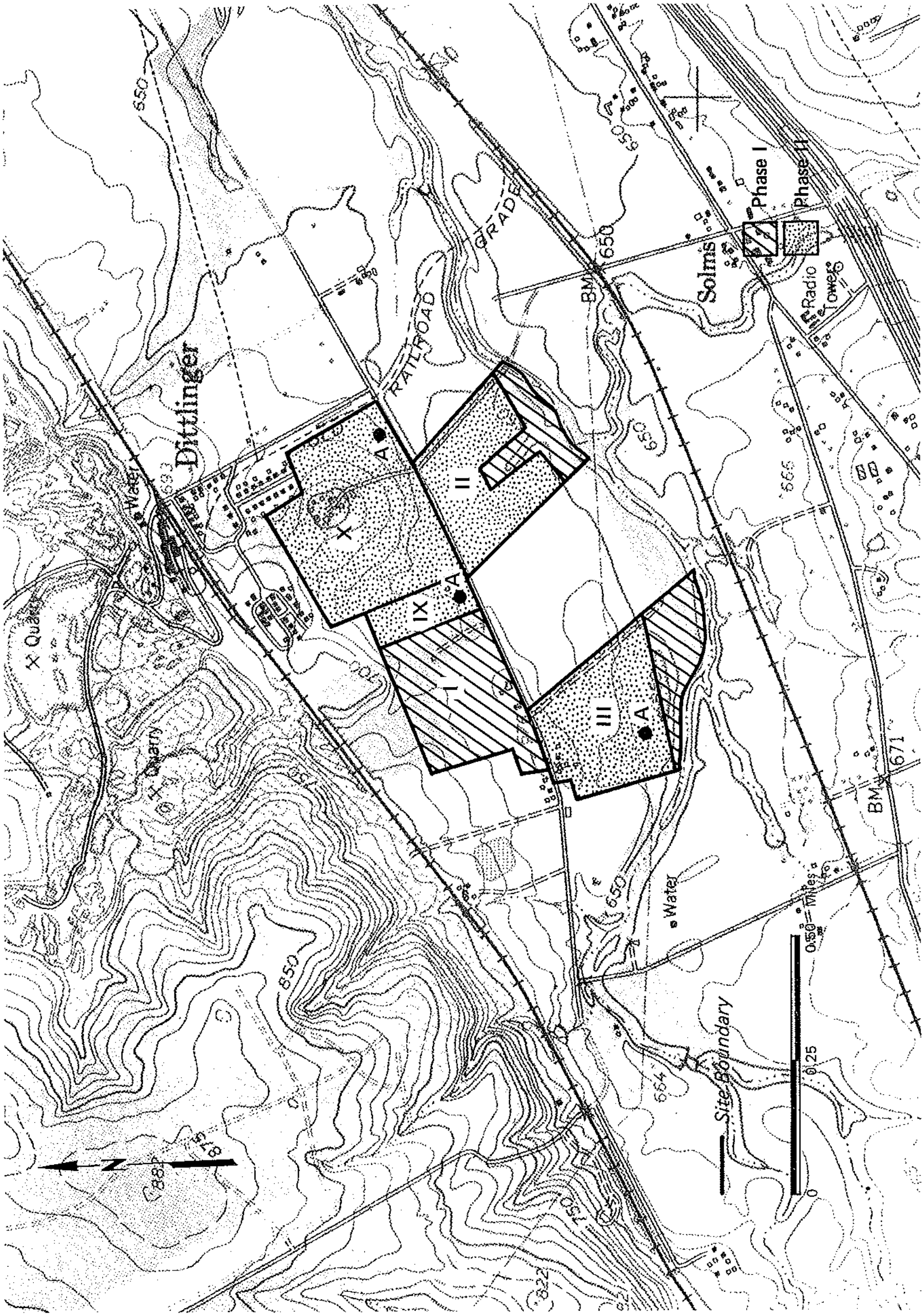


Figure 5-1 Zones Surveyed in Comal County

454-2 805045

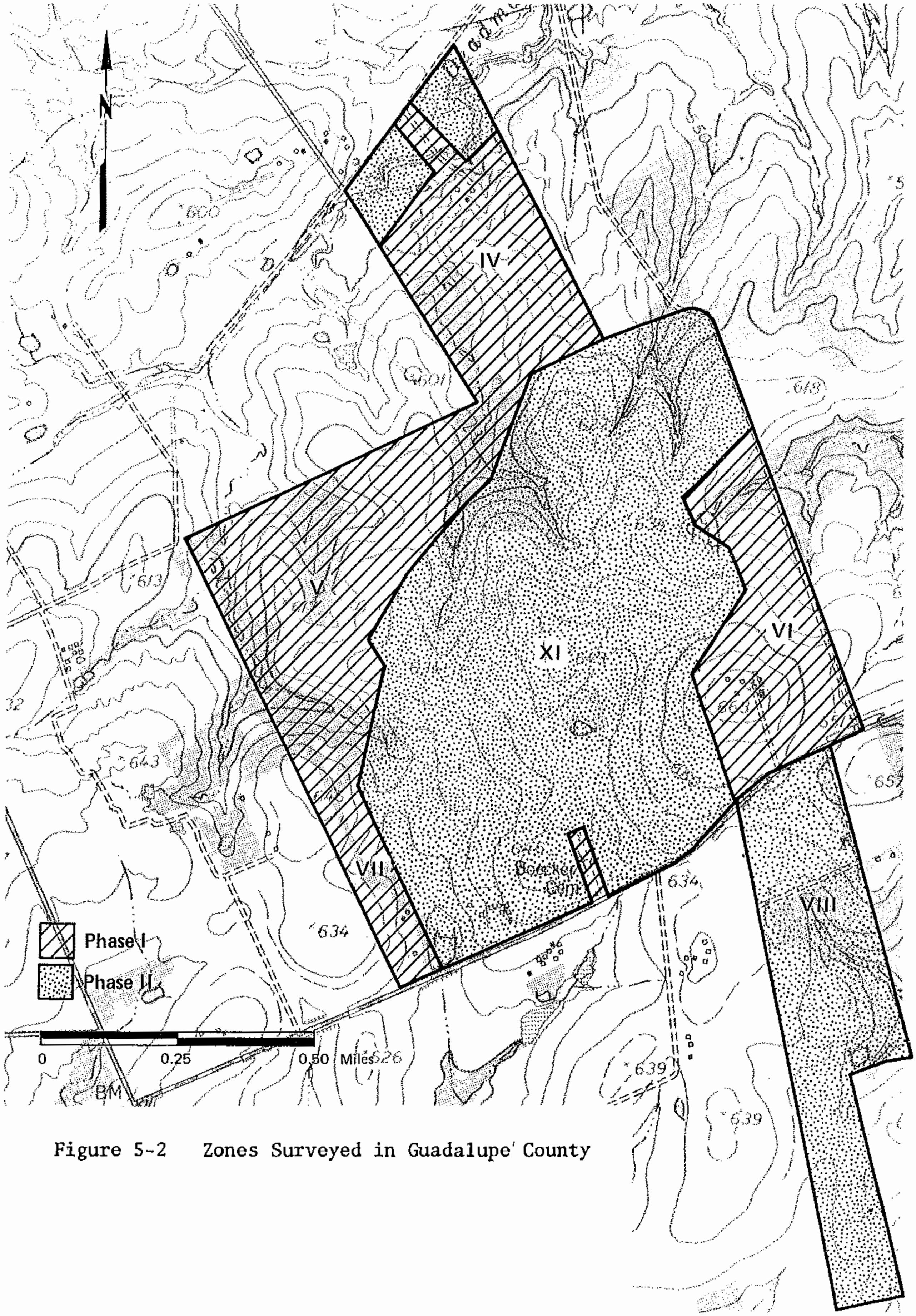


Figure 5-2 Zones Surveyed in Guadalupe County

Zone II, the designated area for a cooling and settling pond, was re-examined with particular attention to the upland areas north of Dry Comal Creek. Although the areas were covered with grasses, a moderate amount of natural chert material was discovered. Only in the south-easternmost corner was a single, large secondary flake encountered.

Zone III encompasses the properties of the Feick homestead. A recent harvest of oats on the fields south of Wald Road clearly exposed most of the zone's surface, a small area approximately 100 to 150 feet in circumference located about 400 feet north of Dry Comal Creek. Within this limited radius of 50 yards, cores, secondary flakes, bifacial tools, and a fragment of shell/fiber-tempered pottery were recovered. Conversation with owners of the property disclosed that this area's artifacts had been extensively collected over several decades during plowing and cultivation. The collection reflects use of the area from the Archaic period until recent times (see Appendix D). Oral history records that there was once a crossing of Dry Comal Creek in that vicinity and that Indians may have temporarily camped at this location in the period of early European settlement. Therefore, the area of surface scatter may be the remains of previous temporary encampment.

5.2 Guadalupe County

The areas designated as Zones V, VI, VII, VIII, and XI constitute the total properties considered part of the GPI mining plans. A portion of Zones IV, V, VI, and XI will be used in developing an open pit clay mine. Previous field investigations had disclosed limited lithic surface scatter at specific locations in Zones IV and V. Subsequent field work examined the areas in Zones IV and XI that were believed to have a low potential for the existence of prehistoric materials.

The flood plain of Deadman Creek in the northern portion of Zone IV is overgrown pasture. The ground surface exposes natural chert cobbles at certain locations. However, no prehistoric lithic materials were encountered at any point on either side of the creek.

Zone VIII is open grazing area with a variety of ground cover, ranging from sparse to dense, the latter occurring along a small surface drainage. A thorough surface inspection disclosed no artifacts of any kind.

The central portion of the Guadalupe County property is identified as Zone XI. This is the driest portion of terrain that could potentially be affected (see Figure 5-2). Nearly all of the zone has been cleared of vegetation and affords good ground surveillance. The drainage in the northeast corner of Zone XI has been cleared of vegetation and contained considerable amounts of eroded chert cobble material. One small core was recovered. The highest portion of the property, surrounding the 649-foot contour is largely overgrown pasture. Two widely disparate cores were found on this high area. The survey in the southerly section of Zone XI, covered currently cultivated fields that lacked any chert material. No further evidences of prehistoric use were encountered.

6. HISTORY

To evaluate the significance of the Feick homestead more fully, further documentation of selected aspects of the property was undertaken. Supplementary data included a review of land title as it relates to family history and a detailed analysis of the buildings that constitute the homestead. In addition, limited test excavations were made to confirm the use of certain structures. The results of these investigations are discussed below.

6.1 Family History and Land Title

A memorial to the original settlers of New Braunfels, situated in Landa Park on the Comal River, New Braunfels, lists Kasper Feick among the area's first residents. The earliest deed records a transfer of 15 acres to him in 1853 by the German Emigration Company. Whether Feick moved in before or after the legal settlement of the land cannot be confirmed. However, the single room log structure that was part of the homestead presumably served as the first residence of Kasper Feick until he constructed the four-room structure that formed the nucleus of the main house. This log building was subsequently used as a smokehouse by those on the homestead. (Today this structure is located in the town of Solms.)

Kasper Feick married a woman identified as Anna, and they had two sons. David Feick is the son to whom, in 1884, Kasper and Anna Feick deeded the original 15 acres plus another 50 acres of land acquired in the decades subsequent to settlement. David continued to run the farm, probably with the assistance of his father, who died in December 1894, and mother, who died in September 1900. David apparently divorced his first wife, Caroline, in 1887, as it was then that she deeded to him the sole title to lands acquired three years earlier from his parents. David remarried a younger woman, identified as Augusta, by whom he had two sons, Karl and Otto. Although David Feick died in 1922, Augusta was widowed for the remaining 25 years of her life. However, it was only nine years after her husband's death, in 1931, that she and her son Carl deeded all the family land to Otto, under the condition that she could continue to live at the homestead.

This pattern of providing a life estate to residents following transfer of the property was repeated in 1960, when Otto and his wife, Charlotte, sold the homestead to their neighbor Arthur Kneuper. Otto Feick died two months before the final transfer of property, but Charlotte continued to live in the main house until 1976.

The property has been since sold to Arthur Kneuper's son, Felix. It was Felix Kneuper who agreed to sell the property to GPI on condition that he could remove the log cabin structure (smokehouse) from the property. The main house is currently occupied by tenants and will continue to be a residence under ownership by GPI.

6.2 Homestead Plan and Use

Homestead Activities

Like other homesteaders of the area, the Feicks grew a variety of crops, raised swine and cattle, used horses for farming, and engaged in a number of light industrial activities to make their farm as self-supporting as possible. Figure 6-1 is a plan of the Feick homestead, including both existing structures and the approximate locations of former buildings. Much useful information was provided by Felix Kneuper, who grew up across the street from the homestead and knew both Otto and Charlotte, and by his wife, Linda Kneuper, who was a close friend of Charlotte during her last years.

The homestead has not been moved since it was originally constructed, but because the roads have changed, the orientation of the house has been reversed. The earlier orientation was toward the south, as a road from the nearby community of Solms ran in front of the homestead. The Kneupers possess a watercolor of the homestead painted in 1883 showing that this small lane originally ran south of the building cluster, roughly parallel to the barn and workshop, in an east-west direction. The blacksmith shop stood at a point where the lane turned southeast to traverse the Feick property. The lane continued along the east fence line to a point near the Dry Comal Creek where several large oaks now

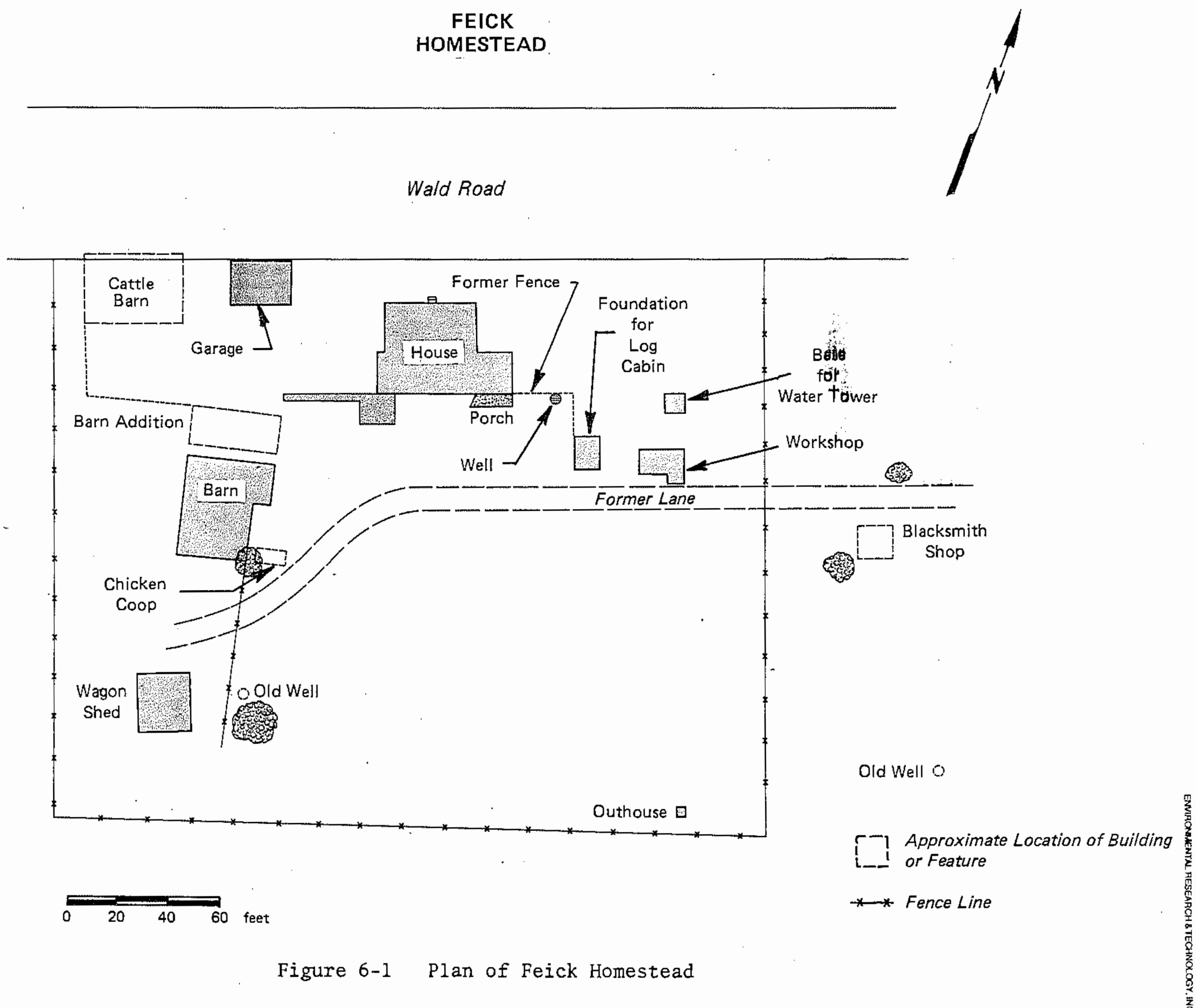


Figure 6-1 Plan of Feick Homestead

stand. It is believed the creek was forded at this point, where the road continued on into Solms. The construction of Wald Road now requires that the property be entered from its northernmost boundary.

The Feicks grew corn for the livestock and, to a limited extent, for food. A small amount of native sugar cane was grown and processed at a shared sugar cane press a few hundred feet west of the homestead along Wald Road. Neighbors helped cultivate and harvest oats. Small amounts of cotton were raised for bedding and pillows, and tobacco, which was cured in the attic of the main house, was also grown. Meat and sausages were preserved by smoking, and vegetables were pickled in crockery and kept in the cellar of the main house.

Main House Structural Features

The homestead's main house at first consisted of a four-room structure framed by hand-hewn cedar timbers with walls made of a double row of sun-dried bricks faced with plaster (Figure 6-2). This construction technique is locally recognized as "fachwerk" and was typical of early German architecture in Texas settlements. Figure 6-3 is a plan of the main house, including later additions. A dry stone cellar exists only under one west room of the original structure (see Figure 6-4) and its access is by the central stairs. Originally, a doorway on the south face of the house opened onto the homestead front yard from the center hallway, known as a "dog run" (Figure 6-5). The rear doorway (Wald Road) apparently had double doors; the door frame is original but the doors have been replaced (Figure 6-5a). The house was later expanded by the addition of several rooms onto the front of the structure, including a small kitchen with a porch. This kitchen contains a small wood/coal-burning stove and was the means of all cooking done by Charlotte Feick until the time she left the house in 1976. This newer kitchen has no plumbing, but is nearer the stone-lined well to the east of the house. This well was probably the last of three wells that were dug on the property and is still serviceable. The cedar-post foundation of a former water tank stands east of the well and behind the workshop. This tank may have been supplied by a fourth drilled well, like that now in use.

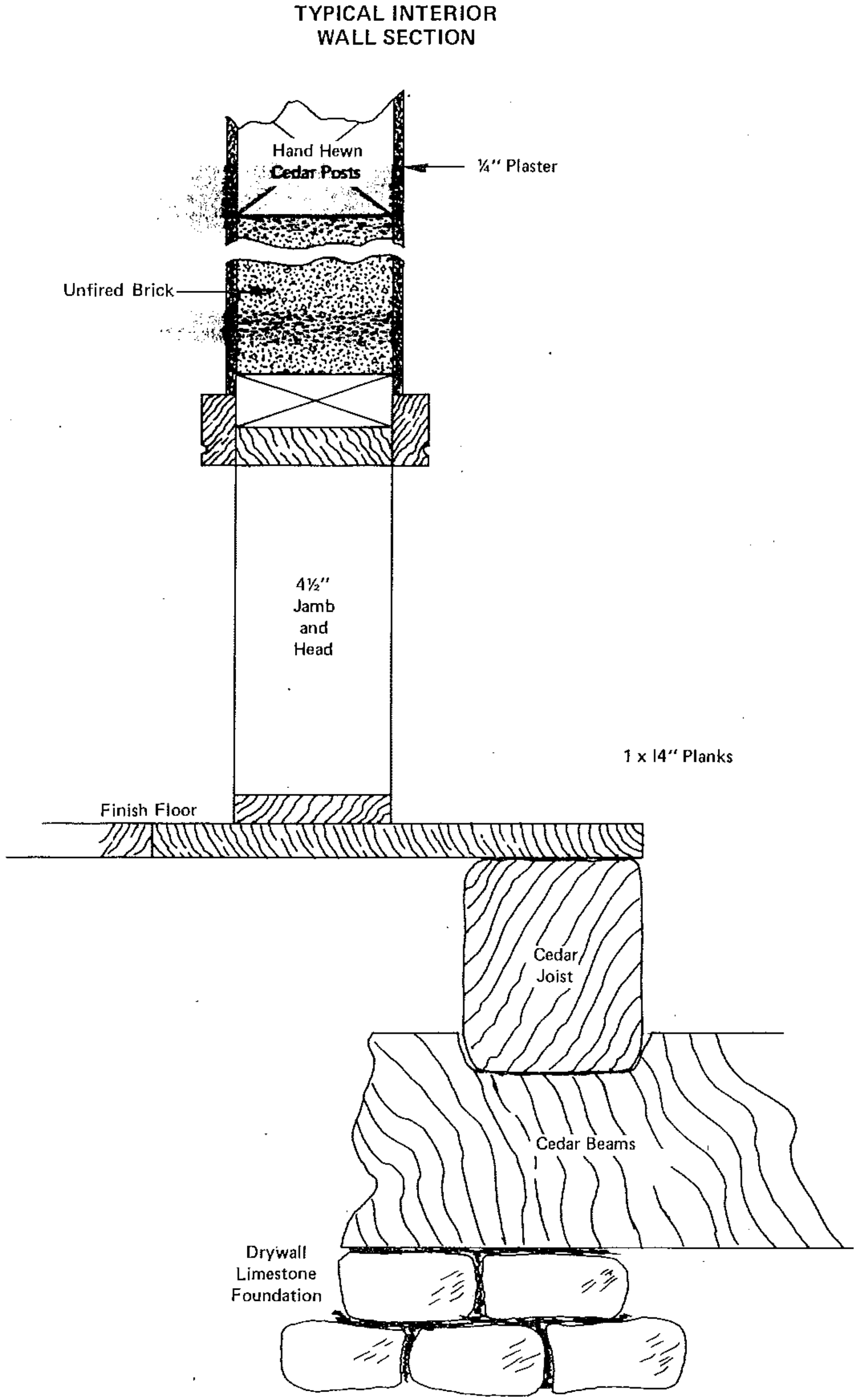


Figure 6-2 Interior Construction of Main House

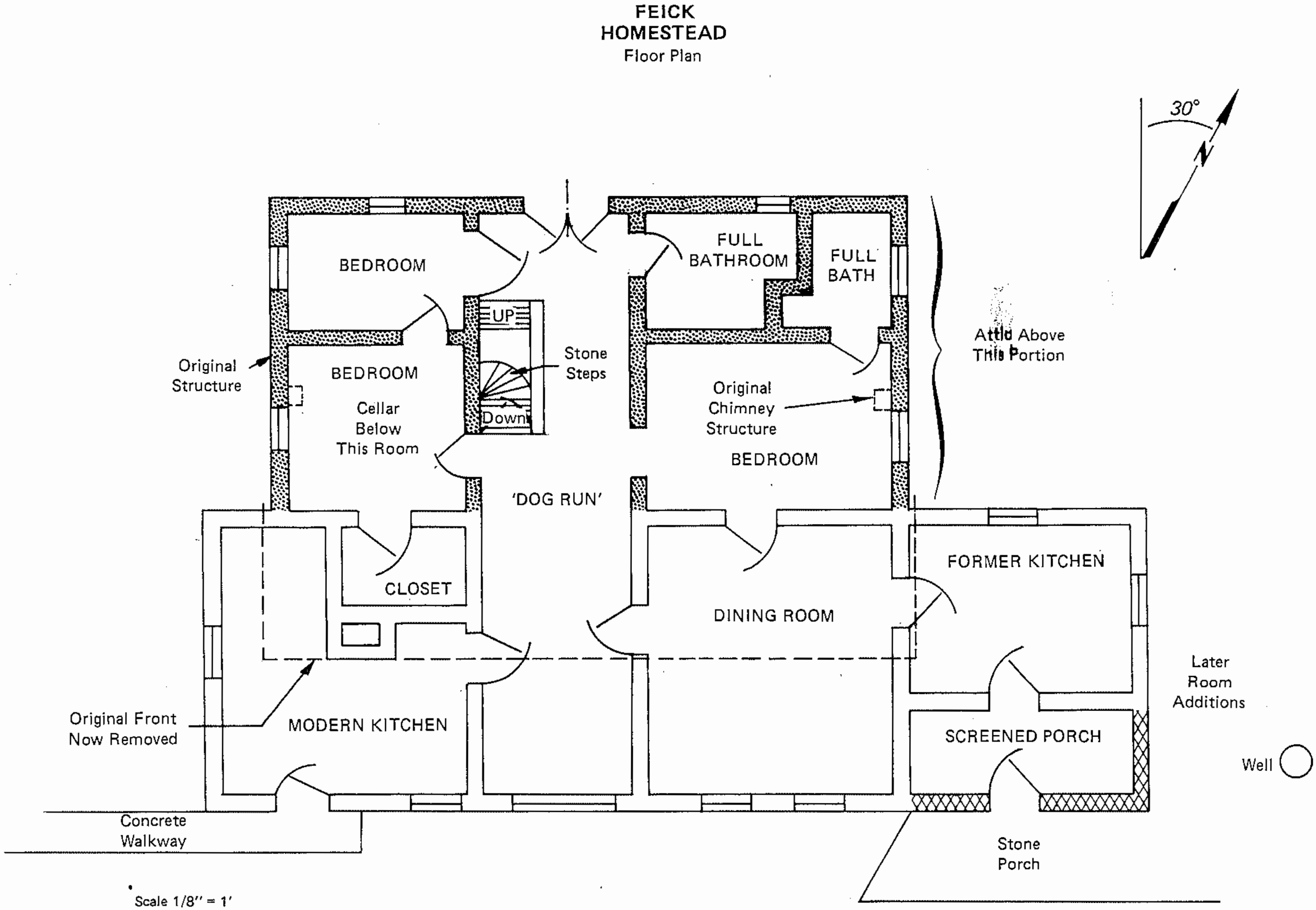
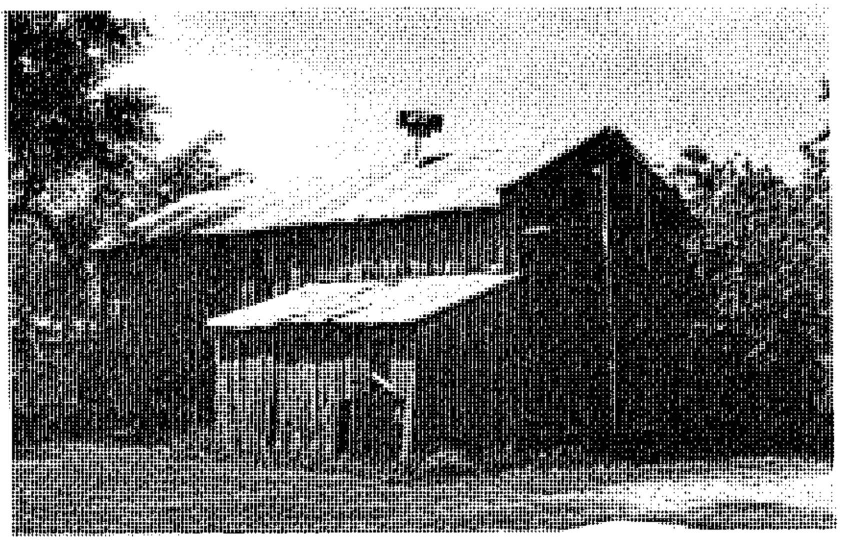
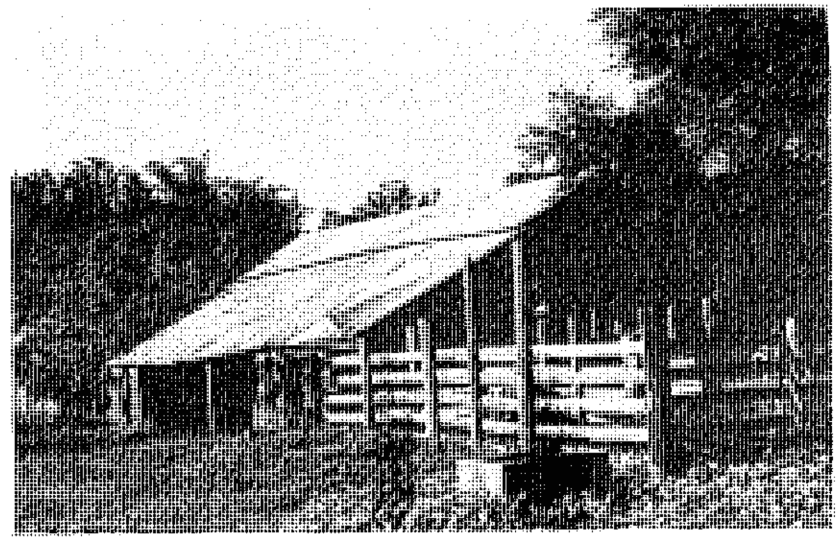


Figure 6-3 Floor Plan of Main House

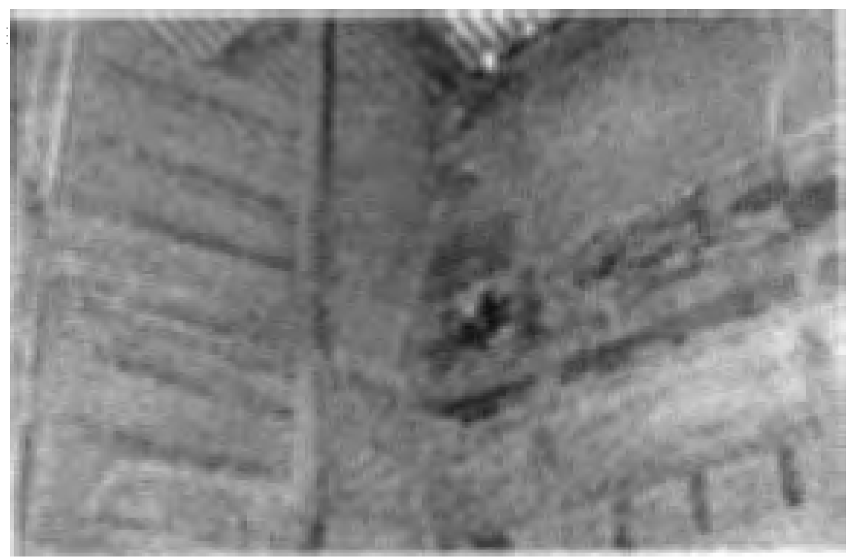


(a) North View



(b) South View

(c) Addition to Corncrib



(d) Interior of Corncrib

Figure 6-7 Views of Barn

(a) Main Hallway (Dog Run)

(b) Center Stairway

(c) Original Fachwerk

Figure 6-5 Views of Interior of Main House between the tank foundation and workshop. Two other wells existed south of the barn, near the wagon shed and south of the blacksmith shop (see Figure 6-1). Both were filled in, the latter about ten years ago.

As the main house grew, several exteriors were added. The original fachwerk section had a plaster exterior. To this exterior was added vertical board and batten (1- by 11-inch boards), which are still in place. With the addition of rooms to the original home, horizontal clapboard siding became the final surface. It is worth noting that different clapboard siding exists on the original portion of the house from that on the additions.

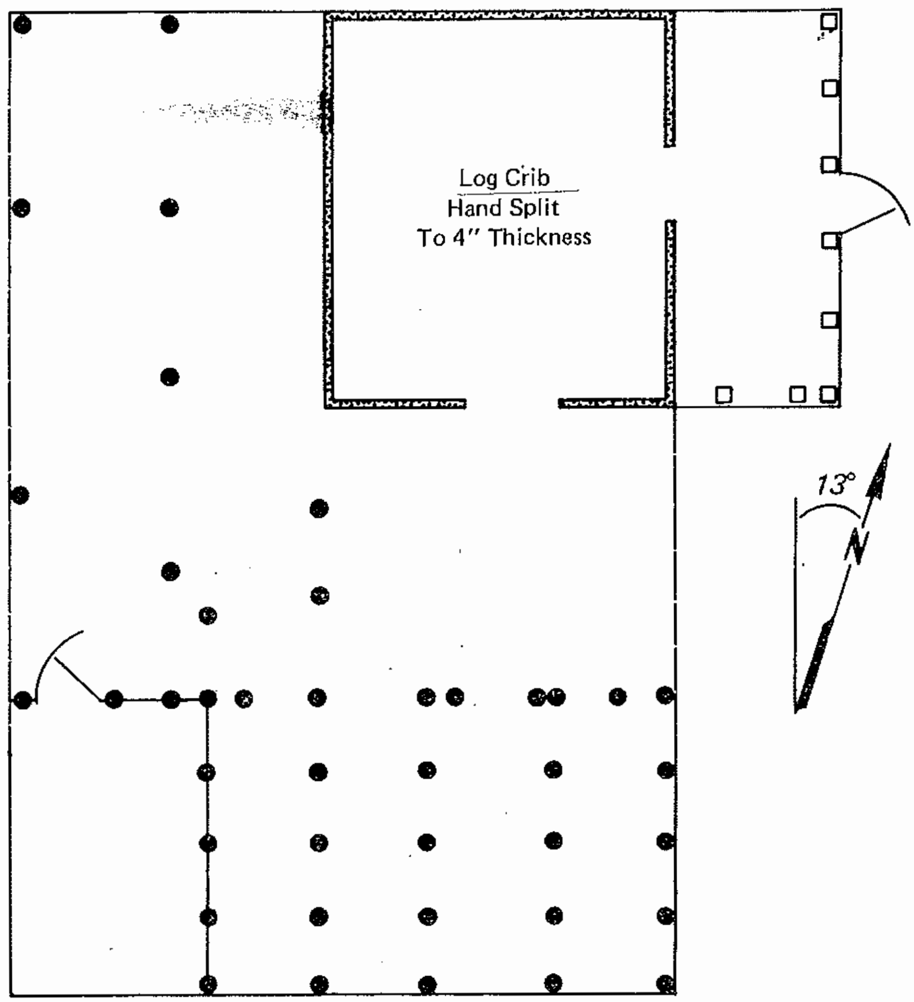
Outbuildings and their Features

Over a period of approximately 75 years, the homestead developed with the addition of several important outbuildings. These structures include a barn (with corncrib), cattle shed, workshop, blacksmith/ farrier shop, garage, and wagon shed. Some buildings were converted to other uses, while others were removed by the owners.

Perhaps the most important outbuilding to the homestead was the barn. The oldest portion is constructed of handsplit logs to form a corncrib (see Figure 6-6). Numerous additions were made to this structure using simple pole construction techniques. Western and subsequent southern additions were made to provide cattle and horse stalls. A shed was added to the eastern wall to provide storage space (Figure 6-7). The barn had been extended to the north in a section separated from the log wall by a narrow walkway. This extension was removed in the past decade because it was in poor condition.

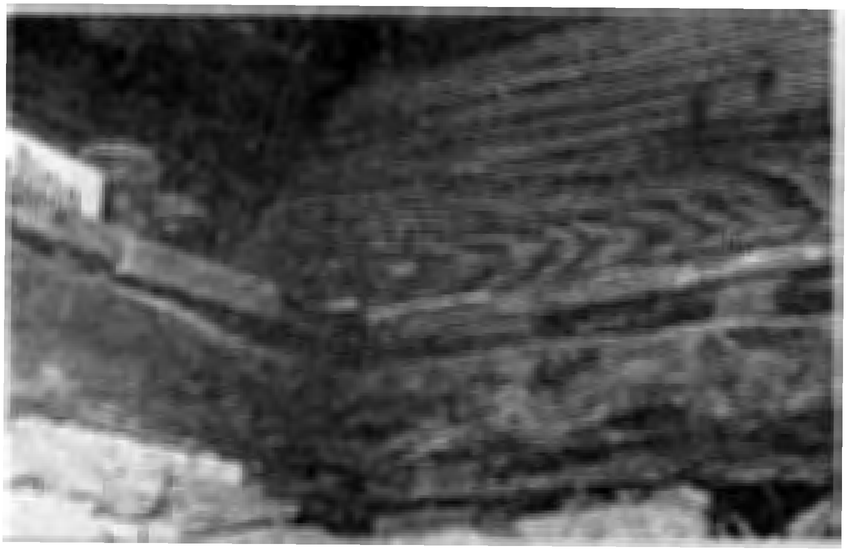
North of the barn addition was a small cattle pen with an attached shed that directly abutted the northern property line. The expansion of Wald Road, necessitated the removal of this structure because it was too close to the new right-of-way (see Figure 6-1). An easement given to the Comal Power Company in 1926 by Augusta Feick for a power line on the north edge of the property may indicate the approximate time of road expansion and development.

BARN

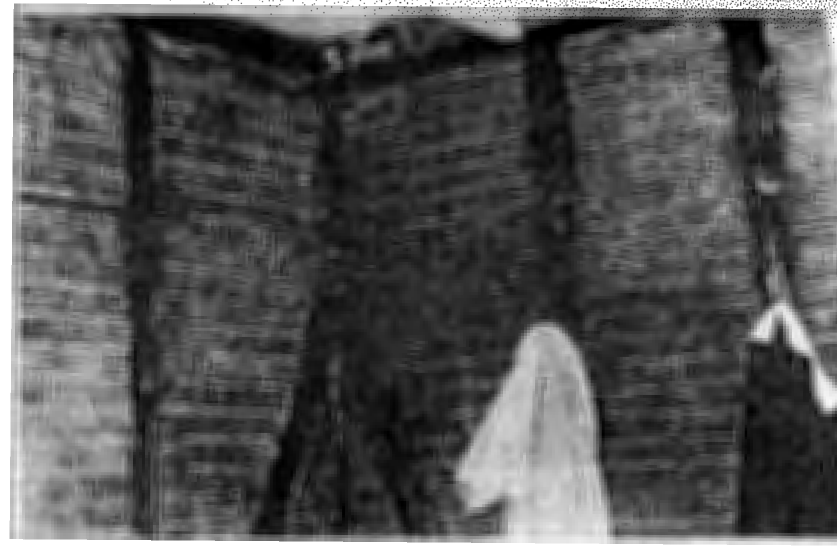


Scale 1/4" = 1'

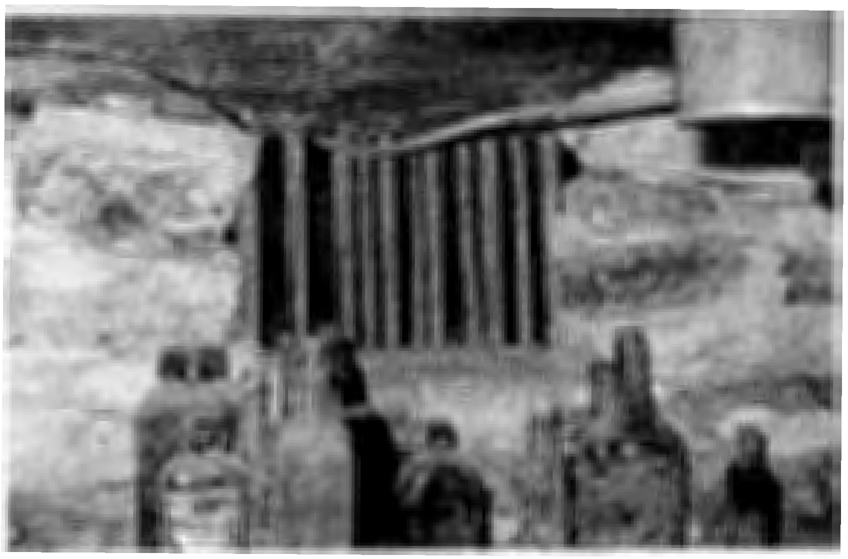
Figure 6-6 Floor Plan of Barn



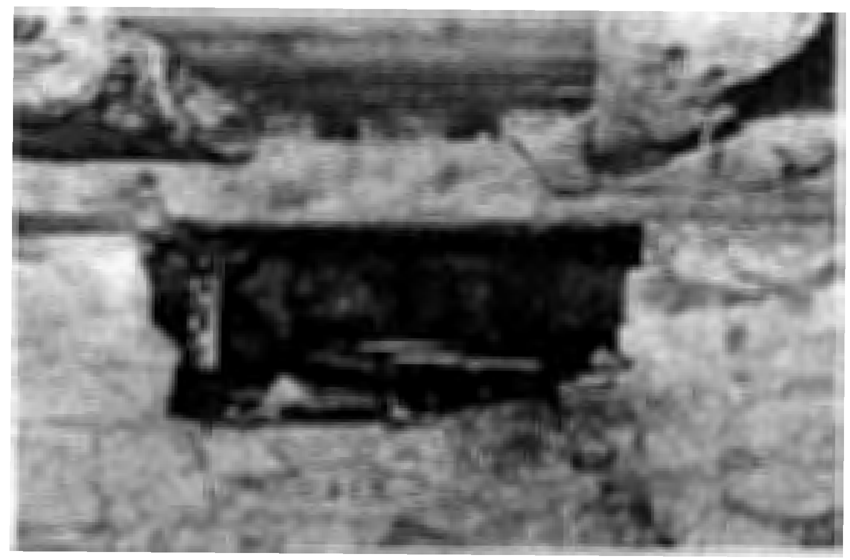
(a) Floor and Foundation



(b) Original Walls Without Plaster



(c) Cellar Wall - South View



(d) Cellar - North Wall Area of Preserved Food Storage

Figure 6-4 Views of Interior Construction of Main House

Some time after the road was moved north to the present Wald Road alignment, a wagon shed was built south of the barn. The materials for this building were taken from older structures and include posts sawn on an up-and-down lumber mill. The shed had a double set of doors that faced east and opened into the homestead yard. A partial storage area existed above the main section, but lower sections stood to the right and left of the central entrance (see Figures 6-8 and 6-9).

The log cabin, presumably the first structure on the property, continued in use even after the main house was occupied. The condition of the structure was excellent, including the original chinking between logs (see Figure 6-10) and possibly the original rafters with cedar shingles. Figure 6-11 is a plan of the structure's dimensions, including the foundation, which was surveyed after the building was moved to an off-site location. (The log cabin was not part of the original purchase option negotiated between GPI and the owner. The cabin is now situated near Solms where it will be restored.) The structure was used principally as a smokehouse. Glass bottles were hung along the support wires of drying racks suspended from the ceiling to discourage rodents. These bottles date from the turn of the century. Former use of the structure as a residence is attested to by the clothes hooks at either end, as well as the sideboard supported by inset wall supports.

East of the log cabin is a workshop, primarily designed for woodworking (Figures 6-12 and 6-13). Its power source was a single cylinder engine located in the building's northeast corner. (This engine was also used to operate a grain elevator to load corn into the corncrib in the barn.) A belt-driven pulley system connected the engine to an overhead pulley system from which other machinery could be powered (Figure 6-14). One interesting facet of the building is the construction of small openings in the walls on opposite walls (see Figure 6-12, western section of building). This feature may indicate the placement of saws or planing equipment that would allow the working of long boards that could not fit within the building. It is possible that this building was constructed by David Feick, who may have had the single cylinder engine as part of his farm machinery before his death in 1922. The building was extensively used by his son, Otto Feick.

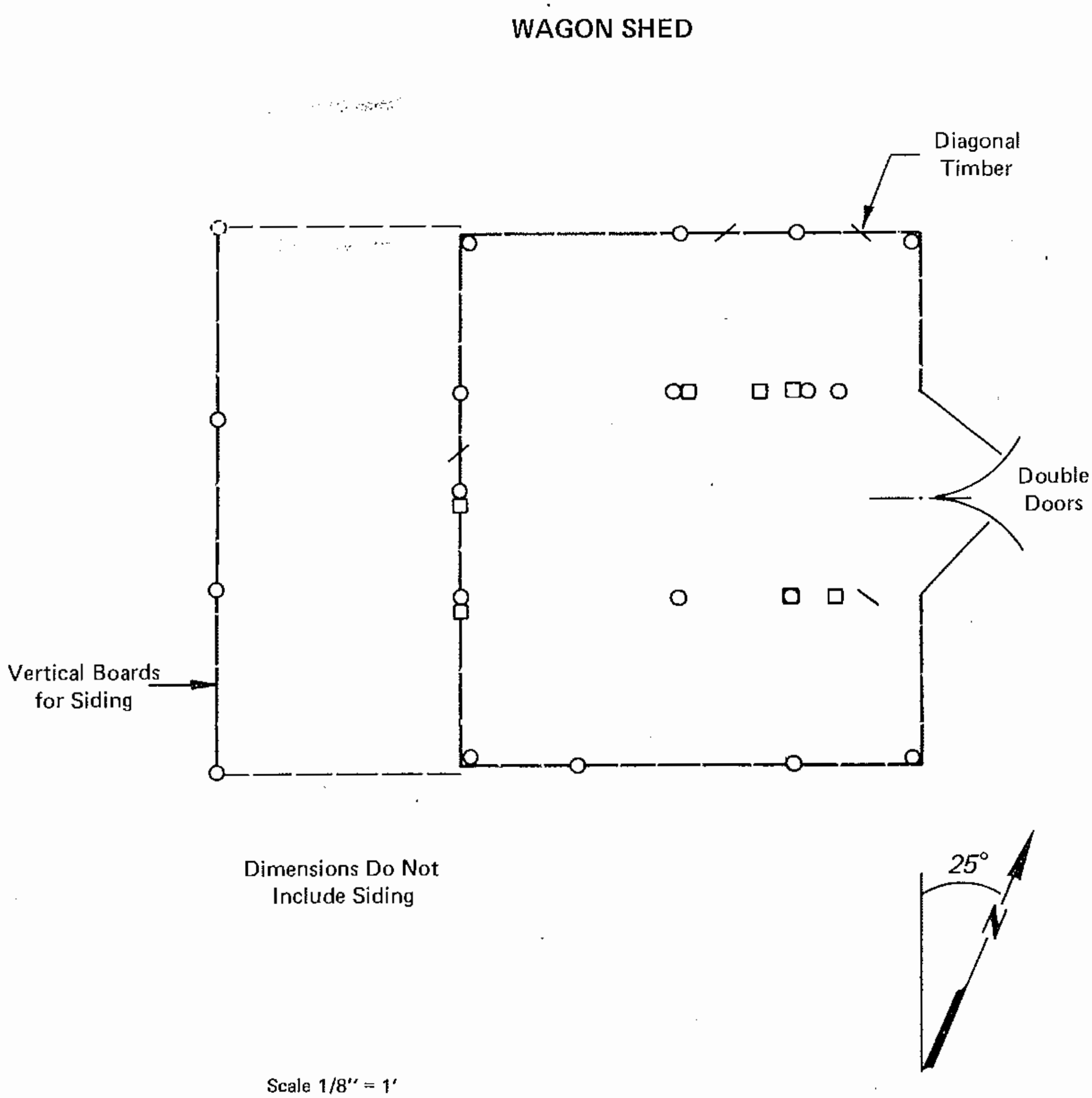


Figure 6-8 Floor Plan of Wagon Shed

805073

(a) Wagon Shed - Northwest View of Principal Beams

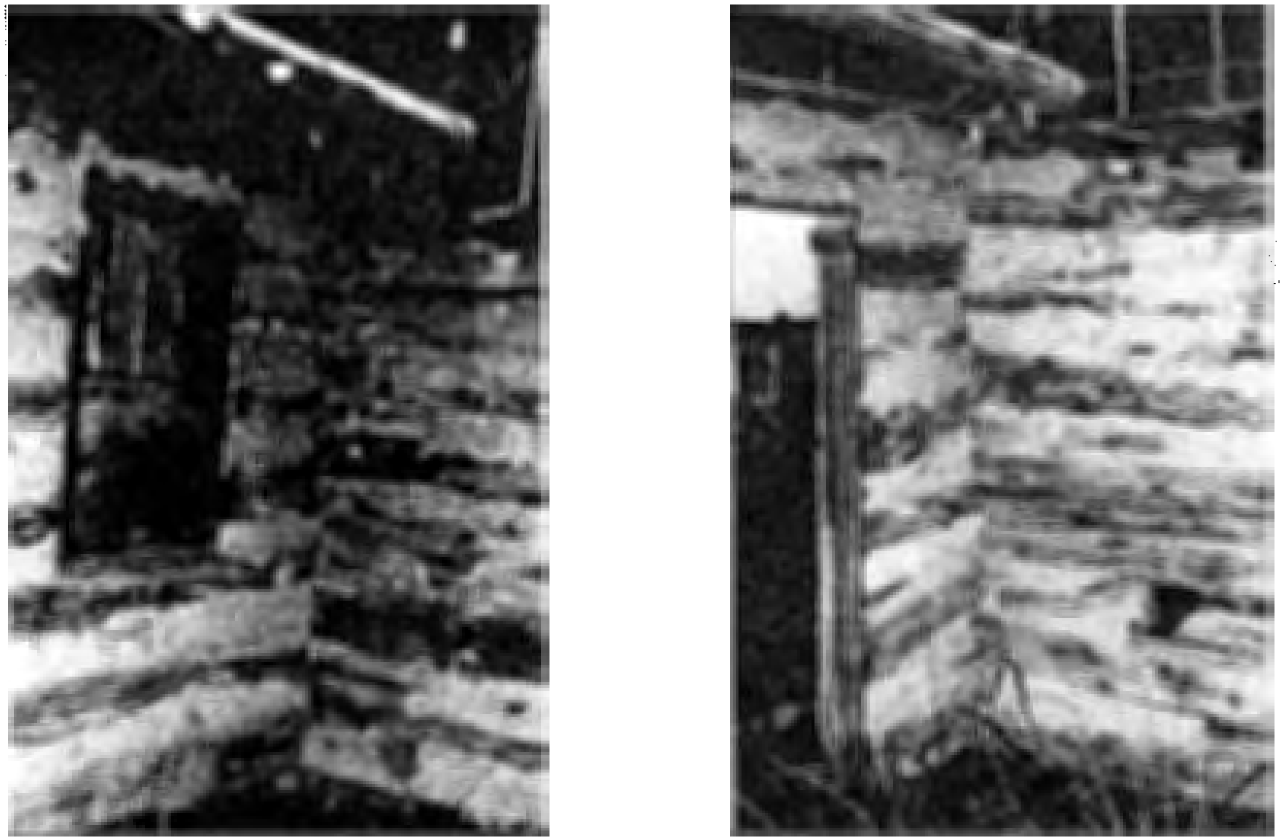
(b) Construction Detail

Figure 6-9 Views of Wagon Shed

(a) Present Cabin Location

(b) Sideboard in Cabin

Figure 6-10 Views of Log Cabin

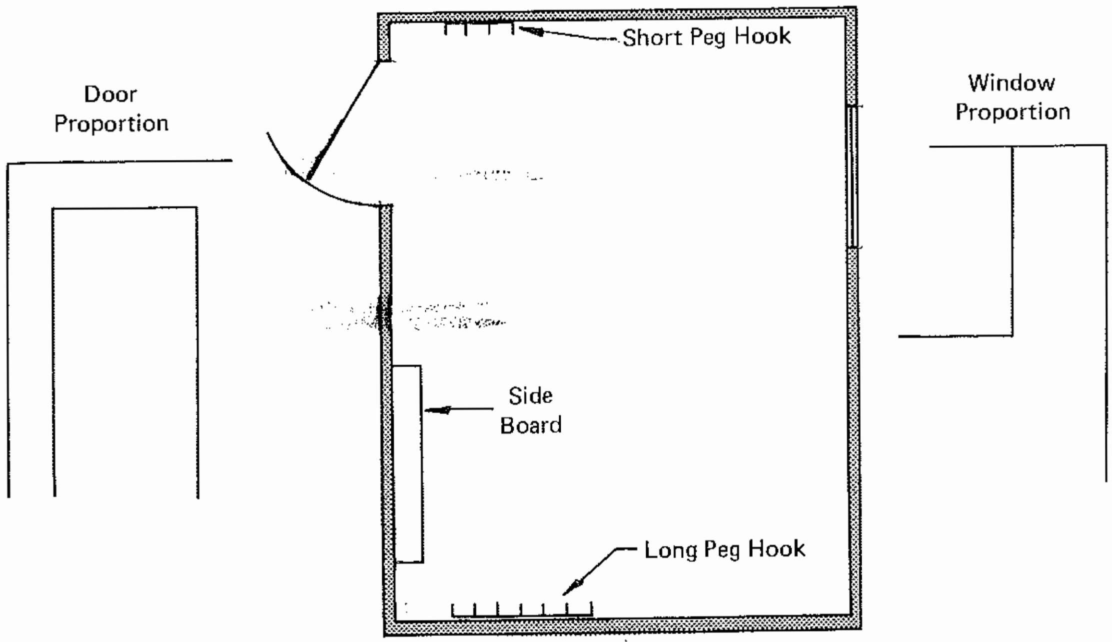


(c) Window Placement (note overhead pole for meat preservation)

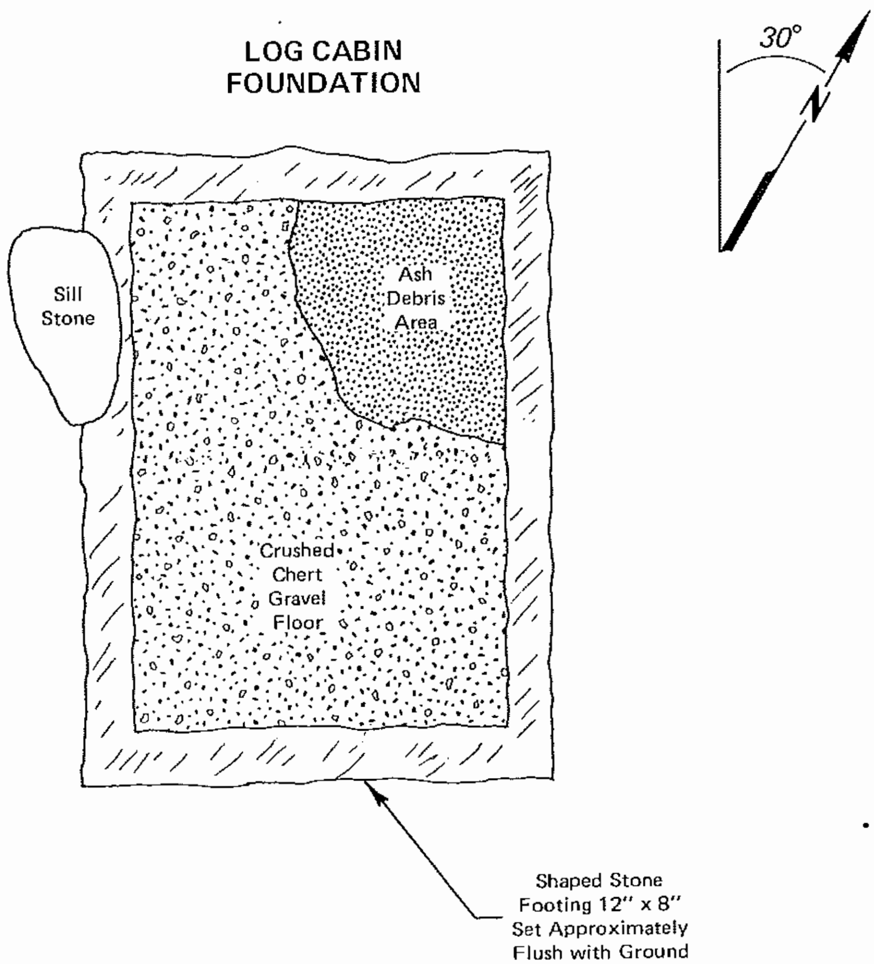
(d) Door Placement

Figure 6-10 (continued)

LOG CABIN



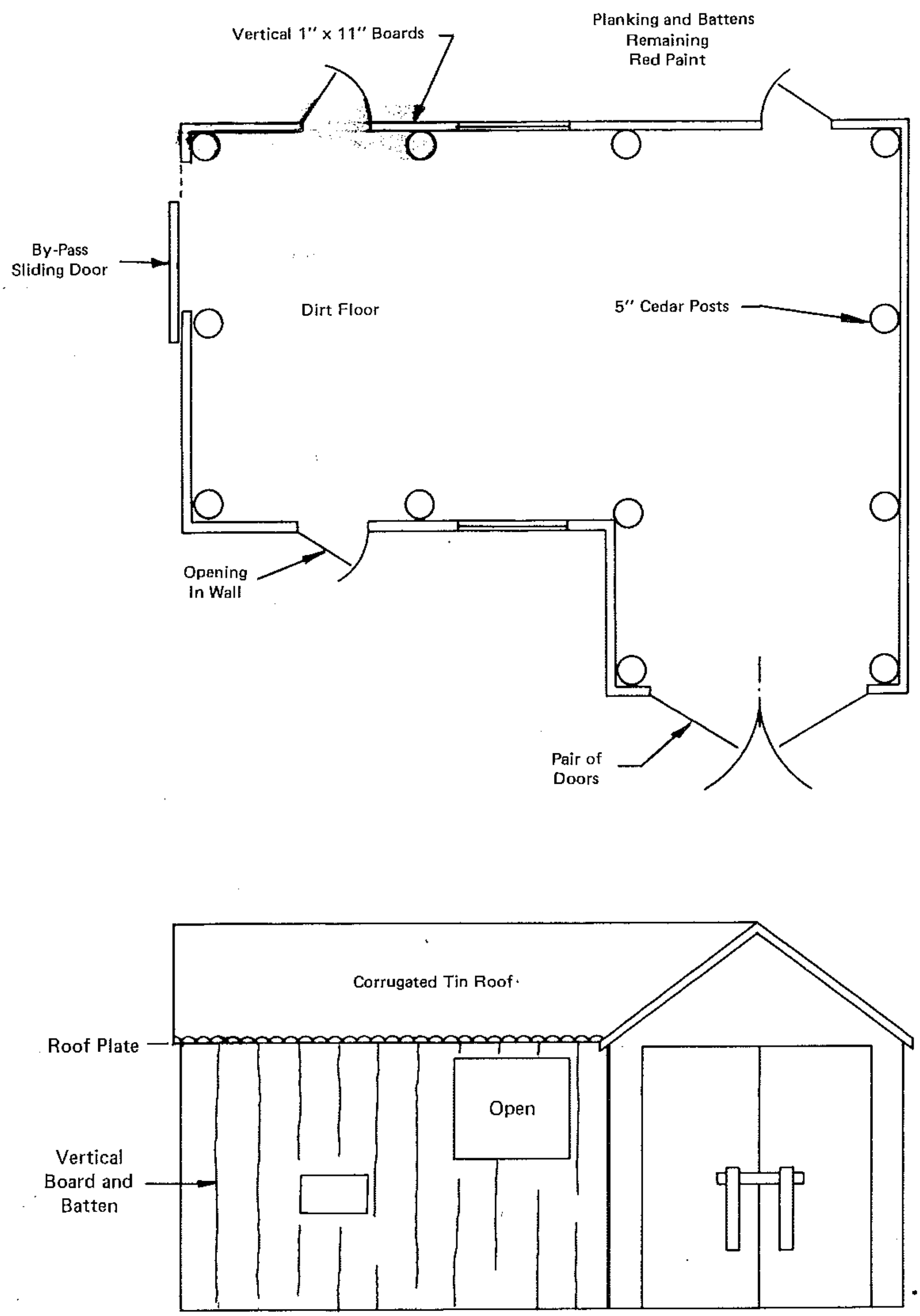
LOG CABIN FOUNDATION



Scale 1/4" = 1'

Figure 6-11 Floor Plan of Log Cabin

WORKSHOP

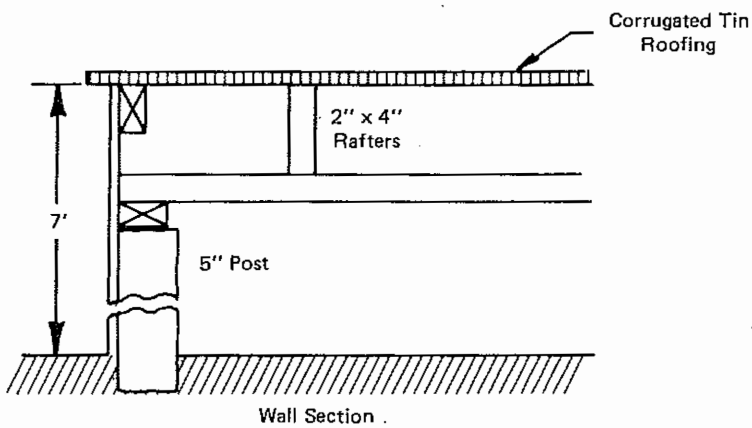


SOUTH ELEVATION

Scale 1/4" = 1'

Figure 6-12 Floor Plan and Elevation of Workshop

WORKSHOP
WALL SECTION

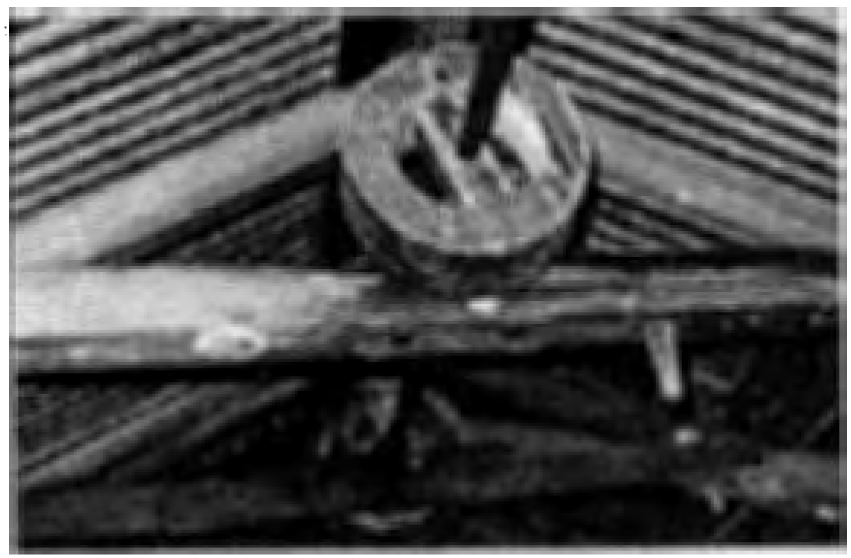


Scale 1/4" = 4"

Figure 6-13 Interior Construction of Workshop

(a) North View

(b) South View



(c) Belt/Pulley System

Figure 6-14 Views of Workshop

Farther east, beyond the workshop and immediate homestead building cluster, a blacksmith shop was constructed. Here utilitarian hardware was made, farm machinery repaired, and farm animals shod. On the east wall, a forge was built, formed primarily of sun-dried bricks, except for those directly lining the fire-box and chimney, and framed with wood beams. South of the blacksmith shop was a stone-lined well, which has since been filled, but not before the stones were removed.

The only other outbuilding on the property is a three-stall garage of pole construction with a corrugated metal roof. This structure was built subsequent to the development of Wald Road and is adjacent to the new driveway entrance of the homestead.

Test Excavations at the Homestead

Two locations within the homestead were chosen for limited test excavations with the intent of clarifying the use or function of particular structures. The first location was adjacent to the log cabin, the second within the blacksmith shop.

In an area adjacent to the window of the log cabin, a test pit was excavated. An extremely hard, packed humus existed over the entire one-meter square. Only troweling was possible, and this was limited to a depth of five centimeters. Below this level, cultural materials diminished significantly. The most diagnostic artifacts included stoneware from household china, bone sections, bottle fragments, both cut and wire nails, and many fragments of window glass. These materials indicate the customary activities associated with a household. There is also the suggestion of the smokehouse function from the distribution of ash on the house floor (Figure 6-11). It is also interesting to note that chert was brought in for the log cabin floor. This material must have been derived from an Indian quarry area, as it contains several pieces of flint from tool production efforts. (A list of materials recovered is included in Appendix B).

The blacksmith shop was the second area investigated (see Figures 6-15 and 6-16). A surface collection was made of the immediate area surrounding the test pit. The test pit was located next to a board still in place in the ground, which later analysis disclosed was part of the

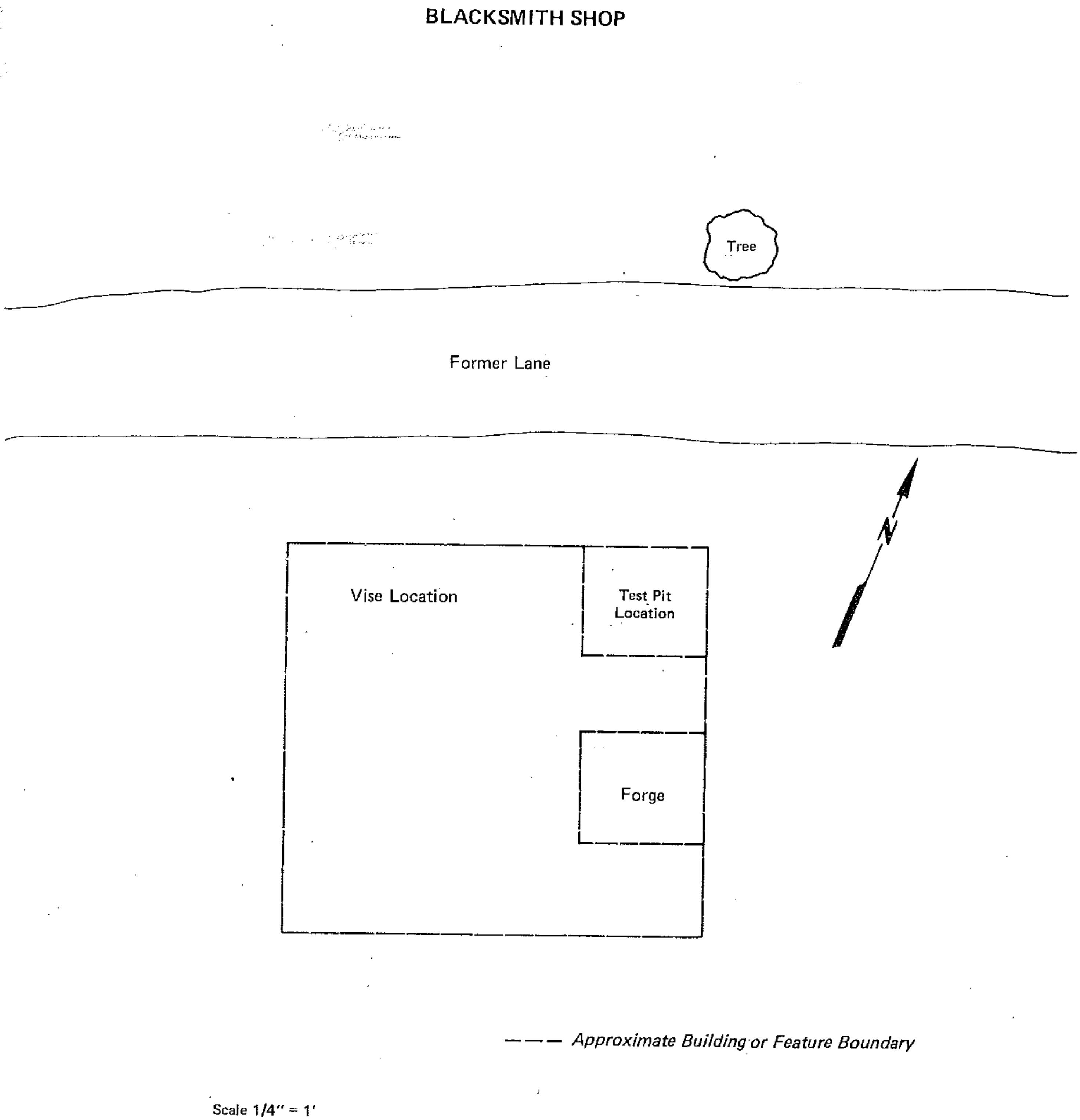


Figure 6-15 Approximate Plan of Blacksmith Shop

(a) South View - Blacksmith Shop Location

(b) East View Down Former Lane Past Blacksmith Shop

(c) Water Tank Foundation

(d) Well East of Main House

Figure 6-16 Views of Blacksmith Shop

forge. The soil here was almost as compacted as that in the test pit previously dug, but contained many fragments of coal - total depth did not exceed eight centimeters. Both machine-made and handmade items were found. Portions of iron bar stock (up to six inches in length) were found on the surface and included fragments of iron tools produced by machine. Small items like rings and hinges were found both on and below the surface; these items were hand wrought. Mixed with the hand wrought material were more common industrial items, such as washers, wire, rivets, and bolts. As for farrier activities, it appears that both horses and ponies received new shoes at the shop. Thus, the blacksmith shop appears to have been a multifaceted work location where all types of metal repair were performed.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Prehistoric Resources

7.1.1 Comal County

Two additional areas on the Comal County property were identified as containing limited amounts of prehistoric material. One of these areas, Location A, Zone IX, is on a section of the property that will be developed for the cement plant. The other area, Location A, Zone III, is situated on a lower section of the Feick homestead that is a buffer zone property for the plant site.

During the reconaissance and intensive surveys, several areas on the Comal County property were found to contain certain prehistoric materials. These recovered materials indicate periodic use of specific localities as sites of tool manufacture and possible transient occupation. Since the density of materials on the section of the property that would experience direct impact by the cement plant construction do not constitute long-term occupation or extensive use of local resources, the following recommendation is made.

The Texas Historical Commission should be informed of the construction schedule and be offered the opportunity to observe the site preparation activities. The Commission should be allowed to collect any additional materials that may be uncovered by construction.

7.1.2 Guadalupe County

No further prehistoric resources were located by the intensive survey in Guadalupe County. Since the earlier work disclosed limited materials that warranted no further recovery work, there will therefore be no direct or indirect impacts on prehistoric resources on the GPI properties in Guadalupe County.

7.2 Historic Resources

7.2.1 Comal County

The supplementary research on the Feick homestead examined the family history of ownership and provided detailed description of the homestead's structures, including their uses. As the homestead of an early settler to the area, the Feick property documents the development of a family farm typical of the New Braunfels region. The homestead is located on a portion of the GPI properties that will not be developed but will be part of a buffer zone area. The main house will continue to be maintained, and therefore neither the house nor the rest of the property will be affected by the development of the cement plant on other GPI property in Comal County.

7.2.2 Guadalupe County

The supplementary survey disclosed no further historic resources on the GPI Guadalupe County property. Because the initial survey work similarly found no historic resources in this area, no impacts on historic resources will result from the development of mining operations in Guadalupe County.

REFERENCES

Brandes, R. J. and H. O. Andrews 1977. Data Report for the Lake Dunlap Eutrophication Study. Water Resources Engineers Inc., Austin, TX.

Hass, O. 1961. **New Braunfels, TX.**

Hester, T. R. (ed.) 1976. The Texas Archaic: A Symposium. Center for Archeological Research, The University of Texas at San Antonio. Special Report No. 2.

Hester, Thomas R., F. Bass, Jr., and T. C. Kelly 1975. Archaeological Survey of Portions of the Comal River Watershed, Comal County, Texas. Archaeological Survey Report. 6. Center for Archaeological Research, The University of Texas at San Antonio.

Johnson, LeRoy, Jr., D. A. Suhm and C. Tunnell 1962. Salvage Archeology of Canyon Reservoir: The Wunderlich, Footbridge and Oblate Sites. Texas Memorial Museum Bulletin 5.

Kelly, T. C. and T. R. Hester 1975. Additional Archeological Survey in the Dry Comal Watershed Comal County. Archeological Survey Report. 10. South Central Texas Center for Archeological Research, Univ. of Texas, San Antonio.

______ 1976a. Archeological Investigations at Four Sites in the Dry Comal Watershed, Comal County. Archeological Survey Report. 15. South Central Texas Center for Archeological Research University of Texas, San Antonio.

______ 1976b. The McQueeny Municipal Utility District Project: An Archeological Reconnaissaince. Archeological Survey Report. 19. Center for Archeological Research Univ. of Texas, San Antonio.

Rawson, G. 1932. New Braunfels, A Story of Triumph. New Braunfels: Zeitung Publishing Co., Texas.

Shafer, H. J. undated. Archeological Survey of the Blieder's Creek Reservoir. Unpublished manuscript on file at the Texas Archeological Survey, University of Texas, Austin.

Stephenson, R. L. 1951. A Preliminary Survey of Canyon Reservoir, Comal County, Texas. Mineographed Report of the River Basin Surveys, Smithsonian Institution, Austin Office.

Suhm, P. E. and E. B. Jelks 1962. Handbook of Texas Archeology: Type Descriptions. Texas Archeological Society and Texas Memorial Museum, Austin.

Texas State Historical Association 1952. The Handbook of Texas (Vol. 1 and 2), Austin.

Texas Natural Resources Reporter 1977. RPC Services, Austin Texas.

APPENDIX A

PHOTOGRAPHIC INVENTORY OF GENERAL PORTLAND PROPERTIES IN COMAL AND GUADALUPE COUNTIES

803323

Trailer Opposite Feick Homestead

East View from Feick Homestead

Needmore Farms

Figure 1 Wald Road Residences (Comal County)

ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.

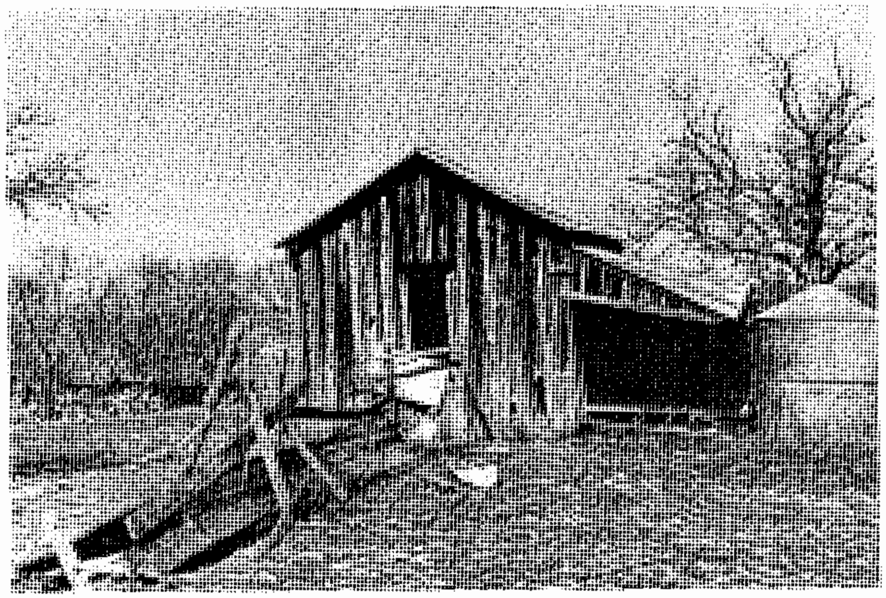


Figure 2A   Abandoned Farmhouse (Guadalupe County)

Figure 2B   Boecker Cemetery (Guadalupe County)

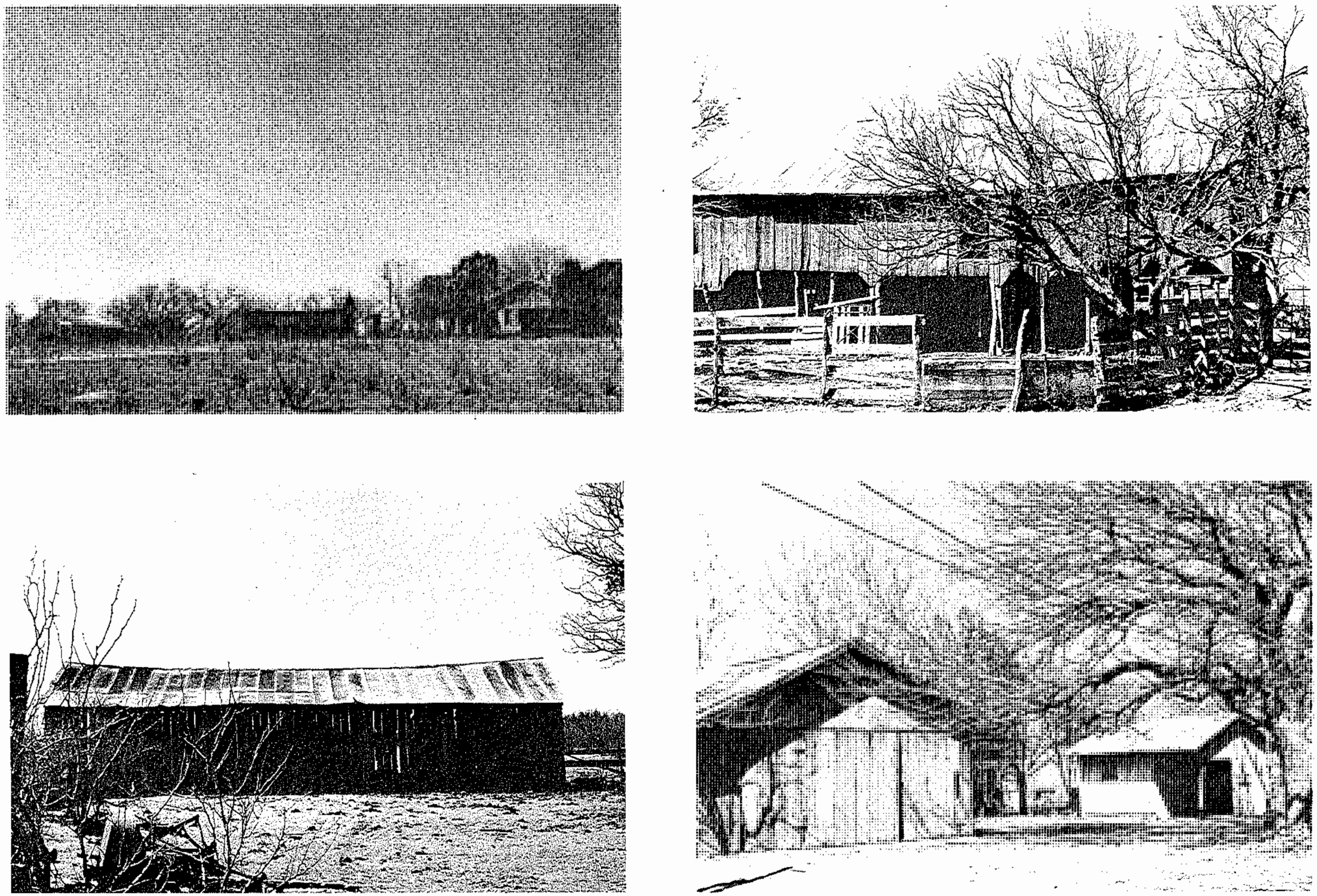


Figure 3   Boecker Homestead (Guadalupe County)

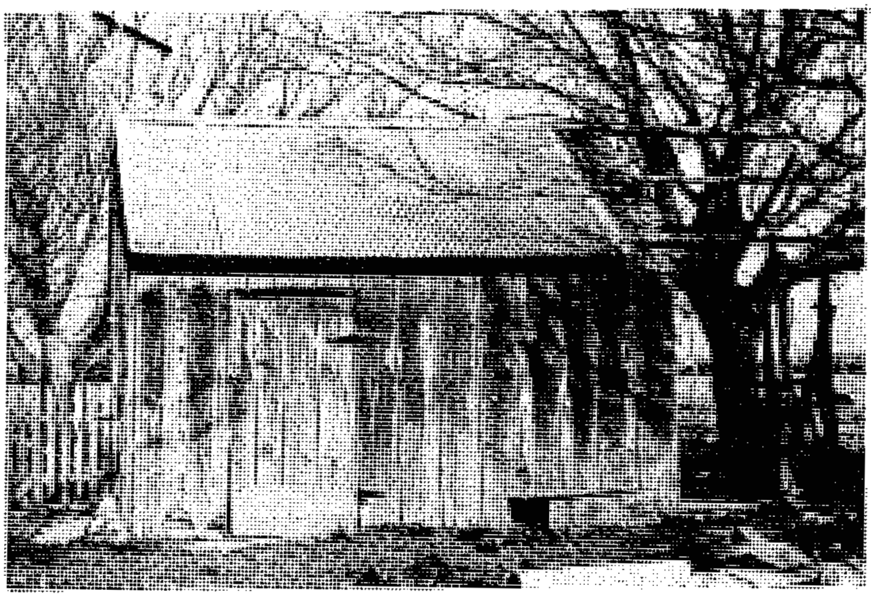


Figure 4   Original Feick House

APPENDIX B

INVENTORY OF ARTIFACTS FROM ARCHEOLOGICAL SURVEY IN COMAL AND GUADALUPE COUNTIES

APPENDIX B

INVENTORY OF ARTIFACTS ON GPI PROPERTY - COMAL AND GUADALUPE COUNTY

This appendix lists by zone the types and quantity of materials found on the GPI properties in Comal and Guadalupe Counties

Zone I

Location A

- Primary Flakes - 2
- Secondary Flakes - 18
- Thin Biface - 2
- Core - 1
- Gauge - 1 (Clear Fork)
- Core (Blanks - 5)

Location B

- Primary Flakes - 2
- Secondary Flakes - 3

Location C

- Large Bifaces - 2*
- Cores - 2*

Open Field Southwest of Location A

- Secondary Flakes - 7
- Thick Biface - 5
- Thin Biface - 4
- Core - 2
- Pedernales Point fragment

*One not in collection

Zone II

Thick Biface - 2

Primary Flakes - 1

Secondary Flakes - 4

Thin Biface - 1

Zone III

Secondary Flakes - 5

Thin Biface - 1

Thick Biface - 1

Guadalupe County

Zone IV

Primary Flakes - 1

Secondary Flakes - 9

Thick Biface - 5

Thin Biface - 4

Gouge - fragment

Core - 1

Archaic Point - fragment

Zone IV - Other Locations

East Fence Line

Secondary Flakes - 1

Thick Bifaces - 3

Location D

Secondary Flakes - 3

Thick Bifaces - 2

Bifacial Chopper - 1

Location E

Secondary Flakes - 7

Thick Biface - 1

Location F

Primary Flakes - 1

Secondary Flakes - 5

Thin Biface - 1

Core - 1

Zone VI

Location G

Core - 1

Thick Biface - 2

Location H

Thick Bifaces - 2

Zone VII

Thick Biface - 1

APPENDIX B

PHASE II SURVEY ARTIFACTS

Prehistoric Resources

Zone IX - North of Wald Road

8	cores
2	primary flakes
16	secondary flakes
8	small bifacial tools (1 of limestone)
1*	large bifacial tool
1	sherd stoneware pottery

Zone IX/Zone I Border

4	secondary flakes
1	small bifacial tool

Zone II

1	large secondary flake (from lower portion of field near creek)

Zone III - Lower Feick Field

2	cores
22	secondary flakes
3	small bifacial tools
1	shell (fiber tempered pottery fragment)

Zone X

1	small bifacial tool fragment

Zone XI

3	cores

Note: All materials are of chert unless otherwise indicated.

*Two large cores and one large biface not in collection.

Historic Resources

Feick Homestead - Log Cabin Test Pit

4	chert flakes (3 primary, 1 secondary)
1	fire-cracked rock fragment
3	flat iron fragments
2	bone fragments
3	fragments white glazed stoneware, hand painted
1	fragment yellow stoneware
3	fragments bottle glass
1	snail shell
5	cut nails (four 1-1/2", one 2")
2	wire nails (one soft iron)
35	fragments window glass
	iron carriage pole connector (hand wrought)
	miscellaneous limestone fragments

Feick Homestead - Log Cabin Surface Collection of Foundation

3	stoneware sherds (burnt), one yellow lead glaze, one grey salt glazed, one buff
1	fragment white glass
1	"22-long" caliber shell

Feick Homestead - Blacksmith Shop Surface Collection

1	plow scrapper (hand wrought)
5	fragments of hinges or clasps (hand wrought)
1	iron carriage pole connector (hand wrought)
1	pony shoe (2-1/2" width)
	miscellaneous fragments of bar iron parts

Feick Homestead - Blacksmith Shop Test Pit

1	horseshoe - 7" width
1	pony shoe - 2-1/2" width
1	straight razor blade

4 hooks/latches - various diameters

5 rings or strap guides

1 ring and loop connecter

9 fragments of flat and round iron stock

4 machine-made bolts

1 fragment brown glass

miscellaneous contemporary metal fragments including washers, wire, rivets, pulley, screw, bolts

wood fragments

coal fragments

APPENDIX C

COPY OF DEED TO FEICK LAND GRANT

NO. 55992 - WARRANTY DEED. GERMAN EMIGRATION COMPANY TO CASPAR FEICK.

The State of Texas
County Comal

Know all men by these presents that I, Herman Spiess acting as trustee of the German Emigration Company for and in consideration that Mr. Caspar Feick is an emigrant under contract of the Company aforesaid and for the Grant on the waters of the Llano and San Saba have granted, bargained, sold released and conveyed and by these presents do grant, bargain, sell, release and convey unto him Mr. Caspar Feick his heirs and assigns all and singular the right, title interest, claim and demand of the German Emigration Company in and to all that certain lot or parcel of land, situated, lying and being near the city of New Braunfels County Comal and designated in the map of said city of New Braunfels according to the list of the outlots as No. one hundred and thirty eight (138) containing about fifteen acres (15 acres) of land and bounded as follows: Beginning at a stake at the left bank of Comal Creek from which an Elmtree 12" diam mkd I bears S21½°E 7 yards dist. and another Elmtree 24" diam mkd K bears N51°E 7 yards dist. thence S71°45' W 1134' to a stake from which an Elm bears S10 W 22'. thence N18°E 586' to a stake from which an Elmtree mkd K bears N25°40'E 44'; thence S17°45' E 1134 to a stake on the Comal Creek thence up said Creek with its meanders to the place of beginning." as it will more fully appear by reference to the plot hereby annexed, together with all and singular the rights, members hereditaments and appurtenances to the same

belonging

belonging, to have and to hold all and singular the said lot or parcel of land and premises unto him the said Mr Caspar Feick his heirs and assigns forever.

And I the said Hermann Spiess acting as trustee of the German Emigration Company bind myself my successors and constituents to warrant and forever defend all and singular the said lot or parcel of land and premises unto him the said Mr Caspar Feick, his heirs and assigns against the claim or claims of all and every person or persons whomsoever claiming or to claim the same or any part thereof by through or under me my successors and constituents

In witness whereof I have hereunto set my hand and official seal this the 16th day of April AD 1849

Signed sealed and delivered
in presence of witnesses

H. Wilke
Substitute for L. Martin, trustee of the German Emigration Comp. and successor to H. Spiess

[illegible signatures]

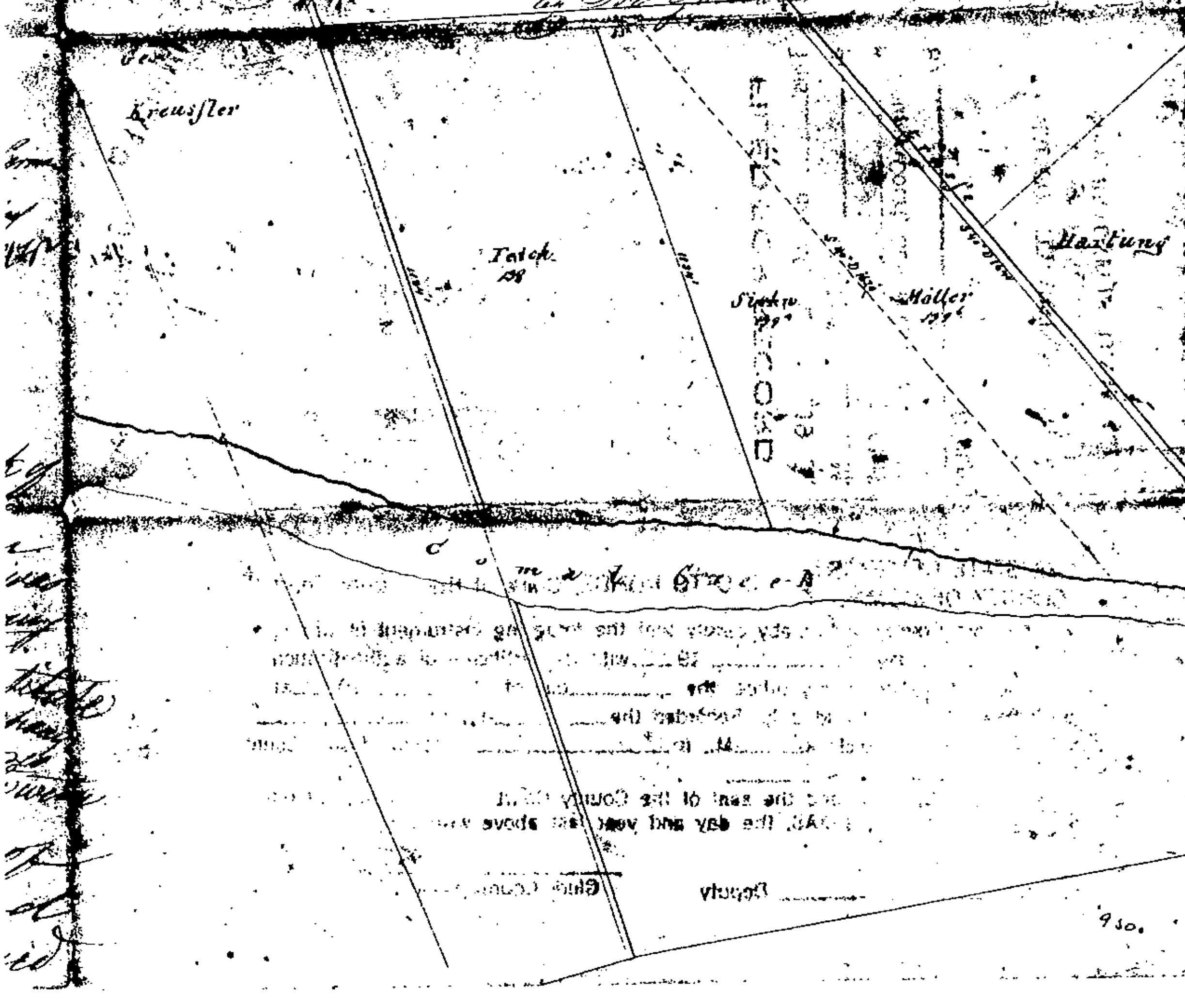
The State of Texas } Before me the undersigned Clerk of
County of Comal } said County Court this day personally appeared Johann Rennsteper to me well known who on oath solemnly deposed and said that he was present at the signing and sealing of the foregoing and within deed and instrument of writing to C. Caspar Feick and saw Hermann Wilke substitute for L. Martin trustee of the German Emigration Company sign the same for the consideration and purposes therein set forth and that he deponent signed as one of the witnesses.

In testimony whereof I hereto set my hand and

and affix the seal of said County Court at New Braunfels November the 21st A.D. 1853.

C. Seabaugh
Clk C Court
Comal County

The State of Texas } I do hereby certify that the
County of Comal } within Instrument of writing is
filed for Record on the 21st day of November 1853 at 12 m.
and is duly recorded in the Records of said County
book D Deeds page 90 & 91 the same day & date.
Witness my hand & the seal of said
County Court at New Braunfels Nov. 21st
1853. C. Seabaugh Clk C. C. Comal Co.
by Th. Goldbeck Depty



APPENDIX D

LITHIC ASSEMBLAGE FROM LOCAL COLLECTION IN VICINITY OF FEICK HOMESTEAD FIELDS ALONG DRY COMAL CREEK

APPENDIX D:

Copies of References Cited

At the request of the US Environmental Protection Agency (EPA), copies of references cited in this report are provided on the CD-ROM attached to the inner back cover of this report.

PREVENTION OF SIGNIFICANT DETERIORATION GREENHOUSE GAS PERMIT APPLICATION FOR A CLINKER PRODUCTION INCREASE AT THE CEMEX CONSTRUCTION MATERIALS SOUTH LLC BALCONES CEMENT PLANT COMAL COUNTY, TEXAS

SUBMITTED TO:

ENVIRONMENTAL PROTECTION AGENCY
REGION VI
MULTIMEDIA PLANNING AND PERMITTING DIVISION
FOUNTAIN PLACE 12TH FLOOR, SUITE 1200
1445 ROSS AVENUE
DALLAS, TEXAS 75202-2733

SUBMITTED BY:

ZEPHYR ENVIRONMENTAL CORPORATION
2600 VIA FORTUNA, SUITE 450
AUSTIN, TEXAS 78746

PREPARED BY:

ZEPHYR ENVIRONMENTAL CORPORATION
2600 VIA FORTUNA, SUITE 450
AUSTIN, TEXAS 78746

REVISED AUGUST 2013

zephyr

TABLE OF CONTENTS

1.0 INTRODUCTION 1
FORM PI-1 GENERAL APPLICATION 3
2.0 PROJECT SCOPE 13
2.1 Introduction 13
2.2 Kiln No. 2 Production Increase 13
2.3 Upgrades to Kiln 1 and 2 Burners 13
PLOT PLAN 15
AREA MAP 16
KILN 1 PROCESS FLOW DIAGRAM 17
KILN 2 PROCESS FLOW DIAGRAM 18
3.0 GHG EMISSION CALCULATIONS 19
3.1 GHG Emissions From Cement Kilns 19
4.0 PREVENTION OF SIGNIFICANT DETERIORATION APPLICABILITY 23
TCEQ PSD NETTING TABLES 24
5.0 BEST AVAILABLE CONTROL TECHNOLOGY (BACT) 27
5.1 BACT for the Kilns 28
5.1.1 Step 1: Identify All Available Control Technologies 28
5.1.2 Step 2: Eliminate Technically Infeasible Options 35
5.1.3 Step 3: Rank Remaining Control Technologies 38
5.1.4 Step 4: Evaluate Most Effective Controls and Document Results 38
5.1.5 Step 5: Select BACT 40
MAP OF EXISTING CO2 PIPELINES AND POTENTIAL GEOLOGIC STORAGE SITES IN TEXAS 43
6.0 OTHER PSD REQUIREMENTS 44
6.1 Impacts Analysis 44
6.2 GHG Preconstruction Monitoring 44
6.3 Additional Impacts Analysis 44
7.0 PROPOSED GHG MONITORING PROVISIONS 46

APPENDICES

APPENDIX A: GHG PSD APPLICABILITY FLOWCHART – EXISTING SOURCES

1.0 INTRODUCTION

Cemex Construction Materials South, LLC (CEMEX) owns and operates a cement production plant in New Braunfels, Comal County, Texas. Air emissions generated at the Balcones Plant are authorized via multiple Texas Commission on Environmental Quality (TCEQ) Air Permits, permit by rule authorizations, and standard permit authorizations. The cement kilns (Kiln No. 1 and 2) and material handling emissions that are affected by this amendment are authorized under Air Permit No. 6048. The State and PSD air permit application for non-GHG pollutants was submitted previously to the TCEQ.

CEMEX is submitting this air permit amendment application for Air Permit No 6048 to authorize an increase in Kiln No. 2 clinker production. Kiln No. 2 is currently limited to 3,600 tons clinker per day (30-day average). CEMEX is proposing a 10% increase in the Kiln No. 2 production to 3,960 tons of clinker per day (30-day average). Kiln No. 2 began initial operation in 2008 and based on operational experience CEMEX believes the kiln can achieve higher production levels than what was originally estimated and permitted. The production increase does not require any physical changes to the kiln system.

CEMEX is also submitting this air permit amendment application to authorize upgrades to the main kiln burners in Kiln No. 1 and Kiln No. 2 to multipath adjustable units. The upgrades consist of adding a channel to allow the use of currently authorized alternative fuels as Biomass and Refuse Derived Fuel in the main kiln burners. The burner upgrades will not increase the maximum fuel firing rate for either kiln but will increase flexibility in the amount and kind of fuels that can be burned in the main kiln.

On June 3, 2010, the EPA published final rules for permitting sources of Greenhouse Gases (GHGs) under the prevention of significant deterioration (PSD) and Title V air permitting programs, known as the GHG Tailoring Rule.[1] After July 1, 2011, new sources emitting more than 100,000 tons/yr of GHGs and modifications increasing GHG emissions more than 75,000 tons/yr at existing major sources are subject to PSD review, regardless of whether PSD was triggered for other pollutants. Facilities that emit at least 100,000 tons/yr are subject to Title V permitting requirements.

On December 23, 2010, EPA signed a Federal Implementation Plan (FIP) authorizing EPA to issue PSD permits in Texas for GHG sources until Texas submits the required SIP revision for GHG permitting and it is approved by EPA.[2]

The proposed project increase triggers PSD review for GHG regulated pollutants because the calculated project emissions increase of GHG emissions is greater than 75,000 tons/yr and the site is considered an existing major source. Included in this application are a project scope

[1] 75 FR 31514 (June 3, 2010).

[2] 75 FR 81874 (Dec. 29, 2010).

description, GHG emissions calculations, GHG netting analysis, and a GHG Best Available Control Technology (BACT) analysis.

FORM PI-1
GENERAL APPLICATION

Texas Commission on Environmental Quality
Form PI-1 General Application for Air Preconstruction Permit and Amendment

TCEQ

Important Note: The agency **requires** that a Core Data Form be submitted on all incoming applications unless a Regulated Entity and Customer Reference Number have been issued *and* no core data information has changed. For more information regarding the Core Data Form, call (512) 239-5175 or go to www.tceq.texas.gov/permitting/central_registry/guidance.html.

I. Applicant Information		
A. Company or Other Legal Name: CEMEX Construction Materials South, LLC		
Texas Secretary of State Charter/Registration Number (*if applicable*):		
B. Company Official Contact Name: Jimmy Rabon		
Title: Plant Manager		
Mailing Address: 2580 Wald Road		
City: New Braunfels	State: Texas	ZIP Code: 78132
Telephone No.: 210-250-4097	Fax No.: 210-250-4144	E-mail Address: jimmy.rabon@cemex.com
C. Technical Contact Name: Kim Bradley		
Title: Environmental Manager		
Company Name: CEMEX Construction Materials South, LLC		
Mailing Address: 2580 Wald Road		
City: New Braunfels	State: Texas	ZIP Code: 78132
Telephone No.: 210-250-4009	Fax No.: 210-250-4144	E-mail Address: kimberlyb.bradley@cemex.com
D. Site Name: CEMEX - Balcones Cement Plant		
E. Area Name/Type of Facility:		☑ Permanent ☐ Portable
F. Principal Company Product or Business: cement		
Principal Standard Industrial Classification Code (SIC): 3241		
Principal North American Industry Classification System (NAICS):		
G. Projected Start of Construction Date: 6/1/2012		
Projected Start of Operation Date: 6/1/2012		
H. Facility and Site Location Information (If no street address, provide clear driving directions to the site in writing.):		
Street Address: 2580 Wald Road		
City/Town: New Braunfels	County: Comal	ZIP Code: 78132
Latitude (nearest second): 29 40' 22"	Longitude (nearest second): 98 10' 56"	

I. Applicant Information (continued)	
I. Account Identification Number (leave blank if new site or facility): CS-0022-K	
J. Core Data Form.	
Is the Core Data Form (Form 10400) attached? If *No*, provide customer reference number and regulated entity number (complete K and L).	☐ YES ☑ NO
K. Customer Reference Number (CN): CN603403973	
L. Regulated Entity Number (RN): RN102605375	
II. General Information	
A. Is confidential information submitted with this application? If *Yes*, mark each **confidential** page **confidential** in large red letters at the bottom of each page.	☐ YES ☑ NO
B. Is this application in response to an investigation or enforcement action? If *Yes*, attach a copy of any correspondence from the agency.	☐ YES ☑ NO
C. Number of New Jobs: 0	
D. Provide the name of the State Senator and State Representative and district numbers for this facility site:	
Senator: Hon. Jeff Wentworth,	District No.: 25
Representative: Hon. Doug Miller	District No.: 73
III. Type of Permit Action Requested	
A. Mark the appropriate box indicating what type of action is requested. Initial ☐ Amendment ☑ Revision (30 TAC 116.116(e)) ☐ Change of Location ☐ Relocation ☐	
B. Permit Number (if existing): 6048	
C. Permit Type: Mark the appropriate box indicating what type of permit is requested. *(check all that apply, skip for change of location)* Construction ☑ Flexible ☐ Multiple Plant ☐ Nonattainment ☐ Prevention of Significant Deterioration ☑ Hazardous Air Pollutant Major Source ☐ Plant-Wide Applicability Limit ☐ Other:__________	
D. Is a permit renewal application being submitted in conjunction with this amendment in accordance with 30 TAC 116.315(c).	☐ YES ☑ NO

III. Type of Permit Action Requested (continued)		
E. Is this application for a change of location of previously permitted facilities? If Yes, complete III.E.1 - III.E.4.		☐ YES ☑ NO
1. Current Location of Facility (If no street address, provide clear driving directions to the site in writing.):		
Street Address:		
City:	County:	ZIP Code:
2. Proposed Location of Facility (If no street address, provide clear driving directions to the site in writing.):		
Street Address:		
City:	County:	ZIP Code:
3. Will the proposed facility, site, and plot plan meet all current technical requirements of the permit special conditions? If *No*, attach detailed information.		☐ YES ☐ NO
4. Is the site where the facility is moving considered a major source of criteria pollutants or HAPs?		☐ YES ☐ NO
F. Consolidation into this Permit: List any standard permits, exemptions or permits by rule to be consolidated into this permit including those for planned maintenance, startup, and shutdown.		
List: none		
G. Are you permitting planned maintenance, startup, and shutdown emissions? If *Yes*, attach information on any changes to emissions under this application as specified in VII and VIII.		☐ YES ☑ NO
H. Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability)		
Is this facility located at a site required to obtain a federal operating permit? If *Yes*, list all associated permit number(s), attach pages as needed).		☑ YES ☐ NO ☐ To be determined
Associated Permit No (s.): O-1126		
1. Identify the requirements of 30 TAC Chapter 122 that will be triggered if this application is approved. FOP Significant Revision ☐ FOP Minor ☐ Application for an FOP Revision ☐ To Be Determined ☐ Operational Flexibility/Off-Permit Notification ☐ Streamlined Revision for GOP ☐ None ☑		

III. Type of Permit Action Requested (continued)	
H. Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability) *(continued)*	
2. Identify the type(s) of FOP(s) issued and/or FOP application(s) submitted/pending for the site. (check all that apply)	
GOP Issued ☐	GOP application/revision application: submitted or under APD review ☐
SOP Issued ☑	SOP application/revision application submitted or under APD review ☑

IV. Public Notice Applicability	
A. Is this a new permit application or a change of location application?	☐ YES ☑ NO
B. Is this application for a concrete batch plant? If Yes, complete V.C.1 – V.C.2.	☐ YES ☑ NO
C. Is this an application for a major modification of a PSD, nonattainment, FCAA 112(g) permit, or exceedance of a PAL permit?	☐ YES ☐ NO
D. Is this application for a PSD or major modification of a PSD located within 100 kilometers of an affected state?	☐ YES ☐ NO
If *Yes*, list the affected state(s).	
E. Is this a state permit amendment application? If Yes, complete IV.E.1. – IV.E.3.	
1. Is there any change in character of emissions in this application?	☐ YES ☑ NO
2. Is there a new air contaminant in this application?	☐ YES ☑ NO
3. Do the facilities handle, load, unload, dry, manufacture, or process grain, seed, legumes, or vegetables fibers (agricultural facilities)?	☐ YES ☑ NO
F. List the total annual emission increases associated with the application (*list* **all** *that apply and attach additional sheets as needed*):	
Volatile Organic Compounds (VOC): 0	
Sulfur Dioxide (SO_2): 0	
Carbon Monoxide (CO): 0	
Nitrogen Oxides (NO_x): 0	
Particulate Matter (PM): 4.69	
PM $_{10}$ microns or less (PM_{10}): 2.32	
PM $_{2.5}$ microns or less ($PM_{2.5}$): 0.89	
Lead (Pb):	
Hazardous Air Pollutants (HAPs):	
Other speciated air contaminants **not** listed above:	

V. Public Notice Information (complete if applicable)		
A. Public Notice Contact Name: Kim Bradley		
Title: Environmental Manager		
Mailing Address: 2580 Wald Road		
City: New Braunfels	State: Texas	ZIP Code: 78132
B. Name of the Public Place: New Braunfels Public Library		
Physical Address (No P.O. Boxes): 700 East Common St.		
City: New Braunfels	County: Comal	ZIP Code: 78130
The public place has granted authorization to place the application for public viewing and copying.		☑ YES ☐ NO
The public place has internet access available for the public.		☑ YES ☐ NO
C. Concrete Batch Plants, PSD, and Nonattainment Permits		
1. County Judge Information (For Concrete Batch Plants and PSD and/or Nonattainment Permits) for this facility site.		
The Honorable: Sherman Krause		
Mailing Address: 150 N. Seguin Ave		
City: New Braunfels	State: Texas	ZIP Code: 78130
2. Is the facility located in a municipality or an extraterritorial jurisdiction of a municipality? *(For Concrete Batch Plants)*		☐ YES ☐ NO
Presiding Officers Name(s):		
Title:		
Mailing Address:		
City:	State:	ZIP Code:
3. Provide the name, mailing address of the chief executives of the city and county, Federal Land Manager, or Indian Governing Body for the location where the facility is or will be located.		
Chief Executive:		
Mailing Address:		
City:	State:	ZIP Code:
Name of the Federal Land Manager:		
Title:		
Mailing Address:		
City:	State:	ZIP Code:

V. Public Notice Information (complete if applicable) (continued)			
3. Provide the name, mailing address of the chief executives of the city and county, State, Federal Land Manager, or Indian Governing Body for the location where the facility is or will be located. *(continued)*			
Name of the Indian Governing Body:			
Title:			
Mailing Address:			
City:	State:	ZIP Code:	
D. Bilingual Notice			
Is a bilingual program **required** by the Texas Education Code in the School District?			☑ YES ☐ NO
Are the children who attend either the elementary school or the middle school closest to your facility eligible to be enrolled in a bilingual program provided by the district?			☑ YES ☐ NO
If *Yes*, list which languages are required by the bilingual program? Spanish			
VI. Small Business Classification (Required)			
A. Does this company (including parent companies and subsidiary companies) have fewer than 100 employees or less than $6 million in annual gross receipts?			☐ YES ☑ NO
B. Is the site a major stationary source for federal air quality permitting?			☑ YES ☐ NO
C. Are the site emissions of any regulated air pollutant greater than or equal to 50 tpy?			☑ YES ☐ NO
D. Are the site emissions of all regulated air pollutants combined less than 75 tpy?			☑ YES ☐ NO
VII. Technical Information			
A. The following information must be submitted with your Form PI-1 (this is just a checklist to make sure you have included everything)			
1. Current Area Map ☑			
2. Plot Plan ☑			
3. Existing Authorizations ☑			
4. Process Flow Diagram ☐ Process unchanged from previous submittal			
5. Process Description ☑			
6. Maximum Emissions Data and Calculations ☑			
7. Air Permit Application Tables ☑			
a. Table 1(a) (Form 10153) entitled, Emission Point Summary ☑			
b. Table 2 (Form 10155) entitled, Material Balance ☑			
c. Other equipment, process or control device tables ☐ No new equipment with applicable tables.			

VII. Technical Information				
B. Are any schools located within 3,000 feet of this facility?				☐ YES ☑ NO
C. Maximum Operating Schedule:				
Hours: 24	Day(s): 7	Week(s): 52	Year(s):	
Seasonal Operation? If Yes, please describe in the space provide below.				☐ YES ☑ NO
D. Have the planned MSS emissions been previously submitted as part of an emissions inventory?				☐ YES ☑ NO
Provide a list of each planned MSS facility or related activity and indicate which years the MSS activities have been included in the emissions inventories. Attach pages as needed.				
E. Does this application involve any air contaminants for which a *disaster review* is required?				☐ YES ☑ NO
F. Does this application include a pollutant of concern on the *Air Pollutant Watch List (APWL)*?				☐ YES ☑ NO

VIII. State Regulatory Requirements **Applicants must demonstrate compliance with all applicable state regulations to obtain a permit or amendment**. *The application must contain detailed attachments addressing applicability or non applicability; identify state regulations; show how requirements are met; and include compliance demonstrations.*	
A. Will the emissions from the proposed facility protect public health and welfare, and comply with all rules and regulations of the TCEQ?	☑ YES ☐ NO
B. Will emissions of significant air contaminants from the facility be measured?	☑ YES ☐ NO
C. Is the Best Available Control Technology (BACT) demonstration attached?	☑ YES ☐ NO
D. Will the proposed facilities achieve the performance represented in the permit application as demonstrated through recordkeeping, monitoring, stack testing, or other applicable methods?	☑ YES ☐ NO

IX. Federal Regulatory Requirements **Applicants must demonstrate compliance with all applicable federal regulations to obtain a permit or amendment** *The application must contain detailed attachments addressing applicability or non applicability; identify federal regulation subparts; show how requirements are met; and include compliance demonstrations.*	
A. Does Title 40 Code of Federal Regulations Part 60, (40 CFR Part 60) New Source Performance Standard (NSPS) apply to a facility in this application?	☑ YES ☐ NO
B. Does 40 CFR Part 61, National Emissions Standard for Hazardous Air Pollutants (NESHAP) apply to a facility in this application?	☐ YES ☑ NO
C. Does 40 CFR Part 63, Maximum Achievable Control Technology (MACT) standard apply to a facility in this application?	☑ YES ☐ NO

TCEQ

IX. Federal Regulatory Requirements **Applicants must demonstrate compliance with all applicable federal regulations to obtain a permit or amendment** ***The application must contain detailed attachments addressing applicability or non applicability; identify federal regulation subparts; show how requirements are met; and include compliance demonstrations.***	
D. Do nonattainment permitting requirements apply to this application?	☐ YES ☑ NO
E. Do prevention of significant deterioration permitting requirements apply to this application?	☑ YES ☐ NO
F. Do Hazardous Air Pollutant Major Source [FCAA 112(g)] requirements apply to this application?	☐ YES ☑ NO
G. Is a Plant-wide Applicability Limit permit being requested?	☐ YES ☑ NO
X. Professional Engineer (P.E.) Seal	
Is the estimated capital cost of the project greater than $2 million dollars?	☐ YES ☑ NO
If *Yes*, submit the application under the seal of a Texas licensed P.E.	
XI. Permit Fee Information	
Check, Money Order, Transaction Number ,ePay Voucher Number: Check # 22757	Fee Amount: $ 7,500
Company name on check: Zephyr Environmental Corporation	Paid online?: ☐ YES ☑ NO
Is a copy of the check or money order attached to the original submittal of this application?	☑ YES ☐ NO ☐ N/A
Is a Table 30 (Form 10196) entitled, Estimated Capital Cost and Fee Verification, attached?	☑ YES ☐ NO ☐ N/A

XII. Delinquent Fees and Penalties
This form **will not be processed** until all delinquent fees and/or penalties owed to the TCEQ or the Office of the Attorney General on behalf of the TCEQ is paid in accordance with the Delinquent Fee and Penalty Protocol. For more information regarding Delinquent Fees and Penalties, go to the TCEQ Web site at: www.tceq.texas.gov/agency/delin/index.html.
XIII. Signature
The signature below confirms that I have knowledge of the facts included in this application and that these facts are true and correct to the best of my knowledge and belief. I further state that to the best of my knowledge and belief, the project for which application is made will not in any way violate any provision of the Texas Water Code (TWC), Chapter 7, Texas Clean Air Act (TCAA), as amended, or any of the air quality rules and regulations of the Texas Commission on Environmental Quality or any local governmental ordinance or resolution enacted pursuant to the TCAA I further state that I understand my signature indicates that this application meets all applicable nonattainment, prevention of significant deterioration, or major source of hazardous air pollutant permitting requirements. The signature further signifies awareness that intentionally or knowingly making or causing to be made false material statements or representations in the application is a criminal offense subject to criminal penalties.
Name: Jimmy Rabon
Signature: [signature] *Original Signature Required*
Date: 29 DEC 11

2.0 PROJECT SCOPE

2.1 INTRODUCTION

The CEMEX facility consists of two cement kilns, raw and finish mills, clinker coolers, and ancillary material transfer equipment. The general operation of the kilns is not changing as a result of this amendment.

Raw materials (including limestone, sand, gypsum, and various other materials) are mixed and ground in the raw mills and then fed through a pre-heater or pre-heater/pre-calciner system into a rotary kiln. In the kiln, the pre-heated materials are heated to increasingly higher temperatures as they traverse the length of kiln. The high temperatures create different chemical reactions that transform the raw materials into conglomerated cement known as clinker. The clinker exits the kiln and travels along the clinker cooler until it is cool enough to move to storage or on for further processing. In the finish mills the clinker and additives are ground to create the final cement product.

The fuels coal and coke are ground in the coal/coke mill and can be introduced into the kiln or at the pre-heater or pre-heater/pre-calciner. Alternative fuels and natural gas can be introduced directly into the kiln or at the pre-heater or pre-heater/pre-calciner.

The primary combustion air to the kiln is blown in from the exterior, while secondary combustion air can be supplied from the clinker cooler. Air from the clinker cooler can also be used to dry material in the coal/coke mills. Exhaust gases from fuel combustion in the kiln and pre-heater (or pre-heater/pre-calciner) are used in the raw mill for heating and drying the material and eventually exhausted to atmosphere at the main kiln baghouse (Emission Point Numbers, EPNs, PS-16 and PS-77). Process flow diagrams for Kiln 1 and Kiln 2 are included in this section.

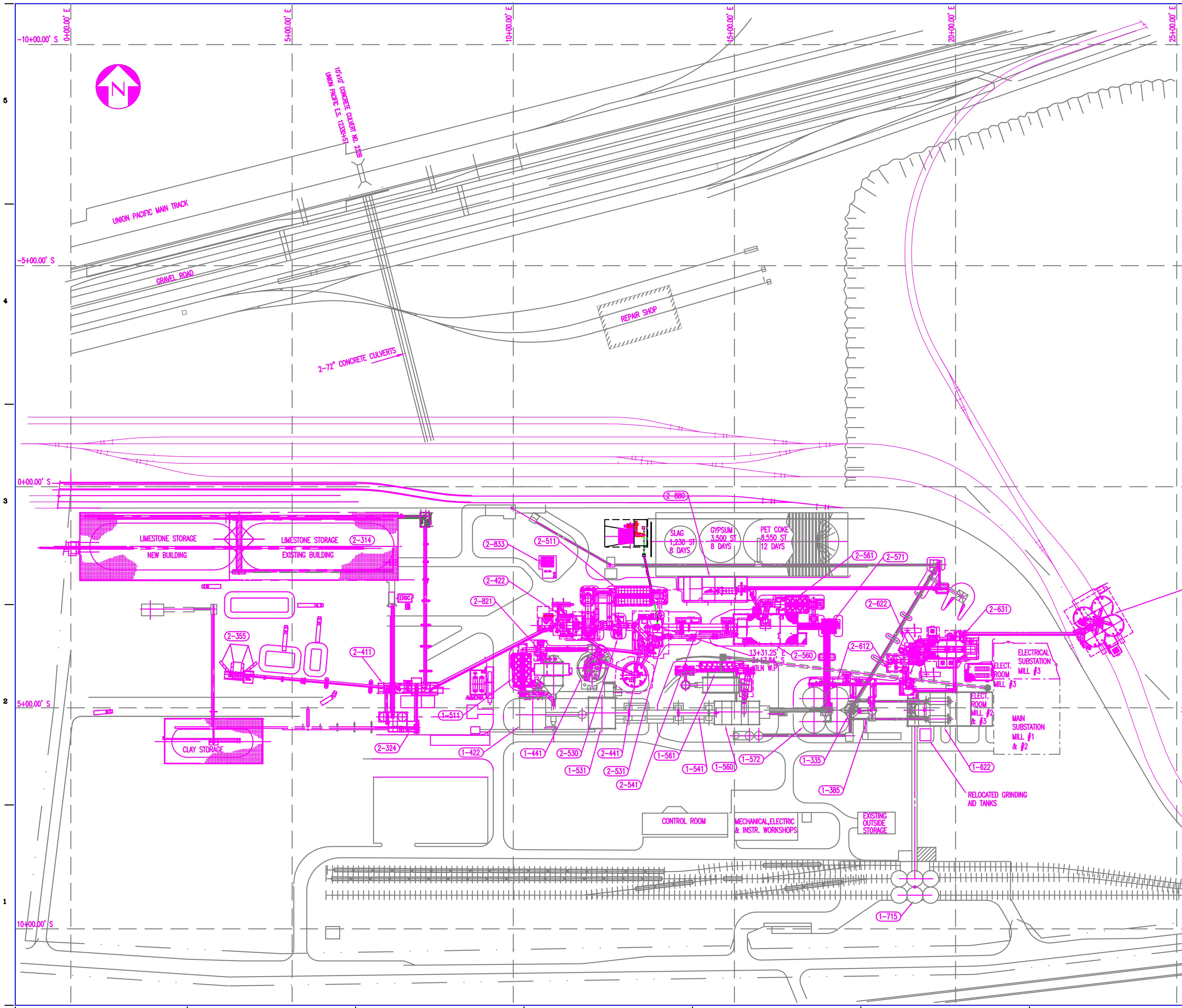
2.2 KILN NO. 2 PRODUCTION INCREASE

The kiln will not require any equipment modifications in order to increase the production to the proposed rate of 3,960 tons of clinker per day (30-day average) and 1,386,000 tons of clinker per year. This kiln has been in operation for less than three years and has demonstrated an ability to reach a higher production capacity than what was originally estimated and permitted.

2.3 UPGRADES TO KILN 1 AND 2 BURNERS

CEMEX is proposing to upgrade the kiln burners to multipath adjustable units. The upgraded burners will allow the kiln operator to react quickly to changing process conditions. Advantages of the new burner include:

- Potential for easy and accurate adjustment of flame shape to improve flame stability, heat transfer to the clinker, and to extend service life of brickwork as well;
- Potential to lower primary air rate by 6% - 12% according to kiln and fuel requirements with possibility to reduce the specific heat consumption (less fuel consumption);
- Ability to handle and feed alternative fuels in distinct and separate fuel lines.



LEGEND

LINE NO.	AREA	DESCRIPTION
1	335	GYPSUM SILO
1	385	SLAG SILO
1	422	RAW MILL SYSTEM
1	441	BLENDING SILO
1	511	MAIN BAGHOUSE
1	531	PREHEATER TOWER
1	541	KILN
1	560	CLINKER COOLER
1	561	COOLER VENT
1	572	CLINKER STORAGE
1	622	CEMENT MILL
1	715	CEMENT STORAGE
2	314	LIMESTONE STORAGE HALL
2	324	CLAY TRANSPORT
2	411	RAW MILL FEED BINS
2	351	RAW MILL ADDITIVES RECEPTION
2	355	RAW MILL ADDITIVES STORAGE
~~2~~	~~385~~	~~SLAG SILO~~
2	411	RAW MILL FEED
2	422	RAW MILL SYSTEM 322 STPH
2	441	BLENDING SILO 10,240 ST
2	511	KILN DUST SYSTEM
2	530	KILN ID FAN
2	531	PREHEATER TOWER
2	541	KILN
2	560	CLINKER COOLER
2	561	COOLER VENT
2	571	CLINKER HANDLING
2	612	CEMENT MILL FEED
2	622	CEMENT MILL 198 STPH
2	631	CEMENT TRANSPORT
2	715	CEMENT STORAGE 40,000 ST
2	821	COMPRESSOR ROOM
2	833	WATER COOLING TOWER
2	880	PET COAL MILL 27.5 STPH

REVISIONS

No.	DATE	DESCRIPTION	BY

DRAWING No.	TITLE	SUPPLIER
898-11-02-002	ELEVATIONS	CEMEX
898-11-02-001	LAYOUT	CEMEX

REFERENCE DRAWING

CEMEX

CHECKED BY: – DATE: DD-MMM-AA
APPROVED BY: – DATE: DD-MMM-AA

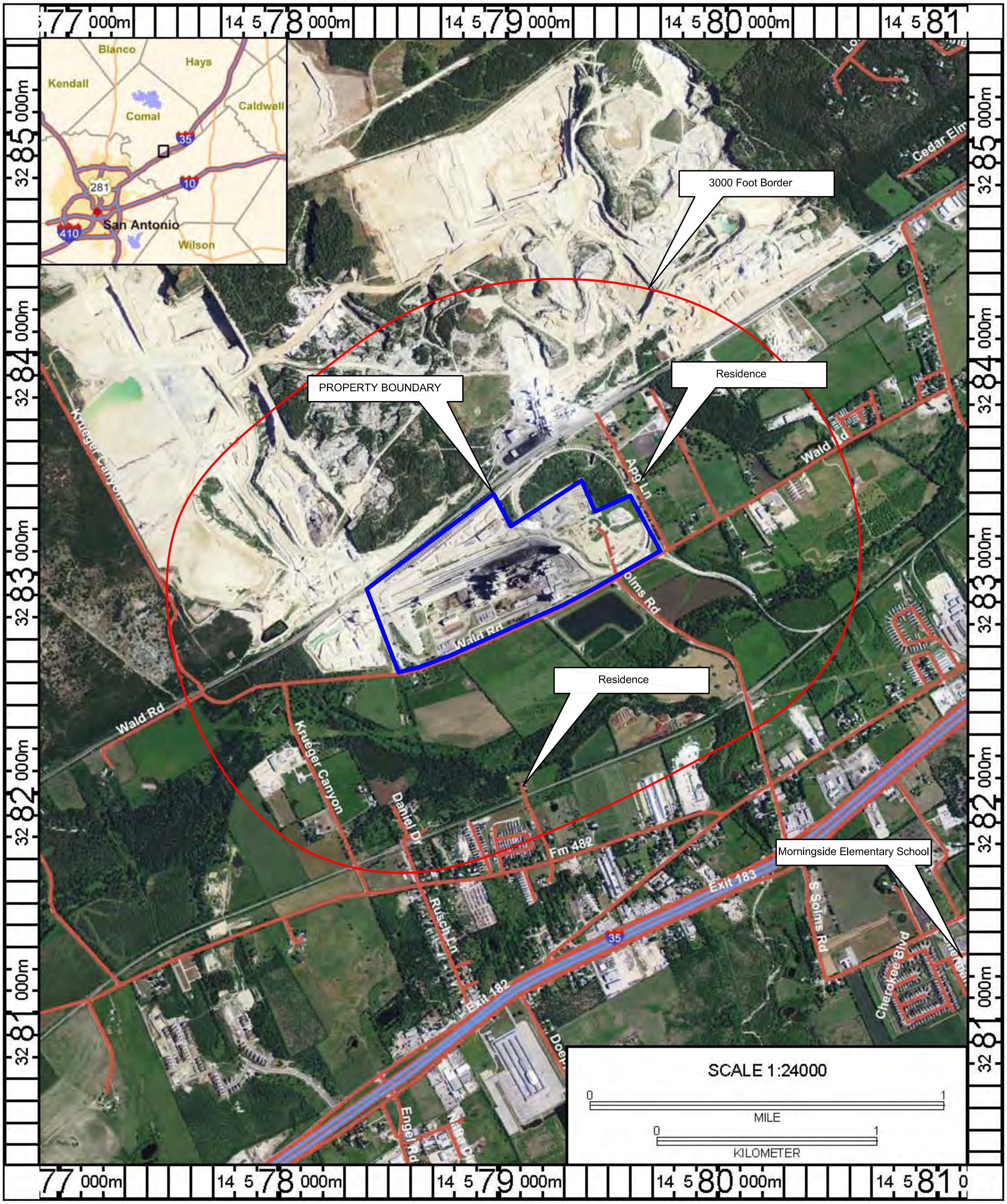
CEMEX
CEMEX USA

CLIENT:
PLANT: BALCONES, PLANT
PROJECT No. –
NAME: PLANT BALCONES ALTERNATIVE FUELS
TITLE:

PLOT PLAN

DRAWN: LSC	DATE: 04-APR-11
CHECKED: EJdlC	DATE: 04-APR-11
APPROVED:	DATE:
UNITS: Inches	SCALE: 1"=100'
DRAWING No. 111-11-02-001	REV.No. 0

FILE:
PRINT DATE:



Datum: NAD83

Digital USGS AERIAL PHOTOGRAPH
—NEW BRAUNFELS WEST SE, TX (May 4, 2010)
MAP SOURCE: Terrain Navigator Pro

SITE LOCATION

zephyr

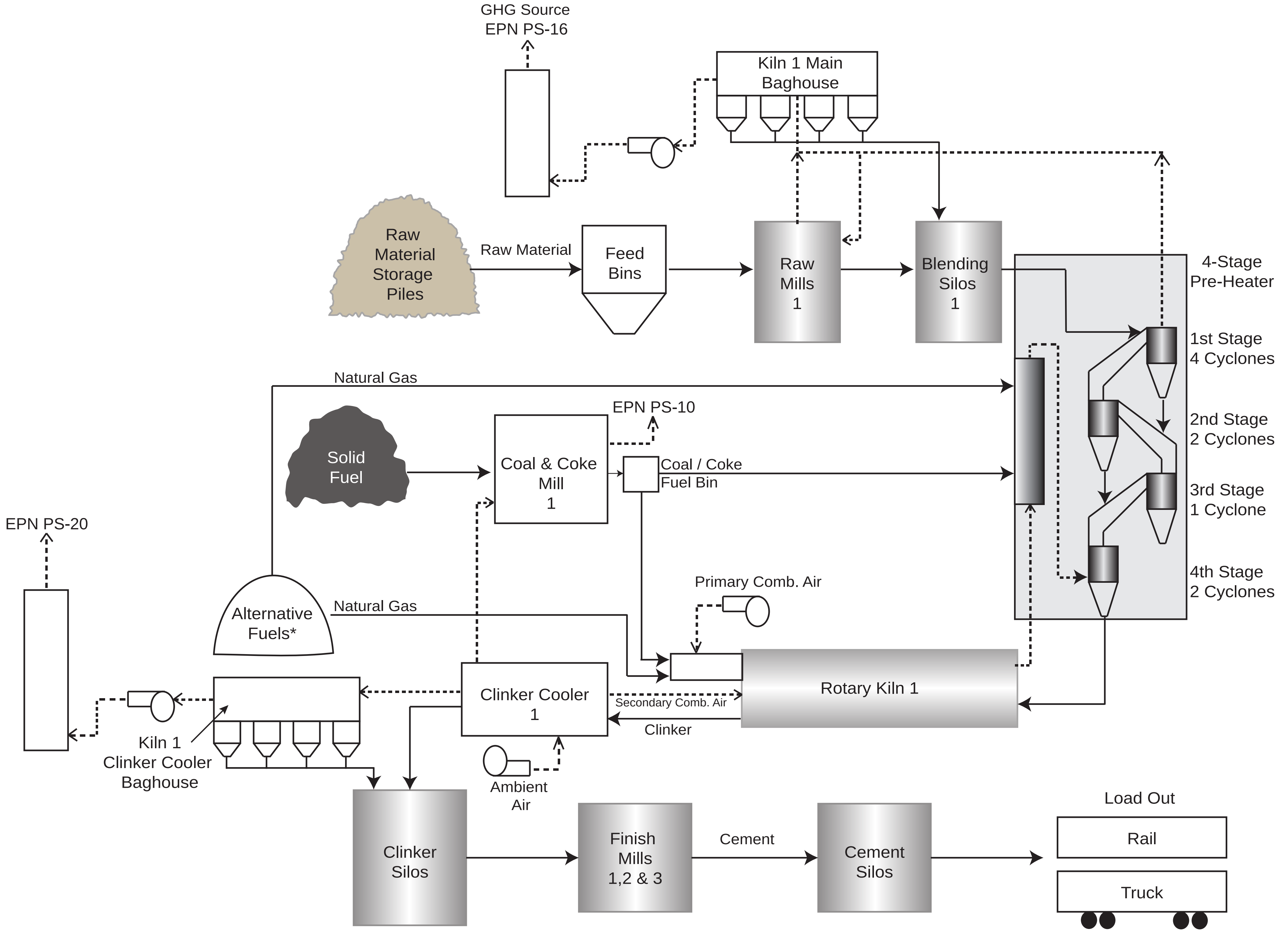
AREA MAP

BALCONES CEMENT PLANT

CEMEX CEMENT of TEXAS, L.P.
New Braunfels, TX

File Name: H:\CEMEX\Balcones\10537 Graphics

Designed By:	Reviewed By:	Project No.:	Date:
R. von Czoernig	Thomas S.	10537	8/24/2011



*Alternative Fuel Categories Include:
-Tires and rubber products
-Wood products
-Construction and demolition debris
-Textiles
-Agricultural products

Gas Flow - - - - -
Material Flow ———

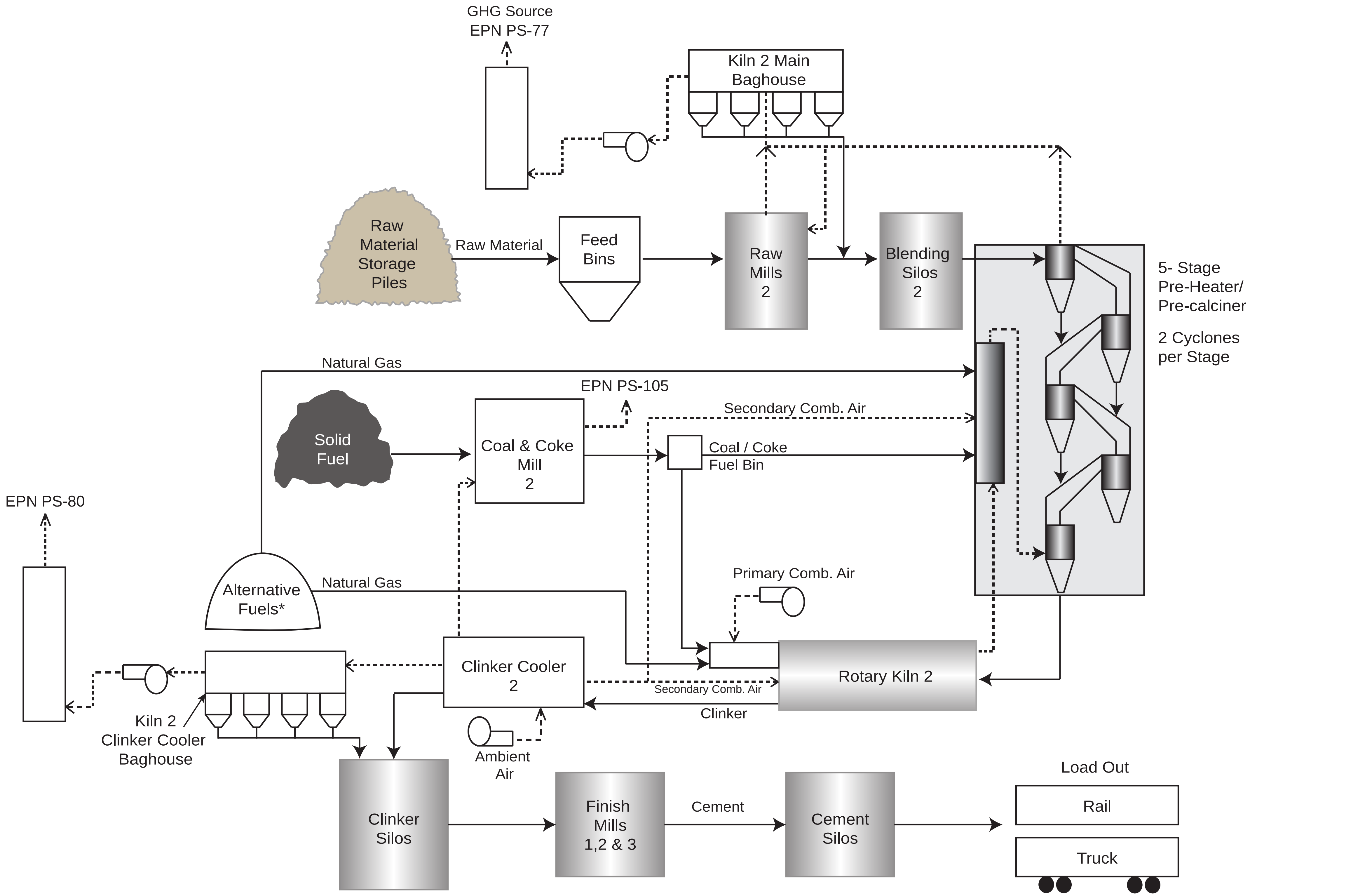
zephyr

PROCESS FLOW DIAGRAM- KILN 1

CEMEX BALCONES CEMENT PLANT
New Braunfels, Texas

H:\Cemex\Balcones\10537 Graphics

Drafted By:	Reviewed By:	Project No.:	Date:
J. Knowles	L. Moon	010537	08.29.2013



*Alternative Fuel Categories Include:
- Tires and rubber products
- Wood products
- Construction and demolition debris
- Textiles
- Agricultural products

Gas Flow - - - - -
Material Flow ———

zephyr

PROCESS FLOW DIAGRAM- KILN 2

CEMEX BALCONES CEMENT PLANT
New Braunfels, Texas

H:\Cemex\Balcones\10537 Graphics

Drafted By:	Reviewed By:	Project No.:	Date:
J. Knowles	L. Moon	010537	08.29.2013

3.0 GHG EMISSION CALCULATIONS

3.1 GHG EMISSIONS FROM CEMENT KILNS

GHG emission calculations for the kilns are based on maximum annual clinker production rates and the lb CO_2e/ton clinker emission factor proposed as Best Available Control Technology (BACT). During kiln start-up there is a period of time where fuel is being combusted to warm up the system and no clinker is being produced. The actual GHG emissions on a lb/hr basis will be lower during startup than during normal operation because less fuel is being combusted. The BACT calculation in Table 3-1 and the GHG emission calculations in Table 3-2 include GHG emissions associated with startup, shutdown, and maintenance in the annual totals.

The clinker production represented for Kiln No. 1 is the same as currently permitted. The clinker production represented for Kiln No. 2 includes a 10% increase over currently permitted levels. See Tables 3-1 and 3-2 for more details.

CEMEX Construction Material South, LLC
Balcones Cement Plant
Permit 6048 Amendment

Table 3-1
Kiln CO_2e Emissions Calculations

EPN	EPN Name	Proposed Clinker produced per day [1] Tons	Proposed Clinker produced per year Tons	CO_2e Emission Factor [2] lb/ton clinker	Proposed CO_2e Annual Emissions (tons/yr)
PS-16	Kiln No. 1	3,250	1,137,500	1900	1,080,625
PS-77	Kiln No. 2	3,960	1,386,000	1900	1,316,700

1. 30 day average
2. Based on 12-month rolling average BACT limit of 0.95 tons of CO_2e/ton of clinker.

Table 3-2
CEMEX Construction Material South, LLC
Balcones Cement Plant
Kiln CO_2e Emissions Calculations

GHG Emissions from fuel firing

EPN	Maximum Heat Input (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[1, 2]	GHG Mass Emissions (tpy)	Global Warming Potential[3]	CO_2e (tpy)
Kiln 1	4,102,239	CO_2	102.41	463,088	1	463,088
		CH_4	1.1E-02	49.74	21	1,044.6
		N_2O	1.6E-03	7.24	310	2,242.9
				463,145		466,375
Kiln 2	4,998,420	CO_2	102.41	564,254	1	564,254
		CH_4	1.1E-02	60.61	21	1,272.8
		N_2O	1.6E-03	8.82	310	2,732.8
			Totals	564,324		568,260

GHG Emissions from Limestone Calcination

	Clinker Production tons/yr	Calcination Emission Factor[4] ton CO2/ton clinker	CO2 (tpy)	GHG Mass Emissions (tpy)	CO_2e (tpy)
Kiln 1	1,137,500	0.54	614,250.0	1	614,250
Kiln 2	1,386,000	0.54	748,440.0	1	748,440

Total Kiln GHG Emissions

	CO_2 (tpy)	CO_2e (tpy)
Kiln 1	1,077,395	1,080,625
Kiln 2	1,312,764	1,316,700

Note

1. Based on firing 100% petroleum coke which provides a worst case estimate of GHG emissions
2. *Factors from Table C-1 and C-2 of 40 CFR Part 98, Mandatory Greenhouse Gas Reporting.*
3. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*
4. Developed from Balcones Plant 2011 CO_2 monitoring data (total CEMs measured CO_2 - CO_2 calculated from fuel combustion / clinker production)

Table 3-3
CEMEX Construction Material South, LLC
Balcones Cement Plant
CO_2e Baseline Emission Calculations

Year	Emission Source	EPN	CO2 MT/yr[1,2]	CH4 MT/yr[1,2]	N2O MT/yr[1,2]	CO2 ton/yr[3]	CH4 ton/yr[3]	N2O ton/yr[3]	CO2e ton/yr[4]
2010	Kiln 1	PS-16	507,938.7	60.0	8.7	559,897.2	66.2	9.6	564,269.9
2011	Kiln 1	PS-16	663,737.5	78.4	11.4	731,633.0	86.5	12.6	737,347.6
								2-yr average	650,808.7
2010	Kiln 2	PS-77	765,912.3	90.5	13.2	844,259.6	99.8	14.6	850,865.1
2011	Kiln 2	PS-77	863,863.3	102.1	14.8	952,230.3	112.5	16.4	959,667.8
								2-yr average	905,266.4

1. Reported for 40 CFR 98 Mandatory Greenhouse Gas Reporting Rule for Calendar Year 2010
2. Reported for 40 CFR 98 Mandatory Greenhouse Gas Reporting Rule for Calendar Year 2011
3. Metric tons converted to short tons using 2204.586 ton/ 2000 MT conversion factor
4. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

4.0 PREVENTION OF SIGNIFICANT DETERIORATION APPLICABILITY

In the EPA guidance document *PSD and Title V Permitting Guidance for Greenhouse Gases,* the following PSD Applicability Test was provided for Step 1 of the PSD Tailoring rule for existing sources:

EPA Tailoring Rule Step 1 - PSD Applicability Test for GHGs

PSD applies to the GHG emissions from a proposed modification to an existing major source if the following is true:

- The emissions increase ***and*** the **net** emissions increase of GHGs from the modification would be equal to or greater than 75,000 TPY on a CO_2e basis ***and*** greater than zero TPY on a mass basis.

Since the net emissions increase of GHG is greater than 75,000 ton/yr of CO_2e and greater than zero ton/yr on a mass basis, PSD is triggered for GHG emissions. The emissions netting analysis is documented on the attached TCEQ PSD netting tables: Table 1F and Table 2F. Also included in Appendix A is the “The GHG PSD APPLICABILITY FLOWCHART – EXISTING SOURCES from the *PSD and Title V Permitting Guidance for Greenhouse Gases.*

TCEQ PSD NETTING TABLES

TCEQ

TABLE 1F
AIR QUALITY APPLICATION SUPPLEMENT

Permit No.:	6048	Application Submittal Date:	
Company	CEMEX Construction Materials South, LLC		
RN:	RN102605375	Facility Location:	New Braunfels
City	New Braunfels	County:	Comal
Permit Unit I.D.:	PS-77	Permit Name:	Kiln No. 2 Baghouse
Permit Activity:	☐ New Major Source	☑ Modification	
Project or Process Description: Authorize a production increase for Kiln 2 and burner upgrades for both kilns.			

Complete for all pollutants with a project emission increase.	POLLUTANTS						
	Ozone		CO	SO_2	PM	GHG	CO_2e
	NOx	VOC					
Nonattainment? (yes or no)						No	No
Existing site PTE (tpy)	This form for GHG only					> 100,000	> 100,000
Proposed project increases (tpy from 2F)[3]						> 0	841,250
Is the existing site a major source? If not, is the project a major source by itself? (yes or no)	Yes						
If site is major, is project increase significant? (yes or no)						Yes	Yes
If netting required, estimated start of construction: 5 years prior to start of construction: estimated start of operation:		Contemporaneous Period				***SEE NOTE***	
Net contemporaneous change, including proposed project, from Table 3F (tpy)						> 0	>841250
FNSR applicable? (yes or no)						Yes	Yes

1. Other PSD pollutants
2. Nonattainment major source is defined in Table 1 in 30 TAC 116.12(11) by pollutant and county. PSD thresholds are found in 40 CFR §51.166(b)(1).
3. Sum of proposed emissions minus baseline emissions, increases only. Nonattainment thresholds are found in Table 1 in 30 TAC 116.12(11) and PSD thresholds in 40 CFR §51.166(b)(23).

NOTES Netting was not performed since no projects occurred in the contemporaneous period that reduced GHG emissions.

The presentations made above and on the accompanying tables are true and correct to the best of my knowledge.

Kimberly Bradley — Director, Environmental — 7/11/12

Signature — Title — Date

H:\Cemex\Balcones\10537 - K2 Production Increase\Work Products\GHG application\calcs and PSD tables xlsx 7/11/2012

TCEQ

TABLE 2F
PROJECT EMISSION INCREASE

Pollutant[1]:	GHG (CO2e)	Permit:	6048
Baseline Period:	Jan. 2010	to	Dec. 2011

	Affected or Modified Facilities[2] FIN	EPN	Permit No.	Actual Emissions[3]	A Baseline Emissions[4]	Proposed Emissions[5]	B Projected Actual	Difference (A-B)[6]	Correction[7]	Project Increase[8]
1	KF13	PS-16	6048	650,808.73	650,808.73		1,080,625.00	429,816.27		429,816.27
2	KILN2	PS-77	6048	905,266.43	905,266.43		1,316,700.00	411,433.57		411,433.57
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
									Page Subtotal[9]	841,249.84

5.0 BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

The PSD rules define BACT as:

> *Best available control technology* means an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under [the] Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results.[3]

In the EPA guidance document titled *PSD and Title V Permitting Guidance for Greenhouse Gases*, EPA recommended the use of the Agency's five-step "top-down" BACT process to determine BACT for GHGs.[4] In brief, the top-down process calls for all available control technologies for a given pollutant to be identified and ranked in descending order of control effectiveness. The permit applicant should first examine the highest-ranked ("top") option. The top-ranked options should be established as BACT unless the permit applicant demonstrates to the satisfaction of the permitting authority that technical considerations, or energy, environmental, or economic impacts justify a conclusion that the top ranked technology is not "achievable" in that case. If the most effective control strategy is eliminated in this fashion, then the next most effective alternative should be evaluated, and so on, until an option is selected as BACT.

EPA has broken down this analytical process into the following five steps:

Step 1: Identify all available control technologies.
Step 2: Eliminate technically infeasible options.
Step 3: Rank remaining control technologies.

[3] 40 C.F.R. § 52.21(b)(12.)

[4] EPA, *PSD and Title V Permitting Guidance for Greenhouse Gases*, p. 18 (Nov. 2010).

Step 4: Evaluate most effective controls and document results.
Step 5: Select the BACT.

Please note, 40 CFR 52.21 (j)(3) states "A major modification shall apply best available control technology for each regulated NSR pollutant for which it would result in a significant net emissions increase at the source. This requirement applies to each proposed emissions unit at which a net emissions increase in the pollutant would occur as a result of a physical change or change in the method of operation in the unit".

40 CFR 52.21(b)(2)(iii)(f) states that "A physical change or change in the method of operation shall not include …an increase in the hours of operation or in the production rate, unless such change would be prohibited under any federally enforceable permit condition…"

Pages 22-24 of the PSD and Title V Permitting Guidance for Greenhouse Gases (March 2011) discuss these issues in a section called "Determining the Scope of the BACT Analysis". This guidance contends that for new sources triggering PSD, the rules provide discretion for permitting authorities to evaluate BACT on a facility-wide basis by taking into account operations and equipment which affect the environmental performance of the whole facility. However for existing units, the guidance refers to the above citation (52.21(j)(3)), and reiterates that BACT only applies to emissions units that are physically or operationally changed. Therefore, this BACT analysis will only address Kilns 1 and 2.

5.1 BACT FOR THE KILNS

5.1.1 Step 1: Identify All Available Control Technologies

EPA has issued a "white paper", entitled *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Portland Cement Industry*[5] *(referred to in this application as "The Cement Industry GHG White Paper")*, which provides GHG BACT guidance specific to the industry. The recommended control techniques and measures to mitigate greenhouse gas emissions are addressed below.

5.1.1.1 Cement Kiln Energy Efficiency

Process Control and Management Systems

The Cement Industry GHG White Paper recommends using automated control systems to maintain operating conditions in the kiln at optimum levels. The Balcones plant has automated control systems for both Kiln 1 and Kiln 2 which are integrated into a central control room. The kilns have an indirect firing system with the main characteristics of low amount of primary air,

[5] EPA, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From the Portland Cement Industry*, (Oct. 2010).

flame adjustment control and fuel rate control by the dosing equipment. Process gas analyzers are used by control room operators to monitor CO and O_2 levels to insure efficient combustion. The calciner fuel rate is automatically controlled based on the stage 5 temperature and the kiln main burner is adjusted by the operator depending of the oxygen levels, kiln burning zone temperature and clinker quality.

Replacement of kiln seals

The Cement Industry GHG White Paper recommends that all facilities should have a regular maintenance plan for the kiln seals. Leaking seals can result in increased heat loss which increases fuel use. The CEMEX Balcones Plant has a maintenance routine to inspect the kiln seals weekly and during the major outages. Components of the kiln seals are replaced as needed based on inspections during kiln stops.

Kiln Combustion System Optimization

The Cement Industry GHG White Paper recommends incorporating available technologies to optimize kiln combustion into kiln designs. Incomplete fuel burning, poor mixing of fuel with combustion air, and poorly adjusted firing can lead to increased fuel usage (as well as increased NOx and CO emissions).

The combustion system process for Kilns 1 and 2 are designed to provide for efficient use of fuel. Kilns 1 and 2 have an indirect firing system with the main characteristics of low amount of primary air, flame adjustment control, and fuel rate control by the dosing equipment.

The primary air accounts for 10 to 40% of the total air needed depending on the type of firing system. The additional 90 or 60% of the air is called secondary air and consists of hot air from the clinker cooler. The higher the secondary air the more efficient the combustion system.

Precalciner kilns like the Balcones Kiln 1 and Kiln 2 are designed to maximize the heat input to the calciner and typically 60% of fuel is fed to the calciner. Most of the air required by the combustion at the calciner is hot air from the clinker cooler. This air is known as tertiary air. Mixing and heat transfer at the calciner has proven calcination levels above 90% and significantly reduces the thermal load at the kiln.

Use of Fluxes and Mineralizers to Reduce Energy Demand

The Cement Industry GHG White Paper recommends considering the use of fluxes and mineralizers to reduce the temperature at which the clinker melt begins to form in the kiln, promote formation of clinker compounds, and reduce the lower temperature limit of the tricalcium silicate stability range. The Cement Industry GHG White Paper states: *"Fluorides are often used as a mineralizer and can reduce the sintering temperature by 190°F. Although there* *is a fuel savings, that savings may be offset by the high cost of the fluxing agent or mineralizer. (ECRA, 2009)."*

CEMEX conducted a test using fluoride in a kiln at one of its other U.S. cement plants. Based on the test results, CEMEX evaluated the use of fluoride in kilns and determined the benefit in fuel savings does not offset the cost of the fluoride. There were also negative effects in quality of cement and concrete physical properties that prohibited the use at some plants. Therefore, CEMEX does not use fluxes and mineralizers in Kilns 1 and 2.

Kiln/Preheater Insulation

The Cement Industry GHG White Paper recommends proper insulation to keep heat loss through the kiln shell at a minimum. Kilns 1 and 2 are insulated with refractory brick and the preheaters are insulated with a combination of brick and castable over a light-weight insulating material. The kiln refractory is inspected during every major outage and portions of the refractory are replaced, as needed, depending on the condition.

Refractory Material Selection

The Cement Industry GHG White Paper states: "*The refractory bricks lining the combustion zone of the kiln protect the outer shell from the high combustion temperatures, as well as chemical and mechanical stresses. Although the choice of refractory materials is highly dependent on fuels, raw materials, and operating conditions, consideration should be given to refractory materials that provide the highest insulating capacity and have the longest life."*

The kiln refractory for Kiln 1 and 2 is very standard for the cement industry and was selected based on the conditions of each zone (mainly thermal and chemical conditions). The refractory is inspected every major outage and it is replaced depending on the condition.

Grate Cooler Conversion

The Cement Industry GHG White Paper recommends replacing planetary and travelling grate coolers with a more energy efficient reciprocating grate coolers as an option for improving energy efficiency. Kilns 1 and 2 are equipped with reciprocating grate coolers which recuperate heat back to the kiln. The secondary air coming from the coolers provide oxygen for combustion and heat recuperated from the clinker improving the overall kiln energy efficiency.

Heat Recovery from Kiln and Clinker Cooler Exhausts

The Cement Industry GHG White Paper states: "*There are several exhaust streams in the cement manufacturing operation that contain significant amounts of heat energy, including the kiln exhaust, clinker cooler, and kiln preheater and precalciner. …Generally, only long dry kilns* *produce exhaust gases with temperatures high enough to make heat recovery for power economical….Heat recovery for power may not be possible at facilities with in-line raw mills where the waste heat is used to extensively dry the raw materials…*".

Kilns 1 and 2 have in-line raw mills, where the waste heat from the kiln and precalciners are used to dry and preheat the raw materials. The exhaust from the clinker coolers is used partly as secondary air which provide oxygen and heat to the kilns and also to provide heat for drying the coal.

Suspension Preheater Low Pressure Drop Cyclones

Cyclones are used to preheat the raw meal prior to the kiln. Exhaust gases from the in-line kiln, precalciner are routed to the cyclones and provide the heat to preheat the raw meal suspended or residing in the cyclone. The Cement Industry GHG White Paper recommends the use of low pressure drop cyclones as a method of improving energy efficiency. The preheater cyclones and ducts areas associated with Kilns 1 and 2 are designed to minimize pressure drop and to minimize the dust lost in the preheater.

Conversion to Multistage Preheater

The Cement Industry GHG White Paper recommends converting to multistage preheaters to allow higher energy transfer efficiency and lower fuel requirements. Kilns 1 and 2 are equipped with multi-stage preheaters consisting of several cyclones in suspension. The material is fed at the top of the calciner and exchange heat with hot gases from the kiln. The contact between the material and the hot gas in each cyclone explains the great efficiency of heat exchange between materials. Multi-stage preheaters are designed to preheat the material using the hot gas flow coming from the kiln. The material in suspension contacts the hot gas flow as the material is falling in each stage of the preheater.

Conversion of Long Dry Kiln to Preheater/Precalciner Kiln

The Cement Industry GHG White Paper recommends reducing energy consumption by converting a long dry kiln to a preheater/precalciner kiln. The CEMEX Kilns 1 and 2 are both preheater/precalciner kilns.

Kiln Drive Efficiency

The Cement Industry GHG White Paper recommends using high efficiency motors to rotate the kiln. The Balcones Kiln 1 has a direct current adjustable speed drive and Kiln 2 has an alternating current adjustable speed drive. The variable frequency drive installed at both kilns provides a high energy efficiency. Both kilns have a single pinion drive with a direct coupled gear coupling.

Adjustable Speed Drive for Kiln Fan

The Cement Industry GHG White Paper recommends installing adjustable speed drives on kiln fans for increased energy efficiency. Kilns 1 and 2 use variable frequency drives which allow for high efficiency of the kiln fans. The fan efficiency is maintained in different speeds using variable frequency drive instead of the damper operation where the fan efficiency is reduced while the damper is closing.

Mid Kiln Firing

The Cement Industry GHG Whiter Paper states that: "*Mid kiln firing, which is the practice of adding fuel (often scrap tires) at a point near the middle of the kiln, can result in reduced fuel usage thereby potentially reducing overall CO_2 emissions. This practice is most often used with long wet or long dry kilns.*" Mid-kiln firing is proven for long dry kilns but results are not the same for calciner kilns. In a long, dry kiln with mid-kiln firing, the combustion efficiency increases for two reasons: (1) the fuel at the main burner is reduced and (2) hot flame at mid-kiln firing will destroy and ensure complete combustion of the main fuel. The kiln in a calciner system, like Kilns 1 and 2, is shorter than long dry or wet kilns and therefore do not have the adequate conditions for mid-kiln firing.

Air Mixing Technology

The Cement Industry GHG White Paper states that: "Mixing air is the practice of injecting a high pressure air stream into a kiln to break up and mix stratified layers of gases within the kiln. Mixing the air improves the combustion efficiency. Due to the increased efficiency, less fuel is required, leading to lower CO_2 emissions."

The type of mixing air technology discussed in the Cement Industry White Paper is only needed if there is poor mixing at the burner pipe. CEMEX Kilns 1 and 2 have multichannel burners that allow for necessary mixing of fuel and air to complete combustion. Multichannel burners allow for adjustment of multiple streams of mixing air to complete combustion.

Preheater Duct Rising

The Cement Industry GHG White Paper states that: "The operation of cement manufacturing operations that include a preheater prior to the kiln can be improved by firing a portion of the fuel in the riser duct to increase the degree of calcination in the preheater." In the CEMEX Kilns 1 and 2, a portion of the fuel is fired in the riser duct to increase the degree of calcinations in the preheater. Firing at the riser serves two functions: (1) more mixing and longer residence time for the fuel to complete combustion and (2) generate enough CO to destroy NOx from the kiln by the reaction NO + CO ➔ N2 + CO2. This reaction has been reported to be catalyzed by limestone present in the hot meal.

5.1.1.2 Use of Lower GHG Emitting Fuel

Kilns 1 and 2 are currently authorized by Air Permit 6048/PSD-TX-74M1 to fire the following fuels in the kiln/preheater system: natural gas, coal, petroleum coke, wood, tire derived fuel, other rubber products, and other alternative fuels including carpet products, non-asbestos containing shingles, construction and demolition waste, oil filter fluff, oily rags, oily wood, paper, cardboard, rick husks, and cotton gin residue.

Fuel costs, fuel availability, and fuel reliability have primarily dictated the fuel mix used in the kilns. The use of natural gas in the kilns is increasing as the price of natural gas becomes more competitive with petroleum coke and coal.

The EPA PSD and Title V Permitting Guidance for Greenhouse Gases states that "…permitting authorities might determine that, with respect to the biomass component of a facility's fuel stream, certain types of biomass by themselves are BACT for GHGs." This is based on the premise that CO_2 emissions from burning biomass are the result of carbon that has relatively recently been removed from the atmosphere through uptake by plants and thus does not have the global warming impact that burning fossil fuel has. Potential types of biomass that can be burned in the Balcones cement kilns include:

- Wood
- Paper
- Cardboard
- Rice Husks,
- Pecan shells, and
- Cotton gin residue.

This permit application includes upgrades to the main kiln burners in Kiln No. 1 and Kiln No. 2 to multipath adjustable units. The upgrades will increase flexibility in the amount and kind of fuels that can be burned in the main kiln. The use of biomass is limited by cost, availability, and kiln process variables including high moisture or high chlorides content. Because biomass wastes have heating values that are typically lower than heating values for coal and petroleum coke, more biomass is needed to provide the same heating value as a given weight of coal or petroleum coke. In combustion systems any water content in the fuel must be driven off before the first stage of combustion can occur, requiring energy, and thus reducing overall system efficiency. Higher chlorides contents of fuels can negatively affect the quality of the cement product from the kiln.

5.1.1.3 Add On Controls

In addition to the cement production process technology options discussed above, it is appropriate to consider add-on technologies as possible ways to capture GHG emissions that are emitted from combustion and calcination, and to prevent them from entering the atmosphere. These emerging CCS technologies generally consist of processes that separate CO_2 from combustion process flue gas, and then inject it into geologic formations such as oil and gas reservoirs, un-mineable coal seams, or underground saline formations.

Post-combustion technologies include the Calera process, which captures carbon dioxide from flue gas and converts the gas to stable solid minerals. The process employs a scrubber with high pH water containing calcium, magnesium, sodium, and chloride as the scrubbing liquid. The CO_2 is absorbed by the water, converting it to a dissolved carbonic acid species. However, this technology has not been on a full scale basis and pilot plant testing has only been in relation to the electric utility industry.

Membrane technology is being research as a means to separate or adsorb CO_2 in the kiln exhaust. The captured CO_2 would then be purified and compressed for transport. This technology is still primarily in the research stage, with industrial application at least 10 years away. There are significant problems to overcome designing membrane reactors large enough to handle the kiln exhaust.[6]

A superheated Calcium Oxide (CaO) process has also been noted as potential CO_2 control technology. The superheated CaO process separates the calcination and combustion reactions into independent chambers. The heat necessary to run the calciner is provided by circulating a stream of superheated CaO particles between a fluidized bed combustor and a fluidized bed calciner. Retrofits of an existing kiln would involve removal of existing preheaters and precalciners, construction of the fluidized beds, cyclones, heat exchangers, and compressors associated with the process. Superheated CaO simulations have shown that the superheated CaO process is theoretically feasible; however, the system remains theoretical with no systems yet built.[7]

Of the emerging CO_2 capture technologies that have been identified, only amine absorption (post-combustion solvent capture and stripping) is currently commercially used for state-of-the-art CO_2 separation processes. Amine absorption has been applied to processes in the petroleum refining and natural gas processing industries and for exhausts from gas-fired industrial boilers but there has been little work discussing its feasibility at cement plants.

If CO_2 capture can be achieved at a cement plant at full scale, it would need to be routed to a geologic formation capable of long-term storage. The long-term storage potential for a formation is a function of the volumetric capacity of a geologic formation and CO_2 trapping mechanisms within the formation, including dissolution in brine, reactions with minerals to form solid carbonates, and/or adsorption in porous rock. The U.S. Department of Energy's National Energy

---

[6] EPA, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From the Portland Cement Industry*, Page 38, (Oct. 2010).

[7] EPA, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From the Portland Cement Industry*, Page 38, (Oct. 2010).

Technology Laboratory (DOE-NETL) describes the geologic formations that could potentially serve as CO_2 storage sites as follows:

"Geologic carbon dioxide (CO_2) storage involves the injection of supercritical CO_2 into deep geologic formations (injection zones) overlain by competent sealing formations and geologic traps that will prevent the CO_2 from escaping. Current research and field studies are focused on developing better understanding of 11 major types of geologic storage reservoir classes, each having their own unique opportunities and challenges. Understanding these different storage classes provides insight into how the systems influence fluids flow within these systems today, and how CO_2 in geologic storage would be anticipated to flow in the future. The different storage formation classes include: deltaic, coal/shale, fluvial, alluvial, strandplain, turbidite, eolian, lacustrine, clastic shelf, carbonate shallow shelf, and reef. Basaltic interflow zones are also being considered as potential reservoirs. These storage reservoirs contain fluids that may include natural gas, oil, or saline water; any of which may impact CO_2 storage differently…"[8]

5.1.2 Step 2: Eliminate Technically Infeasible Options

5.1.2.1 Energy Efficiency Improvements in Clinker Production

CEMEX conducted a test using fluoride in a kiln at one of its other U.S. cement plants. Based on the test results, CEMEX evaluated the use of fluoride in kilns and determined the benefit in fuel savings does not offset the cost of the fluoride. There were also site specific impacts in quality of cement and concrete physical properties that prohibited the use at some plants. Therefore, CEMEX does not use fluxes and mineralizers in Kilns 1 and 2.

Mid-kiln firing is not conducted at Kilns 1 and 2. The kiln in a calciner system, like Kilns 1 and 2, is shorter than long dry or wet kilns and therefore do not have the adequate conditions for mid-kiln firing.

5.1.2.2 Post-combustion CO_2 Capture and Compression

Though amine absorption technology for CO_2 capture has been applied to processes in the petroleum refining and natural gas processing industries, it has not been commercially applied to cement kiln exhausts. The Cement Industry GHG White Paper lists the following major additions to a cement plant to retrofit this technology include:

- A CO_2 capture plant which includes a solvent scrubber and regenerator
- A compressor to increase the pressure of the CO_2 product for transport by pipeline
- High efficiency flue gas desulfurization and De-NOx (a NOx removal process) to satisfy the flue gas purity requirements of the CO_2 capture process

[8] DOE-NETL, *Carbon Sequestration: Geologic Storage Focus Area,* http://www.netl.doe.gov/technologies/carbon_seq/corerd/storage.html (last visited Feb. 27, 2012)

- A boiler to provide the steam required for regeneration of the CO_2 capture solvent.[9]

While post-combustion capture of CO_2 has been studied extensively for combustion sources at gas-fired power stations, there has been little work to address feasibility at cement plants. The Cement Industry GHG White Paper listed the following technical issues associated with using post-combustion amine scrubbing at a cement kiln:

- Additional Steam Requirements. One of the major issues with using MEA CO_2 capture is the large steam requirement for solvent regeneration. The CEMEX Balcones plant currently does not have steam generation capabilities.
- Sulfur Dioxide (SO2). The concentration of SO2 in the flue gas from the cement process is important for post-combustion capture with amines because amines react with acidic compounds to form salts that will not dissociate in the amine stripping system.
- Nitrogen Dioxide (NO2). NOx within the flue gas is problematic for MEA absorption as this result in solvent degradation.
- Dust. The presence of dust reduces the efficiency of the amine absorption process. The dust level must be kept below 15 mg/Nm^3.
-
- Reducing Conditions. The clinker must not be generated in reducing conditions and an excess of oxygen must be maintained in the process.
- Heat Reduction for MEA Absorption. The flue gas must be cooled from about 110°C to about 50°C to meet the ideal temperature for CO_2 absorption with MEA.
- Other Gases. The presence of any acidic components will reduce the efficiency of the MEA absorption process.[10]

In addition to the technical issues addressed in the Cement Industry GHG White Paper, construction of a carbon capture facility will affect the footprint of the plant and may require a larger site.

5.1.2.3 CO_2 Transport

Even if it is assumed that CO_2 capture and compression could feasibly be achieved for the proposed project, the high-volume CO_2 stream generated would need to be transported to a facility capable of storing it. Potential geologic storage sites in Texas, Louisiana, and Mississippi to which CO_2 could be transported if a pipeline was constructed are delineated on the map found at the end of Section 5.[11] The potential length of such a CO_2 transport pipeline is

---

[9] EPA, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From the Portland Cement Industry*, Page 37, (Oct. 2010).

[10] EPA, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From the Portland Cement Industry*, Page 37, (Oct. 2010).

[11] Susan Hovorka, University of Texas at Austin, Bureau of Economic Geology, Gulf Coast Carbon Center, *New Developments: Solved and Unsolved Questions Regarding Geologic Sequestration of CO_2 as a Greenhouse Gas*

uncertain due to the uncertainty of identifying a site(s) that is definitively suitable for large-scale, long-term CO_2 storage. The hypothetical minimum length required for any such pipeline(s) will be the distance to the closest site with recognized potential for some geological storage of CO_2, which is an enhanced oil recovery (EOR) reservoir site located approximately 50 miles to the south-southeast of the plant in Karnes County. However, the reservoir site in Karnes County has not been technically demonstrated for large-scale, long-term CO_2 storage.

In comparison, the closest site that is currently being field-tested to demonstrate its capacity for large-scale geological storage of CO_2 is the Southeast Regional Carbon Sequestration Partnership's (SECARB) Cranfield test site, which is located in Adams and Franklin Counties, Mississippi over 260 miles away (see the map at the end of Section 5 for the test site location). Therefore, to access this potentially large-scale storage capacity site, assuming that it is eventually demonstrated to indefinitely store a substantial portion of the large volume of CO_2 generated by the proposed project, a very long and sizable pipeline would need to be constructed to transport the large volume of high-pressure CO_2 from the plant to the storage facility, thereby rendering implementation of a CO_2 transport system infeasible.

5.1.2.4 CO_2 Storage

Even if it is assumed that CO_2 capture and compression could feasibly be achieved for the proposed project and that the CO_2 could be transported economically, the feasibility of CCS technology would still depend on the availability of a suitable sequestration site. The suitability of potential storage sites is a function of volumetric capacity of their geologic formations, CO_2 trapping mechanisms within formations (including dissolution in brine, reactions with minerals to form solid carbonates, and/or adsorption in porous rock), and potential environmental impacts resulting from injection of CO_2 into the formations. Potential environmental impacts resulting from CO_2 injection that still require assessment before CCS technology can be considered feasible include:

- Uncertainty concerning the significance of dissolution of CO_2 into brine,
- Risks of brine displacement resulting from large-scale CO_2 injection, including a pressure leakage risk for brine into underground drinking water sources and/or surface water,
- Risks to fresh water as a result of leakage of CO_2, including the possibility for damage to the biosphere, underground drinking water sources, and/or surface water,[12] and
- Potential effects on wildlife.

Potentially suitable storage sites, including EOR sites and saline formations, exist in Texas, Louisiana, and Mississippi. The closest EOR sites with such recognized potential for some

Reduction Method (GCCC Digital Publication #08-13) at slide 4 (Apr. 2008), available at: http://www.beg.utexas.edu/gccc/forum/codexdownloadpdf.php?ID=100(last visited Aug. 8, 2011).

[12] *Id.*

geological storage of CO_2 are located within 50 miles of the proposed project, but such nearby sites have not yet been technically demonstrated with respect to all of the suitability factors described above. In comparison, the closest site that is currently being field-tested to demonstrate its capacity for geological storage of the volume of CO_2 that would be generated by the proposed power unit, i.e., SECARB's Cranfield test site, is located in Mississippi over 260 miles away. It should be noted that, based on the suitability factors described above, currently the suitability of the Cranfield site or any other test site to store a substantial portion of the large volume of CO_2 generated by the proposed project has yet to be fully demonstrated.

5.1.3 Step 3: Rank Remaining Control Technologies

As documented above, CEMEX believes that implementation of CCS technology is currently infeasible, leaving energy efficiency measures as the only technically feasible emission control options. As all of the energy efficiency related processes, practices, and designs discussed in Section 5.1.1 of this application are being proposed for this project, a ranking of the control technologies is not necessary for this application.

5.1.4 Step 4: Evaluate Most Effective Controls and Document Results

As all of the energy efficiency related processes, practices, and designs discussed in Section 5.1.1 of this application which are technically feasible are being proposed for this project, an examination of the energy, environmental, and economic impacts of the efficiency designs is not necessary for this application.

Based on the reasons provided in Section 5.1.2 above, CEMEX believes that CCS technology should be eliminated from further consideration as a potential feasible control technology for purposes of this BACT analysis. However, to answer possible questions that the public or the EPA may have concerning the relative costs of implementing hypothetical CCS systems, a cost estimate for implementing a CCS system is provided below.

The International Energy Agency (IEA) Greenhouse Gas R&D Programme conducted a study to assess the technologies that could be used to capture CO_2 in cement plant and their associated performance and costs.[13] The technical and economic assessments were based on a new preheater/precalciner cement plant in the United Kingdom producing 1 million tonnes/year of cement (910,000 ton/yr of cement). The post combustion CO_2 capture technology chosen for the study was CO_2 absorption using monoethynolamine. The study listed the main additions to the plant for post combustion CO_2 capture as: a CO_2 capture plant including a solvent scrubber and regenerator; a compressor to increase the pressure of the CO_2 product for transport by pipeline; high efficiency flue gas desulfurization and de-NOx to satisfy the flue gas purity requirements of the CO_2 capture process; and a plant to provide the steam required for

[13] CO_2 Capture in the Cement Industry, Final Report, July 2008, Mott MacDonal, International Energy Agency Greenhouse Gas R&D Programme

regeneration of the CO_2 capture solvent. The initial capital cost for a CO_2 capture system was estimated to be $295 €/tonne cement ($401.44/ton cement at the 1.5 $/€ exchange rate used in the study). At this rate, the projected costs for installation of CO_2 capture equipment for the Balcones Kiln 1 and 2 would be $1,013,000,000. For comparison purposes, the estimated capital cost for the upgrades to the main kiln burners in Kiln No. 1 and Kiln No. 2 to multipath adjustable units is $750,000. Implementation of post combustion carbon capture system for Kilns 1 and 2 would result in initial capital costs of approximately 1,350 times higher than the projected project costs which would make the project not viable.

The average annual cost per tonne of CO_2 emissions avoided in the IEA study for CO_2 capture and compression was calculated to be 118.15 €/tonne ($146.15/ton at the 1.5 $/€ exchange rate used in the study). It was reported in the "Report of the Interagency Task Force on Carbon Capture and Storage"[14] that recent studies have shown that CO_2 pipeline transport costs for a 100 kilometer (62 mile) pipeline transporting 5 million tonnes per year range from approximately $1 per tonne to $3 per tonne ($0.91 per ton to $2.72 per ton). The distance from the CEMEX Balcones Plant to the nearest enhanced oil recovery site with a recognized potential for some geological storage of CO_2 is 50 miles. Conservatively assuming that the pipeline cost is linear, the estimate average annual cost for CO_2 transport would be $1.46/ton CO_2 avoided. It was reported in "Report of the Interagency Task Force on Carbon Capture and Storage"[15] that the costs associated with CO_2 storage have been estimated to be approximately $0.4 – 20/tonne plus $0.16 – 0.30/tonne CO_2 stored for monitoring. The average annual cost on a $/ton CO_2 storage basis for storage and monitoring would be $9.33/ton. A summary of the calculated annual costs associated with a CCS system is shown in the following table. This is a very high annual cost and would make the proposed project economically unviable if selected.

Economic Feasibility Analysis for CCS

	Cost ($/ton CO_2 Avoided)	Potential Tons of CO_2 Avoided Per Year	Total Projected Annual Cost (Million $ per Year)
Capture and Compression	$146.15/ton	2,157,593 tons/yr	$315.2
Transport	$1.46/ton	2,157,593 tons/yr	$3.2
Storage	$9.33/ton	2,157,593 tons/yr	$20.1
Total CCS System Cost	$157.04/ton		$338.1

[14]Report of the Interagency Task Force on Carbon Capture and Storage, p. 37 (Aug. 2010) (http://www.epa.gov/climatechange/policy/ccs_task_force.html)

[15]Report of the Interagency Task Force on Carbon Capture and Storage, p. 44 (Aug. 2010) (http://www.epa.gov/climatechange/policy/ccs_task_force.html)

In summary the high initial capital costs for CO_2 capture equipment and high annual average operating costs for CO_2 capture, transport, and storage would make the proposed project not economically feasible. Therefore, CCS is eliminated as a potential control option in this BACT analysis for CO_2 emissions.

5.1.5 Step 5: Select BACT

CEMEX proposes as BACT for this project, the following energy efficiency processes, practices, and designs for the proposed combined cycle combustion turbine:

- Cement Kiln Energy Efficiency
  - Kiln process control and management system
  - Kiln seal maintenance program
  - Kiln combustion system optimization
  - Kiln/Preheater insulation inspection program
  - Use of reciprocating grate clinker coolers
  - Use of in-line raw mills which recover heat from the kiln exhausts
  - Use of clinker cooler exhaust as secondary air to provide oxygen and heat to the kilns
  - Use of suspension preheater low pressure drop cyclones
  - Use of preheater/precalciner kilns
  - Use of efficient, variable frequency drives for kilns
  - Use of efficient, variable frequency drives for kiln fans
  - Use of multichannel kiln burners that allow for necessary mixing of fuel and air to complete combustion
  - Firing a portion of the fuel in the preheater riser duct
- Use of Lower GHG Emitting Fuels Including Natural Gas
- Use of Biomass Fuels

CEMEX proposes a combined BACT limit for Kilns 1 and 2 of 0.95 tons CO_{2e} per ton of clinker, rolling 12 month average. Compliance will be determined with the annual reporting of GHG emissions in accordance with 40 CFR Part 98.

CEMEX performed a search of the EPA's RACT/BACT/LAER Clearinghouse for Portland cement kilns and found no entries which address BACT for GHG emissions.
Although not listed in the RACT/BACT/LAER Clearinghouse, a GHG BACT analysis was performed by the following Portland Cement Plants: LaFarge Building Materials, Inc., Town of Coeymans, New York (commonly known as the Ravena Plant) and Universal Cement, Chicago, Illinois. A discussion of CEMEX's proposed BACT as compared to those projects is provided below:

LaFarge Ravena Plant

The proposed LaFarge project would replace the existing "wet" cement-making process at the Ravena Plant with a preheater/precalciner "dry" cement-making process. The proposed capacity of the modified plant was 2.81 million tons of clinker per year. The kiln system was designed to fire coal, petroleum coke, oil, and tire derived fuel. PSD Permit 4-0124-00001/00112 was issued on July 19, 2011. The permit included a GHG emission limit for the kiln system of 1900 pounds (0.95 tons) of CO_2 equivalent per ton of clinker, rolling 12 month average.

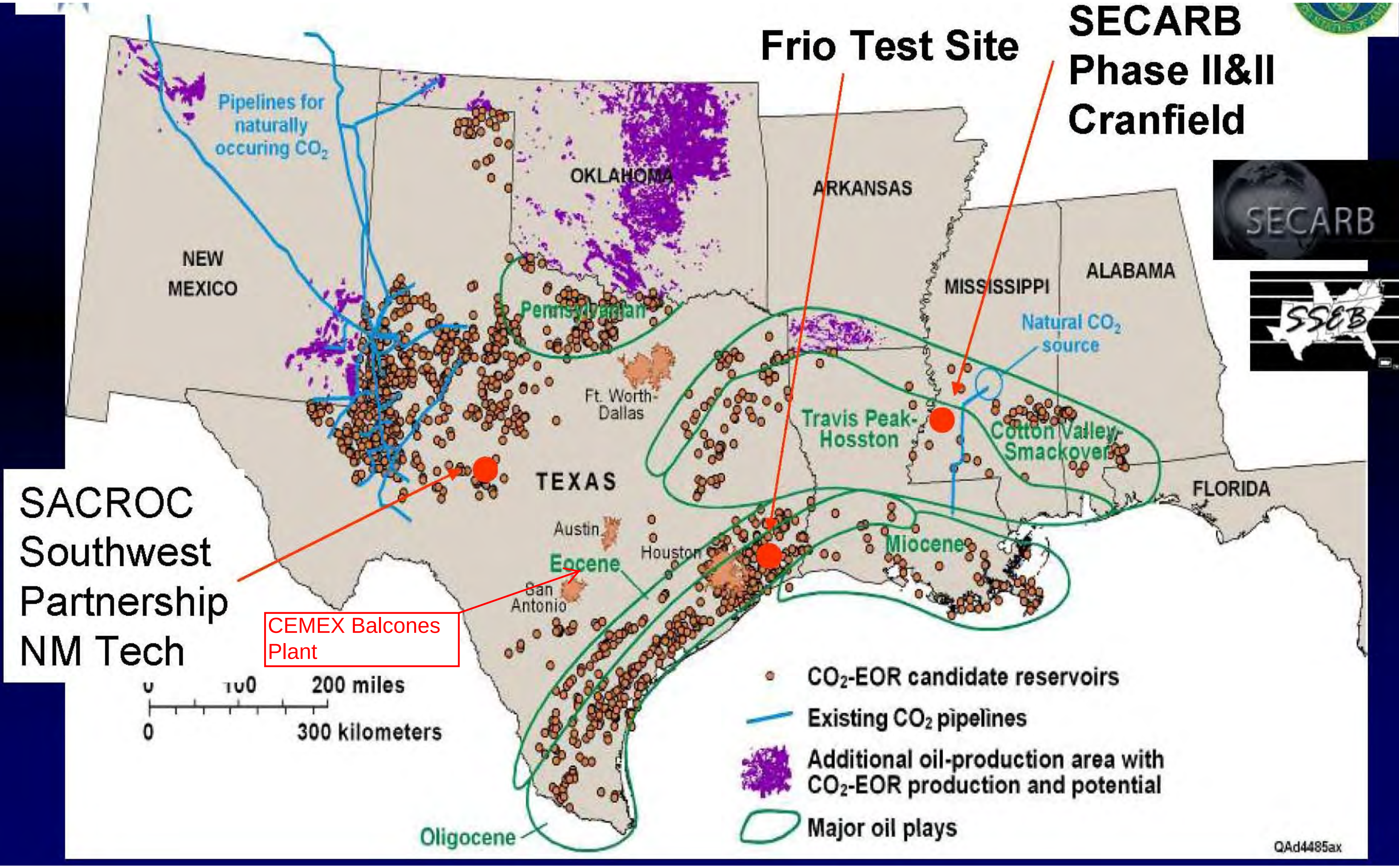
Universal Cement

Universal Cement proposed construction of a new preheater/precalciner kiln system capable of producing about 1 million tons per year of clinker. The clinker production train consists of an in-line raw mill, a blending silo, kiln system (preheat tower, precalciner, rotary kiln), clinker cooler and a solid fuel mill. Other equipment in the project includes clinker storage silos, a finish mill, and the associated raw material, solid fuel and finished product handling equipment. The kiln system was designed to fire coal and petroleum coke in the kiln and the precalciner; scrap tires, as available, in the precalciner; and natural gas or propane during kiln startup. Permit 031600GVX was issued by the Illinois Environmental Protection Agency on December 20, 2011. The permit included a GHG emission limit for the kiln system of 1860 pounds (0.93 tons) of CO_2 equivalent per ton of clinker, rolling 12 month average.

Carolinas Cement Company

Carolinas Cement Company proposed to construct a new Portland cement manufacturing facility at the site of an existing cement storage terminal near Castle Hayne, North Carolina. The proposed plant consisted of a multistage preheater-precalciner kiln with an in-line raw mill, coal mill, alkali bypass and clinker cooler venting through the main stack. Production was proposed to be 6000 tons per day (tons/day) and 2,190,000 tons per year (tons/yr) of clinker. Fuels included coal, petroleum coke, biomass fuels (organic material that is available on a renewable or recurring basis), and distillate fuel oil. Coal and petroleum coke was proposed as the primary fuels. Biomass was proposed to be utilized to the extent practical depending on performance, availability, and economic viability. Fuel oil was proposed to be used mainly for kiln startup. Permit O7300R09 was issued by the North Caroline Department of Environment and Natural Resources on February 29, 2012. The permit included a GHG emission limit for the kiln system of 0.91 tons of CO_2 equivalent per ton of clinker, rolling 12 month average, determined with procedures used for reporting GHG emissions pursuant to 40 CFR Part 98.

CEMEX's proposed BACT limit of 0.95 ton CO_2e/ton clinker is equivalent to the BACT limit for the Ravena Plant modification but slightly higher than the BACT limit for the new Universal Cement Plant and the new Carolinas Cement Company Plant. Since the CEMEX kilns are existing, it is more appropriate to compare the BACT limit to the LaFarge Plant modification rather than the new plants being proposed by Universal Cement and Carolinas Cement Company. The CEMEX Kilns 1 and 2 incorporates a lower GHG emitting fuel, natural gas, and biomass into the fuel mix for the kilns and precalciner. The LaFarge Plant is not authorized for natural gas. The Universal Plant is authorized for natural gas or propane only during kiln startup. The Carolinas Cement Plant is not authorized for natural gas. Neither the LaFarge Plant nor the Universal Plant are authorized to fire biomass. The Carolinas Cement Plant proposed to utilize biomass to the extent practical depending on performance, availability, and economic viability.


Frio Test Site
SECARB
Phase II&II
Cranfield
SACROC
Southwest
Partnership
NM Tech
CEMEX Balcones
Plant
Pipelines for
naturally
occuring CO_2
NEW
MEXICO
OKLAHOMA
ARKANSAS
MISSISSIPPI
ALABAMA
FLORIDA
TEXAS
Ft. Worth-
Dallas
Austin
San
Antonio
Houston
Pennsylvanian
Eocene
Oligocene
Miocene
Travis Peak-
Hosston
Cotton Valley-
Smackover
Natural CO_2
source
200 miles
300 kilometers
0
CO_2-EOR candidate reservoirs
Existing CO_2 pipelines
Additional oil-production area with
CO_2-EOR production and potential
Major oil plays
QAd4485ax
SECARB
SSEB

6.0 OTHER PSD REQUIREMENTS

6.1 IMPACTS ANALYSIS

An impacts analysis is not being provided with this application in accordance with EPA's recommendations:

> *Since there are no NAAQS or PSD increments for GHGs, the requirements in sections 52.21(k) and 51.166(k) of EPA's regulations to demonstrate that a source does not cause contribute to a violation of the NAAQS are not applicable to GHGs. Therefore, there is no requirement to conduct dispersion modeling or ambient monitoring for CO_2 or GHGs.*[16]

6.2 GHG PRECONSTRUCTION MONITORING

A pre-construction monitoring analysis for GHG is not being provided with this application in accordance with EPA's recommendations:

> *EPA does not consider it necessary for applicants to gather monitoring data to assess ambient air quality for GHGs under section 52.21(m)(1)(ii), section 51.166(m)(1)(ii), or similar provisions that may be contained in state rules based on EPA's rules. GHGs do not affect "ambient air quality" in the sense that EPA intended when these parts of EPA's rules were initially drafted. Considering the nature of GHG emissions and their global impacts, EPA does not believe it is practical or appropriate to expect permitting authorities to collect monitoring data for purpose of assessing ambient air impacts of GHGs.*[17]

6.3 ADDITIONAL IMPACTS ANALYSIS

A PSD additional impacts analysis is not being provided with this application in accordance with EPA's recommendations:

> *Furthermore, consistent with EPA's statement in the Tailoring Rule, EPA believes it is not necessary for applicants or permitting authorities to assess impacts from GHGs in the context of the additional impacts analysis or Class I area provisions of the PSD regulations for the following policy reasons. Although it is clear that GHG emissions contribute to global warming and other climate changes that result in impacts on the environment, including impacts on Class I areas and soils and vegetation due to the global scope of the problem, climate change modeling and evaluations of risks and impacts of GHG emissions is typically conducted for changes in emissions orders of magnitude larger than the emissions from individual projects that might be analyzed in PSD permit reviews. Quantifying the exact impacts attributable to a specific GHG source obtaining a permit in specific places and points would not be possible with*

[16] EPA, *PSD and Title V Permitting Guidance For Greenhouse Gases* at 48-49.

[17] *Id.* at 49.

current climate change modeling. Given these considerations, GHG emissions would serve as the more appropriate and credible proxy for assessing the impact of a given facility. Thus, EPA believes that the most practical way to address the considerations reflected in the Class I area and additional impacts analysis is to focus on reducing GHG emissions to the maximum extent. In light of these analytical challenges, compliance with the BACT analysis is the best technique that can be employed at present to satisfy the additional impacts analysis and Class I area requirements of the rules related to GHGs.[18]

[18] *Id.*

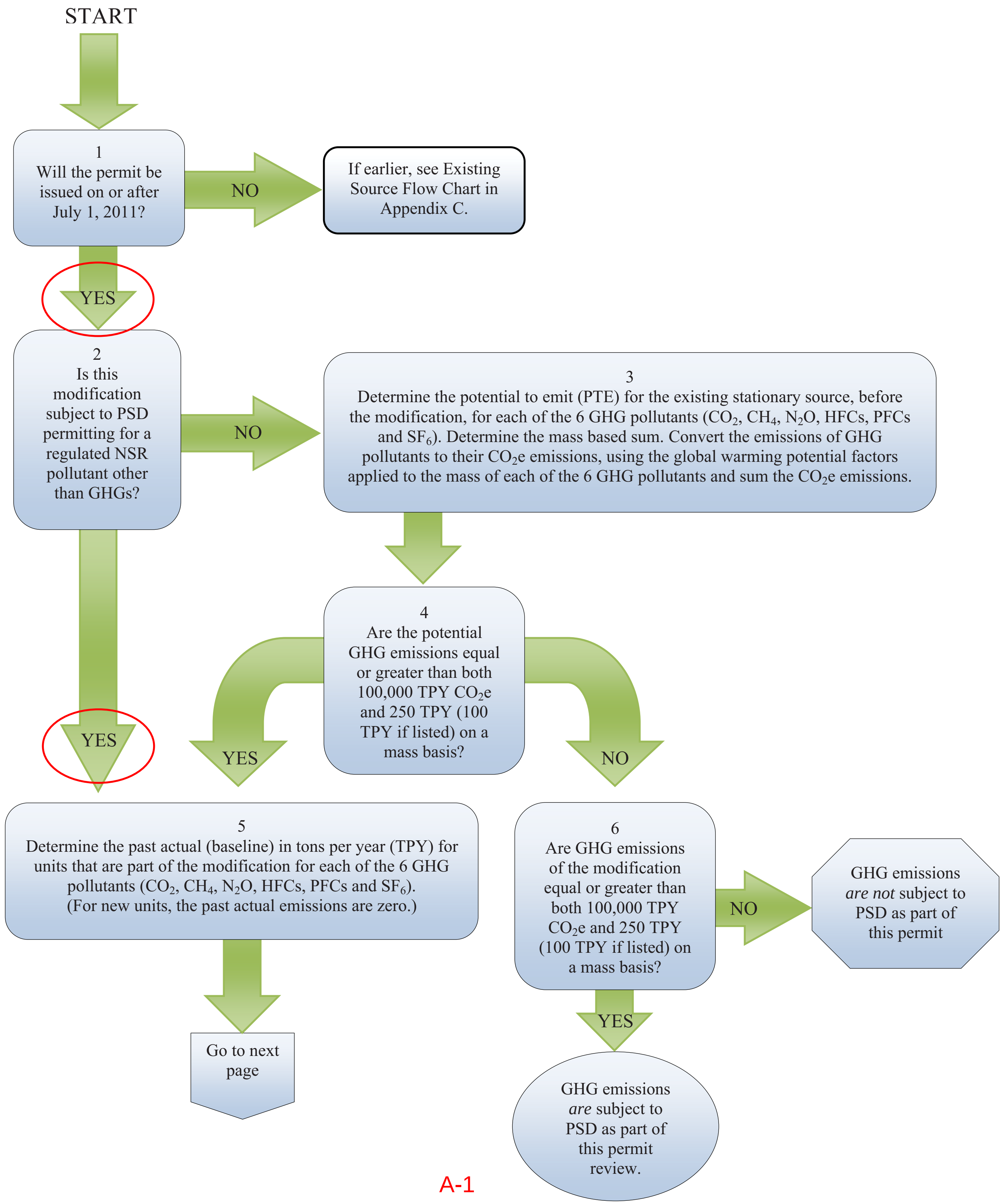
7.0 PROPOSED GHG MONITORING PROVISIONS

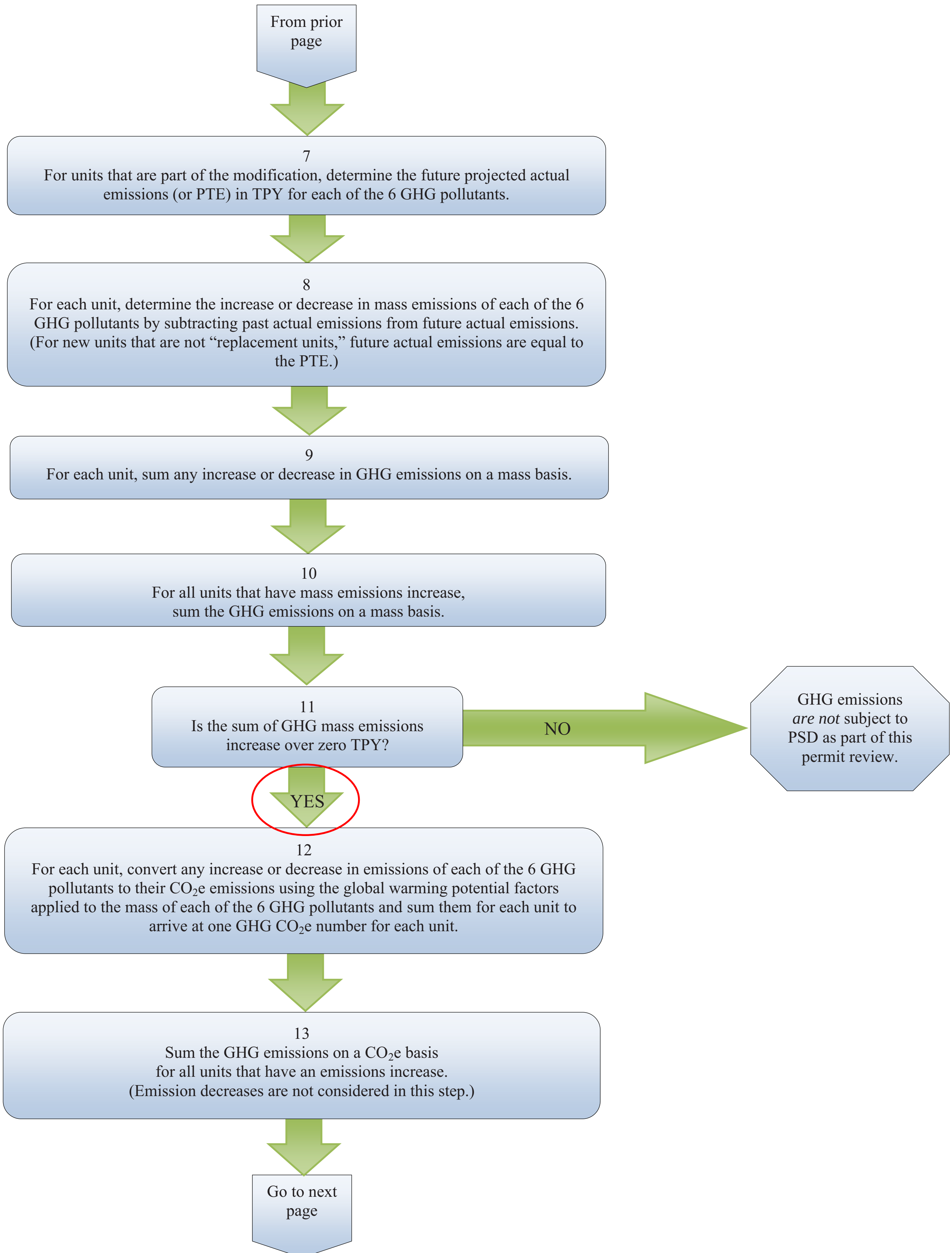
Kilns 1 and 2 currently have CO_2 continuous emission monitors that measure CO_2 emissions in the kiln stacks. Emissions of CH_4 and N_2O are calculated based on measured fuel inputs for each of the authorized fuels and multiplying by fuel specific emission factors from Table C-2 of the Mandatory Greenhouse Gas Reporting Rules, 40 CFR 98, Appendix C.

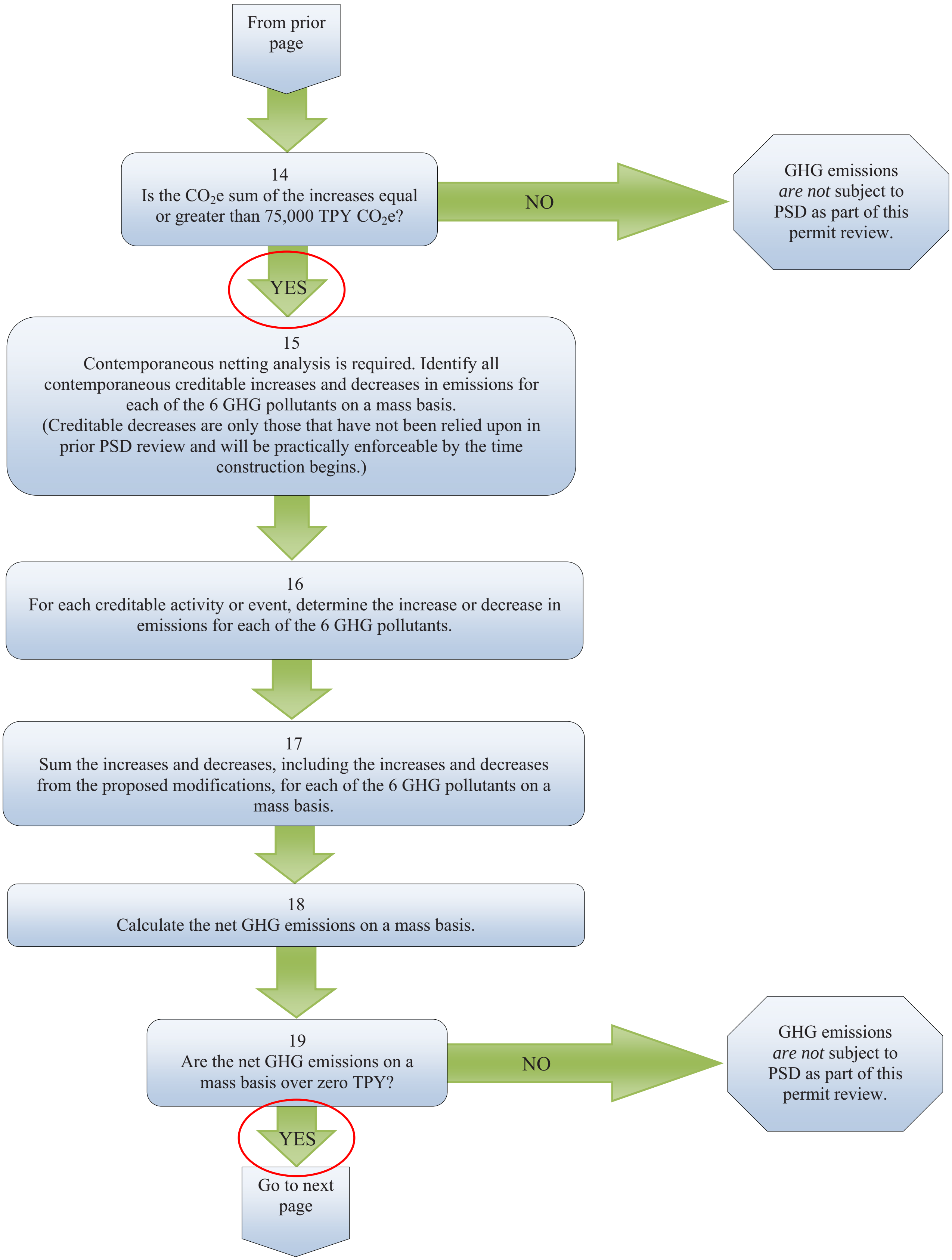
APPENDIX A

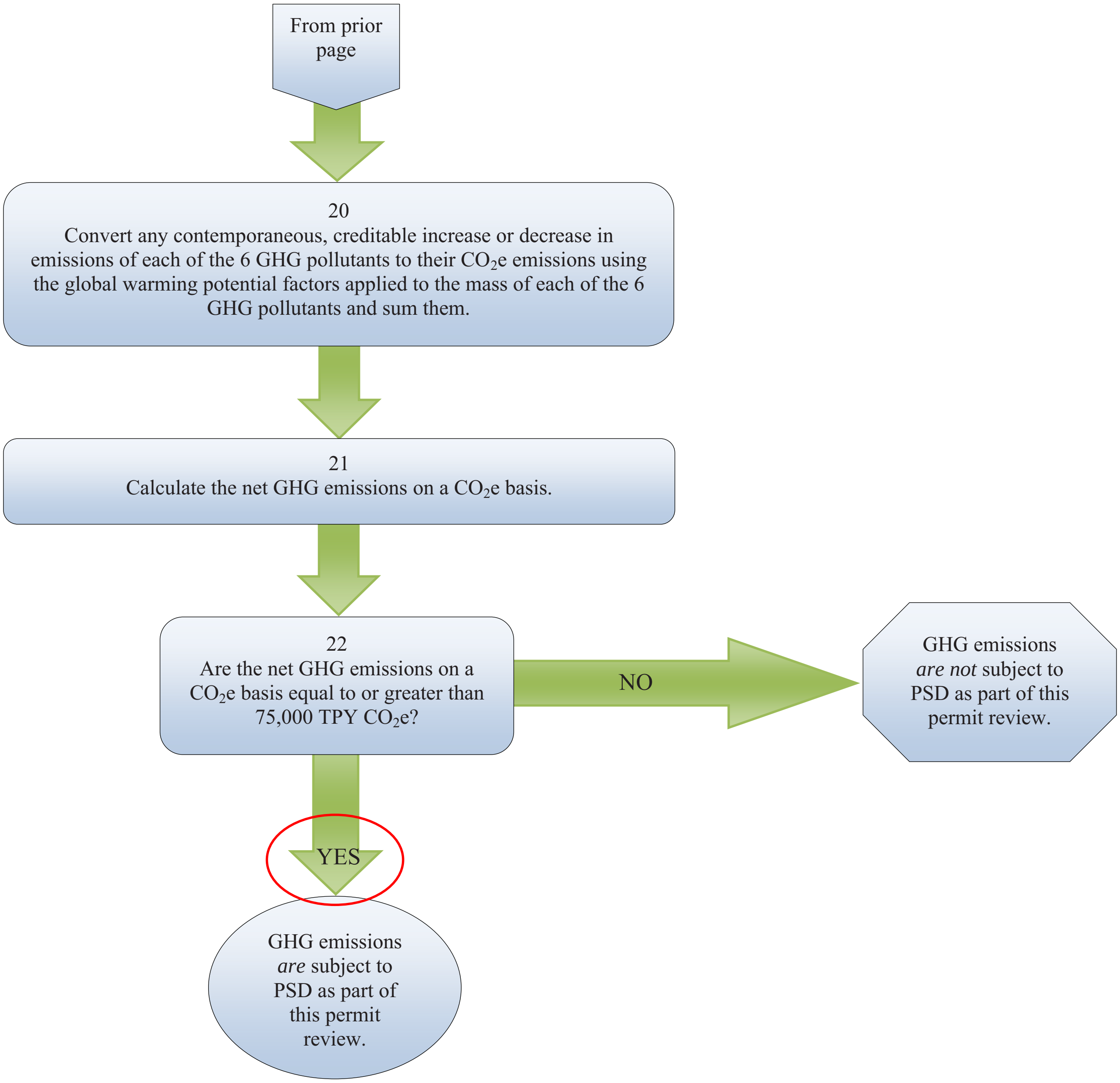
GHG PSD APPLICABILITY FLOWCHART – EXISTING SOURCES

GHG Applicability Flowchart – Modified Sources
(On or after July 1, 2011)




From prior page
7
For units that are part of the modification, determine the future projected actual emissions (or PTE) in TPY for each of the 6 GHG pollutants.
8
For each unit, determine the increase or decrease in mass emissions of each of the 6 GHG pollutants by subtracting past actual emissions from future actual emissions. (For new units that are not "replacement units," future actual emissions are equal to the PTE.)
9
For each unit, sum any increase or decrease in GHG emissions on a mass basis.
10
For all units that have mass emissions increase, sum the GHG emissions on a mass basis.
11
Is the sum of GHG mass emissions increase over zero TPY?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
12
For each unit, convert any increase or decrease in emissions of each of the 6 GHG pollutants to their CO_2e emissions using the global warming potential factors applied to the mass of each of the 6 GHG pollutants and sum them for each unit to arrive at one GHG CO_2e number for each unit.
13
Sum the GHG emissions on a CO_2e basis for all units that have an emissions increase. (Emission decreases are not considered in this step.)
Go to next page


From prior page
14
Is the CO_2e sum of the increases equal or greater than 75,000 TPY CO_2e?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
15
Contemporaneous netting analysis is required. Identify all contemporaneous creditable increases and decreases in emissions for each of the 6 GHG pollutants on a mass basis.
(Creditable decreases are only those that have not been relied upon in prior PSD review and will be practically enforceable by the time construction begins.)
16
For each creditable activity or event, determine the increase or decrease in emissions for each of the 6 GHG pollutants.
17
Sum the increases and decreases, including the increases and decreases from the proposed modifications, for each of the 6 GHG pollutants on a mass basis.
18
Calculate the net GHG emissions on a mass basis.
19
Are the net GHG emissions on a mass basis over zero TPY?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
Go to next page


From prior page
20
Convert any contemporaneous, creditable increase or decrease in emissions of each of the 6 GHG pollutants to their CO_2e emissions using the global warming potential factors applied to the mass of each of the 6 GHG pollutants and sum them.
21
Calculate the net GHG emissions on a CO_2e basis.
22
Are the net GHG emissions on a CO_2e basis equal to or greater than 75,000 TPY CO_2e?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
GHG emissions *are* subject to PSD as part of this permit review.

February 6, 2013 VIA EMAIL

Ms. Erica LeDoux
Multimedia Planning and Permitting Division
U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

RE: Response to Application Completeness Comments
CEMEX Construction Materials South, LLC
Greenhouse Gas Prevention of Significant Deterioration Permit
CEMEX Balcones Cement Plant
New Braunfels, Comal County, Texas

Dear Ms. LeDoux:

The following is a response to questions/requests raised during our call on January 16, 2013 and in the email from Suran Peiris in that same day regarding the above referenced Greenhouse Gas Prevention of Significant Deterioration permit application for the CEMEX Construction Materials South, LLC (CEMEX) Balcones Cement Plant located in New Braunfels, Texas. The questions and requests are repeated below followed by responses.

1. Please revise the process flow diagram (PFD) and resubmit. The PFD needs to identify all GHG EPN & equipment and needs to clarify heat recovery and add exhaust stack. Please make the process description and PFD consistent and easily understood by the general public.

   Attached in the revised permit application are revised PFDs that should be more clearly understandable for the general public. These PFDs identify all GHG related emission points and equipment and are consistent with the revised written process description (revised Section 2.1 of application).

2. Discuss GHG start-up emissions in the application.

During kiln start-up there is a period of time where fuel is being combusted to warm up the system and no clinker is being produced. The actual GHG emissions on a lb/hr basis will be lower during startup than during normal operation because less fuel is being combusted. The revised Section 3.0 of the attached application contains this information.

3. Explain how hourly clinker production is calculated.

The CEMEX Balcones plant calculates clinker production using the methods outlined in 40 CFR 63.1350(d)(ii). A weigh scale system is used to measure and record the amount of feed to the kiln. The hourly clinker production is calculated using a kiln specific feed to clinker ratio based on reconciled clinker production determined for accounting purposes and recorded feed rates. This ratio is updated monthly.

4. Provide Carbon content for all fuels.

For this application, we used default emission factors from Table C-1 of Subpart C of 40 CFR Part 98 (copy attached) for calculation of GHG emissions from combustion of fuel.

5. Please provide data on measurement of fuel consumption

Natural gas fuel usage is measured via flow meter. Solid fuel usage is measured using weigh feeders.

<u>Responses regarding Suran's additional concerns</u>

6. Was 8760 hours used for calculating the emissions due to firing of 100% Petroleum Coke? How is 100% Petroleum Coke justified when a mixture of fuels including biofuels with lower calorific values is used.

Kilns 1 and 2 are currently authorized by Air Permit 6048/PSD-TX-74M1 to fire the following fuels in the kiln/preheater system: natural gas, coal, petroleum coke, wood, tire derived fuel, other rubber products, and other alternative fuels including carpet products, non-asbestos containing shingles, construction and demolition waste, oil filter fluff, oily rags, oily wood, paper, cardboard, rick husks, and cotton gin residue.

The GHG calculations in Table 3-2 were based on firing 100% petroleum coke because the kilns are currently authorized to fire 100% petroleum coke and petroleum coke is the higher GHG emitting fuel of the fuel mix options on a lb per heat input basis. Cemex cannot commit to firing a specific fuel mixture over the course of a year because fuel mixture is

zephyr

dictated by fuel costs, fuel availability, fuel reliability, and fuel quality and potential effects on the kiln system stability and clinker/cement quality.

This is consistent with the GHG permits issued for LaFarge Ravena Plant, Universal Cement, and Carolinas Cement Company. None of those three GHG permits had a specific fuel mixture requirement. However, the CEMEX Kilns 1 and 2 has more options for lower GHG emitting fuels in its fuel mix than the LaFarge Ravena Plant, Universal Cement, and Carolinas Cement Company. The Cemex fuel mixture incorporates a lower GHG emitting fuel, natural gas, and biomass into the fuel mix for the kilns and precalciner. The LaFarge Plant is not authorized for natural gas. The Universal Plant is authorized for natural gas or propane only during kiln startup. The Carolinas Cement Plant is not authorized for natural gas. Neither the LaFarge Plant nor the Universal Plant are authorized to fire biomass. The Carolinas Cement Plant proposed to utilize biomass to the extent practical depending on performance, availability, and economic viability.

7. Please clarify how the factor of 0.54 ton CO_2/ton clinker shown in the table of GHG emissions from Limestone Calcination was derived.

The estimated CO_2 emissions from the calcination process are based on the 2011 GHG annual inventory for the Cemex Balcones Plant. Total CO_2 emissions for each kiln are measured in the respective kiln stack with a CO_2 continuous emission monitor. The CO_2 emissions due combustion of fuel for each kiln were calculated based on the measured annual fuel flow for each specific fuel times the fuel specific GHG emission factor from 40 CFR 98, Table C-1. The ton CO_2/ton clinker due to calcination for each kiln was calculated as follows:

Total annual CO2 emissions measured by CO2 CEMs (tons) – total annual calculated CO2 emissions due to fuel combustion (tons) / annual clinker production (tons)

If you have any questions about this information, please contact me by email at lmoon@zephyrenv.com or telephone at (512) 879-6619 or Ms. Kimberly Bradley of Cemex by email at kimberlyb.bradley@cemex.com or by telephone at (713)722-1710.

Sincerely,
ZEPHYR ENVIRONMENTAL CORPORATION

Larry G. Moon

Larry Moon, P.E.
Principal

cc: Ms. Kimberley Bradley, Director, Environmental - US Operations , CEMEX- Via email
Mr. Lee Cover, Environmental Manager, Balcones Plant – Via email

zephyr

November 16, 2012

Ms. Melanie Magee
Multimedia Planning and Permitting Division
U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

RE: Response to Application Completeness Comments
CEMEX Construction Materials South, LLC
Greenhouse Gas Prevention of Significant Deterioration Permit
CEMEX Balcones Cement Plant
New Braunfels, Comal County, Texas

Dear Ms. Magee:

This is in response to Mr. Carl Edlund's, P.E. letter of September 20, 2012 in which he requested additional information regarding the above referenced Greenhouse Gas Prevention of Significant Deterioration permit application for the CEMEX Construction Materials South, LLC (CEMEX) Balcones Cement Plant located in New Braunfels, Texas. The questions are repeated below followed by responses.

1. Please provide a process flow diagram that identifies all GHG emission units with corresponding emission source numbers (EPNs), i.e., fugitive and maintenance, startup and shutdown emissions.

   A process flow diagram is attached in Attachment A to this letter.

2. The proposed BACT limit presented in Table 3-1 entitled *Kiln CO_2e Emissions Calculations* of the permit application for Kiln No. 1 is 3,250 tons Clinker/day (30 day average), 1900 CO_2e lb/ton (12 month rolling average) and Kiln No.2 is 3,960 tons Clinker/day (30 day average), 1900 CO_2e lb/ton (12 month rolling average). What is the company's proposed compliance monitoring methodology for this limit?

   CO_2 emission from Kilns 1 and 2 are measured with CO_2 continuous emission monitors (CEMs) which were installed in accordance with the Mandatory Greenhouse Gas Reporting Rules, 40 CFR 98. Emissions of CH_4 and N_2O are calculated based on measured fuel usage and emission factors in 40 CFR 98, Table C-2.

3. On page 24 of the permit application, it states "Process gas analyzers are used by control room operators to monitor CO and O_2 levels to insure efficient combustion." Please provide supplemental data on the control scheme of the CO and O_2 analyzers and how it is used to insure efficient combustion. What are the proposed monitoring requirements for the kilns operating parameters? How will the air/fuel ratio be assured during operation of the kiln, i.e., alarms, alerts, continuous monitoring, etc? Is there an optimal air/fuel ratio? Also, on page 41 of the permit application, it is stated that "Kilns 1 and 2 currently have $C0_2$ continuous emission monitors (CEMs) that measure CO_2 emissions in the kiln stacks." Is CEMEX's preferred monitoring method for the kilns the use of the current CO_2 CEMs?

   The optimum air to fuel ratio varies depending on many factors or conditions in the kiln, such as fuel type, fuel calorific value, volatile matter content, the kiln feed burnability/chemistry, volatile recirculation in the kiln. The CO and O_2 analyzers are process analyzers and are not certified continuous emission monitors. Those analyzers are used as a visual aid for the kiln operators to efficiency burn the fuel and ensure a quality clinker product. The CO_2 CEMs is the preferred monitoring method for the kilns.

4. On page 24 of the permit application, it states "The calciner fuel rate is automatically controlled based on the stage 5 temperature and the kiln main burner is adjusted by the operator depending on the oxygen levels, kiln burning zone temperature and clinker quality." Please explain what is the "stage 5 temperature"? Please provide supplemental data that discusses how often previously mentioned operating parameters (e.g., oxygen, kiln burning zone temperature and clinker quality) are evaluated to determine fuel adjustments. Is this continuously monitored? Are there manual overrides?

   The Stage 5 temperature refers to the temperature of the exit gas out of the lower preheater cyclone. This is the last preheater cyclone before the feed material goes into the kiln. The temperature is monitored as an indication that the raw material is adequately prepared before entering the kiln, as determined by the internal quality control laboratory. The temperature is monitored continuously and is used to control the raw material feed rate. The feed rate can be controlled manually if the operator deems it is necessary to make a correction.

5. Please provide a 5-step BACT analysis for fugitives that include a comprehensive evaluation of alternative technologies for detection and repair to minimize leaks or other LDAR programs considered to reduce methane fugitive emissions and a basis for elimination. The technologies could include, but are not limited to, the following:

   - Installing leakless technology components to eliminate fugitive emission sources;
   - implementing an alternative monitoring program using a remote sensing technology such as infrared camera monitoring;

- Designing and constructing facilities with high quality components and materials of construction;
- Monitoring of flanges for leaks;
- Using a lower leak detection level for components

There are no new natural gas piping components being installed as a result of this project. Therefore, a BACT analysis for natural gas piping component fugitives is not being submitted with this application.

5. Please provide supplemental technical data to support the GHG emission rates presented in Table 3-1. Please provide all emission data and calculations that were used to derive these emission rates. Please include all bases or rationales used in the calculations for the affected and/or modified sources. Please include emission calculations by source (i.e., kiln, preheater, etc.). Also, include fuel rates and/or beat input factors that were used in these calculations.

GHG emission calculations for Kilns 1 and 2 are provided in Table 3-2 in Attachment B to this letter. These are the only GHG emitting emission sources which are being modified in this project. The calculations are based on firing 100% petroleum coke, which provides a worst-case estimate for GHG emissions.

If you have any questions about this information, please contact me by email at lmoon@zephyrenv.com or telephone at (512) 879-6619 or Ms. Kimberly Bradley of Cemex by email at kimberlyb.bradley@cemex.com or by telephone at (713)722-1710.

Sincerely,
ZEPHYR ENVIRONMENTAL CORPORATION

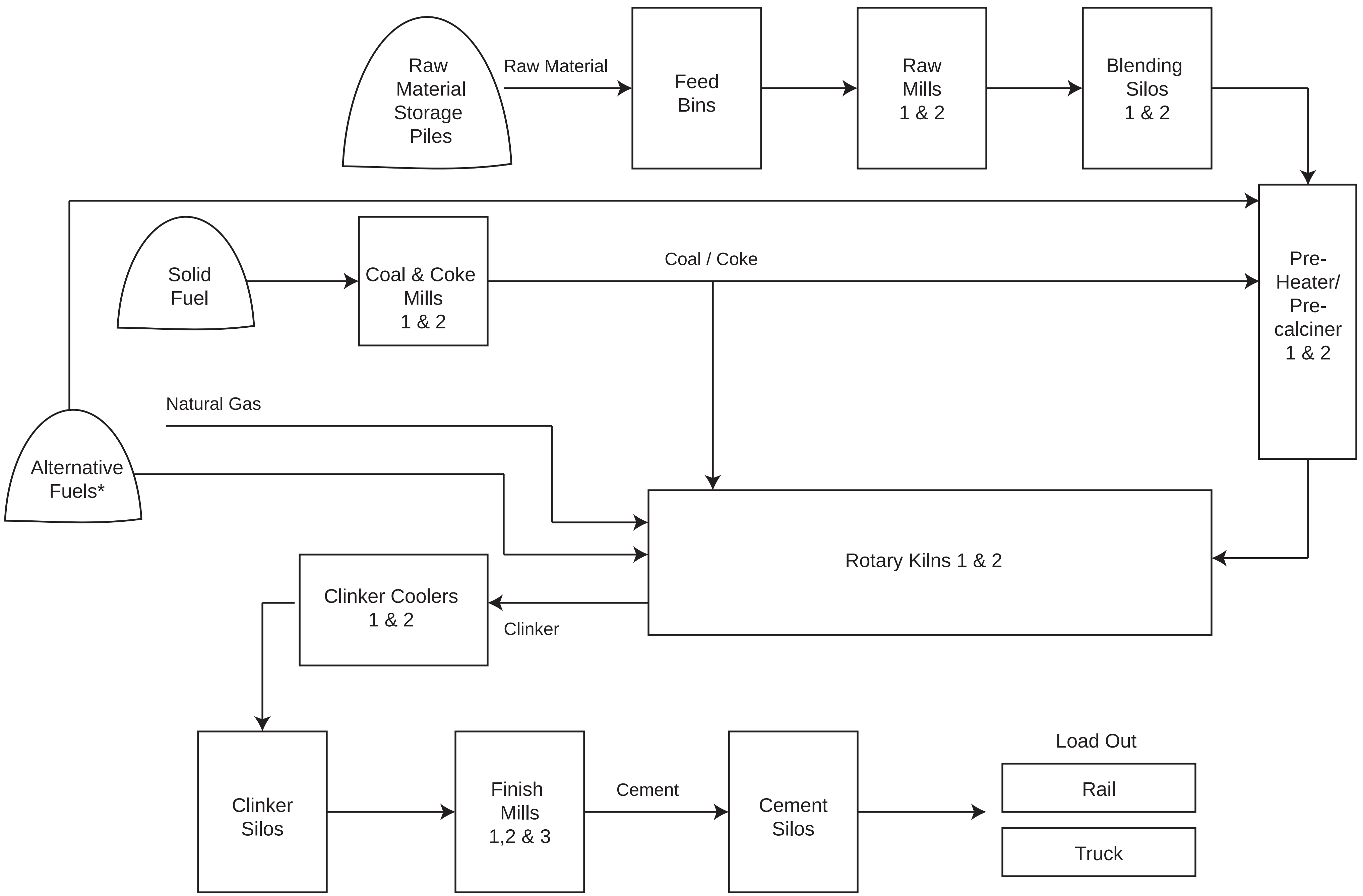
Larry G. Moon

Larry Moon, P.E.
Principal

cc: Ms. Kimberley Bradley, Director, Environmental - US Operations , CEMEX

ATTACHMENT A

PROCESS FLOW DIAGRAM



*Alternative Fuel Categories Include:
- Tires and rubber products
- Wood products
- Construction and demolition debris
- Textiles
- Agricultural products
- Engineered sharps (incl. plastic)
- Rubberized Asphalt

zephyr

PROCESS FLOW DIAGRAM

CEMEX BALCONES CEMENT PLANT
New Braunfels, Texas

H:\Cemex\Balcones\10537 Graphics

Drafted By:	Reviewed By:	Project No.:	Date:
J. Knowles	A. de la Garza	010537	11.16.2012

ATTACHMENT B

TABLE 3-2 GHG EMISSION CALCULATIONS

Table 3-2
CEMEX Construction Material South, LLC
Balcones Cement Plant
Kiln CO_2e Emissions Calculations

GHG Emissions from fuel firing

EPN	Maximum Heat Input (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[1, 2]	GHG Mass Emissions (tpy)	Global Warming Potential[3]	CO_2e (tpy)
Kiln 1	4,102,239	CO_2	102.41	463,088	1	463,088
		CH_4	1.1E-02	49.74	21	1,044.6
		N_2O	1.6E-03	7.24	310	2,242.9
				463,145		466,375
Kiln 2	4,998,420	CO_2	102.41	564,254	1	564,254
		CH_4	1.1E-02	60.61	21	1,272.8
		N_2O	1.6E-03	8.82	310	2,732.8
			Totals	564,324		568,260

GHG Emissions from Limestone Calcination

	Clinker Production tons/yr	Calcination Emission Factor[4] ton CO2/ton clinker	CO2 (tpy)	GHG Mass Emissions (tpy)	CO_2e (tpy)
Kiln 1	1,137,500	0.54	614,250.0	1	614,250
Kiln 2	1,386,000	0.54	748,440.0	1	748,440

Total Kiln GHG Emissions

	CO_2 (tpy)	CO_2e (tpy)
Kiln 1	1,077,395	1,080,625
Kiln 2	1,312,764	1,316,700

<u>Note</u>

1. Based on firing 100% petroleum coke which provides a worst case estimate of GHG emissions
2. *Factors from Table C-1 and C-2 of 40 CFR Part 98, Mandatory Greenhouse Gas Reporting.*
3. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*
4. Developed from Balcones Plant 2011 CO_2 monitoring data (total CEMs measured CO_2 - CO_2 calculated from fuel combustion / clinker production)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

SEP 20 2012

Mr. Jimmy Rabon
Plant Manager
CEMEX Construction Materials South, LLC
2580 Wald Road
New Braunfels, TX 78132

RE: Application Completeness Determination for CEMEX Construction Materials South, LLC
Greenhouse Gas Prevention of Significant Deterioration Permit
CEMEX Balcones Cement Plant, New Braunfels, Comal County, Texas

Dear Mr. Rabon:

This letter is in response to your application received by this office on July 16, 2012, for a Greenhouse Gas (GHG) Prevention of Significant Deterioration (PSD) permit. After our initial review of the application and supporting information, we have determined that this application is incomplete based on the requirements of 40 CFR 124 and additional information is required to begin the processing of the application. Enclosed is a list of the information required (see Enclosure).

Upon receipt of the additional information, the Environmental Protection Agency (EPA) will prepare a completeness determination. The requested information is necessary for EPA to develop a Statement of Basis and Rationale for the terms and conditions for the requisite permit. As we develop our preliminary determination, it may be necessary for EPA to request additional clarifying or supporting information. If the supporting information substantially changes the original scope of the permit application, an amendment or new application may be required.

Although not required as a part of our completeness determination, the EPA may not issue a final permit without determining that there will be no effects on endangered species or until it has completed consultation under Section 7 of the Endangered Species Act(16 USC 1536). In addition, the EPA must undergo consultation pursuant to Section 106 of the National Historic Preservation Act (16 USC 470f). To expedite these consultations, the EPA requests that permit applicants provide a Biological Assessment and a cultural resources report covering the project and action area.

If you have any questions concerning the review of your application, please contact Melanie Magee of my staff at (214) 665-7161.

Sincerely yours,

Carl E. Edlund, P.E.
Director
Multimedia Planning and
Permitting Division

Enclosure

cc: Mr. Mike Wilson, P.E.
Director, Air Permits Division
Texas Commission on Environmental Quality

ENCLOSURE

EPA Completeness Comments
CEMEX Construction Materials South, LLC
Application for Greenhouse Gas Prevention of Significant Deterioration Permit
CEMEX Balcones Cement Plant, New Braunfels, Comal County, Texas

1. Please provide a process flow diagram that identifies all GHG emission units with corresponding emission source numbers (EPNs), i.e., fugitive and maintenance, startup and shutdown emissions.

2. The proposed BACT limit presented in Table 3-1 entitled *Kiln CO_2e Emissions Calculations* of the permit application for Kiln No.1 is 3,250 tons Clinker/day (30 day average), 1900 CO_2e lb/ton (12 month rolling average) and Kiln No. 2 is 3960 tons Clinker/day (30 day average), 1900 CO_2e lb/ton (12 month rolling average). What is the company's proposed compliance monitoring methodology for this limit?

3. On page 24 of the permit application, it states "Process gas analyzers are used by control room operators to monitor CO and O_2 levels to insure efficient combustion." Please provide supplemental data on the control scheme of the CO and O_2 analyzers and how it is used to insure efficient combustion. What are the proposed monitoring requirements for the kiln's operating parameters? How will the air/fuel ratio be assured during operation of the kiln, i.e., alarms, alerts, continuous monitoring, etc? Is there an optimal air/fuel ratio? Also, on page 41 of the permit application, it is stated that "Kilns 1 and 2 currently have CO_2 continuous emission monitors (CEMs) that measure CO_2 emissions in the kiln stacks." Is CEMEX's preferred monitoring method for the kilns the use of the current CO_2 CEMs?

4. On page 24 of the permit application, it states "The calciner fuel rate is automatically controlled based on the stage 5 temperature and the kiln main burner is adjusted by the operator depending on the oxygen levels, kiln burning zone temperature and clinker quality." Please explain what is the "stage 5 temperature"? Please provide supplemental data that discusses how often previously mentioned operating parameters (e.g., oxygen, kiln burning zone temperature and clinker quality) are evaluated to determine fuel adjustments. Is this continuously monitored? Are there manual overrides?

5. Please provide a 5-step BACT analysis for fugitives that include a comprehensive evaluation of alternative technologies for detection and repair to minimize leaks or other LDAR programs considered to reduce methane fugitive emissions and a basis for elimination. The technologies could include, but are not limited to, the following:

    - Installing leakless technology components to eliminate fugitive emission sources;
    - Implementing an alternative monitoring program using a remote sensing technology such as infrared camera monitoring;
    - Designing and constructing facilities with high quality components and materials of construction;
    - Monitoring of flanges for leaks;
    - Using a lower leak detection level for components

6. Please provide supplemental technical data to support the GHG emission rates presented in Table 3-1. Please provide all emission data and calculations that were used to derive these emission rates. Please include all bases or rationales used in the calculations for the affected and/or modified sources. Please include emission calculations by source (i.e., kiln, preheater, etc). Also, include fuel rates and/or heat input factors that were used in these calculations.

Proposed Clinker Production Increase at the CEMEX Construction Materials South, LLC, Balcones Cement Plant, Comal County, Texas

Cultural Resources Review

Prepared for:

zephyr

Zephyr Environmental Corporation
11200 Westheimer Road, Suite 600
Houston, Texas 77042

Prepared by:

Horizon Environmental Services, Inc.

Horizon Environmental Services, Inc.
1507 South IH 35
Austin, Texas 78741

HJN 080122.39 AR

November 2012

ABSTRACT

Horizon Environmental Services, Inc. (Horizon), has been contracted to provide a cultural resources background review for the proposed upgrade of the existing Balcones Cement Plant located at 2580 Wald Road, New Braunfels, Comal County, Texas, 78132. The Balcones Cement Plant is owned and operated by CEMEX Construction Materials South, LLC (CEMEX), and the existing CEMEX facility consists of 2 cement kilns, raw and finish mills, clinker coolers, and ancillary material transfer equipment. CEMEX is proposing to authorize the use of additional alternate fuels for both cement kilns (Kiln Nos. 1 and 2), including engineered “Sharps” (including plastic) and rubberized asphalt; to increase Kiln No. 2 clinker production; and to authorize upgrades to the main kiln burners in Kiln Nos. 1 and 2 to multipath adjustable units. The production upgrades would improve kiln fuel efficiency; however, CEMEX is not proposing a production increase related to this upgrade, no physical changes to the existing kiln system would be required, and no ground disturbance would be required to install the upgrades to the existing kilns.

As the proposed upgrades would require a Prevention of Significant Deterioration (PSD) permit issued by the US Environmental Protection Agency (EPA), the undertaking falls under the regulations of Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, which is invoked when federal funds are utilized or when federal permitting is required for a proposed project. The NHPA states that the Advisory Council for Historic Preservation (ACHP) and the Texas Historical Commission (THC), which serves as the State Historic Preservation Office (SHPO) for the state of Texas, must be afforded the opportunity to comment when any cultural resources potentially eligible for inclusion in the National Register of Historic Places (NRHP) are present in a project area affected by federal agency actions or covered under federal permits or funding.

In November 2012, Horizon conducted a cultural resources background review for the proposed project. The background review examined an area extending 1.0 mile from the proposed kiln site. Two previously recorded archeological sites, 41CM107 and 41CM332, are located within the 1.0-mile review radius; however, both of these sites are located outside the proposed kiln upgrade location. Both sites were recommended as ineligible for listing on the NRHP and/or for designation as State Archeological Landmarks (SAL) when they were originally recorded in 1978 and 2011, respectively, and both sites have been either largely or entirely destroyed from prior industrial development. Neither site would be affected by the

proposed undertaking. No cemeteries, listed NRHP properties or districts, or SALs were identified within the 1.0-mile review radius or at the location of the proposed kiln upgrades.

Furthermore, the location of the 2 existing cement kilns on the Balcones Cement Plant was surveyed for cultural resources in 1978 in connection with a US EPA undertaking prior to construction of the existing facility. No cultural resources were recorded at the location of the kilns during this prior survey.

Based on the extent of prior disturbances on the proposed project site resulting from construction of the existing Balcones Cement Plant and its ancillary facilities and the limited scope of the proposed upgrades to the 2 existing cement kilns, the proposed undertaking would have no potential to adversely affect any significant cultural resources. The portion of the Balcones Cement Plant in which the 2 existing cement kilns are located was surveyed for cultural resources in 1978 prior to construction of the plant, and no cultural resource sites were recorded at this location. It is Horizon's opinion that the proposed project site does not require any further cultural resources investigations and that no archeological or historic properties that are listed on, eligible for, or potentially eligible for inclusion in the NRHP would be adversely affected.

TABLE OF CONTENTS

Chapter		Page
	ABSTRACT	i
1.0	INTRODUCTION	1
2.0	ENVIRONMENTAL SETTING	3
	2.1 Physiography and Hydrology	3
	2.2 Geology and Geomorphology	3
	2.3 Climate	3
	2.4 Flora and Fauna	4
3.0	CULTURAL BACKGROUND	5
	3.1 PaleoIndian Period (ca. 12,000 to 8500 B.P.)	5
	3.2 Archaic Period (ca. 8500 to 1200 B.P.)	6
	3.3 Late Prehistoric Period (ca. 1200 to 350 B.P.)	6
	3.4 Historic Period (ca. 350 B.P. to Present)	6
4.0	ARCHIVAL RESEARCH	11
5.0	SUMMARY AND RECOMMENDATIONS	13
	5.1 Eligibility Criteria for Inclusion in the National Register of Historic Places	13
	5.2 Summary and Recommendations	15
6.0	REFERENCES CITED	17

APPENDIX A: Project Area Location Maps
APPENDIX B: Project Area Overview Photographs
APPENDIX C: Russ Brownlow Resume

1.0 INTRODUCTION

Horizon Environmental Services, Inc. (Horizon), has been contracted to provide a cultural resources background review for the proposed upgrade of the existing Balcones Cement Plant located at 2580 Wald Road, New Braunfels, Comal County, Texas, 78132. The Balcones Cement Plant is owned and operated by CEMEX Construction Materials South, LLC (CEMEX), and the existing CEMEX facility consists of 2 cement kilns, raw and finish mills, clinker coolers, and ancillary material transfer equipment. CEMEX is proposing to authorize the use of additional alternate fuels for both cement kilns (Kiln Nos. 1 and 2), including engineered "Sharps" (including plastic) and rubberized asphalt; to increase Kiln No. 2 clinker production; and to authorize upgrades to the main kiln burners in Kiln Nos. 1 and 2 to multipath adjustable units. The production upgrades would improve kiln fuel efficiency; however, CEMEX is not proposing a production increase related to this upgrade, no physical changes to the existing kiln system would be required, and no ground disturbance would be required to install the upgrades to the existing kilns.

As the proposed upgrades would require a Prevention of Significant Deterioration (PSD) permit issued by the US Environmental Protection Agency (EPA), the undertaking falls under the regulations of Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, which is invoked when federal funds are utilized or when federal permitting is required for a proposed project. The NHPA states that the Advisory Council for Historic Preservation (ACHP) and the Texas Historical Commission (THC), which serves as the State Historic Preservation Office (SHPO) for the state of Texas, must be afforded the opportunity to comment when any cultural resources potentially eligible for inclusion in the National Register of Historic Places (NRHP) are present in a project area affected by federal agency actions or covered under federal permits or funding.

In November 2012, Horizon conducted a cultural resources background review for the proposed project. The background review examined an area extending 1.0 mile from the proposed kiln site. Two previously recorded archeological sites, 41CM107 and 41CM332, are located within the 1.0-mile review radius; however, both of these sites are located outside the proposed kiln upgrade location. Both sites were recommended as ineligible for listing on the NRHP and/or for designation as State Archeological Landmarks (SAL) when they were originally recorded in 1978 and 2011, respectively, and both sites have been either largely or entirely destroyed from prior industrial development. Neither site would be affected by the

proposed undertaking. No cemeteries, listed NRHP properties or districts, or SALs were identified within the 1.0-mile review radius or at the location of the proposed kiln upgrades.

Furthermore, the location of the 2 existing cement kilns on the Balcones Cement Plant was surveyed for cultural resources in 1978 in connection with a US EPA undertaking prior to construction of the existing facility. No cultural resources were recorded at the location of the kilns during this prior survey.

Based on the extent of prior disturbances on the proposed project site resulting from construction of the existing Balcones Cement Plant and its ancillary facilities and the limited scope of the proposed upgrades to the 2 existing cement kilns, the proposed undertaking would have no potential to adversely affect any significant cultural resources. The portion of the Balcones Cement Plant in which the 2 existing cement kilns are located was surveyed for cultural resources in 1978 prior to construction of the plant, and no cultural resource sites were recorded at this location. It is Horizon's opinion that the proposed project site does not require any further cultural resources investigations and that no archeological or historic properties that are listed on, eligible for, or potentially eligible for inclusion in the NRHP would be adversely affected.

This document presents the results of Horizon's cultural resources background review of the proposed project site. Following this introductory chapter, Chapters 2.0 and 3.0 present the environmental and cultural backgrounds of the project area, respectively. Chapter 4.0 presents the results of the background review, and Chapter 5.0 summarizes the results of the background review and presents management recommendations for the proposed undertaking. Chapter 6.0 lists the references cited in the document. Appendix A presents project area location maps, Appendix B provides representative overview photographs of the existing plant facility and the proposed project area, and Appendix C includes the resume of Russ Brownlow, Horizon's Cultural Resources Director (CRD), who served as Principal Investigator for this project.

2.0 ENVIRONMENTAL SETTING

2.1 PHYSIOGRAPHY AND HYDROLOGY

The existing Balcones Cement Plant is located in southwestern New Braunfels in southeastern Comal County in Central Texas. The project site is located on an old alluvial terrace remnant along the northern margins of the Dry Comal Creek floodplain. The project site is situated within an existing industrial cement plant. The landscape within the existing industrial facility has been artificially leveled via prior construction of the plant, and the elevation of the project site is 660 feet above mean sea level. Hydrologically, the project area is situated within the Dry Comal Creek basin, which drains into the Guadalupe River on the eastern side of New Braunfels. The Guadalupe River, in turn, flows southeastward before ultimately discharging into the Gulf of Mexico near Port Lavaca. The project site is drained to the south toward Dry Comal Creek.

2.2 GEOLOGY AND GEOMORPHOLOGY

Comal County is underlain by a relatively thick sequence of Cretaceous-age, sedimentary rock strata. These strata are composed of 3 formations, including the Anachaco Limestone, Pecan Gap Chalk, and Austin Chalk formations (Fisher 83). These formations range in depth from 30 to 152 meters (m) (100 to 500 feet [ft]) and are composed of limestone and marl, chalk and chalky marl, and chalk and marl, respectively. Specifically, the project site is situated on the Early Pleistocene Leona Formation, which consists of fine calcareous silt grading down into course gravels.

Specifically, the project area is underlain by Branyon clay, 1 to 3% slopes (ByB), which consists of clayey alluvium of Quaternary age derived from mixed sources found on stream terraces (NRCS 2012). A typical profile of this soil type consists of deep, undifferentiated deposits of clay extending to depths of more than 80 inches below surface. This soil is moderately well drained.

2.3 CLIMATE

The modern climate in Comal County is typically dry to subhumid with long, hot summers and short, mild winters. The climate is influenced primarily by tropical maritime air masses from the Gulf of Mexico, but it is modified by polar air masses. Tropical maritime air masses predominate throughout spring, summer, and fall. Modified polar air masses are dominant in winter and provide a continental climate characterized by considerable variations in temperature.

In winter, the average temperature is 52 degrees Fahrenheit (°F); however, during winter the temperature tends to fluctuate greatly as air masses move in and out of the area. These air masses can produce light rain and drizzle, and conditions can become cloudy. Spring is relatively dry, with some thunderstorms and cool spells. Summer temperatures are high, with the daily maximum temperature often reaching or exceeding 90°F. Fall is warm, dry, and pleasant, with increasing cold spells.

The average precipitation within the region is 33 inches. The majority of this precipitation occurs as rain that falls between April and September. The growing season is approximately 265 days long.

2.4 Flora and Fauna

The project area is situated in the southwestern portion of the Texan biotic province (Blair 1950), an intermediate zone between the forests of the Austroriparian and Carolinian provinces and the grasslands of the Kansan, Balconian, and Tamaulipan provinces (Dice 1943). Some species reach the limits of their ecological range within the Texan province. Rainfall in the Texan province is barely in excess of water need, and the region is classified by Thornwaite (1948) as a C_2 (moist subhumid) climate with a moisture surplus index of from 0 to 20%.

Edaphic controls on vegetation types are important in the Texan biotic province, which is located near the border between moisture surplus and moisture deficiency. Sandy soils support oak-hickory forests dominated by post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*), and hickory (*Carya buckleyi*). Clay soils originally supported a tall-grass prairie, but much of this soil type has been placed under cultivation. Dominant tall-grass prairie species include western wheatgrass (*Agrophyron smithii*), silver beardgrass (*Andropogon saccharoides*), little bluestem (*Andropogon scoparius*), and Texas wintergrass (*Stipa leucotricha*). Major areas of oak-hickory forest include the Eastern and Western Cross Timbers, and major tall-grass prairie areas include the Blackland, Grand, and Coastal prairies. Some characteristic associations of the Austroriparian province occur locally in the Texan province, such as a mixed stand of loblolly pine (*Pinus taeda*) and blackjack and post oak in Bastrop County and a series of peat and bog marshes distributed in a line extending from Leon to Gonzales counties.

3.0 CULTURAL BACKGROUND

The project site is located within Prewitt's (1981, 1985) Central Texas Archeological Region. The indigenous human inhabitants of Central Texas practiced a generally nomadic hunting and gathering lifestyle throughout all of prehistory, and, in contrast to much of the rest of North America, mobility and settlement patterns do not appear to have changed markedly through time in this region.

3.1 PALEOINDIAN PERIOD (CA. 12,000 TO 8500 B.P.)

The initial human occupations in the New World can now be confidently extended back before 12,000 B.P. (Dincauze 1984; Haynes et al. 1984; Kelly and Todd 1988; Lynch 1990; Meltzer 1989). Evidence from Meadowcroft Rockshelter in Pennsylvania suggests that humans were present in Eastern North America as early as 14,000 to 16,000 years ago (Adovasio et al. 1990), while more recent discoveries at Monte Verde in Chile provide unequivocal evidence for human occupation in South America by at least 12,500 years ago (Dillehay 1989, 1997; Meltzer et al. 1997). Most archeologists presently discount claims of much earlier human occupation during the Pleistocene glacial period (cf. Butzer 1988).

The earliest generalized evidence for human activities in Central Texas is represented by the PaleoIndian period (12,000 to 8500 B.P.) (Collins 1995). This stage coincided with ameliorating climatic conditions following the close of the Pleistocene epoch that witnessed the extinction of herds of mammoth, horse, camel, and bison. Cultures representing various periods within this stage are characterized by series of distinctive, relatively large, often fluted, lanceolate projectile points. These points are frequently associated with spurred end scrapers, gravers, and bone foreshafts. PaleoIndian groups are often inferred to have been organized into egalitarian bands consisting of a few dozen individuals that practiced a fully nomadic subsistence and settlement pattern. Due to poor preservation of floral materials, subsistence patterns in Central Texas are known primarily through the study of faunal remains. Subsistence focused on the exploitation of plants, small animals, fish, and shellfish, even during the PaleoIndian period. There is little evidence in this region for hunting of extinct megafauna, as has been documented elsewhere in North America. Rather, a broad-based subsistence pattern appears to have been practiced throughout all prehistoric time periods. In Central Texas, the PaleoIndian stage is divided into 2 periods based on recognizable differences in projectile point styles. These include the Early PaleoIndian period, which is recognized based on large, fluted projectile points (i.e., Clovis, Folsom, Dalton, San Patrice, and Big Sandy), and the Late

PaleoIndian period, which is characterized by unfluted lanceolate points (i.e., Plainview, Scottsbluff, Meserve, and Angostura).

3.2 ARCHAIC PERIOD (CA. 8500 TO 1200 B.P.)

The onset of the Hypsithermal drying trend marks the beginning of the Archaic period (8500 to 1200 B.P.) (Collins 1995). This climatic trend marked the beginning of a significant reorientation of lifestyle throughout most of North America, but this change was far less pronounced in Central Texas. Elsewhere, the changing climatic conditions and corresponding decrease in the big game populations forced people to rely more heavily upon a diversified resource base composed of smaller game and wild plants. In Central Texas, however, this hunting and gathering pattern is characteristic of most of prehistory. The appearance of a more diversified tool kit, the development of an expanded groundstone assemblage, and a general decrease in the size of projectile points are hallmarks of this cultural stage. Material culture shows greater diversity during this broad cultural period, especially in the application of groundstone technology.

Traditionally, the Archaic period is subdivided into Early, Middle, and Late subperiods. Changes in projectile point morphology are often used as markers differentiating these 3 subperiods, though other changes in material culture occurred as well. Perhaps most markedly, burned rock middens appear during the Middle Archaic subperiod, continuing into the Late Archaic subperiod, and large cemeteries appear during the Late Archaic subperiod. In addition, the increasing density of prehistoric sites through time is often considered to constitute evidence of population growth, though differential preservation probably at least partially accounts for the lower numbers of older sites.

3.3 LATE PREHISTORIC PERIOD (CA. 1200 TO 350 B.P.)

The onset of the Late Prehistoric period (1200 to 350 B.P.) (Collins 1995) is defined by the appearance of the bow and arrow. In Central Texas, pottery also appears during the Late Prehistoric period (though ceramics appear earlier in Southeast Texas). Use of the atlatl (i.e., spearthrower) and spear was generally discontinued during the Late Prehistoric period, though they continued to be used in the inland subregion of Southeast Texas along with the bow and arrow through the Late Prehistoric period (Patterson 1980, 1995; Wheat 1953). In Texas, unifacial arrow points appear to be associated with a small prismatic blade technology. The Late Prehistoric period is generally divided into 2 phases, the Austin and Toyah phases. Austin phase sites occur earliest to the north, which has led some researchers (e.g., Prewitt 1985) to suggest that the Austin-phase populations of Central Texas were migrants from the north, and lack the ceramic industry of the later Toyah phase.

3.4 HISTORIC PERIOD (CA. 350 B.P. TO PRESENT)

The first European incursion into what is now known as Texas was in 1519, when Álvarez de Pineda explored the northern shores of the Gulf of Mexico. In 1528, Cabeza de Vaca crossed South Texas after being shipwrecked along the Texas Coast near Galveston Bay. However, European settlement did not seriously disrupt native ways of life until after 1700. The first half of the 18th century was the period in which the fur trade and mission system, as well as the first effects of epidemic diseases, began to seriously disrupt the native culture and social systems. This process is clearly discernable at the Mitchell Ridge site, where burial data suggest population declines and group mergers (Ricklis 1994) as well as increased participation on the part of the Native American population in the fur trade. By the time that heavy settlement of Texas began in the early 1800s by Anglo-Americans, the indigenous Indian population was greatly diminished.

Spanish explorers were familiar with the Comal Springs area but showed little interest in settling the region.[1] After the expedition of Domingo Terán de los Ríos of 1691, the Old San Antonio Road crossed the Guadalupe River near the future site of New Braunfels. Subsequent French and Spanish expeditions, including those of the Marqués de Aguayo and Louis Juchereau de St. Denis, commonly passed through what later became southeastern Comal County. In 1756, Comal Springs became the site of the short-lived Nuestra Senora de Guadalupe Mission, but, rather than fortify the mission against anticipated Comanche depredations, Spanish authorities closed it in 1758. Nearly a century passed before settlement became permanent, although a Mexican land grant of 1825 gave title of the area around the springs to Juan M. Veramendi. During the 18th century, the springs and river (which had been called Las Fontanas and the Little Guadalupe, respectively) took the name Comal, Spanish for "flat dish." It is thought that the name was suggested to the Spanish by the numerous small islands in the river or by the shallow basin through which the river runs.

The inhabitants of the region on the eve of settlement were primarily Tonkawa and Waco Indians, although Lipan Apaches and Karankawas also roamed the area. Early settlers' contacts with the indigenous populations were generally uneventful. Nomadic Wacos camped at springs north of New Braunfels moved their camp west within a year of the founding of the settlement, and a village of some 500 Tonkawas on the Guadalupe River above New Braunfels initially welcomed German visitors. Notwithstanding the rapid influx of settlers in the 1840s and 1850s and isolated incidents of violence, county fathers and Indian leaders generally maintained peaceful relations.

Permanent settlement of the area began in 1845, when Prince Carl of Solms-Braunfels secured title to 1,265 acres of the Veramendi grant, including the Comal springs and river, for the Adelsverein. In succeeding years, thousands of Germans and Americans were attracted to the rich farm and ranch land around New Braunfels. Settlement progressed rapidly; in March 1846 the Texas legislature formed Comal County from the Eighth Precinct of Bexar County and made New Braunfels the county seat. The final boundary determination was made in 1858 with the separation of part of western Comal County to Blanco and Kendall counties. The first county elections were held on 13 July 1846. In 1854, the county commissioners divided the county into 8 public school districts, and, in 1858, long before they were required by law to do so, New Braunfels citizens voted to collect a tax for support of public schools. The population of

[1] The following historical summary has been compiled from Biesele (1946), Dabney (1927), Haas (1968), and Jordan (1966), as summarized in the online *Handbook of Texas History*.

the county grew 133% between 1850 and 1860, and numbered more than 4,000 on the eve of the Civil War.

Comal County was exceptional among the largely German counties of southern and western Central Texas in the strength of its 1861 vote in favor of secession. The county contributed 3 all-German volunteer companies—2 cavalry and 1 infantry—to the Confederate cause. There is little to suggest that the county's support for the Confederacy reflected enthusiasm for slavery. Free labor predominated over slave labor in all counties with large German populations; a survey of 130 German farms in Comal and 2 other counties in 1850 revealed no slave laborers. By 1860, as Anglo-Americans settled alongside the German pioneers, blacks still made up less than 5% of county residents, and the family remained the primary source of labor. Comal County residents seem to have embraced the Southern cause because of their support of the larger cause of states' rights. There is no record in the county of the violence between Unionists and Confederates that broke out in German counties to the northwest.

From the early years of its settlement, Comal County supported diversified farming and ranching industries. Corn was almost universally cultivated by pioneers and quickly became a staple both of the German diet and of the local economy as a cash crop. It declined in importance relative to other crops and to livestock, however, during and after the Civil War as county ranchers and farmers began to produce commercially significant amounts of cotton, wheat, oats, wool, dairy products, and beef.

As farming and ranching spread beyond the environs of New Braunfels into the Hill Country, the county seat developed as an important supply and processing center for products of the expanding agricultural frontier. Many immigrants brought manufacturing experience and commercial acumen to their new home and applied these skills to the products of local agriculture. Comal County never developed as a major cotton-producing area, but the crop played an important role in the local economy. Production rose from 1,220 bales in 1860 to a peak of more than 16,000 bales in 1900. Perhaps more significant, however, was early interest in cotton processing. The first cotton gin in the county was built in the mid-1850s, and there were 20 gins by 1885. During the Civil War, John F. Torrey imported machinery and looms to manufacture cotton textiles and laid the foundation of the Comal County cotton industry of the 20th century. At almost the same time, another New Braunfels industrialist, George Weber, established the first cottonseed press in the state. Local businessmen also moved rapidly from sheep herding to woolen textiles. Production of raw wool expanded from 621 pounds in 1850 to 72,000 pounds in 1890, and a company was organized in New Braunfels in 1867 for the manufacture of woolen products.

After World War I, Comal County farming declined relative to ranching. As the diversified farms and ranches of the original Comal County agriculturalists gave way to the livestock economy of the 20th century, local industrialists were increasing the scope and the scale of county manufactures. By 1982, 50 manufacturers, employing almost 30% of the county labor force, had a gross product of more than $188 million. The production of such construction materials as gravel, sand, limestone, crushed stone, and concrete, in addition to the manufacture of textiles and clothing and the milling of wheat and corn, were still the mainstays of the industrial sector and accounted for much of its expansion. Metal and wood work and food processing also became important industries.

The county grew rapidly after World War II and boomed after 1970. From 16,357 residents in 1950, the population expanded by 21% in the subsequent decade and by the same amount in the 1960s, reaching 24,165 by 1970. In 1980, the figure was 36,446, a 50% increase from the previous census.

The emergence of tourism as a primary industry, as well as attendant increases in retail and service employment, explains much of the population growth. The county is located in the "corridor" along Interstate Highway 35 between San Antonio and Austin; in 1973, it was included in the San Antonio Metropolitan Statistical Area. Between 1970 and 1984, the number of residents employed in trade nearly doubled, to 2,287; the number of jobs in service industries increased more than 600% to 1,977; and employment in financial, insurance, and real estate businesses rose 400%.

4.0 ARCHIVAL RESEARCH

Project maps showing the location of the 2 existing kilns that are proposed for upgrades at the Balcones Cement Plant, located at 2580 Wald Road, New Braunfels, Comal County, Texas, 78132, are presented in Appendix A.

Background archival research conducted via the Internet at the THC's online *Texas Archeological Sites Atlas* (Atlas) restricted-access database indicated that the presence of 2 previously recorded archeological sites within a 1.0-mile radius of the project site (Table 1) (THC 2012), while a review of the National Park Service's (NPS) NRHP Google Earth map layer indicated the presence of no historic properties listed on the NRHP within the review area (NPS 2012).

Site 41CM107 was originally recorded in 1978 in connection with a survey conducted for a US EPA undertaking. While the original report for this survey is not on file at the THC, the site form on file for site 41CM107 indicates the site consisted of a surficial scatter of aboriginal lithic artifacts in what was then a plowed agricultural field. Temporally diagnostic projectile points associated with the Middle to Late Archaic periods were observed among the artifacts on the site. Cultural materials were observed only on the surface of the plowed field, though the site form does not specify whether or not any subsurface investigations were undertaken, so the depth of cultural deposits is unknown. The site was recommended as ineligible for inclusion in the NRHP. While the mapped location of site 41CM107 places it approximately 100 feet southwest of the location of the existing cement kilns that are being proposed for upgrades, this site was recorded prior to construction of the Balcones Cement Plant. Prior construction of the plant would have destroyed any vestiges of this ephemeral prehistoric site.

Site 41CM332 represents the remnants of the mid-20th-century company town of Dittlinger, also known locally as The Village, or alternately the USG Village (for the US Gypsum Company). Site 41CM332 was recorded in 2011 during a cultural resources survey conducted by the Lower Colorado River Authority (LCRA) for a New Braunfels Utilities transmission line project (Malof et al. 2012). Dittlinger was established between 1917 and 1936, though probably closer to 1936, to provide housing and community services for the workers of the nearby US Gypsum mines. By 1951, Dittlinger consisted of approximately 30 individual homes situated on 50-foot lots that ran along APG Lane. The town was officially closed in 1968 over a labor dispute. A few of the residents purchased their homes and continued to live in them, but

Table 1. Summary of documented cultural resources within 1.0 mile of project site

Site No.	Site Type	NRHP/SAL Eligibility	Distance/Direction from Project Area	Potential to be Impacted by Project?
41CM107	Middle to Late Archaic aboriginal lithic scatter	Recommended ineligible	100 feet southwest	No
41CM332	Mid-20th century company town (Dittlinger)	Recommended ineligible	1,075 feet northeast	No

km Kilometer
NRHP National Register of Historic Places
SAL State Archeological Landmark

the rest were demolished. Based on the extent of prior disturbance observed when the former community of Dittlinger was recorded as an archeological site in 2011, the site was recommended as being ineligible for designation as an SAL under the Antiquities Code of Texas, and no further investigations were recommended.

Both sites 41CM107 and 41CM332 were recommended as ineligible for listing on the NRHP and/or for designation as State Archeological Landmarks (SAL) when they were originally recorded in 1978 and 2011, respectively, and both sites have been either largely or entirely destroyed from prior industrial development. Neither site would be affected by the proposed undertaking. No cemeteries, listed NRHP properties or districts, or SALs were identified within the 1.0-mile review radius or at the location of the proposed kiln upgrades.

Furthermore, the location of the 2 existing cement kilns on the Balcones Cement Plant was surveyed for cultural resources in 1978 in connection with a US EPA undertaking prior to construction of the existing facility. No cultural resources were recorded at the location of the 2 cement kilns that are proposed for upgrades in connection with the current project during this prior survey.

Based on the extent of prior disturbances on the proposed project site resulting from construction of the existing Balcones Cement Plant and its ancillary facilities and the limited scope of the proposed upgrades to the 2 existing cement kilns, the proposed undertaking would have no potential to adversely affect any significant cultural resources. The portion of the Balcones Cement Plant in which the 2 existing cement kilns are located was surveyed for cultural resources in 1978 prior to construction of the plant, and no cultural resource sites were recorded at this location. It is Horizon's opinion that the proposed project site does not require any further cultural resources investigations and that no archeological or historic properties that are listed on, eligible for, or potentially eligible for inclusion in the NRHP would be adversely affected.

5.0 SUMMARY AND RECOMMENDATIONS

5.1 ELIGIBILITY CRITERIA FOR INCLUSION IN THE NATIONAL REGISTER OF HISTORIC PLACES

Determinations of eligibility for inclusion in the NRHP are based on the criteria presented in the Code of Federal Regulations (CFR) in 36 CFR §60.4(a-d). The 4 criteria of eligibility are applied following the identification of relevant historical themes and related research questions:

> The quality of significance in American history, architecture, archeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:
>
> a. [T]hat are associated with events that have made a significant contribution to the broad patterns of our history; or,
>
> b. [T]hat are associated with the lives of persons significant in our past; or,
>
> c. [T]hat embody the distinctive characteristics of a type, period, or method of construction, or that represent a significant and distinguishable entity whose components may lack individual distinction; or,
>
> d. [T]hat have yielded, or may be likely to yield, information important in prehistory or history.

The first step in the evaluation process is to define the significance of the property by identifying the particular aspect of history or prehistory to be addressed and the reasons why information on that topic is important. The second step is to define the kinds of evidence or the data requirements that the property must exhibit to provide significant information. These data requirements in turn indicate the kind of integrity that the site must possess to be significant. This concept of integrity relates both to the contextual integrity of such entities as structures, districts, or archeological deposits and to the applicability of the potential database to pertinent research questions. Without such integrity, the significance of a resource is very limited.

For an archeological resource to be eligible for inclusion in the NRHP, it must meet legal standards of eligibility that are determined by 3 requirements: (1) properties must possess significance, (2) the significance must satisfy at least 1 of the 4 criteria for eligibility listed above, and (3) significance should be derived from an understanding of historic context. As discussed here, historic context refers to the organization of information concerning prehistory and history according to various periods of development in various times and at various places. Thus, the significance of a property can best be understood through knowledge of historic development and the relationship of the resource to other, similar properties within a particular period of development. Most prehistoric sites are usually only eligible for inclusion in the NRHP under Criterion D, which considers their potential to contribute data important to an understanding of prehistory. All 4 criteria employed for determining NRHP eligibility potentially can be brought to bear for historic sites.

Criterion A—Events

To be considered for listing under Criterion A, a property must be associated with 1 or more events important in the defined historic context. Criterion A recognizes resources associated with single events, such as the founding of a town, or with a pattern of events, repeated activities, or historic trends, such as the gradual rise of a port city's prominence in trade and commerce. The event or trends, however, must clearly be important within the associated context of settlement, in the case of the town, or development of a maritime economy, in the case of the port city. Moreover, the property must have an important association with the event or historic trends, and it must retain historic integrity.

Criterion B—Persons

Criterion B applies to resources associated with individuals whose specific contributions to history can be identified and documented. Persons “significant in our past” refers to individuals whose activities are demonstrably important within a local, state, or national historic context. The criterion is generally restricted to those resources that illustrate (rather than commemorate) a person's important achievements.

Criterion C—Design or Construction

This criterion applies to resources significant for their physical design or construction, including such elements as architecture, landscape architecture, engineering, and artwork. To be eligible under this criterion, a property must meet *at least one* of the following requirements—embody distinctive characteristics of a type, period, or method of construction; represent the work of a master; possess high artistic value; or represent a significant and distinguishable entity whose components may lack individual distinction.

Criterion D—Information Potential

Certain important research questions about human history can only be answered by the actual physical material of cultural resources. Criterion D encompasses the resources that have the potential to answer, in whole or in part, those types of research questions. The most common type of property nominated under this Criterion is the archeological site (or a district composed of archeological sites). Buildings, objects, and structures (or districts composed of these property types), however, can also be eligible for their information potential. Criterion D has 2 requirements, which must *both* be met for a property to qualify—the property must have, or have had, information to contribute to our understanding of human history or prehistory, and the information must be considered important.

5.2 SUMMARY AND RECOMMENDATIONS

Based on the results of the background Atlas review, inspection of current maps and aerial photographs, and inspection of site photographs provided by Zephyr, the proposed project site area is the site of an existing industrial cement plant with no low potential to contain intact cultural resources that would meet the criteria for significance for inclusion in the NRHP. Two previously recorded archeological sites, 41CM107 and 41CM332, are located within the 1.0-mile review radius; however, both of these sites are located outside the proposed kiln upgrade location. Both sites were recommended as ineligible for listing on the NRHP and/or for designation as State Archeological Landmarks (SAL) when they were originally recorded in 1978 and 2011, respectively, and both sites have been either largely or entirely destroyed from prior industrial development. Neither site would be affected by the proposed undertaking. No cemeteries, listed NRHP properties or districts, or SALs were identified within the 1.0-mile review radius or at the location of the proposed kiln upgrades.

Furthermore, the location of the 2 existing cement kilns on the Balcones Cement Plant was surveyed for cultural resources in 1978 in connection with a US EPA undertaking prior to construction of the existing facility. No cultural resources were recorded at the location of the kilns during this prior survey.

Based on the extent of prior disturbances on the proposed project site resulting from construction of the existing Balcones Cement Plant and its ancillary facilities and the limited scope of the proposed upgrades to the 2 existing cement kilns, the proposed undertaking would have no potential to adversely affect any significant cultural resources. The portion of the Balcones Cement Plant in which the 2 existing cement kilns are located was surveyed for cultural resources in 1978 prior to construction of the plant, and no cultural resource sites were recorded at this location. It is Horizon's opinion that the proposed project site does not require any further cultural resources investigations and that no archeological or historic properties that are listed on, eligible for, or potentially eligible for inclusion in the NRHP would be adversely affected.

6.0 REFERENCES CITED

Adovasio, J.M., J. Donahue, and R. Stuckenrath
1990 The Meadowcroft Rockshelter Chronology 1975-1990. *American Antiquity* 55:348-354.

Batte, C.D.
1984 *Soil Survey of Comal and Hays Counties, Texas*. US Department of Agriculture, Soil Conservation Service, in cooperation with the Texas Agricultural Experiment Station. Washington, D.C.

Biesele, R.
1946 Early Times in New Braunfels and Comal County. *Southwestern Historical Quarterly* 50, July.

Blair, W. F.
1950 The Biotic Provinces of Texas. *Texas Journal of Science* 2:93-117.

Bryant, V. M., Jr., and R.G. Holloway
1985 A Late-Quaternary Paleoenvironmental Record of Texas: An Overview of the Pollen Evidence. In *Pollen Records of Late-Quaternary North American Sediments*, edited by V.M. Bryant, Jr., and R.G. Holloway, pp. 39-70. American Association of Stratigraphic Palynologists Foundation, Dallas, Texas.

Butzer, K.W.
1988 A Marginality Model to Explain Major Spatial and Temporal Gaps in the Old and New World Pleistocene Settlement Records. *Geoarcheology* 3:193-203.

Collins, M.B.
1995 Forty Years of Archeology in Central Texas. *Bulletin of the Texas Archeological Society* 66:361-400.

Dabney, E.R.
1927 The Settlement of New Braunfels and the History of Its Earlier Schools. Unpublished Masters Thesis, The University of Texas at Austin.

Dice, L.R.
1943 *The Biotic Provinces of North America*. University of Michigan Press, Ann Arbor.

Dillehay, T.D.

1989 *Monte Verde: A Late Pleistocene Settlement in Chile—Paleoenvironment and Site Context*, Vol. 1. Smithsonian Institution Press: Washington, D.C.

1997 *Monte Verde: A Late Pleistocene Settlement in Chile—The Archaeological Context*, Vol. 2. Smithsonian Institution Press: Washington, D.C.

Dincauze, D.F.

1984 An Archaeo-Logical Evaluation of the Case for Pre-Clovis Occupations. *Advances in World Archaeology* 3:275-323. Academic Press, New York.

Fisher, W.L.

1976 *Geologic Atlas of Texas—San Antonio Sheet*. Bureau of Economic Geology, The University of Texas at Austin.

Haas, O.

1968 *History of New Braunfels and Comal County, Texas, 1844-1946.* Steck, Austin.

Haynes, C.V., Jr., D.J. Donahue, A.J. T. Hull, and T.H. Zabel

1984 Application of Accelerator Dating to Fluted Point Paleoindian Sites. *Archaeology of Eastern North America* 12:184-191.

Jordan, T.G.

1966 *German Seed in Texas Soil: Immigrant Farmers in Nineteenth-Century Texas*. University of Texas Press, The University of Texas at Austin.

Jurney, D.H., F. Winchell, and R.W. Moir

1989 *Cultural Resources Overview of the National Grasslands in North Texas: Studies in Predictive Archaeological Modeling for the Caddo and LBJ Grasslands*. Archaeology Research Program, Institute for the Study of Earth and Man, Southern Methodist University, Dallas. Submitted to the US Forest Service, Lufkin, Texas.

Kelly, R.L., and L.C. Todd

1988 Coming into the Country: Early Paleo-Indian Hunting and Mobility. *American Antiquity* 53:231-244.

Lynch, T.F.

1990 Glacial-Age Man in South America?: A Critical Review. *American Antiquity* 55(1):12-36.

Malof, A.F., C.A. Hixson, and D.J. Prikryl

2012 *Intensive Cultural Resource Investigations of New Braunfels Utilities Proposed T-336, GPI Switch to Loop 337 Tie and T-586, E.C. Mornhinweg to GPI Switch Transmission Line Project, Comal County, Texas*. Cultural Resource Report No. 16, Cultural Resource Services, Lower Colorado River Authority. Austin, Texas.

Meltzer, D.J.

1989 Why Don't We Know When the First People Came to America? *American Antiquity* 54(3):471-490.

Meltzer, D.J., D.K. Grayson, G. Ardila, A.W. Barker, D.F. Dincauze, C.V. Haynes, F. Mena, L. Nuñez, and D.J. Stanford

1997 On the Pleistocene Antiquity of Monte Verde, Southern Chile. *American Antiquity* 62(4):659-663.

National Park Service (NPS)

2012 National Park Service National Register of Historic Places Google Earth Map Layer – South Region. <http://nrhp.focus.nps.gov/natreg/docs/Google_Earth_Layers.html>. Accessed November 20, 2012.

Patterson, L.W.

1980 *The Owen Site, 41HR315: A Long Occupation Sequence in Harris County, Texas*. Houston Archeological Society, Report No. 3.

1995 The Archeology of Southeast Texas. *Bulletin of the Texas Archeological Society* 66:239-264

Prewitt, E.

1981 Cultural Chronology in Central Texas. In *Bulletin of the Texas Archeological Society* 52:65-90.

1985 From Circleville to Toyah: Comments on Central Texas Chronology. *Bulletin of the Texas Archeological Society* 53:201-238.

Ramsey, R., and N. Bade

1977 *Soil Survey of Guadalupe County*. US Department of Agriculture, Soil Conservation Service, in cooperation with the Texas Agricultural Experiment Station. Washington, D.C.

Ricklis, R.A.

1994 Toyah Components: Evidence for Occupation in the Project Area During the Latter Part of the Late Prehistoric Period. In *Archaic and Late Prehistoric Human Ecology in the Middle Onion Creek Valley, Hays County, Texas*, by R.A. Ricklis and M.B. Collins, pp. 207-316. Studies in Archeology, No. 19. Texas Archeological Research Laboratory, The University of Texas at Austin.

Texas Historical Commission (THC)

2012 *Texas Archeological Sites Atlas Restricted Database*. <http://www.nueces.thc.state.tx.us/>. Accessed November 20, 2012.

Thornwaite, C.W.

1948 An Approach Toward a Rational Classification of Climate. *Geographical Review* 38:55-94.

US Geological Survey (USGS)

1988 7.5-minute series topographic maps, New Braunfels West, Texas, quadrangle.

US Department of Agriculture, Natural Resources Conservation Service (NRCS)

2012 Web Soil Survey. <http://websoilsurvey.nrcs.usda.gov/app/>. Accessed November 20, 2012.

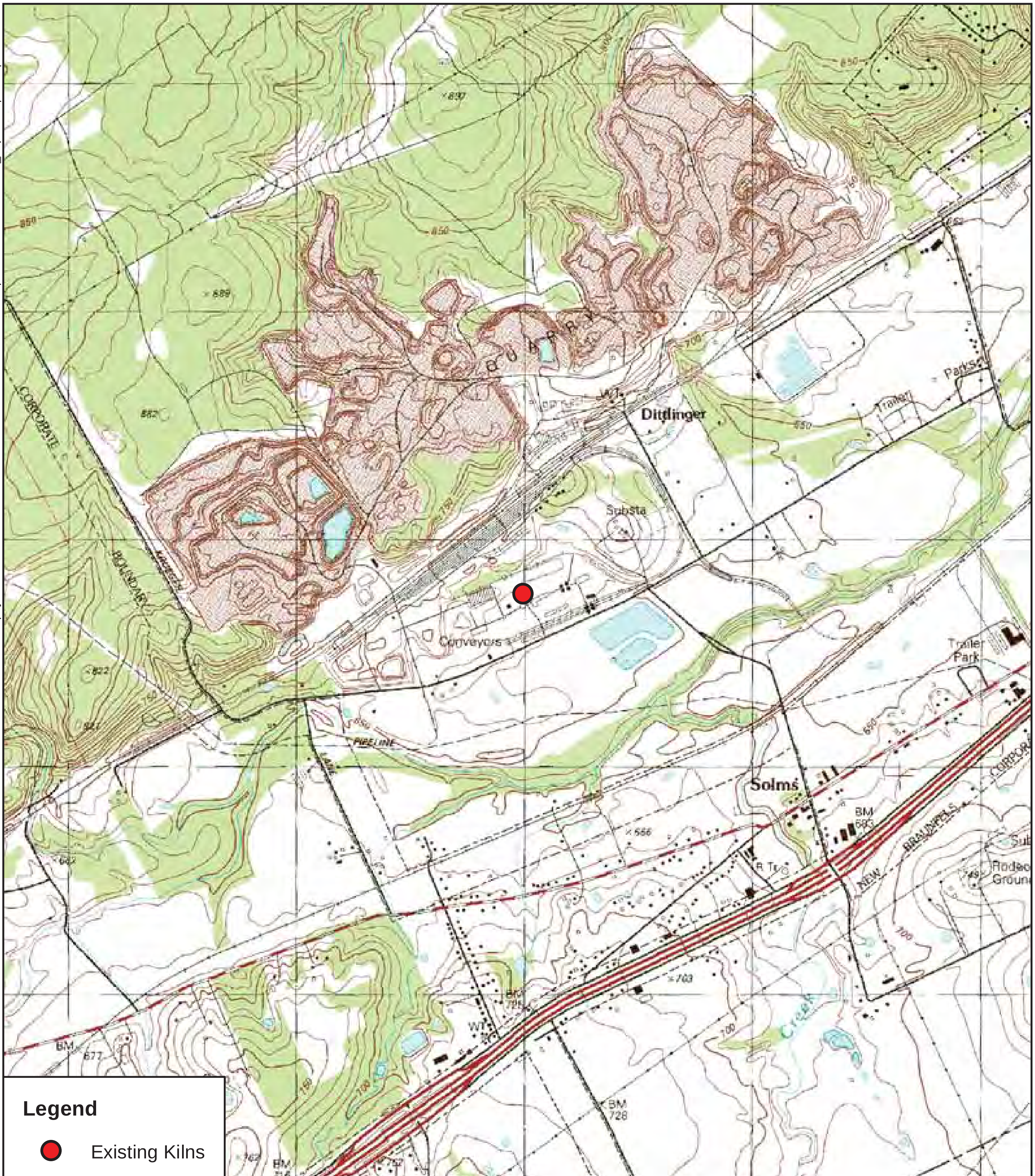
Wheat, J.B.

1953 *The Addicks Dam Site*. Bulletin 154:143-252. Bureau of American Ethnology, US Government Printing Office, Washington, D.C.

APPENDIX A:

Project Area Location Maps

080122 - Zephyr Archival Searches\BG 21-30\39 - CEMEX Cement Plant\Graphics\080122A01-AR39_Topo.mxd | MLM | 11-19-2012



MAP SOURCE: USGS, NEW BRAUNFELS WEST, 1988.

0 300 600
Meters

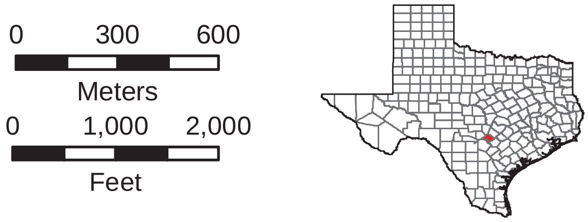
0 1,000 2,000
Feet

CEMEX CEMENT PLANT
NEW BRAUNFELS,
COMAL COUNTY, TEXAS

Horizon
Environmental Services, Inc.

080122 - Zephyr Archival Searches\BG 21-30139 - CEMEX Cement Plant\Graphics\080122A02-AR39_Aerial.mxd | MLM | 11-19-2012

MAP SOURCE: NAIP, NEW BRAUNFELS WEST SE AND SW, 2010.



Horizon Environmental Services, Inc.

CEMEX CEMENT PLANT
NEW BRAUNFELS,
COMAL COUNTY, TEXAS

APPENDIX B:

Project Area Overview Photographs

(Provided by Zephyr Environmental Corporation)

CEMEX entry

Front of CEMEX Facility looking north

Front of CEMEX Facility looking southwest

Front of CEMEX Facility looking west

Inside facility looking northwest

Aerial view of facility looking north

Aerial view of the facility looking north

Aerial view of facility looking northeast settling ponds

Aerial view of the facility looking west

Aerial view of facility looking east

APPENDIX C:

Russ Brownlow Resume

RUSSELL K. BROWNLOW

PRINCIPAL / CULTURAL RESOURCES DIRECTOR

TECHNICAL SPECIALTIES

- Cultural resource management (CRM);
- Prehistoric archeology of Texas, Oklahoma, and Louisiana;
- Compliance with the Antiquities Code of Texas (ACT), Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and the Native American Graves Protection and Repatriation Act (NAGPRA);
- Prehistoric lithic technology (flint knapping);
- Ethnohistory;
- Project management;
- Archeological survey, testing, and data recovery;
- Technical report writing

EDUCATION

- B.A., Anthropology / Archeology, The University of Texas at Austin, 1992
- M.A., Anthropology, The University of Houston, 1998

PROFESSIONAL REGISTRATIONS AND TRAINING

- Registered Professional Archeologist since 2001 (RPA ID# 11924)
- TxDOT pre-certified for Service 2.10.1 (Archeological Surveys, Documentation, Excavations, Testing, Reports, and Data Recovery Plans)
- Mine Safety and Health Administration (MSHA) certified through 11/23/12

PROFESSIONAL / TECHNICAL SOCIETIES

- Texas Archeological Society (TAS)
- Council of Texas Archeologists (CTA)
- Register of Professional Archeologists (RPA)
- Texas Association of Environmental Professionals (TAEP)

AWARDS

- Texas Historical Commission Award of Merit (2004) for exceptional field research, laboratory analysis, and report production associated with 41WM815 in Williamson County, Texas

PROFESSIONAL EXPERIENCE

- Horizon Environmental Services, Inc., Austin, Texas
    - 2000 to present
    - Horizon Principal / Cultural Resources Director / Principal Investigator / Project Manager
- Texas Archeological Research Laboratory, University of Texas at Austin
    - 1998 to 2000
    - Research Associate
- Archeological and Environmental Consultants, Inc., Austin, Texas
    - 1999
    - Project Archeologist
- Houston Museum of Natural Science, Houston, Texas
    - 1998
    - Consultant
- University of Houston, Department of Anthropology, Houston, Texas
    - 1997 to 1998
    - Teaching Assistant
- Espey, Huston & Associates, Inc., Austin, Texas (now PBS&J)
    - 1994 to 1998
    - Field Technician, Laboratory Technician, Crew Chief, Field Director
- Prewitt and Associates, Inc., Austin, Texas
    - 1993
    - Field Technician
- Texas Archeological Research Laboratory, University of Texas at Austin
    - 1992
    - Laboratory Technician

FIELDS OF EXPERIENCE

Mr. Brownlow has over 19 years of experience conducting archeological research for both public institutions and private consulting firms. Examples of his archeological project experience include the following:

- In excess of 300 cultural resources surveys completed for a wide array of projects within Texas, Oklahoma, and Louisiana;
- National Register of Historic Places and/or State Archeological Landmark eligibility testing on a minimum of 36 archeological sites;
- Data recovery/mitigation efforts on a minimum of 11 archeological sites;

- Excavation of human burials from at least 7 different archeological sites including a historic cemetery containing in excess of 431 human interments, a Caddoan cemetery containing 16 human interments, and a burned rock midden site containing at least 4 human interments;
- Archeo-Geophysical (remote sensing) sampling on 3 archeological sites;
- Authoring or co-authoring over 250 technical reports of archeological investigations;
- Preparation of several archeological avoidance plans for seismic projects;
- Countless desktop archival reviews to determine the potential for cultural resources on various properties for inclusion in non-archeological documents (i.e. Phase I Environmental Site Assessments, Categorical Exclusions, etc.);
- Section 106 and/or Antiquities Code of Texas consultation for hundreds of projects with various permitting agencies including the Texas Historical Commission, Texas Water Development Board, Texas Parks and Wildlife Department, US Army Corps of Engineers, US Fish and Wildlife Service, Oklahoma State Historic Preservation Office, the Louisiana Department of Culture, Recreation, and Tourism, as well as a vast array of Tribal Historic Preservation Officers;
- In addition to his cultural resources experiences, Mr. Brownlow has also prepared a variety of non-archeological documents includes numerous Categorical Exclusions (CEs), Phase I Environmental Site Assessments (Phase I ESAs), Environmental Reports (ERs), and Environmental Assessments (EAs). He has also contributed to the production of several Environmental Impacts Statements (EISs).

Types of projects in which Mr. Brownlow has participated in or managed cultural resources services include:

- Oil and gas exploration, development, and transportation;
- Ethanol production;
- Coastal and inland residential, commercial, and industrial land development;
- Solid waste landfills;
- Dredging activities;
- Surface lignite mines;
- Municipal planning;
- Reservoir development;
- Coastal port and channel improvements;
- Transportation corridors;
- Water and wastewater transportation and treatment;
- Electricity generation and transportation;
- University research;
- Military installations.

PRESENTATIONS

- Flint knapping and stone tool technology lecture for the 1997 spring semester Introduction to Archeology class at the Department of Anthropology, University of Houston.
- Flint knapping and stone tool technology lecture for the 1997 spring semester Archeology of Texas class at the Department of Anthropology, University of Houston.
- Flint knapping and stone tool technology lecture for the 1997 fall semester Introduction to Archeology class at the Department of Anthropology, University of Houston.
- Flint knapping and stone tool technology lecture for the 1997 fall semester Introduction to Physical Anthropology class at the Department of Anthropology, University of Houston.
- Two flint knapping demonstrations for the Brazoria County summer archeology programs sponsored by BCI Long Distance.
- Perdiz Arrow Point Origins for the TARL Brown Bag Lunch, 1998.
- Perdiz Arrow Point Origins for the Houston Archeological Society, 1998.
- Perdiz Arrow Point Origins for the Travis County Archeological Society, 1998.
- Flint knapping demonstration for the Austin French Legation's annual summer camp program, 1999.
- Data Recovery Investigations at the Holt Site (41HY341). "Burned Rock Midden" Symposium at the Annual Council of Texas Archeologists Spring Meeting, 2005.
- Yearly flint knapping demonstrations for Camp Mabry's annual "Muster Day" Event.
- Routine visits to various elementary school classes to conduct flint knapping demonstrations and present archeological career details for "career days".

ARTICLES

Brownlow, R.K.

2000 Excavations at Rice's Crossing (41WM815). *Current Archeology in Texas*. November 2000, Volume 2, No. 2. Texas Historical Commission. Austin, Texas.

2009 In Search of the Lost Community of Nottingham: Archival and Archeo-Geophysical Investigations on Site 41GV71. *Current Archeology in Texas*. April 2009, Volume 11, No. 1. Texas Historical Commission. Austin, Texas.

TECHNICAL PUBLICATIONS

Espey, Huston & Associates (EH&A now PBS&J):

Brownlow, R.K.

1994 *Facilities Response Plan for Holly Street Power Plant, Austin, Texas*. EH&A Doc. No. 941257. Austin, Texas.

1995 *Facilities Response Plan for Decker Lake Power Plant, Austin, Texas*. EH&A Doc. No.950028. Austin, Texas.

1996 *Intensive Cultural Resource Survey of Proposed ORYX-MOYER 1-5 New 4-inch Pipeline Project*. EH&A Doc. No. 960270. Austin, Texas.

Schmidt, J.S., M.E. Cruse, and R.K. Brownlow

1995 *Cultural Resources Survey of Camp Swift, Bastrop County, Texas*. EH&A Doc. No. 951178. Austin, Texas.

Masters Thesis:

Brownlow, R.K.

1998 *Evaluating the Co-occurrence of Arrow Point Types in South Texas: Archaeological Excavations at the Batot-Hooker Site (41ME34), Medina County, Texas*. Masters Thesis presented to the Anthropology Department of the University of Houston. Houston, Texas.

Texas Archeological Research Laboratory (TARL):

Brownlow, R.K.

1999 Intensive Cultural Resource Survey of Fort Wolters Army National Guard Base, Parker and Palo Pinto Counties, Texas. *Studies in Archeology 32*. Texas Archeological Research Laboratory, The University of Texas at Austin.

2000 *Emergency Burial Salvage at 41PR88 on the Fort Wolters Training Facility, Parker Co., Texas*. Letter Report. Texas Archeological Research Laboratory, The University of Texas at Austin.

2000 Archeological Investigations at 41WM815, A Blackland Prairie Site, Williamson County, Texas. *Studies in Archeology 36*. Texas Archeological Research Laboratory, The University of Texas at Austin.

2001 National Register Eligibility of Four Sites at the Texas Army National Guard's Fort Wolters Facility, Parker Co., Texas. *Studies in Archeology 37*. Texas Archeological Research Laboratory, The University of Texas at Austin.

Contributing author in:

Takac, P.R., J.G. Paine, and M.B. Collins

2000 Reassessment of Ten Archeological Sites along the Houston Ship Channel – Morgan's Point to Buffalo Bayou, Harris County, Texas. *Studies in Archeology 38*. Texas Archeological Research Laboratory, The University of Texas at Austin.

Archeological and Environmental Consultants, Inc.:

Pertulla, T.K. and R.K. Brownlow

1999 An Archeological Survey of the Jett Road Water Project in Bexar County, Texas. *Letter Report of Investigations, No. 37*. Archeological & Environmental Consultants, Inc. Austin, Texas.

Horizon Environmental Services, Inc.:

Brownlow, R.K.

2000 *An Intensive Cultural Resources Survey of a Proposed Wal-Mart Site at the Northwestern Corner of the Intersection of U.S. Highway 183 and FM 1431, Cedar Park, Williamson County, Texas*. HJN 000255 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *Backhoe Trench Investigations for a Proposed Wastewater Line Crossing Brushy Creek on the Ivie Tract, Williamson County, Texas*. HJN 010016 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *Profile Documentation of Erosional Gullies in Borrow Pits Nos. 1 and 2 on Site 41WA255 for the Texas Department of Criminal Justice's Estelle Unit, Huntsville, Walker County, Texas*. Texas Antiquities Committee Permit No. 2509. HJN 000425 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of Centennial Pipeline's Proposed Pump Stations A, B, and C, Bearegard, La Salle, and West Carroll Parishes, Louisiana*. HJN 000302 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of the Proposed Centennial Pipeline Right-of-Way, Beauregard Parish, Louisiana*. HJN 000151 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of the Proposed Centennial Pipeline Right-of-Way, Jefferson, Orange, Jasper, and Newton Counties, Texas*. HJN 000151 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of a Proposed 15-acre Leander Independent School District School Site Located on the Steiner Ranch Tract, Travis County, Texas*. Texas Antiquities Committee Permit No. 2583. HJN 010136 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey and Subsequent Testing Along a Proposed Water/Wastewater Line within the Northern Right-of-Way of FM 1431 East, Williamson County, Texas*. Texas Antiquities Committee Permit Nos. 2385 and 2433. HJN 000053 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of 15 Proposed Well Sites and Flow Lines on the Freeman Ranch and Tucker Leases, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of 22 Proposed Well Sites and Flow Lines on the Freeman Ranch and Tucker Leases, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of 13 Proposed Well Sites and Flow Lines on the Freeman Ranch and Tucker Leases, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of the Proposed Legacy Ridge Estates Residential Subdivision and Golf Course, Bonham, Fannin County, Texas*. HJN 010348 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of the Proposed UNOCAL Keystone Gas Storage Project, Winkler County, Texas*. HJN 000256 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of 300 Acres on the Phillips Ranch, Hays County, Texas*. HJN 010367 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of the approximately 25-acre United RV Campground, San Marcos, Hays County, Texas*. HJN 010382 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of a Proposed Lower Neches Valley Authority 33-acre Water Treatment Plant Site and Associated Waterline Routes, Winnie, Chambers County, Texas*. HJN 010090. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of the 4.5-mile Rainbolt Lateral Pipeline Right-of-Way, Robertson and Leon Counties, Texas*. HJN 010392 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of the Proposed Widening of Ranch-to-Market Road 2243 (Alternates A and B), Leander, Williamson County, Texas*. Texas Antiquities Committee Permit No. 2722. HJN 010185 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of 12 Proposed Well Sites and Flow Lines on the Freeman Ranch and Tucker Leases, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of a Proposed 1.25-mile Natural Gas Pipeline Right-of-Way, Sweeny, Brazoria County, Texas*. HJN 020041 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of a Proposed 12-acre Home Depot Site at the Rivery, Georgetown, Williamson County, Texas*. HJN 020027 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey for a Proposed 29-mile Crude Oil Pipeline Right-of-Way, Port Neches Route of the Cameron Highway Pipeline Project, Jefferson County, Texas*. HJN 010344 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of the Proposed 27-acre Target in Bee Cave #2 Site, Bee Cave, Travis County, Texas*. HJN 020067 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of The Rivery, A Proposed 125-acre Development Site in Georgetown, Williamson County, Texas*. HJN 020046 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of the Buttercup Creek Channelization and Wetland Mitigation Project (30 Acres), Cedar Park, Williamson County, Texas*. HJN 010333 PA. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of 5 Proposed Well Sites and Flow Lines on the Freeman Ranch and Tucker Leases, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of a Proposed 122-acre Target Store Site Located at Parmer Lane and Interstate Highway 35, Austin, Travis County, Texas*. HJN 010354 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of a Proposed 17-acre Tract to be Annexed to Kit McConnico Park Located in Lufkin, Angelina County, Texas*. Texas Antiquities Committee Permit No. 2876. HJN 020113 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of 11 Proposed Well Sites and Flow Lines on the Freeman Ranch and Tucker Leases, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of the 197-acre El Camino Real Phase I Tract, A Proposed Subdivision Site in San Marcos, Hays County, Texas*. HJN 020123 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of the Proposed 75-acre Greenshores Subdivision Tract Located in Northwest Austin, Travis County, Texas*. HJN 020145 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of the 100-acre Wolf Tract, A Proposed Development Site in Georgetown, Williamson County, Texas*. HJN 020144 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of 9 Proposed Well Sites and Associated Flow Lines on the Freeman Ranch and Tucker Leases, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of the Proposed UNOCAL Keystone Gas Storage Project and 3.8 Miles of Associated Pipeline ROW, Winkler County, Texas*. HJN 000256 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey, Monitoring, and Geomorphological Investigations along the Proposed 2.5-Mile Northern Natural Interconnect, UNOCAL Keystone Gas Storage Project, Winkler County, Texas*. HJN 000256 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *Archeological Monitoring Conducted during Texas Eastern Transmission's Replacement of Approximately 1600 feet of Pipe via Horizontal Directional Drill under the San Antonio River, Goliad County, Texas*. HJN 020169 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *Backhoe Trench Investigations Conducted on the 3.8-acre Hunt TDC No. 1 Well Site and Access Road, Anderson County, Texas*. Texas Antiquities Committee Permit No. 2935. HJN 020181. Horizon Environmental Services, Inc. Austin, Texas.

2002 *Backhoe Trench Investigations Conducted along the 8-mile Pinnacle Gregory A-1 Pipeline Right-of-Way, Anderson County, Texas*. Texas Antiquities Committee Permit No. 2916. HJN 020149 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of a Proposed 8-mile EPGT Natural Gas Transmission Pipeline in Travis and Hays Counties, Texas*. HJN 020128 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of a Proposed 6-acre Village 7 Sewer Treatment Plant #1 Located in The Woodlands, Harris County, Texas*. HJN 020207 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of 13 Proposed Well Sites and Associated Flow Lines on the Freeman Ranch Lease, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas

2002 *Cultural Resources Investigations Conducted along Sections of New Hope and Bagdad Roads for Proposed Widening Efforts, Cedar Park, Williamson County, Texas*. Texas Antiquities Committee Permit No. 2967. HJN 020185 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Terrestrial Cultural Resources Survey of the Proposed Crude Oil Pipeline Right-of-Way for the Cameron Highway Pipeline Project's Texas City Extension, Chambers County, Texas*. HJN 020077 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *Pipeline Realignments, Cameron Highway Oil Pipeline System New 24-inch Crude Oil Pipeline, Port Neches Extension, Jefferson County, Texas*. An Addendum to: *An Intensive Cultural Resources Survey for a Proposed 29-mile Crude Oil Pipeline Right-of-Way, Port Neches Route of the Cameron Highway Pipeline Project, Jefferson County, Texas*. HJN 020078 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of the Proposed 1600-acre Belterra Subdivision Tract Located in Hays County, Texas*. HJN 020196 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of a Proposed Orange County WCID No. 1 2-acre Water Well Site; 2-acre Water Storage Tank Site; and 37,400 Linear Feet of Associated Waterline Routes in Vidor, Orange County, Texas*. Texas Antiquities Committee Permit No. 2998. HJN 020233 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of Extra Work Spaces Associated with Centennial Pipeline LLC's Proposed Horizontal Directional Drill of the Little River in Grant and La Salle Parishes, Louisiana*. HJN 020258 AR. Horizon Environmental Services, Inc. Austin, Texas.

2002 *An Intensive Cultural Resources Survey of 1 Proposed Well Site and 1 Proposed Flow Line on EOG Resources' Tucker Lease, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Horizon Environmental Services, Inc. Austin, Texas.

2003 *Addendum to An Intensive Cultural Resources Survey of the Proposed Widening of Ranch-to-Market Road 2243 (Alternates A and B), Leander, Williamson County, Texas*. Texas Antiquities Committee Permit No. 2722. HJN 010185 AR. TXDOT CSJ No. 2103-01-021. Horizon Environmental Services, Inc. Austin, Texas.

2003 *An Intensive Cultural Resources Survey of 6 Proposed Well Sites and Associated Flow Lines on the Freeman Ranch Lease, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2003 *An Intensive Cultural Resources Survey of 3 Proposed Well Sites and Associated Flow Lines on the Freeman Ranch Lease, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2003 *An Intensive Cultural Resources Survey of 1 Proposed Well Site and 1 Proposed Flow Line on EOG Resources, Inc.'s Tucker Lease, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2003 *An Intensive Cultural Resources Survey of 26 Proposed Well Sites and Associated Flow Lines on the Freeman Ranch and Tucker Leases, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2003 *An Intensive Cultural Resources Survey of the Jefferson County Drainage District No. 6's Proposed Mayhaw Diversion, Needmore Diversion, and Green Pond Detention Area, Jefferson County, Texas*. Texas Antiquities Committee Permit No. 3031. HJN 000418 AR. Horizon Environmental Services, Inc. Austin, Texas.

2003 *An Intensive Cultural Resources Survey of a Proposed Elevated Water Storage Tank Site and 2 Associated Waterline Easements, Cedar Park, Williamson County, Texas*. Texas Antiquities Committee Permit No. 3049. HJN 030012 AR. Horizon Environmental Services, Inc. Austin, Texas.

2003 *An Intensive Cultural Resources Survey of a Proposed 110-acre Sand and Gravel Mine and Sorting Plant for Riverside Aggregates, Austin County, Texas*. HJN 030023 AR. Horizon Environmental Services, Inc. Austin, Texas.

2003 *An Intensive Cultural Resources Survey of a Portion of the 47-acre Holt Property Located in San Marcos, Hays County, Texas*. HJN 030195 AR. Horizon Environmental Services, Inc. Austin, Texas.

2003 *An Intensive Cultural Resources Survey and Subsequent Testing of the Proposed Woodlands Southwest Detention Pond, The Woodlands, Montgomery County, Texas*. Texas Antiquities Committee Permit No. 3055. HJN 030019 AR. Horizon Environmental Services, Inc. Austin, Texas.

2003 *An Intensive Cultural Resources Survey of a Proposed 6-mile Natural Gas Pipeline for the UNOCAL Keystone Gas Storage Project, Winkler County, Texas.* HJN 000256. AR

2004 *An Intensive Cultural Resources Survey of a Proposed 31.18-acre Wal-Mart Site Located in Rockdale, Milam County, Texas*. HJN 040030. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of Proposed Oil/Gas Well Development on the Attwater's Prairie Chicken National Wildlife Refuge, Colorado County, Texas*. USFWS Special Use Permit #ATW-04-008. HJN 040088 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *Data Recovery Investigations at the Holt Site (41HY341), San Marcos, Hays County, Texas*. HJN 040032 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of a Proposed Water Transmission Line from High Island to Singing Sands, Galveston County, Texas*. Texas Antiquities Committee Permit No. 3298. HJN 020189 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *Archeological Avoidance Plan: Proposed Seismic Survey, Brigham Oil and Gas, L.P., Alamo Project, Aransas, Calhoun, and Refugio Counties, Texas*. HJN 040006 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of 13 Proposed Well Sites and Associated Flow Lines on the Freeman Ranch Lease, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of 7 Proposed Well Sites on EOG Resources, Inc.'s Freeman Ranch and Tucker Leases, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *National Register of Historic Places Eligibility Testing of 2 Sites (41WM650 and 41WM651) Located within the Cedar Park Town Center Development, Cedar Park, Williamson County, Texas*. HJN 040024 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *Intensive Cultural Resources Survey of the Proposed Sierra Vista Substation Site and 138 kV Transmission Line, Webb County, Texas*. HJN 050144 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *An Intensive Cultural Resources Survey of the Proposed 452-acre Park Lakes East Development near Humble, Harris County, Texas*. HJN 050131 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *Archeological Monitoring of Scraping Investigations within the Port Bolivar Community Cemetery, Galveston County, Texas.* Texas Antiquities Committee Permit No. 3857. HJN 050057 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *An Intensive Cultural Resources Survey of EOG Resources, Inc.'s Proposed Carthage Gas Unit No. 112 Alt Natural Gas Well Pad and Access Road, Panola County, Texas*. HJN 030169 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *An Intensive Cultural Resources Survey for the Proposed Widening of Jefferson County Drainage District No. 6's Griffing Ditch, Beaumont, Jefferson County, Texas.* Texas Antiquities Committee Permit No. 3804. HJN 040240 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *An Intensive Cultural Resources Survey of the USACE Jurisdictional Areas within a Proposed Ethanol Plant Facility in Hereford, Deaf Smith County, Texas*. HJN 050113 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *Backhoe Trenching at 2 Proposed Lift Stations Located in Richmond, Fort Bend County, Texas*. Texas Antiquities Committee Permit No. 3712. HJN 050043 AR. Horizon Environmental Services, Inc. Austin, Texas.

2006 *An Intensive Cultural Resources Survey of the USACE Jurisdictional Areas Associated with the Proposed Realignment of Macho Creek, Duval County, Texas.* HJN 060199 AR. Horizon Environmental Services, Inc. Austin, Texas.

2006 *An Intensive Cultural Resources Survey of the USACE Jurisdictional Areas Associated with 3 Proposed Detention Ponds and 2 Proposed Road Crossings within the Proposed Headwaters of Barton Creek Development, Drippings Springs, Hays County, Texas.* HJN 040116 AR. Horizon Environmental Services, Inc. Austin, Texas.

2006 *An Intensive Cultural Resources Survey of the Area of Potential Effect within the 164-acre Webb Development, Austin, Travis County, Texas*. HJN 050068 AR. Horizon Environmental Services, Inc. Austin, Texas.

2006 *Cultural Resources Assessments of 4 Maintenance Locations along the Longhorn Partners Pipeline, L.P. in Schleicher County, Texas.* HJN 050175 AR. Horizon Environmental Services, Inc. Austin, Texas.

2006 *An Intensive Cultural Resources Survey of the Proposed Moore Street Detention Basin, Beaumont, Jefferson County, Texas.* Texas Antiquities Committee Permit No. 4028. HJN 060015 AR. Horizon Environmental Services, Inc. Austin, Texas.

2006 *An Intensive Cultural Resources Survey of the Proposed Erie Street Detention Basin, Beaumont, Jefferson County, Texas*. Texas Antiquities Committee Permit No. 4031. HJN 060017 AR. Horizon Environmental Services, Inc. Austin, Texas.

2006 *An Intensive Cultural Resources Survey of the Proposed Corley-Cartwright Detention Basin, Beaumont, Jefferson County, Texas*. Texas Antiquities Committee Permit No. 4030. HJN 060016 AR. Horizon Environmental Services, Inc. Austin, Texas.

2006 *An Intensive Cultural Resources Survey of the Proposed Ridgewood Detention Basin, Beaumont, Jefferson County, Texas*. Texas Antiquities Committee Permit No. 4029. HJN 060014 AR. Horizon Environmental Services, Inc. Austin, Texas.

2006 *Cultural Resources Assessments of 21 Maintenance Locations along the Longhorn Partners Pipeline, L.P. in Travis, Bastrop, and Fayette Counties, Texas.* HJN 050175 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *An Intensive Cultural Resources Survey of 4 HDD Locations on the Proposed Pecan Pipeline Right-of-Way, Palo Pinto County, Texas.* HJN 060191 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *An Intensive Cultural Resources Survey of 4 Additional HDD Locations on the Proposed Pecan Pipeline Right-of-Way, Palo Pinto County, Texas.* HJN 060191 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *Cultural Resources Assessments of 53 Maintenance Locations along the Longhorn Partners Pipeline, L.P. ROW in Gillespie, Kimble, Schleicher, Crockett, Reagan, Upton, and Crane Counties, Texas.* HJN 050175 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *An Intensive Cultural Resources Survey of 78 Archeological High Probability Areas between the Cedar Valley and Fort McKavett Pump Stations on the Longhorn Pipeline Right-of-Way in Hays, Blanco, Gillespie, Llano, Mason, Kimble, Menard, and Schleicher Counties, Texas*. Texas Antiquities Committee Permit No. 4576. HJN 050175 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *An Intensive Cultural Resources Survey of Lake Travis ISD's 12.75-acre West Cypress Hills Elementary School Tract, Travis County, Texas*. Texas Antiquities Committee Permit No. 4729. HJN 070187 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *An Intensive Cultural Resources Survey and Subsequent NRHP Eligibility Testing of Areas within the Proposed 238-acre Blanco Riverwalk Development, Hays County, Texas*. HJN 060195 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *An Intensive Cultural Resources Survey of 12 Archeological High-Probability Areas along 42 Miles of Extra Work Spaces on the Longhorn Partners Pipeline Right-of-Way in Ward and Reeves Counties, Texas*. HJN 070176 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *Cultural Resources Assessments of 4 Maintenance Locations along the Longhorn Partners Pipeline, L.P. Pipeline Right-of-Way in Gillespie and Blanco Counties, Texas.* HJN 050175 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *An Intensive Cultural Resources Survey of the 15-acre Round Rock ISD Paloma Lake Tract, Round Rock, Williamson County, Texas*. Texas Antiquities Committee Permit No. 4713. HJN 070166 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *An Intensive Cultural Resources Survey of 12 Cathodic Protection Beds along the Longhorn Pipeline Right-of-Way in Travis, Blanco, Gillespie, Mason, Crockett, Reagan, and Culberson Counties, Texas*. Texas Antiquities Committee Permit No. 4594. HJN 050175 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *An Intensive Cultural Resources Survey of a Proposed HDD beneath an Abandoned Tram Road Owned by the US Forest Service in Nacogdoches County, Texas.* HJN 070193 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *Cultural Resources Investigations on the Proposed 1060-acre Vizcaya Development, Spicewood, Travis County, Texas (Volume 1: Survey Level Investigations)*. HJN 060231 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *An Intensive Cultural Resources Survey of the Proposed 883-acre Siena Subdivision Property, Round Rock, Williamson County, Texas*. HJN 070065 AR. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of the Keechi Creek and Brazos River HDD Bore Pits on the Proposed Pecan Pipeline Right-of-Way, Palo Pinto County, Texas*. HJN 060191 AR. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Orange County WCID No. 1's Oak Lane WWTP Improvements, Vidor, Orange County, Texas*. Texas Antiquities Committee Permit No. 4748. HJN 080006 AR. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of the Proposed 80-acre Arbol Grande on St. Charles Bay Subdivision Tract, Aransas County, Texas*. HJN 080045 AR. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of the Proposed Woodland Acres Flood Mitigation Project, Beaumont, Jefferson County, Texas.* Texas Antiquities Committee Permit No. 4972. HJN 080094 AR. Horizon Environmental Services, Inc. Austin, Texas.

2008 *Cultural Resources Investigations Conducted for the City of Anahuac's Proposed Water System Improvements, Anahuac, Chambers County, Texas*. Texas Antiquities Committee Permit No. 3856. HJN 050139 AR. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of the Proposed Houston Fuel Oil Terminal Barge Docks #7 and #8 on Carpenters Bayou, Harris County, Texas*. HJN 080106 AR. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of the Trinity Bay Conservation District's Proposed 90-acre Freshwater Impoundment Reservoir in Chambers County, Texas.* Texas Antiquities Committee Permit No. 5189. HJN 090009 AR. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of a Proposed TBCD Water Line and Sanitary Sewer Force Main ROW in Chambers County, Texas.* Texas Antiquities Committee Permit No. 5206. HJN 090039 AR. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of the Proposed 38.0-acre Hutto Lake Park Property, Hutto, Williamson County, Texas.* Texas Antiquities Committee Permit No. 5247. HJN 090049 AR. Horizon Environmental Services, Inc. Austin, Texas.

2009 *Cultural Resources Investigations along the Proposed LyondellBasell CVOS ETBE Pipeline Right-of-Way in Harris County, Texas.* HJN 090059 AR. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of Phase 2 of the Proposed Wild Horse Ranch Northwest Wastewater Interceptor Right-of-Way, Travis County, Texas.* HJN 090061 AR. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of M2 Midstream, LLC's proposed Blackstone 8-Inch Lateral Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 090055 AR 13. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of Louisiana Midstream Gas Services' proposed CHK LA Minerals 32 H-1 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 107. Horizon Environmental Services, Inc. Austin, Texas.

2009 *Cultural Resources Investigations within a Proposed 27.0-acre US Army Reserve Training Center Survey Area, Humble, Harris County, Texas*. HJN 090108 AR. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of the Houston Fuel Oil Terminal Company's Proposed Ship Dock #4 on Buffalo Bayou, Harris County, Texas*. HJN 090101 AR. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of the Proposed 89.0-acre Lake Travis ISD Education Facilities Tract, Travis County, Texas*. Texas Antiquities Committee Permit No. 5419. HJN 090115 AR. Horizon Environmental Services, Inc. Austin, Texas.

2009 *Cultural Resources Investigations of a Proposed Reroute of the LyondellBasell CVOS ETBE Pipeline Right-of-Way in Harris County, Texas.* Texas Antiquities Committee Permit No. 5316. HJN 090059 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of Louisiana Midstream Gas Services' proposed 15.0-acre Pines Compressor Facility Site, DeSoto Parish, Louisiana*. HJN 080147 AR 122. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of Louisiana Midstream Gas Services' proposed Porter-Beach 26-12-1 Natural Gas Gathering Line in DeSoto Parish, Louisiana*. HJN 080147 AR 125. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of Louisiana Midstream Gas Services' proposed Gilliam 23-13-14 H-1 Natural Gas Gathering Line in DeSoto Parish, Louisiana*. HJN 080147 AR 130. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Bolton 26-H1 Well Pad and Access Road in Bossier Parish, Louisiana*. HJN 100011 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Ratzburg 18H No.1 Well Pad and Access Road in Caddo Parish, Louisiana*. HJN 100029 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of Louisiana Midstream Gas Services' proposed Nabors Properties 13 H-1 Natural Gas Gathering Line in DeSoto Parish, Louisiana*. HJN 080147 AR 124. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of Louisiana Midstream Gas Services' proposed Brush Bayou Natural Gas Gathering Line in Caddo Parish, Louisiana*. HJN 080147 AR 138. Horizon Environmental Services, Inc. Austin, Texas.

2010 *Archeological Avoidance Plan for the Proposed Union Grave 3-D Seismic Survey Project in Sabine, San Augustine, and Nacogdoches Counties, Texas*. HJN 100026 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *Archeological Avoidance Plan for the Proposed Union Grave 3-D Seismic Survey Project in San Augustine County, Texas*. HJN 100026 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *Archeological Avoidance Plan for the Proposed Nac East 3-D Seismic Survey Project in Nacogdoches, San Augustine, and Shelby Counties, Texas*. HJN 100032 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of the Proposed TGG 36-inch Phase 3 Section 1 Natural Gas Gathering Line in Caddo and DeSoto Parishes, Louisiana*. HJN 100050 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed CHK LA Minerals 24-13-12 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 140. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Mansfield Lateral 4A East Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 141. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Calhoun 9-13-12 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 149. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Petrohawk Energy Corporation's Proposed TBD 22-16N-10W Off-Unit Alt. No. 1 Well Pad and Access Road in Bienville Parish, Louisiana*. HJN 100057 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Talco Midstream Assets, Ltd's Proposed Country Club 29H No.2 Natural Gas Gathering Line, Caddo and DeSoto Parishes, Louisiana*. HJN 100058 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Weyerhauser 29H-1 and 32H-1 Well Pad Projects, DeSoto Parish, Louisiana*. HJN 100068 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Wiggins 31-12-12 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 152. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed CHK LA Min 2-13-12 H-1 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 154. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Keatchie 15-14-15 H-1 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 155. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed JMD 3-14-15 H-1 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 158. Horizon Environmental Services, Inc. Austin, Texas.

2010 *Archeological Monitoring Conducted During the Replacement of Waterline Segment 10, Anahuac, Chambers County, Texas*. HJN 100052 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of G-M WSC's Proposed Surface Water Treatment Facility and Intake Structure Project in Sabine County, Texas*. Texas Antiquities Committee Permit No. 5676. HJN 10074 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *Cultural Resources Investigations Conducted for the Proposed Rocky Creek Ranch WWTP Project in Travis County, Texas*. Texas Antiquities Committee Permit No. 5682. HJN 100081 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Mansfield Lateral 14 West Natural Gas Gathering Line, Sabine Parish, Louisiana*. HJN 080147 AR 148. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Briarwood 25-12N-13W H-1 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 166. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Rollert 23-12-13 H-1 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 170. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Tompkins 2-H No.1 Well Pad and Access Road in Bossier Parish, Louisiana*. HJN 100084 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Petrohawk Energy Corporation's Proposed TBD 19-16N-11W Off Unit Well Pad and Access Road in Bossier Parish, Louisiana*. HJN 100088 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Cowley 29H No. 1 Well Pad and Access Road in Bienville Parish, Louisiana*. HJN 100089 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Rocking G-31 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 173. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Mansfield Lateral 4BE Natural Gas Gathering Line, Red River Parish, Louisiana*. HJN 080147 AR 175. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of the USACE Jurisdictional Areas within the Proposed Crossings at Plum Creek Development in Hays County, Texas*. HJN 100067 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed ABG 25-14-12 & ABG 36-14-12 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 174. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed D'Artois 16 Well Connect Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 185. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Stalder 14-12N-13W Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 192. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Muse 24-14-15 H-1 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 199. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Nabors 7-12-11 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 204. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Aikens 17-12-11 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 206. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Mansfield Lateral 5E-7E Interconnect Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 207. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Quinn 19-11-13 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 180. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Patco 27-13-12 H-1 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 211. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Petro-Hunt 8-13-7 H-1 Natural Gas Gathering Line, Natchitoches and Red River Parishes, Louisiana*. HJN 080147 AR 215. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed LRE/DLP 13-13-12 H-1 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 216. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Mansfield Trunkline Phase 2 Extension Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 131. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Nabors 26-10-13 Natural Gas Gathering Line, Sabine Parish, Louisiana*. HJN 080147 AR 153. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed CHK 36-10-13 Natural Gas Gathering Line, Sabine Parish, Louisiana*. HJN 080147 AR 225. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed NP LLC 17-12-13 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 231. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Petrohawk Energy Corporation's Proposed TBD 18-15N-10W Well Pad and Access Road in Bossier Parish, Louisiana*. HJN 100090 AR 23. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Kinderhawk Field Services, LLC's Proposed CPS-Timberlands Natural Gas Gathering Line ROW in DeSoto Parish, Louisiana*. HJN 100090 AR 24. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Kinderhawk Field Services, LLC's Proposed Culpepper North and Sustainable Natural Gas Gathering Line ROW in Bienville Parish, Louisiana*. HJN 100090 AR 25. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Kinderhawk Field Services, LLC's Proposed Langford Natural Gas Gathering Line ROW in Bossier Parish, Louisiana*. HJN 100125 AR 08. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of a Segment of Kinderhawk Field Services, LLC's Proposed Loftin Lateral Natural Gas Gathering Line ROW in Red River and Bienville Parishes, Louisiana*. HJN 100125 AR 10. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Mansfield Lateral 13-14E Interconnect Natural Gas Gathering Line, Sabine Parish, Louisiana*. HJN 080147 AR 240. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Nabors 6-11-11 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 241. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Gallaspy 19-12-11 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 247. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Martinez 3 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 248. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Norris 1-13-13 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 248. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Kinderhawk Field Services, LLC's Proposed Wilkinson-Almond Natural Gas Gathering Line ROW in Red River Parish, Louisiana*. HJN 100090 AR 28. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed CHK LA Min 14-11-13 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 245. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Bedsole 1-10-13 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 253. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Springridge Lateral 1 West Loop Comped Route Natural Gas Gathering Line, Caddo Parish, Louisiana*. HJN 080147 AR 260. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Morton 34-11-14 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 263. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Kinderhawk Field Services, LLC's Proposed Robbins 8 Natural Gas Gathering Line ROW in DeSoto Parish, Louisiana*. HJN 100125 AR 15. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Cultural Resources Survey of the 18.95-Acre Aspen Heights Tract in San Marcos, Hays County, Texas*. HJN 110019 AR. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Kinderhawk Field Services, LLC's Proposed CPS Timberland 21 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 100125 AR 31. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Kinderhawk Field Services, LLC's Proposed CHK Franks Pipeline Natural Gas Gathering Line, Bossier Parish, Louisiana*. HJN 100125 AR 26. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed CHK LA Min 15-11-13 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 110006 AR 20. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Goodrich Petroleum Corporation's Proposed Lowery No. 1 Well Pad Expansion Project, Nacogdoches County, Texas*. HJN 110040 AR 01. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Cultural Resources Survey of KinderHawk Field Services, LLC's Proposed Dewitt Gathering - East Extension Phase I ROW in DeWitt County, Texas*. HJN 100125 AR 34. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Mid-America Midstream Gas Services' Proposed Center Ranch A1H Natural Gas Gathering Line, Leon County, Texas*. HJN 110028 AR 02. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Rascoe 1-10-14 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 110006 AR 29. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Evans 10-12-13 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 110006 AR 31. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Kinderhawk Field Services, LLC's Proposed Peavy Natural Gas Gathering Line, Bienville Parish, Louisiana*. HJN 100125 AR 56. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of 23 USACE Jurisdictional Crossings along an Eagle Ford Midstream, LLC Proposed 26.0-mile Natural Gas Gathering Line ROW and 2.2-mile Lateral ROW in LaSalle County, Texas*. HJN 080122 AR 10. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Kinderhawk Field Services, LLC's Proposed Wallace Lake Phase II Natural Gas Gathering Line ROW in Caddo Parish, Louisiana*. HJN 100125 AR 46. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Cultural Resources Survey of Extra Work Spaces Associated with 5 Pipe Replacement Segments along the Longhorn Pipeline Right-of-Way in Hays and Blanco Counties, Texas*. HJN 050175 AR 07. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed LA Minerals 36-12-12 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 110006 AR 33. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Petrohawk Energy Corporation' Proposed TBD 36-12N-14W Access Road ROW, DeSoto Parish, Louisiana*. HJN 100090 AR 42. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Cultural Resources Survey of 9 USACE Jurisdictional Crossings along Eagle Ford Midstream, LP's 20.8-mile 16" Natural Gas Pipeline ROW in LaSalle County, Texas*. HJN 080122 AR 17. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Lewis 7-10-13 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 110006 AR 34. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Magnolia Midstream Gas Services' Proposed Gray 14-14-15 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 110026 AR 13. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed J-Hermann F 1H Access Road in DeWitt County, Texas*. HJN 100148 AR 32. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Forest Wheeler B 1H and 2H Dual Well Access Road in McMullen County, Texas*. HJN 100148 AR 33. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Cultural Resources Survey of Aurora Resources Corporation's Proposed Quintanilla and Wheeler Eagle Ford Shale Well Pads in McMullen County, Texas*. HJN 110003 AR. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Louisiana Midstream Gas Services' Proposed Ivory 14-10-13 2H Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 110006 AR 37. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Cultural Resources Survey of 3 Off-Site Wastewater Lines Associated with the Paso Robles Development in San Marcos, Hays County, Texas*. HJN 110078 AR. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Survey of the USACE Jurisdictional Areas within Petrohawk Energy Corporation's Proposed JC Martin State Unit 1H Well Pad and Access Road ROW in LaSalle County, Texas*. HJN 110141 AR. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Cultural Resources Survey of the USACE Jurisdictional Areas along Eagle Ford Midstream, LP's Proposed Asche to Nye Pipeline ROW in LaSalle County, Texas*. HJN 110143 AR. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Enterprise Gathering LLC's Proposed CHK Evans 4-8-13 Natural Gas Gathering Line, Sabine Parish, Louisiana*. HJN 110136 AR2 07. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Wheeler 7 1H Well Pad and Access Road in McMullen County, Texas*. HJN 100148 AR 34. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Gentry 10H Well Pad and Access Road in McMullen County, Texas*. HJN 100148 AR 35. Horizon Environmental Services, Inc. Austin, Texas.

2011 *An Intensive Phase I Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Murphy 12H-1 and Murphy 1H-1 Well Pads and Access Road in Bossier Parish, Louisiana*. HJN 100090 AR 51. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Wheeler Unit 8 1H Well Pad and Access Road in McMullen County, Texas*. HJN 100148 AR 36. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Phase I Cultural Resources Survey of Magnolia Midstream Gas Services' Proposed JMD 2-14-15 3H Well Connect ROW, DeSoto Parish, Louisiana*. HJN 110026 AR 22. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Gentry 1H Well Pad and Access Road in McMullen County, Texas*. HJN 100148 AR 37. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Phase I Cultural Resources Survey of Talco Midstream Assets, Ltd.'s Proposed Owens Extension East Pipeline ROW, DeSoto Parish, Louisiana*. HJN 100048 AR 111. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Phase I Cultural Resources Survey of the Proposed Caddo Mitigation Bank in DeSoto and Caddo Parishes, Louisiana*. HJN 120008 AR. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Phase I Cultural Resources Survey of Enterprise Gathering LLC's Proposed CHK Evans 26-10-14 Natural Gas Gathering Line, Sabine Parish, Louisiana*. HJN 110136 AR2 09. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Phase I Cultural Resources Survey of Enterprise Gathering LLC's Proposed CHK* CHK SUMC 30-9-13 *Natural Gas Gathering Line, Sabine Parish, Louisiana*. HJN 110136 AR2 10. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Phase I Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Buckneck et al. 22H No. 1 Well Pad and Access Road in Natchitoches Parish, Louisiana*. HJN 100090 AR2 54. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Gentry 11H and 21H Dual Well Pad and Access Road in McMullen County, Texas*. HJN 100148 AR 38. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Gentry 17H and 23H Dual Well Pad and Access Road in McMullen County, Texas*. HJN 100148 AR 39. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Wheeler McTee 2H Well Pad and Access Road in McMullen County, Texas*. HJN 100148 AR 40. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Wheeler McTee 3H Well Pad and Access Road in McMullen County, Texas*. HJN 100148 AR 41. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Moy A 1H Well Pad and Access Road in Karnes County, Texas*. HJN 100148 AR 42. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Zgabay 2H, 3H, and 4H Triple Well Pad and Access Road in Gonzales County, Texas*. HJN 100148 AR 43. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Musick A 1H and 2H Dual Well Pad and Access Road in DeWitt County, Texas*. HJN 100148 AR 44. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Mueller 18 A 1H Well Pad and Access Road in McMullen County, Texas*. HJN 100148 AR 45. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of the Proposed Copano-Houston Central Plant Cryo Expansion Project in Colorado County, Texas*. HJN 110012 AR2 07. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Krause B 5H, 6H, and 7H Well Pad and Access Road in DeWitt County, Texas*. HJN 100090 AR2 57. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Krause B 2H, 3H, and 4H Well Pad and Access Road in DeWitt County, Texas*. HJN 100090 AR2 58. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Phase I Cultural Resources Survey of Enterprise Gathering LLC's Proposed Comstock Evans 13-9-13 Well Connect, Sabine Parish, Louisiana*. HJN 110136 AR2 18. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Kinder Morgan's Proposed Galena Park Splitter Project in Harris County, Texas*. HJN 110012 AR2 08. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Unit 73B 1H, 2H, 3H, 4H, and Unit 118 1H and 2H Well Pad and Access Road in DeWitt County, Texas*. HJN 100148 AR 46. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of BHP Billiton's Proposed Banduch A 1H, B 3H, and B 4H Well Pad Project in Karnes County, Texas*. HJN 100148 AR 47. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of BHP Billiton's Proposed Banduch A 2H, A 3H, B 1H, B 2H Well Pad and Access Road in Karnes County, Texas*. HJN 100148 AR 48. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of BHP Billiton's Proposed Hauglum C 1H Well Pad and Access Road in Live Oak County, Texas*. HJN 100148 AR 49. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of BHP Billiton's Proposed Marie A 2H and 3H Well Pad and Access Road in DeWitt County, Texas*. HJN 100148 AR 50. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of BHP Billiton's Proposed House Motherlode Unit 1 1H Well Pad and Access Road in Live Oak County, Texas*. HJN 100148 AR 51. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Robert Gutierrez 3H Well Pad and Access Road in La Salle County, Texas*. HJN 100148 AR 52. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Lowry 1 1H Well Pad and Access Road in La Salle County, Texas*. HJN 100148 AR 53. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Dora Martin A 7H, 10H, and 18H Well Pad and Access Road in La Salle County, Texas*. HJN 100148 AR 54. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Gutierrez-Leyendecker 3H Well Pad and Access Road in La Salle County, Texas*. HJN 100148 AR 55. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of 16 USACE Jurisdictional Areas along the Proposed Eagle Ford Midstream Phase 2A Natural Gas Pipeline ROW in La Salle County, Texas*. HJN 120014 AR. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of 15 USACE Jurisdictional Areas along the Proposed Eagle Ford Midstream Phase 2B Natural Gas Pipeline ROW in LaSalle, McMullen, Duval, Jim Wells, and Nueces Counties, Texas*. HJN 120014 AR. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of PetroHawk Energy Corporation's Proposed Dilworth Frac Pond in McMullen County, Texas*. HJN 100148 AR 56. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of PetroHawk Energy Corporation's Proposed Caroline Pielop 8H Well Pad and Access Road in La Salle County, Texas*. HJN 100148 AR 57. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Wheeler Swenson 1H and 2H Well Pad and Access Road in McMullen County, Texas*. HJN 100148 AR 58. Horizon Environmental Services, Inc. Austin, Texas.

Archambeault, M.J., R. Clark, and R.K. Brownlow

2005 *An Intensive Cultural Resources Survey of a Proposed Water Discharge Pipeline Associated with the Sandy Creek Energy Station, McLennan County, Texas*. HJN 050072 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *An Intensive Cultural Resources Survey of the LCRA's Proposed Andice to Glasscock Transmission Line, Williamson County, Texas*. Texas Antiquities Committee Permit No. 3731. HJN 050059 AR. Horizon Environmental Services, Inc. Austin, Texas.

Brownlow, R.K. and M.J. Archambeault

2006 *An Intensive Cultural Resources Survey and Subsequent NRHP/SAL Testing Conducted for the Proposed Calder Street Diversion Project, Beaumont, Jefferson County, Texas*. Texas Antiquities Committee Permit No. 4032. HJN 060018 AR. Horizon Environmental Services, Inc. Austin, Texas.

Brownlow, R.K. and R.D. Clark

2004 *An Intensive Cultural Resources Survey of a Proposed 2-acre Corner Store Parcel Located within the 150-acre Valero Property, San Antonio, Bexar County, Texas*. HJN 040207 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *An Intensive Cultural Resources Survey of the Proposed Valero 24-mile Harlingen to Brownsville Refined Products Pipeline Right-of-Way, Cameron County, Texas.* HJN 040158 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *An Intensive Cultural Resources Survey of a Proposed Water Discharge Pipeline Associated with the Little Sandy Creek Energy Station, McLennan County, Texas*. HJN 050072 AR. Horizon Environmental Services, Inc. Austin, Texas.

2006 *An Intensive Cultural Resources Survey of the USACE Jurisdictional Areas within the Proposed 33-mile Hull to Mont Belvieu Pipeline Right-of-Way, Liberty County, Texas.* HJN 060067 AR. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Lake Travis ISD's 34-acre Bee Creek Middle School Tract, Travis County, Texas*. Texas Antiquities Committee Permit No. 4802. HJN 080019 AR. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of Louisiana Midstream Gas Services' proposed Mansfield Trunkline Right-of-Way, DeSoto Parish, Louisiana*. HJN 080147 AR 99. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of Louisiana Midstream Gas Services' proposed Nabors 6-12-13 H-1 Natural Gas Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 111. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of Louisiana Midstream Gas Services' proposed Mansfield Lateral 12E Right-of-Way, DeSoto Parish, Louisiana*. HJN 080147 AR 116. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of a Proposed Rebecca Creek Municipal Utility District Waterline ROW in Comal County, Texas.* Texas Antiquities Committee Permit No. 5502. HJN 100003 AR. Horizon Environmental Services, Inc. Austin, Texas.

Brownlow, R.K., R.D. Clark, and M.T. Iruegas

2004 *An Intensive Cultural Resources Survey of the Proposed Edinburg to Harlingen 40-mile Pipeline, Hidalgo and Cameron Counties, Texas*. HJN 040156 AR. Horizon Environmental Services, Inc. Austin, Texas.

Brownlow, R.K., R.D. Clark, and C. Walker

2008 *Cultural Resources Investigations on the Proposed 1087-acre Preserve at West Beach Development on Galveston Island, Galveston County, Texas*. HJN 080022 AR. Horizon Environmental Services, Inc. Austin, Texas.

Brownlow, R.K. and C. Frederick

2005 *Supplemental NRHP Eligibility Testing on 41TV870, Located within the Proposed Scofield Farms Development, Austin, Travis County, Texas*. HJN 050067 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *State Archeological Landmark Eligibility Testing of Site 41WM1104, located within the Proposed Right-of-Way of the Wolf Ranch Force Main Wastewater Line, Georgetown, Williamson County, Texas*. Texas Antiquities Committee Permit No. 3642. HJN 040178 AR. Horizon Environmental Services, Inc. Austin, Texas.

2007 *Cultural Resources Investigations on the Proposed 1060-acre Vizcaya Development, Spicewood, Travis County, Texas (Volume 2: NRHP Eligibility Testing Investigations)*. HJN 060231 AR. Horizon Environmental Services, Inc. Austin, Texas.

Brownlow, R.K. and P. Held

2007 *An Intensive Cultural Resources Survey of the 13.4-acre Brandywine Tract, Austin, Travis County, Texas.* HJN 070031 AR. Horizon Environmental Services, Inc. Austin, Texas.

Brownlow, R.K. and M.L. Mudd

2005 *An Intensive Cultural Resources Survey of a Proposed Valero Horizontal Direction Drill Locations for a Bore Under the Brownsville Ship Channel, Brownsville, Cameron County, Texas*. HJN 050114 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *An Intensive Cultural Resources Survey of EOG Resources, Inc.'s Proposed KD Livestock Pipeline Right-of-Way, Johnson County, Texas*. HJN 030090 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed RG Murphy 1-H No.1 Well Pad and Access Road in Bienville Parish, Louisiana*. HJN 100020 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Weyerhauser 10H-1 Well Pad and Access Road in Bienville Parish, Louisiana*. HJN 100039 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed TBD 22-16N-11W No. 2 Well Pad and Access Road in Bossier Parish, Louisiana*. HJN 100040 AR. Horizon Environmental Services, Inc. Austin, Texas.

2011 *Archeological Avoidance Plan for the Proposed Choke Canyon Reservoir 3-D Seismic Survey Project in McMullen and Live Oak Counties, Texas*. HJN 110022 AR. Horizon Environmental Services, Inc. Austin, Texas.

Brownlow, R.K. and M.L. Mudd, and J.M. Wiersema

2011 *Archeological Avoidance Plan for the Proposed Toledo Bend North 3-D Seismic Survey Project in Shelby County, Texas and DeSoto and Sabine Parishes, Louisiana*. HJN 110033 AR. Horizon Environmental Services, Inc. Austin, Texas.

Brownlow, R.K. and J.D. Owens

2005 *An Intensive Cultural Resources Survey of Portions of the Brakes Bayou Flood Mitigation Project, Beaumont, Jefferson County, Texas*. Texas Antiquities Committee Permit No. 3906. HJN 050149 AR. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Dingee #1 Gathering Line, Cherokee County, Texas*. HJN 080147 AR 05. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Jones (Dixie Farms) #1 Gathering Line, Cherokee County, Texas*. HJN 080147 AR 06. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Blackstone Minerals #1 and #2 Gathering Lines, Cherokee County, Texas*. HJN 080147 AR 07. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Summers #1 Gathering Line, Cherokee County, Texas*. HJN 080147 AR 12. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Temple Inland #6-2 Gathering Line, Houston County, Texas*. HJN 080147 AR 13. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Prestriedge #2 Gathering Line, Cherokee County, Texas*. HJN 080147 AR 15. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Larry Neal #1 Gathering Line, Cherokee County, Texas*. HJN 080147 AR 16. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Miles #1 Gathering Line, Houston and Anderson Counties, Texas*. HJN 080147 AR 18. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed JAF #1 Gathering Line, Freestone County, Texas*. HJN 080147 AR 22. Horizon Environmental Services, Inc. Austin, Texas.

2010 *An Intensive Cultural Resources Survey of the USACE Jurisdictional Areas within Eagle Rock Energy Partner's Proposed "20" East Texas Mainline Extension Pipeline ROW in Nacogdoches, County, Texas*. HJN 100019 AR. Horizon Environmental Services, Inc. Austin, Texas.

Brownlow, R.K., J.D. Owens, and J.M. Wiersema

2009 *Cultural Resources Investigations within Potential Borrow Areas Associated with the Cherokee Lakes Project, Cherokee County, Texas*. HJN 060254 AR. Horizon Environmental Services, Inc. Austin, Texas.

2010 *Cultural Resources Investigations within a Potential Borrow Area Associated with the North Lake of the Cherokee Lakes Project, Cherokee County, Texas*. HJN 060254 AR. Horizon Environmental Services, Inc. Austin, Texas.

Brownlow, R.K., V.A. Peyton, and M.L. Mudd

2007 *An Intensive Cultural Resources Survey of the Proposed MUD 387 Water Plant #2, The Woodlands, Harris County, Texas*. Texas Antiquities Committee Permit No. 4312. HJN 060255 AR. Horizon Environmental Services, Inc. Austin, Texas.

Brownlow, R.K. and R.W. Ralph

2009 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Mansfield Lateral 4E Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 38. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Blackstone et al 27 H-1 Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 39. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Mansfield Lateral 8 East Gathering Line, DeSoto Parish, Louisiana*. HJN 080147 AR 96. Horizon Environmental Services, Inc. Austin, Texas.

Chapa, R., and R.K. Brownlow

2011 *Cultural Resources Investigations within the Proposed 17.0-Acre Boyd Ranch Residential Subdivision Tract, Kingsland, Burnet County, Texas*. HJN 100111 AR. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of a 23.8-acre Woodlands Land Development Company Tract within the George Mitchell Preserve, Harris and Montgomery Counties, Texas*. HJN 100152 AR. Horizon Environmental Services, Inc. Austin, Texas.

Clark, R.D. and R.K. Brownlow

2003 *An Intensive Cultural Resources Survey of 2 Proposed Natural Gas Pipelines for EOG Resources, Inc., Johnson County, Texas*. HJN 030090 AR. Horizon Environmental Services, Inc. Austin, Texas.

2003 *An Intensive Cultural Resources Survey of a Proposed 13.29-acre Property Located at the Intersection of Century Park Boulevard and Ida Ridge Drive, Austin, Travis County, Texas*. HJN 030202 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of the Proposed 14-acre Turtle Creek Elementary School Tract, Round Rock, Williamson County, Texas*. Texas Antiquities Committee Permit No. 3498. HJN 040097 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of a 36-acre Tract Near Smith Point, Chambers County, Texas*. HJN 040105 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of the Proposed Gerron Natural Gas Pipeline for EOG Resources, Inc., Johnson County, Texas*. HJN 030090 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of the Proposed Jernigan and Baptist Foundation Natural Gas Pipelines for EOG Resources, Inc., Johnson County, Texas*. HJN 030090 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of the Proposed O'Dowd to Lancaster Natural Gas Pipeline for EOG Resources, Inc., Johnson County, Texas*. HJN 030090 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of the Proposed Lancaster Natural Gas Pipeline for EOG Resources, Inc., Johnson and Hood Counties, Texas*. HJN 030090 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of the Proposed Long Natural Gas Pipeline for EOG Resources, Inc., Upton County, Texas*. HJN 030090 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of EOG Resources, Inc.'s Proposed Wagner Compressor Station and the Wagner and West Natural Gas Pipeline Rights-of-Way, Johnson County, Texas*. HJN 030090 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of the Proposed River Hills Natural Gas Pipeline for EOG Resources, Inc., Johnson County, Texas*. HJN 030090 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of the 444-acre Formby Tract Located in Travis County, Texas*. HJN 040043 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of Southwest Parkway 2, A 59.5-acre Property Located on Southwest Parkway, Austin, Travis County, Texas*. HJN 040033 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of 2 Proposed Well Sites and 13 Natural Gas Flow Lines on EOG Resources, Inc.'s Freeman Ranch and Tucker Leases, Texas County, Oklahoma*. HJN 010239 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *An Intensive Cultural Resources Survey of the USACE Jurisdictional Drainages within the Proposed 757-acre Paloma Lake Tract, Round Rock, Williamson County, Texas.* HJN 040165 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *An Intensive Cultural Resources Survey of EOG Resources, Inc.'s Proposed Stevenson Natural Gas Pipeline and Mansfield Gathering System Rights-of-Way, Johnson County, Texas*. HJN 030090 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *An Intensive Cultural Resources Survey and Subsequent SAL/NRHP Eligibility Testing of 4 Sites (41HR987, 41HR988, 41HR989, and 41HR990) within the Proposed Woodlands V7 Detention Basin, The Woodlands, Harris County, Texas*. Texas Antiquities Committee Permit Nos. 3635 and 3713. HJN 040235 AR. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of the Eckert Station Cathodic Protection Bed along the Longhorn Pipeline Right-of-Way in Gillespie County, Texas*. HJN 050175 AR. Horizon Environmental Services, Inc. Austin, Texas.

2009 *An Intensive Cultural Resources Survey of the City of Gatesville's Proposed 9.0-acre Hike and Bike Trail Property in Coryell County, Texas.* Texas Antiquities Committee Permit No. 5175. HJN 090033 AR. Horizon Environmental Services, Inc. Austin, Texas. <Clark: Author; Brownlow: Principal Investigator/Permit Holder>

Clark, R.D., R.K. Brownlow, M.L. Mudd, V.A. Weinstein, and J.M. Wiersema

2006 *Archeological Monitoring Conducted During the Former Camp Bowie Ordnance and Explosives Engineering Evaluation and Cost Analysis Field Project, Brown and Mills Counties, Texas*. HJN 030218 AR. Horizon Environmental Services, Inc. Austin, Texas.

Clark, R.D., R.K. Brownlow, and J.D. Owens

2005 *An Intensive Cultural Resources Survey of the USACE Jurisdictional Drainages within the Proposed 101-acre Stone Oak Development Located on US 281 at Stone Oak Parkway, San Antonio, Bexar County, Texas*. HJN 040133 AR. Horizon Environmental Services, Inc. Austin, Texas.

Dooley, S. and R.K. Brownlow

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Dora Martin 1-1H Well Pad and Access Road in La Salle County, Texas*. HJN 100090 AR2 124. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Brown Distributing 2H Well Pad and Access Road in La Salle County, Texas*. HJN 100090 AR2 125. Horizon Environmental Services, Inc. Austin, Texas.

2012 *An Intensive Cultural Resources Survey of Petrohawk Energy Corporation's Proposed Brown Distributing 1H Well Pad and Access Road in La Salle County, Texas*. HJN 100090 AR2 126. Horizon Environmental Services, Inc. Austin, Texas.

Iruegas, M.T., S.A. Iruegas, and R.K. Brownlow

2004 *An Intensive Cultural Resources Survey of US Army Corps of Engineers Jurisdictional Drainages within the Proposed West Cypress Hills Development, Travis County, Texas*. HJN 040060 AR. Horizon Environmental Services, Inc. Austin, Texas.

Iruegas, S.A., R.K. Brownlow, and R.D. Clark

2003 *An Intensive Cultural Resources Survey of the 27.48-acre Chuck Nash Property, San Marcos, Hays County, Texas*. HJN 030116 AR. Horizon Environmental Services, Inc. Austin, Texas.

2003 *An Intensive Cultural Resources Survey on Approximately 800 Acres at the Western End of Galveston Island. Galveston County, Texas.* HJN 03? AR. Horizon Environmental Services, Inc. Austin, Texas.

McLoughlin, P. and R.K. Brownlow

2001 *An Intensive Cultural Resources Survey of the Proposed Del Valle ISD Junior High School #2, Travis County, Texas*. HJN 010287 AR. Horizon Environmental Services, Inc. Austin, Texas.

2001 *An Intensive Cultural Resources Survey of a Proposed Lower Neches Valley Authority 33-acre Water Treatment Plant Site and Associated Waterline Routes, Winnie, Chambers County, Texas*. HJN 010090 AR. Horizon Environmental Services, Inc. Austin, Texas.

Mudd, M.L. and R.K. Brownlow

2008 *Cultural Resources Investigations within a Proposed 14.0-acre US Army Reserve Training Center Survey Area near Sinton, San Patricio County, Texas*. HJN 080172 AR. Horizon Environmental Services, Inc. Austin, Texas.

Murin, M., R.K. Brownlow, V. Galen, and D. Hodges

2000 *An Intensive Cultural Resources Survey on the 290-acre Kit McConnico Park, Lufkin, Angelina County, Texas. HJN 990323 AR. Horizon Environmental Services, Inc. Austin, Texas.*

Newman, A. and R.K. Brownlow

2004 *An Intensive Cultural Resources Survey of US Army Corps of Engineers Jurisdictional Drainages within the Proposed Hills Above Double Horn Creek Development, Spicewood, Burnet County, Texas*. HJN 040063 AR. Horizon Environmental Services, Inc. Austin, Texas.

2004 *An Intensive Cultural Resources Survey of US Army Corps of Engineers Jurisdictional Drainages within the Proposed Spring Creek Ranch Development, Dripping Springs, Hays County, Texas*. HJN 040040 AR. Horizon Environmental Services, Inc. Austin, Texas.

Newman, A., R.D. Clark, and R.K. Brownlow

2004 *An Intensive Cultural Resources Survey of US Army Corps of Engineers Jurisdictional Drainages within the 635-acre Rutter Tract, Travis County, Texas.* HJN 040162 AR. Horizon Environmental Services, Inc. Austin, Texas.

Owens, J.D. and R.K. Brownlow

2008 *Intensive Cultural Resources Survey of the Proposed 10-acre Mitchell Island Development, The Woodlands, Montgomery County, Texas.* HJN 070183 AR. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Lilly Andress #1 Gathering Line, Cherokee County, Texas*. HJN 080147 AR 09. Horizon Environmental Services, Inc. Austin, Texas.

2008 *An Intensive Cultural Resources Survey of Chesapeake Energy's Proposed Southland Paper Mills #1 and Byrd #1 Gathering Lines, Nacogdoches County, Texas*. HJN 080147 AR 10. Horizon Environmental Services, Inc. Austin, Texas.

Sick, R.F., R.K. Brownlow, and J.D. Owens

2005 *An Intensive Cultural Resources Survey of the Proposed Lumberton 2.9-Mile Sewer Line, Hardin County, Texas*. HJN 040111 AR. Horizon Environmental Services, Inc. Austin, Texas.

2005 *An Intensive Cultural Resources Survey of a Proposed 48-acre Wastewater Treatment Plant Expansion Tract in Lumberton, Hardin County, Texas*. HJN 040111 AR. Horizon Environmental Services, Inc. Austin, Texas.

Weinstein, V.A. and R.K. Brownlow

2005 *An Intensive Cultural Resources Survey of the Proposed Longenbaugh Road, Longenbaugh Drainage Ditch, and 5-acre WWTP, Houston, Harris County, Texas.* HJN 050151 AR. Horizon Environmental Services, Inc. Austin, Texas.

THE

Register of Professional Archaeologists

Certifies that

Russ Brownlow, RPA

Has met all professional qualifications
and has been accredited as a

Registered Professional Archaeologist

Donald L. Hardesty
President

July 16, 2001
Date

RPA
Register of Professional Archaeologists

The Texas Historical Commission
proudly presents an

AWARD OF MERIT

to

RUSSELL K. BROWNLOW

and the

TEXAS ARCHEOLOGICAL RESEARCH LABORATORY

for exceptional field research, laboratory analysis and report production associated with 41WM815 in Williamson County.

EXECUTIVE DIRECTOR, TEXAS HISTORICAL COMMISSION

DATE May 7, 2004

TEXAS HISTORICAL COMMISSION
The State Agency for Historic Preservation

July 11, 2012

Mr. Jeff Robinson
Chief, Air Permits Section
U.S. EPA Region 6, 6PD
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

RE: Application for a Prevention of Significant Deterioration Air Quality Permit for Greenhouse Gas Emissions
CEMEX Construction Materials South, LLC
New Braunfels, Comal County, Texas

Mr. Robinson:

CEMEX Construction Materials South, LLC (CEMEX) is hereby submitting this application for a Prevention of Significant Deterioration (PSD) air quality permit for greenhouse gas emissions to authorize increased cement production in Kiln 2 and various minor changes to the existing air permit for the Balcones Cement Plant located in New Braunfels, Comal County, Texas. The state/PSD application for non-greenhouse gas emissions was previously submitted to the Texas Commission on Environmental Quality (TCEQ).

General information for the application is provided on the TCEQ Form PI-1 - General Application for Air Preconstruction Permit and Amendments. The U.S. Environmental Protection Agency's (EPA) document entitled *"PSD and Title V Permitting Guidance For Greenhouse Gases", dated November 2010 and March 2011,* was utilized as a guide for preparation of the attached application.

CEMEX is committed to working closely with EPA Region 6 to get the application review completed as expeditiously as possible. We will be contacting your staff soon after submittal of this application to arrange a meeting to review the application and answer any questions that your team may have developed after initially reading our application.

Should you have any questions regarding this application, please contact me at kimberlyb.bradley@cemex.com or by telephone at (713)722-1710.

Sincerely,

Kimberly Bradley

Kimberly Bradley
Director, Environmental - US Operations

Enclosure

cc: Mr. Mike Wilson, P.E., Director, Air Permits Division, TCEQ
Mr. Satish Seth, Vice President Environmental Affairs, CEMEX, Houston
Mr. Larry Moon, P.E., Zephyr Environmental Corporation

Prevention of Significant Deterioration Greenhouse Gas Permit Application For A Clinker Production Increase at the CEMEX Construction Materials South LLC Balcones Cement Plant Comal County, Texas

Submitted to:

Environmental Protection Agency
Region VI
Multimedia Planning and Permitting Division
Fountain Place 12th Floor, Suite 1200
1445 Ross Avenue
Dallas, Texas 75202-2733

Submitted by:

Zephyr Environmental Corporation
2600 Via Fortuna, Suite 450
Austin, Texas 78746

Prepared by:

Zephyr Environmental Corporation
2600 Via Fortuna, Suite 450
Austin, Texas 78746

July, 2012

zephyr

TABLE OF CONTENTS

1.0 INTRODUCTION....1
FORM PI-1 GENERAL APPLICATION 3
2.0 PROJECT SCOPE 13
2.1 Introduction....13
2.2 Kiln No. 2 Production Increase....13
2.3 Alternate Fuels....13
2.4 Upgrades to Kiln 1 and 2 Burners 13
PLOT PLAN 14
AREA MAP 15
3.0 GHG EMISSION CALCULATIONS....16
3.1 GHG Emissions From Cement Kilns 16
4.0 PREVENTION OF SIGNIFICANT DETERIORATION APPLICABILITY 18
TCEQ PSD NETTING TABLES 19
5.0 BEST AVAILABLE CONTROL TECHNOLOGY (BACT) 22
5.1 BACT for the Kilns 23
5.1.1 Step 1: Identify All Available Control Technologies 23
5.1.2 Step 2: Eliminate Technically Infeasible Options 30
5.1.3 Step 3: Rank Remaining Control Technologies 33
5.1.4 Step 4: Evaluate Most Effective Controls and Document Results 33
5.1.5 Step 5: Select BACT 35
MAP OF EXISTING CO2 PIPELINES AND POTENTIAL GEOLOGIC STORAGE SITES IN TEXAS 38
6.0 OTHER PSD REQUIREMENTS....39
6.1 Impacts Analysis....39
6.2 GHG Preconstruction Monitoring 39
6.3 Additional Impacts Analysis 39

APPENDICES

APPENDIX A: GHG PSD APPLICABILITY FLOWCHART – EXISTING SOURCES

1.0 INTRODUCTION

Cemex Construction Materials South, LLC (CEMEX) owns and operates a cement production plant in New Braunfels, Comal County, Texas. Air emissions generated at the Balcones Plant are authorized via multiple Texas Commission on Environmental Quality (TCEQ) Air Permits, permit by rule authorizations, and standard permit authorizations. The cement kilns (Kiln No. 1 and 2) and material handling emissions that are affected by this amendment are authorized under Air Permit No. 6048. The State and PSD air permit application for non-GHG pollutants was submitted previously to the TCEQ.

CEMEX is submitting this air permit amendment application for Air Permit No 6048 to authorize an increase in Kiln No. 2 clinker production. Kiln No. 2 is currently limited to 3,600 tons clinker per day (30-day average). CEMEX is proposing a 10% increase in the Kiln No. 2 production to 3,960 tons of clinker per day (30-day average). Kiln No. 2 began initial operation in 2008 and based on operational experience CEMEX believes the kiln can achieve higher production levels than what was originally estimated and permitted. The production increase does not require any physical changes to the kiln system.

CEMEX is also submitting this air permit amendment application to authorize the use of additional alternate fuels for both kilns including: engineered "Sharps" (including plastic), and rubberized asphalt. The CEMEX plant is currently authorized to use natural gas, coal, and petroleum coke (pet coke) as primary fuels and authorized to use multiple alternative fuels including wood products, carpet fibers, shingles, oil filter fluff, rice husks, and cotton gin residue.

Finally, CEMEX proposes to authorize upgrades to the main kiln burners in Kiln No. 1 and Kiln No. 2 to multipath adjustable units. The upgrades consist of adding a channel to allow the use of alternative fuels as Biomass and Refuse Derived Fuel in the main kiln burners. The burner upgrades will not increase the maximum fuel firing rate for either kiln but will increase flexibility in the amount and kind of fuels that can be burned in the main kiln.

On June 3, 2010, the EPA published final rules for permitting sources of Greenhouse Gases (GHGs) under the prevention of significant deterioration (PSD) and Title V air permitting programs, known as the GHG Tailoring Rule.[1] After July 1, 2011, new sources emitting more than 100,000 tons/yr of GHGs and modifications increasing GHG emissions more than 75,000 tons/yr at existing major sources are subject to PSD review, regardless of whether PSD was triggered for other pollutants. Facilities that emit at least 100,000 tons/yr are subject to Title V permitting requirements.

[1] 75 FR 31514 (June 3, 2010).

On December 23, 2010, EPA signed a Federal Implementation Plan (FIP) authorizing EPA to issue PSD permits in Texas for GHG sources until Texas submits the required SIP revision for GHG permitting and it is approved by EPA.[2]

The proposed project increase triggers PSD review for GHG regulated pollutants because the calculated project emissions increase of GHG emissions is greater than 75,000 tons/yr and the site is considered an existing major source. Included in this application are a project scope description, GHG emissions calculations, GHG netting analysis, and a GHG Best Available Control Technology (BACT) analysis.

[2] 75 FR 81874 (Dec. 29, 2010).

Texas Commission on Environmental Quality
Form PI-1 General Application for Air Preconstruction Permit and Amendment

Important Note: The agency **requires** that a Core Data Form be submitted on all incoming applications unless a Regulated Entity and Customer Reference Number have been issued *and* no core data information has changed. For more information regarding the Core Data Form, call (512) 239-5175 or go to www.tceq.texas.gov/permitting/central_registry/guidance.html.

I. Applicant Information		
A. Company or Other Legal Name: CEMEX Construction Materials South, LLC		
Texas Secretary of State Charter/Registration Number (*if applicable*):		
B. Company Official Contact Name: Jimmy Rabon		
Title: Plant Manager		
Mailing Address: 2580 Wald Road		
City: New Braunfels	State: Texas	ZIP Code: 78132
Telephone No.: 210-250-4097	Fax No.: 210-250-4144	E-mail Address: jimmy.rabon@cemex.com
C. Technical Contact Name: Kim Bradley		
Title: Environmental Manager		
Company Name: CEMEX Construction Materials South, LLC		
Mailing Address: 2580 Wald Road		
City: New Braunfels	State: Texas	ZIP Code: 78132
Telephone No.: 210-250-4009	Fax No.: 210-250-4144	E-mail Address: kimberlyb.bradley@cemex.com
D. Site Name: CEMEX - Balcones Cement Plant		
E. Area Name/Type of Facility:		☑ Permanent ☐ Portable
F. Principal Company Product or Business: cement		
Principal Standard Industrial Classification Code (SIC): 3241		
Principal North American Industry Classification System (NAICS):		
G. Projected Start of Construction Date: 6/1/2012		
Projected Start of Operation Date: 6/1/2012		
H. Facility and Site Location Information (If no street address, provide clear driving directions to the site in writing.):		
Street Address: 2580 Wald Road		
City/Town: New Braunfels	County: Comal	ZIP Code: 78132
Latitude (nearest second): 29 40' 22"	Longitude (nearest second): 98 10' 56"	

I. Applicant Information (continued)	
I. Account Identification Number (leave blank if new site or facility): CS-0022-K	
J. Core Data Form.	
Is the Core Data Form (Form 10400) attached? If *No*, provide customer reference number and regulated entity number (complete K and L).	☐ YES ☑ NO
K. Customer Reference Number (CN): CN603403973	
L. Regulated Entity Number (RN): RN102605375	
II. General Information	
A. Is confidential information submitted with this application? If *Yes*, mark each **confidential** page **confidential** in large red letters at the bottom of each page.	☐ YES ☑ NO
B. Is this application in response to an investigation or enforcement action? If *Yes*, attach a copy of any correspondence from the agency.	☐ YES ☑ NO
C. Number of New Jobs: 0	
D. Provide the name of the State Senator and State Representative and district numbers for this facility site:	
Senator: Hon. Jeff Wentworth,	District No.: 25
Representative: Hon. Doug Miller	District No.: 73
III. Type of Permit Action Requested	
A. Mark the appropriate box indicating what type of action is requested. Initial ☐ Amendment ☑ Revision (30 TAC 116.116(e)) ☐ Change of Location ☐ Relocation ☐	
B. Permit Number (if existing): 6048	
C. Permit Type: Mark the appropriate box indicating what type of permit is requested. *(check all that apply, skip for change of location)* Construction ☑ Flexible ☐ Multiple Plant ☐ Nonattainment ☐ Prevention of Significant Deterioration ☑ Hazardous Air Pollutant Major Source ☐ Plant-Wide Applicability Limit ☐ Other:__________	
D. Is a permit renewal application being submitted in conjunction with this amendment in accordance with 30 TAC 116.315(c).	☐ YES ☑ NO

III. Type of Permit Action Requested (continued)		
E. Is this application for a change of location of previously permitted facilities? If Yes, complete III.E.1 - III.E.4.		☐ YES ☑ NO
1. Current Location of Facility (If no street address, provide clear driving directions to the site in writing.):		
Street Address:		
City:	County:	ZIP Code:
2. Proposed Location of Facility (If no street address, provide clear driving directions to the site in writing.):		
Street Address:		
City:	County:	ZIP Code:
3. Will the proposed facility, site, and plot plan meet all current technical requirements of the permit special conditions? If *No*, attach detailed information.		☐ YES ☐ NO
4. Is the site where the facility is moving considered a major source of criteria pollutants or HAPs?		☐ YES ☐ NO
F. Consolidation into this Permit: List any standard permits, exemptions or permits by rule to be consolidated into this permit including those for planned maintenance, startup, and shutdown.		
List: none		
G. Are you permitting planned maintenance, startup, and shutdown emissions? If *Yes*, attach information on any changes to emissions under this application as specified in VII and VIII.		☐ YES ☑ NO
H. Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability)		
Is this facility located at a site required to obtain a federal operating permit? If *Yes*, list all associated permit number(s), attach pages as needed).		☑ YES ☐ NO ☐ To be determined
Associated Permit No (s.): O-1126		
1. Identify the requirements of 30 TAC Chapter 122 that will be triggered if this application is approved. FOP Significant Revision ☐ FOP Minor ☐ Application for an FOP Revision ☐ To Be Determined ☐ Operational Flexibility/Off-Permit Notification ☐ Streamlined Revision for GOP ☐ None ☑		

III. Type of Permit Action Requested (continued)	
H. Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability) *(continued)*	
2. Identify the type(s) of FOP(s) issued and/or FOP application(s) submitted/pending for the site. (check all that apply)	
GOP Issued ☐	GOP application/revision application: submitted or under APD review ☐
SOP Issued ☑	SOP application/revision application submitted or under APD review ☑

IV. Public Notice Applicability	
A. Is this a new permit application or a change of location application?	☐ YES ☑ NO
B. Is this application for a concrete batch plant? If Yes, complete V.C.1 – V.C.2.	☐ YES ☑ NO
C. Is this an application for a major modification of a PSD, nonattainment, FCAA 112(g) permit, or exceedance of a PAL permit?	☐ YES ☐ NO
D. Is this application for a PSD or major modification of a PSD located within 100 kilometers of an affected state?	☐ YES ☐ NO
If *Yes*, list the affected state(s).	
E. Is this a state permit amendment application? If Yes, complete IV.E.1. – IV.E.3.	
1. Is there any change in character of emissions in this application?	☐ YES ☑ NO
2. Is there a new air contaminant in this application?	☐ YES ☑ NO
3. Do the facilities handle, load, unload, dry, manufacture, or process grain, seed, legumes, or vegetables fibers (agricultural facilities)?	☐ YES ☑ NO
F. List the total annual emission increases associated with the application (*list* **all** *that apply and attach additional sheets as needed*):	
Volatile Organic Compounds (VOC): 0	
Sulfur Dioxide (SO_2): 0	
Carbon Monoxide (CO): 0	
Nitrogen Oxides (NO_x): 0	
Particulate Matter (PM): 4.69	
PM $_{10}$ microns or less (PM_{10}): 2.32	
PM $_{2.5}$ microns or less ($PM_{2.5}$): 0.89	
Lead (Pb):	
Hazardous Air Pollutants (HAPs):	
Other speciated air contaminants **not** listed above:	

V. Public Notice Information (complete if applicable)			
A. Public Notice Contact Name: Kim Bradley			
Title: Environmental Manager			
Mailing Address: 2580 Wald Road			
City: New Braunfels	State: Texas	ZIP Code: 78132	
B. Name of the Public Place: New Braunfels Public Library			
Physical Address (No P.O. Boxes): 700 East Common St.			
City: New Braunfels	County: Comal	ZIP Code: 78130	
The public place has granted authorization to place the application for public viewing and copying.			☑ YES ☐ NO
The public place has internet access available for the public.			☑ YES ☐ NO
C. Concrete Batch Plants, PSD, and Nonattainment Permits			
1. County Judge Information (For Concrete Batch Plants and PSD and/or Nonattainment Permits) for this facility site.			
The Honorable: Sherman Krause			
Mailing Address: 150 N. Seguin Ave			
City: New Braunfels	State: Texas	ZIP Code: 78130	
2. Is the facility located in a municipality or an extraterritorial jurisdiction of a municipality? *(For Concrete Batch Plants)*			☐ YES ☐ NO
Presiding Officers Name(s):			
Title:			
Mailing Address:			
City:	State:	ZIP Code:	
3. Provide the name, mailing address of the chief executives of the city and county, Federal Land Manager, or Indian Governing Body for the location where the facility is or will be located.			
Chief Executive:			
Mailing Address:			
City:	State:	ZIP Code:	
Name of the Federal Land Manager:			
Title:			
Mailing Address:			
City:	State:	ZIP Code:	

V. Public Notice Information (complete if applicable) (continued)	
3. Provide the name, mailing address of the chief executives of the city and county, State, Federal Land Manager, or Indian Governing Body for the location where the facility is or will be located. *(continued)*	
Name of the Indian Governing Body:	
Title:	
Mailing Address:	
City: State: ZIP Code:	
D. Bilingual Notice	
Is a bilingual program **required** by the Texas Education Code in the School District?	☑ YES ☐ NO
Are the children who attend either the elementary school or the middle school closest to your facility eligible to be enrolled in a bilingual program provided by the district?	☑ YES ☐ NO
If *Yes*, list which languages are required by the bilingual program? Spanish	
VI. Small Business Classification (Required)	
A. Does this company (including parent companies and subsidiary companies) have fewer than 100 employees or less than $6 million in annual gross receipts?	☐ YES ☑ NO
B. Is the site a major stationary source for federal air quality permitting?	☑ YES ☐ NO
C. Are the site emissions of any regulated air pollutant greater than or equal to 50 tpy?	☑ YES ☐ NO
D. Are the site emissions of all regulated air pollutants combined less than 75 tpy?	☑ YES ☐ NO
VII. Technical Information	
A. The following information must be submitted with your Form PI-1 (this is just a checklist to make sure you have included everything)	
1. Current Area Map ☑	
2. Plot Plan ☑	
3. Existing Authorizations ☑	
4. Process Flow Diagram ☐ Process unchanged from previous submittal	
5. Process Description ☑	
6. Maximum Emissions Data and Calculations ☑	
7. Air Permit Application Tables ☑	
a. Table 1(a) (Form 10153) entitled, Emission Point Summary ☑	
b. Table 2 (Form 10155) entitled, Material Balance ☑	
c. Other equipment, process or control device tables ☐ No new equipment with applicable tables.	

VII. Technical Information			
B. Are any schools located within 3,000 feet of this facility?			☐ YES ☑ NO
C. Maximum Operating Schedule:			
Hours: 24	Day(s): 7	Week(s): 52	Year(s):
Seasonal Operation? If Yes, please describe in the space provide below.			☐ YES ☑ NO
D. Have the planned MSS emissions been previously submitted as part of an emissions inventory?			☐ YES ☑ NO
Provide a list of each planned MSS facility or related activity and indicate which years the MSS activities have been included in the emissions inventories. Attach pages as needed.			
E. Does this application involve any air contaminants for which a *disaster review* is required?			☐ YES ☑ NO
F. Does this application include a pollutant of concern on the *Air Pollutant Watch List (APWL)*?			☐ YES ☑ NO
VIII. State Regulatory Requirements **Applicants must demonstrate compliance with all applicable state regulations to obtain a permit or amendment**. *The application must contain detailed attachments addressing applicability or non applicability; identify state regulations; show how requirements are met; and include compliance demonstrations.*			
A. Will the emissions from the proposed facility protect public health and welfare, and comply with all rules and regulations of the TCEQ?			☑ YES ☐ NO
B. Will emissions of significant air contaminants from the facility be measured?			☑ YES ☐ NO
C. Is the Best Available Control Technology (BACT) demonstration attached?			☑ YES ☐ NO
D. Will the proposed facilities achieve the performance represented in the permit application as demonstrated through recordkeeping, monitoring, stack testing, or other applicable methods?			☑ YES ☐ NO
IX. Federal Regulatory Requirements **Applicants must demonstrate compliance with all applicable federal regulations to obtain a permit or amendment** *The application must contain detailed attachments addressing applicability or non applicability; identify federal regulation subparts; show how requirements are met; and include compliance demonstrations.*			
A. Does Title 40 Code of Federal Regulations Part 60, (40 CFR Part 60) New Source Performance Standard (NSPS) apply to a facility in this application?			☑ YES ☐ NO
B. Does 40 CFR Part 61, National Emissions Standard for Hazardous Air Pollutants (NESHAP) apply to a facility in this application?			☐ YES ☑ NO
C. Does 40 CFR Part 63, Maximum Achievable Control Technology (MACT) standard apply to a facility in this application?			☑ YES ☐ NO

IX. Federal Regulatory Requirements **Applicants must demonstrate compliance with all applicable federal regulations to obtain a permit or amendment** ***The application must contain detailed attachments addressing applicability or non applicability; identify federal regulation subparts; show how requirements are met; and include compliance demonstrations.***	
D. Do nonattainment permitting requirements apply to this application?	☐ YES ☑ NO
E. Do prevention of significant deterioration permitting requirements apply to this application?	☑ YES ☐ NO
F. Do Hazardous Air Pollutant Major Source [FCAA 112(g)] requirements apply to this application?	☐ YES ☑ NO
G. Is a Plant-wide Applicability Limit permit being requested?	☐ YES ☑ NO
X. Professional Engineer (P.E.) Seal	
Is the estimated capital cost of the project greater than $2 million dollars?	☐ YES ☑ NO
If *Yes*, submit the application under the seal of a Texas licensed P.E.	
XI. Permit Fee Information	
Check, Money Order, Transaction Number ,ePay Voucher Number: Check # 22757	Fee Amount: $ 7,500
Company name on check: Zephyr Environmental Corporation	Paid online?: ☐ YES ☑ NO
Is a copy of the check or money order attached to the original submittal of this application?	☑ YES ☐ NO ☐ N/A
Is a Table 30 (Form 10196) entitled, Estimated Capital Cost and Fee Verification, attached?	☑ YES ☐ NO ☐ N/A

Texas Commission on Environmental Quality
Form PI-1 General Application for
Air Preconstruction Permit and Amendment

XII. Delinquent Fees and Penalties
This form **will not be processed** until all delinquent fees and/or penalties owed to the TCEQ or the Office of the Attorney General on behalf of the TCEQ is paid in accordance with the Delinquent Fee and Penalty Protocol. For more information regarding Delinquent Fees and Penalties, go to the TCEQ Web site at: www.tceq.texas.gov/agency/delin/index.html.
XIII. Signature
The signature below confirms that I have knowledge of the facts included in this application and that these facts are true and correct to the best of my knowledge and belief. I further state that to the best of my knowledge and belief, the project for which application is made will not in any way violate any provision of the Texas Water Code (TWC), Chapter 7, Texas Clean Air Act (TCAA), as amended, or any of the air quality rules and regulations of the Texas Commission on Environmental Quality or any local governmental ordinance or resolution enacted pursuant to the TCAA I further state that I understand my signature indicates that this application meets all applicable nonattainment, prevention of significant deterioration, or major source of hazardous air pollutant permitting requirements. The signature further signifies awareness that intentionally or knowingly making or causing to be made false material statements or representations in the application is a criminal offense subject to criminal penalties.
Name: Jimmy Rabon
Signature: [signature] *Original Signature Required*
Date: 29 DEC 11

2.0 PROJECT SCOPE

2.1 INTRODUCTION

The CEMEX facility consists of two cement kilns, raw and finish mills, clinker coolers, and ancillary material transfer equipment. The general operation of the kilns is not changing as a result of this amendment.

Raw materials (including limestone, sand, gypsum, and various other materials) are mixed and ground in the raw mills and then fed into a rotary kiln. In the kiln, the materials are heated to increasingly higher temperatures as they traverse the length of kiln. The high temperatures create different chemical reactions that transform the raw materials into conglomerated cement known as clinker. The clinker exits the kiln and travels along grates in the clinker cooler until it is cool enough to move to storage or on for further processing. In the finish mills the clinker is ground and additives are integrated to create the final cement product.

2.2 KILN NO. 2 PRODUCTION INCREASE

The kiln will not require any equipment modifications in order to increase the production to the proposed rate of 3,960 tons of clinker per day (30-day average) and 1,386,000 tons of clinker per year. This kiln has been in operation for less than three years and has demonstrated an ability to reach a higher production capacity than what was originally estimated and permitted.

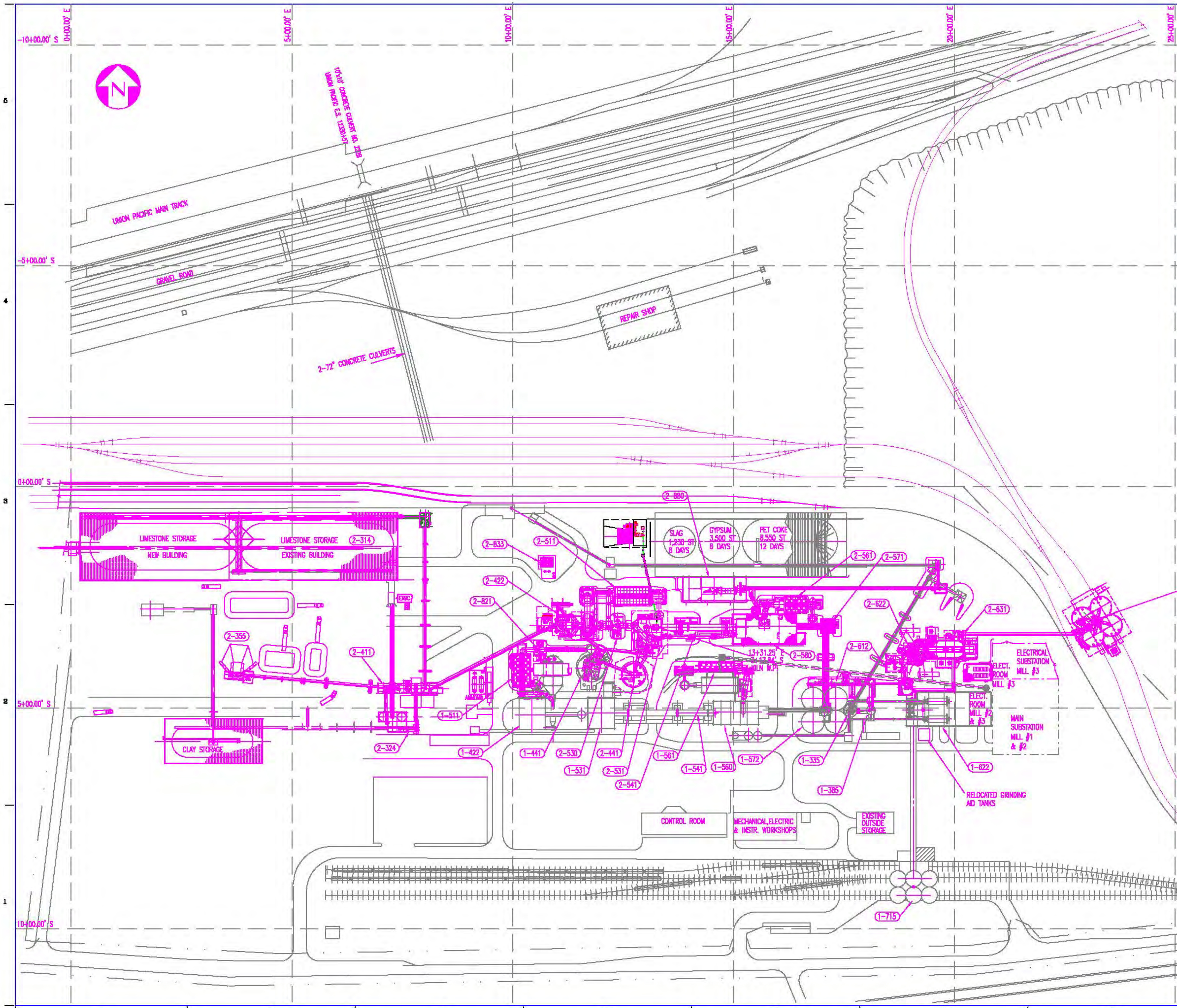
2.3 ALTERNATE FUELS

The kilns at the Balcones Plant are currently permitted for and utilize a wide range of alternative fuels including the following biofuels: sawdust, woodchips, pallets, crates, and carpenter shop waste, rice husks, and cotton gin residue. CEMEX wishes to authorize additional alternative fuels for both kilns to include engineered "Sharps" (including plastic), and rubberized asphalt. The fuels can be handled with existing equipment.

2.4 UPGRADES TO KILN 1 AND 2 BURNERS

CEMEX is proposing to upgrade the kiln burners to multipath adjustable units. The upgraded burners will allow the kiln operator to react quickly to changing process conditions. Advantages of the new burner include:

- Potential for easy and accurate adjustment of flame shape to improve flame stability, heat transfer to the clinker, and to extend service life of brickwork as well;
- Potential to lower primary air rate by 6% - 12% according to kiln and fuel requirements with possibility to reduce the specific heat consumption (less fuel consumption);
- Ability to handle and feed alternative fuels in distinct and separate fuel lines.



LEGEND

LINE NO.	AREA	DESCRIPTION
1	335	GYPSUM SILO
1	385	SLAG SILO
1	422	RAW MILL SYSTEM
1	441	BLENDING SILO
1	511	MAIN BAGHOUSE
1	531	PREHEATER TOWER
1	541	KILN
1	560	CLINKER COOLER
1	561	COOLER VENT
1	572	CLINKER STORAGE
1	622	CEMENT MILL
1	715	CEMENT STORAGE
2	314	LIMESTONE STORAGE HALL
2	324	CLAY TRANSPORT
2	411	RAW MILL FEED BINS
2	351	RAW MILL ADDITIVES RECEPTION
2	355	RAW MILL ADDITIVES STORAGE
~~2~~	~~385~~	~~SLAG SILO~~
2	411	RAW MILL FEED
2	422	RAW MILL SYSTEM 322 STPH
2	441	BLENDING SILO 10,240 ST
2	511	KILN DUST SYSTEM
2	530	KILN ID FAN
2	531	PREHEATER TOWER
2	541	KILN
2	560	CLINKER COOLER
2	561	COOLER VENT
2	571	CLINKER HANDLING
2	612	CEMENT MILL FEED
2	622	CEMENT MILL 198 STPH
2	631	CEMENT TRANSPORT
2	715	CEMENT STORAGE 40,000 ST
2	821	COMPRESSOR ROOM
2	833	WATER COOLING TOWER
2	880	PET COAL MILL 27.5 STPH

REVISIONS

No.	DATE	DESCRIPTION	BY

DRAWING No.	TITLE	SUPPLIER
886-11-02-002	ELEVATIONS	CEMEX
886-11-02-001	LAYOUT	CEMEX

REFERENCE DRAWING

CEMEX

CHECKED	APPROVED
BY: –	BY: –
DATE: DD-MMM-AA	DATE: DD-MMM-AA

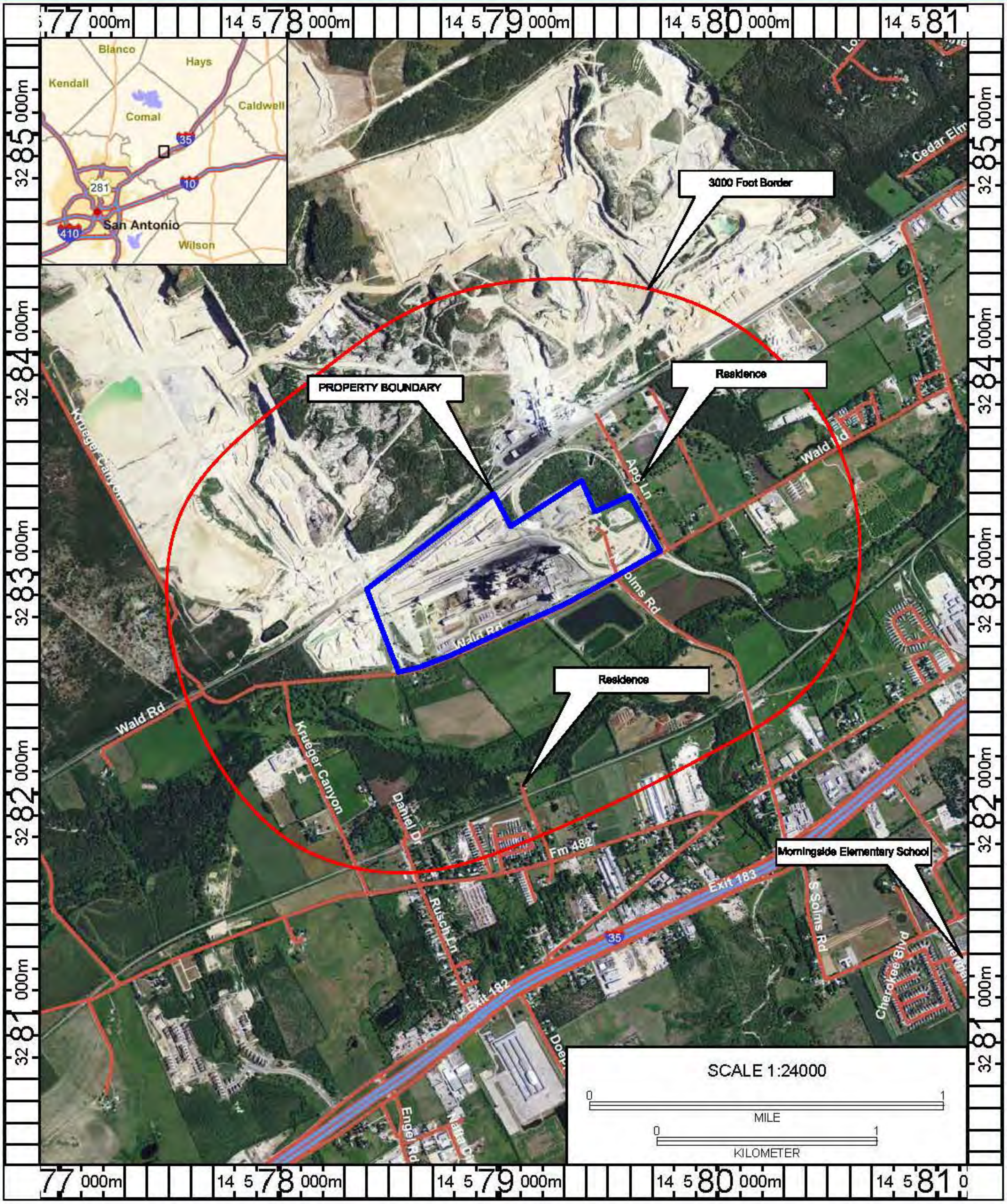
CEMEX
CEMEX USA

CLIENT:
PLANT: BALCONES, PLANT
PROJECT No. –
NAME: PLANT BALCONES ALTERNATIVE FUELS
TITLE:

PLOT PLAN

DRAWN: LSC	DATE: 04-APR-11
CHECKED: EJdlC	DATE: 04-APR-11
APPROVED:	DATE:
UNITS: Inches	SCALE: 1"=100'
DRAWING No. 111-11-02-001	REV.No. 0

FILE:
PRINT DATE:



Datum: NAD83

Digital USGS AERIAL PHOTOGRAPH
—NEW BRAUNFELS WEST SE, TX (May 4, 2010)
MAP SOURCE: Terrain Navigator Pro

SITE LOCATION

zephyr

AREA MAP

BALCONES CEMENT PLANT

CEMEX CEMENT of TEXAS, L.P.
New Braunfels, TX

File Name: H:\CEMEX\Balcones\10537 Graphics			
Designed By: R. von Czoernig	Reviewed By: Thomas S.	Project No.: 10537	Date: 8/24/2011

3.0 GHG EMISSION CALCULATIONS

3.1 GHG EMISSIONS FROM CEMENT KILNS

GHG emission calculations for the kilns are based on maximum annual clinker production rates and the lb CO_2e/ton clinker emission factor proposed as Best Available Control Technology (BACT).

The clinker production represented for Kiln No. 1 is the same as currently permitted. The clinker production represented for Kiln No. 2 includes a 10% increase over currently permitted levels. See Table 3-1 for more details.

CEMEX Construction Material South, LLC
Balcones Cement Plant
Permit 6048 Amendment

Table 3-1
Kiln CO_2e Emissions Calculations

EPN	EPN Name	Proposed Clinker produced per day [1] Tons	Proposed Clinker produced per year Tons	CO_2e Emission Factor [2] lb/ton clinker	Proposed CO_2e Annual Emissions (tons/yr)
PS-16	Kiln No. 1	3,250	1,137,500	1900	1,080,625
PS-77	Kiln No. 2	3,960	1,386,000	1900	1,316,700

1. 30 day average
2. Based on 12-month rolling average BACT limit of 0.95 tons of CO_2e/ton of clinker.

4.0 PREVENTION OF SIGNIFICANT DETERIORATION APPLICABILITY

In the EPA guidance document *PSD and Title V Permitting Guidance for Greenhouse Gases,* the following PSD Applicability Test was provided for Step 1 of the PSD Tailoring rule for existing sources:

EPA Tailoring Rule Step 1 - PSD Applicability Test for GHGs

PSD applies to the GHG emissions from a proposed modification to an existing major source if the following is true:

- The emissions increase ***and*** the **net** emissions increase of GHGs from the modification would be equal to or greater than 75,000 TPY on a CO_2e basis ***and*** greater than zero TPY on a mass basis.

Since the net emissions increase of GHG is greater than 75,000 ton/yr of CO_2e and greater than zero ton/yr on a mass basis, PSD is triggered for GHG emissions. The emissions netting analysis is documented on the attached TCEQ PSD netting tables: Table 1F and Table 2F. Also included in Appendix A is the "The GHG PSD APPLICABILITY FLOWCHART – EXISTING SOURCES from the *PSD and Title V Permitting Guidance for Greenhouse Gases.*

TCEQ PSD NETTING TABLES

TCEQ

TABLE 1F
AIR QUALITY APPLICATION SUPPLEMENT

Permit No.: 6048		Application Submittal Date:	
Company	CEMEX Construction Materials South, LLC		
RN:	RN102605375	Facility Location:	New Braunfels
City	New Braunfels	County:	Comal
Permit Unit I.D.:	PS-77	Permit Name:	Kiln No. 2 Baghouse
Permit Activity:	☐ New Major Source	☑ Modification	
Project or Process Description: Authorize a production increase for Kiln 2 and burner upgrades for both kilns.			

Complete for all pollutants with a project emission increase.	POLLUTANTS						
	Ozone		CO	SO_2	PM	GHG	CO_2e
	NOx	VOC					
Nonattainment? (yes or no)						No	No
Existing site PTE (tpy)	This form for GHG only					> 100,000	> 100,000
Proposed project increases (tpy from 2F)[3]						> 0	841,250
Is the existing site a major source? If not, is the project a major source by itself? (yes or no)	Yes						
If site is major, is project increase significant? (yes or no)						Yes	Yes
If netting required, estimated start of construction: 5 years prior to start of construction: estimated start of operation:		Contemporaneous Period				***SEE NOTE***	
Net contemporaneous change, including proposed project, from Table 3F (tpy)						> 0	>841250
FNSR applicable? (yes or no)						Yes	Yes

1. Other PSD pollutants
2. Nonattainment major source is defined in Table 1 in 30 TAC 116.12(11) by pollutant and county. PSD thresholds are found in 40 CFR §51.166(b)(1).
3. Sum of proposed emissions minus baseline emissions, increases only. Nonattainment thresholds are found in Table 1 in 30 TAC 116.12(11) and PSD thresholds in 40 CFR §51.166(b)(23).

NOTES Netting was not performed since no projects occurred in the contemporaneous period that reduced GHG emissions.

The presentations made above and on the accompanying tables are true and correct to the best of my knowledge.

Kimberly Bradley	Director, Environmental	7/11/12
Signature	Title	Date

TCEQ

TABLE 2F
PROJECT EMISSION INCREASE

Pollutant[1]:	GHG (CO2e)	Permit:	6048
Baseline Period:	Jan. 2010	to	Dec. 2011

	Affected or Modified Facilities[2] FIN	EPN	Permit No.	Actual Emissions[3]	A Baseline Emissions[4]	Proposed Emissions[5]	B Projected Actual	Difference (A-B)[6]	Correction[7]	Project Increase[8]
1	KF13	PS-16	6048	650,808.73	650,808.73		1,080,625.00	429,816.27		429,816.27
2	KILN2	PS-77	6048	905,266.43	905,266.43		1,316,700.00	411,433.57		411,433.57
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
									Page Subtotal[9]	841,249.84

5.0 BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

The PSD rules define BACT as:

> *Best available control technology* means an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under [the] Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results.[3]

In the EPA guidance document titled *PSD and Title V Permitting Guidance for Greenhouse Gases*, EPA recommended the use of the Agency's five-step "top-down" BACT process to determine BACT for GHGs.[4] In brief, the top-down process calls for all available control technologies for a given pollutant to be identified and ranked in descending order of control effectiveness. The permit applicant should first examine the highest-ranked ("top") option. The top-ranked options should be established as BACT unless the permit applicant demonstrates to the satisfaction of the permitting authority that technical considerations, or energy, environmental, or economic impacts justify a conclusion that the top ranked technology is not "achievable" in that case. If the most effective control strategy is eliminated in this fashion, then the next most effective alternative should be evaluated, and so on, until an option is selected as BACT.

EPA has broken down this analytical process into the following five steps:

Step 1: Identify all available control technologies.
Step 2: Eliminate technically infeasible options.
Step 3: Rank remaining control technologies.

[3] 40 C.F.R. § 52.21(b)(12.)

[4] EPA, *PSD and Title V Permitting Guidance for Greenhouse Gases*, p. 18 (Nov. 2010).

Step 4: Evaluate most effective controls and document results.
Step 5: Select the BACT.

Please note, 40 CFR 52.21 (j)(3) states "A major modification shall apply best available control technology for each regulated NSR pollutant for which it would result in a significant net emissions increase at the source. This requirement applies to each proposed emissions unit at which a net emissions increase in the pollutant would occur as a result of a physical change or change in the method of operation in the unit".

40 CFR 52.21(b)(2)(iii)(f) states that "A physical change or change in the method of operation shall not include …an increase in the hours of operation or in the production rate, unless such change would be prohibited under any federally enforceable permit condition…"

Pages 22-24 of the PSD and Title V Permitting Guidance for Greenhouse Gases (March 2011) discuss these issues in a section called "Determining the Scope of the BACT Analysis". This guidance contends that for new sources triggering PSD, the rules provide discretion for permitting authorities to evaluate BACT on a facility-wide basis by taking into account operations and equipment which affect the environmental performance of the whole facility. However for existing units, the guidance refers to the above citation (52.21(j)(3)), and reiterates that BACT only applies to emissions units that are physically or operationally changed. Therefore, this BACT analysis will only address Kilns 1 and 2.

5.1 BACT FOR THE KILNS

5.1.1 Step 1: Identify All Available Control Technologies

EPA has issued a "white paper", entitled *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Portland Cement Industry*[5] *(referred to in this application as "The Cement Industry GHG White Paper")*, which provides GHG BACT guidance specific to the industry. The recommended control techniques and measures to mitigate greenhouse gas emissions are addressed below.

5.1.1.1 Cement Kiln Energy Efficiency

Process Control and Management Systems

The Cement Industry GHG White Paper recommends using automated control systems to maintain operating conditions in the kiln at optimum levels. The Balcones plant has automated control systems for both Kiln 1 and Kiln 2 which are integrated into a central control room. The kilns have an indirect firing system with the main characteristics of low amount of primary air,

[5] EPA, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From the Portland Cement Industry*, (Oct. 2010).

flame adjustment control and fuel rate control by the dosing equipment. Process gas analyzers are used by control room operators to monitor CO and O_2 levels to insure efficient combustion. The calciner fuel rate is automatically controlled based on the stage 5 temperature and the kiln main burner is adjusted by the operator depending of the oxygen levels, kiln burning zone temperature and clinker quality.

Replacement of kiln seals

The Cement Industry GHG White Paper recommends that all facilities should have a regular maintenance plan for the kiln seals. Leaking seals can result in increased heat loss which increases fuel use. The CEMEX Balcones Plant has a maintenance routine to inspect the kiln seals weekly and during the major outages. Components of the kiln seals are replaced as needed based on inspections during kiln stops.

Kiln Combustion System Optimization

The Cement Industry GHG White Paper recommends incorporating available technologies to optimize kiln combustion into kiln designs. Incomplete fuel burning, poor mixing of fuel with combustion air, and poorly adjusted firing can lead to increased fuel usage (as well as increased NOx and CO emissions).

The combustion system process for Kilns 1 and 2 are designed to provide for efficient use of fuel. Kilns 1 and 2 have an indirect firing system with the main characteristics of low amount of primary air, flame adjustment control, and fuel rate control by the dosing equipment.

The primary air accounts for 10 to 40% of the total air needed depending on the type of firing system. The additional 90 or 60% of the air is called secondary air and consists of hot air from the clinker cooler. The higher the secondary air the more efficient the combustion system.

Precalciner kilns like the Balcones Kiln 1 and Kiln 2 are designed to maximize the heat input to the calciner and typically 60% of fuel is fed to the calciner. Most of the air required by the combustion at the calciner is hot air from the clinker cooler. This air is known as tertiary air. Mixing and heat transfer at the calciner has proven calcination levels above 90% and significantly reduces the thermal load at the kiln.

Use of Fluxes and Mineralizers to Reduce Energy Demand

The Cement Industry GHG White Paper recommends considering the use of fluxes and mineralizers to reduce the temperature at which the clinker melt begins to form in the kiln, promote formation of clinker compounds, and reduce the lower temperature limit of the tricalcium silicate stability range. The Cement Industry GHG White Paper states: *"Fluorides are often used as a mineralizer and can reduce the sintering temperature by 190°F. Although there* *is a fuel savings, that savings may be offset by the high cost of the fluxing agent or mineralizer. (ECRA, 2009)."*

CEMEX conducted a test using fluoride in a kiln at one of its other U.S. cement plants. Based on the test results, CEMEX evaluated the use of fluoride in kilns and determined the benefit in fuel savings does not offset the cost of the fluoride. There were also negative effects in quality of cement and concrete physical properties that prohibited the use at some plants. Therefore, CEMEX does not use fluxes and mineralizers in Kilns 1 and 2.

Kiln/Preheater Insulation

The Cement Industry GHG White Paper recommends proper insulation to keep heat loss through the kiln shell at a minimum. Kilns 1 and 2 are insulated with refractory brick and the preheaters are insulated with a combination of brick and castable over a light-weight insulating material. The kiln refractory is inspected during every major outage and portions of the refractory are replaced, as needed, depending on the condition.

Refractory Material Selection

The Cement Industry GHG White Paper states: "*The refractory bricks lining the combustion zone of the kiln protect the outer shell from the high combustion temperatures, as well as chemical and mechanical stresses. Although the choice of refractory materials is highly dependent on fuels, raw materials, and operating conditions, consideration should be given to refractory materials that provide the highest insulating capacity and have the longest life."*

The kiln refractory for Kiln 1 and 2 is very standard for the cement industry and was selected based on the conditions of each zone (mainly thermal and chemical conditions). The refractory is inspected every major outage and it is replaced depending on the condition.

Grate Cooler Conversion

The Cement Industry GHG White Paper recommends replacing planetary and travelling grate coolers with a more energy efficient reciprocating grate coolers as an option for improving energy efficiency. Kilns 1 and 2 are equipped with reciprocating grate coolers which recuperate heat back to the kiln. The secondary air coming from the coolers provide oxygen for combustion and heat recuperated from the clinker improving the overall kiln energy efficiency.

Heat Recovery from Kiln and Clinker Cooler Exhausts

The Cement Industry GHG White Paper states: "*There are several exhaust streams in the cement manufacturing operation that contain significant amounts of heat energy, including the kiln exhaust, clinker cooler, and kiln preheater and precalciner. …Generally, only long dry kilns* *produce exhaust gases with temperatures high enough to make heat recovery for power economical….Heat recovery for power may not be possible at facilities with in-line raw mills where the waste heat is used to extensively dry the raw materials…*".

Kilns 1 and 2 have in-line raw mills, where the waste heat from the kiln and precalciners are used to dry and preheat the raw materials. The exhaust from the clinker coolers is used partly as secondary air which provide oxygen and heat to the kilns and also to provide heat for drying the coal.

Suspension Preheater Low Pressure Drop Cyclones

Cyclones are used to preheat the raw meal prior to the kiln. Exhaust gases from the in-line kiln, precalciner are routed to the cyclones and provide the heat to preheat the raw meal suspended or residing in the cyclone. The Cement Industry GHG White Paper recommends the use of low pressure drop cyclones as a method of improving energy efficiency. The preheater cyclones and ducts areas associated with Kilns 1 and 2 are designed to minimize pressure drop and to minimize the dust lost in the preheater.

Conversion to Multistage Preheater

The Cement Industry GHG White Paper recommends converting to multistage preheaters to allow higher energy transfer efficiency and lower fuel requirements. Kilns 1 and 2 are equipped with multi-stage preheaters consisting of several cyclones in suspension. The material is fed at the top of the calciner and exchange heat with hot gases from the kiln. The contact between the material and the hot gas in each cyclone explains the great efficiency of heat exchange between materials. Multi-stage preheaters are designed to preheat the material using the hot gas flow coming from the kiln. The material in suspension contacts the hot gas flow as the material is falling in each stage of the preheater.

Conversion of Long Dry Kiln to Preheater/Precalciner Kiln

The Cement Industry GHG White Paper recommends reducing energy consumption by converting a long dry kiln to a preheater/precalciner kiln. The CEMEX Kilns 1 and 2 are both preheater/precalciner kilns.

Kiln Drive Efficiency

The Cement Industry GHG White Paper recommends using high efficiency motors to rotate the kiln. The Balcones Kiln 1 has a direct current adjustable speed drive and Kiln 2 has an alternating current adjustable speed drive. The variable frequency drive installed at both kilns provides a high energy efficiency. Both kilns have a single pinion drive with a direct coupled gear coupling.

Adjustable Speed Drive for Kiln Fan

The Cement Industry GHG White Paper recommends installing adjustable speed drives on kiln fans for increased energy efficiency. Kilns 1 and 2 use variable frequency drives which allow for high efficiency of the kiln fans. The fan efficiency is maintained in different speeds using variable frequency drive instead of the damper operation where the fan efficiency is reduced while the damper is closing.

Mid Kiln Firing

The Cement Industry GHG Whiter Paper states that: "*Mid kiln firing, which is the practice of adding fuel (often scrap tires) at a point near the middle of the kiln, can result in reduced fuel usage thereby potentially reducing overall CO_2 emissions. This practice is most often used with long wet or long dry kilns.*" Mid-kiln firing is proven for long dry kilns but results are not the same for calciner kilns. In a long, dry kiln with mid-kiln firing, the combustion efficiency increases for two reasons: (1) the fuel at the main burner is reduced and (2) hot flame at mid-kiln firing will destroy and ensure complete combustion of the main fuel. The kiln in a calciner system, like Kilns 1 and 2, is shorter than long dry or wet kilns and therefore do not have the adequate conditions for mid-kiln firing.

Air Mixing Technology

The Cement Industry GHG White Paper states that: "Mixing air is the practice of injecting a high pressure air stream into a kiln to break up and mix stratified layers of gases within the kiln. Mixing the air improves the combustion efficiency. Due to the increased efficiency, less fuel is required, leading to lower CO_2 emissions."

The type of mixing air technology discussed in the Cement Industry White Paper is only needed if there is poor mixing at the burner pipe. CEMEX Kilns 1 and 2 have multichannel burners that allow for necessary mixing of fuel and air to complete combustion. Multichannel burners allow for adjustment of multiple streams of mixing air to complete combustion.

Preheater Duct Rising

The Cement Industry GHG White Paper states that: "The operation of cement manufacturing operations that include a preheater prior to the kiln can be improved by firing a portion of the fuel in the riser duct to increase the degree of calcination in the preheater." In the CEMEX Kilns 1 and 2, a portion of the fuel is fired in the riser duct to increase the degree of calcinations in the preheater. Firing at the riser serves two functions: (1) more mixing and longer residence time for the fuel to complete combustion and (2) generate enough CO to destroy NOx from the kiln by the reaction NO + CO ➔ N2 + CO2. This reaction has been reported to be catalyzed by limestone present in the hot meal.

5.1.1.2 Use of Lower GHG Emitting Fuel

Kilns 1 and 2 are currently authorized by Air Permit 6048/PSD-TX-74M1 to fire the following fuels in the kiln/preheater system: natural gas, coal, petroleum coke, wood, tire derived fuel, other rubber products, and other alternative fuels including carpet products, non-asbestos containing shingles, construction and demolition waste, oil filter fluff, oily rags, oily wood, paper, cardboard, rick husks, and cotton gin residue.

Fuel costs, fuel availability, and fuel reliability have primarily dictated the fuel mix used in the kilns. The use of natural gas in the kilns is increasing as the price of natural gas becomes more competitive with petroleum coke and coal.

The EPA PSD and Title V Permitting Guidance for Greenhouse Gases states that "…permitting authorities might determine that, with respect to the biomass component of a facility's fuel stream, certain types of biomass by themselves are BACT for GHGs." This is based on the premise that CO_2 emissions from burning biomass are the result of carbon that has relatively recently been removed from the atmosphere through uptake by plants and thus does not have the global warming impact that burning fossil fuel has. Potential types of biomass that can be burned in the Balcones cement kilns include:

- Wood
- Paper
- Cardboard
- Rice Husks,
- Pecan shells, and
- Cotton gin residue.

This permit application includes upgrades to the main kiln burners in Kiln No. 1 and Kiln No. 2 to multipath adjustable units. The upgrades will increase flexibility in the amount and kind of fuels that can be burned in the main kiln. The use of biomass is limited by cost, availability, and kiln process variables including high moisture or high chlorides content. Because biomass wastes have heating values that are typically lower than heating values for coal and petroleum coke, more biomass is needed to provide the same heating value as a given weight of coal or petroleum coke. In combustion systems any water content in the fuel must be driven off before the first stage of combustion can occur, requiring energy, and thus reducing overall system efficiency. Higher chlorides contents of fuels can negatively affect the quality of the cement product from the kiln.

5.1.1.3 Add On Controls

In addition to the cement production process technology options discussed above, it is appropriate to consider add-on technologies as possible ways to capture GHG emissions that are emitted from combustion and calcination, and to prevent them from entering the atmosphere. These emerging CCS technologies generally consist of processes that separate CO_2 from combustion process flue gas, and then inject it into geologic formations such as oil and gas reservoirs, un-mineable coal seams, or underground saline formations.

Post-combustion technologies include the Calera process, which captures carbon dioxide from flue gas and converts the gas to stable solid minerals. The process employs a scrubber with high pH water containing calcium, magnesium, sodium, and chloride as the scrubbing liquid. The CO_2 is absorbed by the water, converting it to a dissolved carbonic acid species. However, this technology has not been on a full scale basis and pilot plant testing has only been in relation to the electric utility industry.

Membrane technology is being research as a means to separate or adsorb CO_2 in the kiln exhaust. The captured CO_2 would then be purified and compressed for transport. This technology is still primarily in the research stage, with industrial application at least 10 years away. There are significant problems to overcome designing membrane reactors large enough to handle the kiln exhaust.[6]

A superheated Calcium Oxide (CaO) process has also been noted as potential CO_2 control technology. The superheated CaO process separates the calcination and combustion reactions into independent chambers. The heat necessary to run the calciner is provided by circulating a stream of superheated CaO particles between a fluidized bed combustor and a fluidized bed calciner. Retrofits of an existing kiln would involve removal of existing preheaters and precalciners, construction of the fluidized beds, cyclones, heat exchangers, and compressors associated with the process. Superheated CaO simulations have shown that the superheated CaO process is theoretically feasible; however, the system remains theoretical with no systems yet built.[7]

Of the emerging CO_2 capture technologies that have been identified, only amine absorption (post-combustion solvent capture and stripping) is currently commercially used for state-of-the-art CO_2 separation processes. Amine absorption has been applied to processes in the petroleum refining and natural gas processing industries and for exhausts from gas-fired industrial boilers but there has been little work discussing its feasibility at cement plants.

---

[6] EPA, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From the Portland Cement Industry*, Page 38, (Oct. 2010).

[7] EPA, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From the Portland Cement Industry*, Page 38, (Oct. 2010).

If CO_2 capture can be achieved at a cement plant at full scale, it would need to be routed to a geologic formation capable of long-term storage. The long-term storage potential for a formation is a function of the volumetric capacity of a geologic formation and CO_2 trapping mechanisms within the formation, including dissolution in brine, reactions with minerals to form solid carbonates, and/or adsorption in porous rock. The U.S. Department of Energy's National Energy Technology Laboratory (DOE-NETL) describes the geologic formations that could potentially serve as CO_2 storage sites as follows:

"Geologic carbon dioxide (CO_2) storage involves the injection of supercritical CO_2 into deep geologic formations (injection zones) overlain by competent sealing formations and geologic traps that will prevent the CO_2 from escaping. Current research and field studies are focused on developing better understanding of 11 major types of geologic storage reservoir classes, each having their own unique opportunities and challenges. Understanding these different storage classes provides insight into how the systems influence fluids flow within these systems today, and how CO_2 in geologic storage would be anticipated to flow in the future. The different storage formation classes include: deltaic, coal/shale, fluvial, alluvial, strandplain, turbidite, eolian, lacustrine, clastic shelf, carbonate shallow shelf, and reef. Basaltic interflow zones are also being considered as potential reservoirs. These storage reservoirs contain fluids that may include natural gas, oil, or saline water; any of which may impact CO_2 storage differently…"[8]

5.1.2 Step 2: Eliminate Technically Infeasible Options

5.1.2.1 Energy Efficiency Improvements in Clinker Production

CEMEX conducted a test using fluoride in a kiln at one of its other U.S. cement plants. Based on the test results, CEMEX evaluated the use of fluoride in kilns and determined the benefit in fuel savings does not offset the cost of the fluoride. There were also site specific impacts in quality of cement and concrete physical properties that prohibited the use at some plants. Therefore, CEMEX does not use fluxes and mineralizers in Kilns 1 and 2.

Mid-kiln firing is not conducted at Kilns 1 and 2. The kiln in a calciner system, like Kilns 1 and 2, is shorter than long dry or wet kilns and therefore do not have the adequate conditions for mid-kiln firing.

5.1.2.2 Post-combustion CO_2 Capture and Compression

Though amine absorption technology for CO_2 capture has been applied to processes in the

[8] DOE-NETL, *Carbon Sequestration: Geologic Storage Focus Area,* http://www.netl.doe.gov/technologies/carbon_seq/corerd/storage.html (last visited Feb. 27, 2012)

petroleum refining and natural gas processing industries, it has not been commercially applied to cement kiln exhausts. The Cement Industry GHG White Paper lists the following major additions to a cement plant to retrofit this technology include:

- A CO_2 capture plant which includes a solvent scrubber and regenerator
- A compressor to increase the pressure of the CO_2 product for transport by pipeline
- High efficiency flue gas desulfurization and De-NOx (a NOx removal process) to satisfy the flue gas purity requirements of the CO_2 capture process
- A boiler to provide the steam required for regeneration of the CO_2 capture solvent.[9]

While post-combustion capture of CO_2 has been studied extensively for combustion sources at gas-fired power stations, there has been little work to address feasibility at cement plants. The Cement Industry GHG White Paper listed the following technical issues associated with using post-combustion amine scrubbing at a cement kiln:

- Additional Steam Requirements. One of the major issues with using MEA CO_2 capture is the large steam requirement for solvent regeneration. The CEMEX Balcones plant currently does not have steam generation capabilities.
- Sulfur Dioxide (SO2). The concentration of SO2 in the flue gas from the cement process is important for post-combustion capture with amines because amines react with acidic compounds to form salts that will not dissociate in the amine stripping system.
- Nitrogen Dioxide (NO2). NOx within the flue gas is problematic for MEA absorption as this result in solvent degradation.
- Dust. The presence of dust reduces the efficiency of the amine absorption process. The dust level must be kept below 15 mg/Nm^3.
-
- Reducing Conditions. The clinker must not be generated in reducing conditions and an excess of oxygen must be maintained in the process.
- Heat Reduction for MEA Absorption. The flue gas must be cooled from about 110°C to about 50°C to meet the ideal temperature for CO_2 absorption with MEA.
- Other Gases. The presence of any acidic components will reduce the efficiency of the MEA absorption process.[10]

In addition to the technical issues addressed in the Cement Industry GHG White Paper, construction of a carbon capture facility will affect the footprint of the plant and may require a larger site.

[9] EPA, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From the Portland Cement Industry*, Page 37, (Oct. 2010).

[10] EPA, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From the Portland Cement Industry*, Page 37, (Oct. 2010).

5.1.2.3 CO_2 Transport

Even if it is assumed that CO_2 capture and compression could feasibly be achieved for the proposed project, the high-volume CO_2 stream generated would need to be transported to a facility capable of storing it. Potential geologic storage sites in Texas, Louisiana, and Mississippi to which CO_2 could be transported if a pipeline was constructed are delineated on the map found at the end of Section 5.[11] The potential length of such a CO_2 transport pipeline is uncertain due to the uncertainty of identifying a site(s) that is definitively suitable for large-scale, long-term CO_2 storage. The hypothetical minimum length required for any such pipeline(s) will be the distance to the closest site with recognized potential for some geological storage of CO_2, which is an enhanced oil recovery (EOR) reservoir site located approximately 50 miles to the south-southeast of the plant in Karnes County. However, the reservoir site in Karnes County has not been technically demonstrated for large-scale, long-term CO_2 storage.

In comparison, the closest site that is currently being field-tested to demonstrate its capacity for large-scale geological storage of CO_2 is the Southeast Regional Carbon Sequestration Partnership's (SECARB) Cranfield test site, which is located in Adams and Franklin Counties, Mississippi over 260 miles away (see the map at the end of Section 5 for the test site location). Therefore, to access this potentially large-scale storage capacity site, assuming that it is eventually demonstrated to indefinitely store a substantial portion of the large volume of CO_2 generated by the proposed project, a very long and sizable pipeline would need to be constructed to transport the large volume of high-pressure CO_2 from the plant to the storage facility, thereby rendering implementation of a CO_2 transport system infeasible.

5.1.2.4 CO_2 Storage

Even if it is assumed that CO_2 capture and compression could feasibly be achieved for the proposed project and that the CO_2 could be transported economically, the feasibility of CCS technology would still depend on the availability of a suitable sequestration site. The suitability of potential storage sites is a function of volumetric capacity of their geologic formations, CO_2 trapping mechanisms within formations (including dissolution in brine, reactions with minerals to form solid carbonates, and/or adsorption in porous rock), and potential environmental impacts resulting from injection of CO_2 into the formations. Potential environmental impacts resulting from CO_2 injection that still require assessment before CCS technology can be considered feasible include:

- Uncertainty concerning the significance of dissolution of CO_2 into brine,

---

[11] Susan Hovorka, University of Texas at Austin, Bureau of Economic Geology, Gulf Coast Carbon Center, *New Developments: Solved and Unsolved Questions Regarding Geologic Sequestration of CO_2 as a Greenhouse Gas Reduction Method* (GCCC Digital Publication #08-13) at slide 4 (Apr. 2008), available at: http://www.beg.utexas.edu/gccc/forum/codexdownloadpdf.php?ID=100(last visited Aug. 8, 2011).

- Risks of brine displacement resulting from large-scale CO_2 injection, including a pressure leakage risk for brine into underground drinking water sources and/or surface water,
- Risks to fresh water as a result of leakage of CO_2, including the possibility for damage to the biosphere, underground drinking water sources, and/or surface water,[12] and
- Potential effects on wildlife.

Potentially suitable storage sites, including EOR sites and saline formations, exist in Texas, Louisiana, and Mississippi. The closest EOR sites with such recognized potential for some geological storage of CO_2 are located within 50 miles of the proposed project, but such nearby sites have not yet been technically demonstrated with respect to all of the suitability factors described above. In comparison, the closest site that is currently being field-tested to demonstrate its capacity for geological storage of the volume of CO_2 that would be generated by the proposed power unit, i.e., SECARB's Cranfield test site, is located in Mississippi over 260 miles away. It should be noted that, based on the suitability factors described above, currently the suitability of the Cranfield site or any other test site to store a substantial portion of the large volume of CO_2 generated by the proposed project has yet to be fully demonstrated.

5.1.3 Step 3: Rank Remaining Control Technologies

As documented above, CEMEX believes that implementation of CCS technology is currently infeasible, leaving energy efficiency measures as the only technically feasible emission control options. As all of the energy efficiency related processes, practices, and designs discussed in Section 5.1.1 of this application are being proposed for this project, a ranking of the control technologies is not necessary for this application.

5.1.4 Step 4: Evaluate Most Effective Controls and Document Results

As all of the energy efficiency related processes, practices, and designs discussed in Section 5.1.1 of this application which are technically feasible are being proposed for this project, an examination of the energy, environmental, and economic impacts of the efficiency designs is not necessary for this application.

Based on the reasons provided in Section 5.1.2 above, CEMEX believes that CCS technology should be eliminated from further consideration as a potential feasible control technology for purposes of this BACT analysis. However, to answer possible questions that the public or the EPA may have concerning the relative costs of implementing hypothetical CCS systems, a cost estimate for implementing a CCS system is provided below.

The International Energy Agency (IEA) Greenhouse Gas R&D Programme conducted a study to assess the technologies that could be used to capture CO_2 in cement plant and their associated

[12] *Id.*

performance and costs.[13] The technical and economic assessments were based on a new preheater/precalciner cement plant in the United Kingdom producing 1 million tonnes/year of cement (910,000 ton/yr of cement). The post combustion CO_2 capture technology chosen for the study was CO_2 absorption using monoethynolamine. The study listed the main additions to the plant for post combustion CO_2 capture as: a CO_2 capture plant including a solvent scrubber and regenerator; a compressor to increase the pressure of the CO_2 product for transport by pipeline; high efficiency flue gas desulfurization and de-NOx to satisfy the flue gas purity requirements of the CO_2 capture process; and a plant to provide the steam required for regeneration of the CO_2 capture solvent. The initial capital cost for a CO_2 capture system was estimated to be $295 €/tonne cement ($401.44/ton cement at the 1.5 $/€ exchange rate used in the study). At this rate, the projected costs for installation of CO_2 capture equipment for the Balcones Kiln 1 and 2 would be $1,013,000,000. For comparison purposes, the estimated capital cost for the upgrades to the main kiln burners in Kiln No. 1 and Kiln No. 2 to multipath adjustable units is $750,000. Implementation of post combustion carbon capture system for Kilns 1 and 2 would result in initial capital costs of approximately 1,350 times higher than the projected project costs which would make the project not viable.

The average annual cost per tonne of CO_2 emissions avoided in the IEA study for CO_2 capture and compression was calculated to be 118.15 €/tonne ($146.15/ton at the 1.5 $/€ exchange rate used in the study). It was reported in the "Report of the Interagency Task Force on Carbon Capture and Storage"[14] that recent studies have shown that CO_2 pipeline transport costs for a 100 kilometer (62 mile) pipeline transporting 5 million tonnes per year range from approximately $1 per tonne to $3 per tonne ($0.91 per ton to $2.72 per ton). The distance from the CEMEX Balcones Plant to the nearest enhanced oil recovery site with a recognized potential for some geological storage of CO_2 is 50 miles. Conservatively assuming that the pipeline cost is linear, the estimate average annual cost for CO_2 transport would be $1.46/ton CO_2 avoided. It was reported in "Report of the Interagency Task Force on Carbon Capture and Storage"[15] that the costs associated with CO_2 storage have been estimated to be approximately $0.4 – 20/tonne plus $0.16 – 0.30/tonne CO_2 stored for monitoring. The average annual cost on a $/ton CO_2 storage basis for storage and monitoring would be $9.33/ton. A summary of the calculated annual costs associated with a CCS system is shown in the following table. This is a very high annual cost and would make the proposed project economically unviable if selected.

[13] CO_2 Capture in the Cement Industry, Final Report, July 2008, Mott MacDonal, International Energy Agency Greenhouse Gas R&D Programme

[14] Report of the Interagency Task Force on Carbon Capture and Storage, p. 37 (Aug. 2010) (http://www.epa.gov/climatechange/policy/ccs_task_force.html)

[15] Report of the Interagency Task Force on Carbon Capture and Storage, p. 44 (Aug. 2010) (http://www.epa.gov/climatechange/policy/ccs_task_force.html)

Economic Feasibility Analysis for CCS

	Cost (\$/ton CO_2 Avoided)	Potential Tons of CO_2 Avoided Per Year	Total Projected Annual Cost (Million \$ per Year)
Capture and Compression	\$146.15/ton	2,157,593 tons/yr	\$315.2
Transport	\$1.46/ton	2,157,593 tons/yr	\$3.2
Storage	\$9.33/ton	2,157,593 tons/yr	\$20.1
Total CCS System Cost	\$157.04/ton		\$338.1

In summary the high initial capital costs for CO_2 capture equipment and high annual average operating costs for CO_2 capture, transport, and storage would make the proposed project not economically feasible. Therefore, CCS is eliminated as a potential control option in this BACT analysis for CO_2 emissions.

5.1.5 Step 5: Select BACT

CEMEX proposes as BACT for this project, the following energy efficiency processes, practices, and designs for the proposed combined cycle combustion turbine:

- Cement Kiln Energy Efficiency
  - Kiln process control and management system
  - Kiln seal maintenance program
  - Kiln combustion system optimization
  - Kiln/Preheater insulation inspection program
  - Use of reciprocating grate clinker coolers
  - Use of in-line raw mills which recover heat from the kiln exhausts
  - Use of clinker cooler exhaust as secondary air to provide oxygen and heat to the kilns
  - Use of suspension preheater low pressure drop cyclones
  - Use of preheater/precalciner kilns
  - Use of efficient, variable frequency drives for kilns
  - Use of efficient, variable frequency drives for kiln fans
  - Use of multichannel kiln burners that allow for necessary mixing of fuel and air to complete combustion
  - Firing a portion of the fuel in the preheater riser duct
- Use of Lower GHG Emitting Fuels Including Natural Gas
- Use of Biomass Fuels

CEMEX proposes a combined BACT limit for Kilns 1 and 2 of 0.95 tons CO_{2e} per ton of clinker, rolling 12 month average. Compliance will be determined with the annual reporting of GHG emissions in accordance with 40 CFR Part 98.

CEMEX performed a search of the EPA's RACT/BACT/LAER Clearinghouse for Portland cement kilns and found no entries which address BACT for GHG emissions.
Although not listed in the RACT/BACT/LAER Clearinghouse, a GHG BACT analysis was performed by the following Portland Cement Plants: LaFarge Building Materials, Inc., Town of Coeymans, New York (commonly known as the Ravena Plant) and Universal Cement, Chicago, Illinois. A discussion of CEMEX's proposed BACT as compared to those projects is provided below:

LaFarge Ravena Plant

The proposed LaFarge project would replace the existing "wet" cement-making process at the Ravena Plant with a preheater/precalciner "dry" cement-making process. The proposed capacity of the modified plant was 2.81 million tons of clinker per year. The kiln system was designed to fire coal, petroleum coke, oil, and tire derived fuel. PSD Permit 4-0124-00001/00112 was issued on July 19, 2011. The permit included a GHG emission limit for the kiln system of 1900 pounds (0.95 tons) of CO_2 equivalent per ton of clinker, rolling 12 month average.

Universal Cement

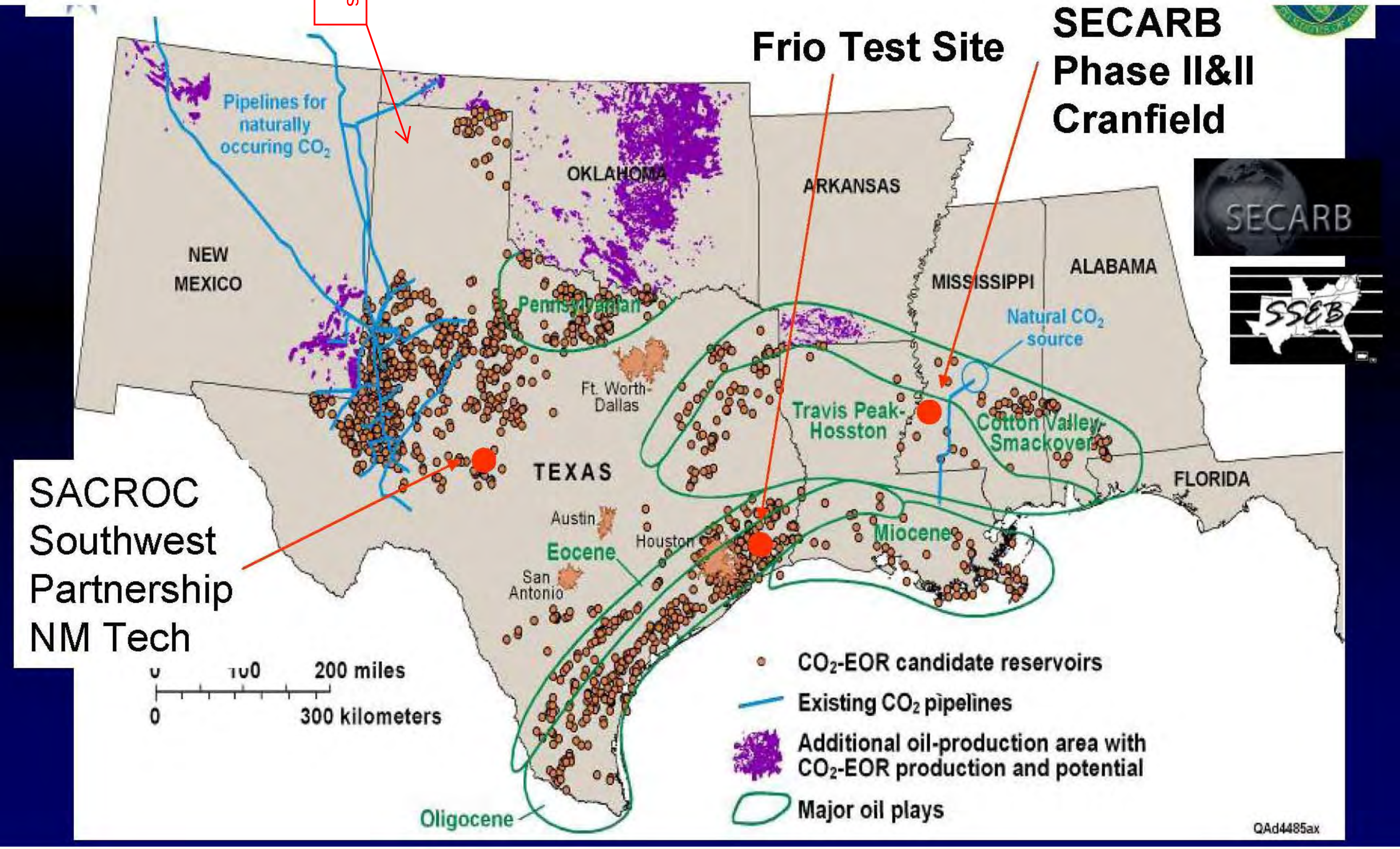
Universal Cement proposed construction of a new preheater/precalciner kiln system capable of producing about 1 million tons per year of clinker. The clinker production train consists of an in-line raw mill, a blending silo, kiln system (preheat tower, precalciner, rotary kiln), clinker cooler and a solid fuel mill. Other equipment in the project includes clinker storage silos, a finish mill, and the associated raw material, solid fuel and finished product handling equipment. The kiln system was designed to fire coal and petroleum coke in the kiln and the precalciner; scrap tires, as available, in the precalciner; and natural gas or propane during kiln startup. Permit 031600GVX was issued by the Illinois Environmental Protection Agency on December 20, 2011. The permit included a GHG emission limit for the kiln system of 1860 pounds (0.93 tons) of CO_2 equivalent per ton of clinker, rolling 12 month average.

Carolinas Cement Company

Carolinas Cement Company proposed to construct a new Portland cement manufacturing facility at the site of an existing cement storage terminal near Castle Hayne, North Carolina. The proposed plant consisted of a multistage preheater-precalciner kiln with an in-line raw mill, coal mill, alkali bypass and clinker cooler venting through the main stack. Production was proposed to be 6000 tons per day (tons/day) and 2,190,000 tons per year (tons/yr) of clinker. Fuels included coal, petroleum coke, biomass fuels (organic material that is available on a renewable or recurring basis), and distillate fuel oil. Coal and petroleum coke was proposed as the primary fuels. Biomass was proposed to be utilized to the extent practical depending on performance, availability, and economic viability. Fuel oil was proposed to be used mainly for kiln startup. Permit O7300R09 was issued by the North Caroline Department of Environment and Natural Resources on February 29, 2012. The permit included a GHG emission limit for the kiln system of 0.91 tons of CO_2 equivalent per ton of clinker, rolling 12 month average, determined with procedures used for reporting GHG emissions pursuant to 40 CFR Part 98.

CEMEX's proposed BACT limit of 0.95 ton CO_2e/ton clinker is equivalent to the BACT limit for the Ravena Plant modification but slightly higher than the BACT limit for the new Universal Cement Plant and the new Carolinas Cement Company Plant. Since the CEMEX kilns are existing, it is more appropriate to compare the BACT limit to the LaFarge Plant modification rather than the new plants being proposed by Universal Cement and Carolinas Cement Company. The CEMEX Kilns 1 and 2 incorporates a lower GHG emitting fuel, natural gas, and biomass into the fuel mix for the kilns and precalciner. The LaFarge Plant is not authorized for natural gas. The Universal Plant is authorized for natural gas or propane only during kiln startup. The Carolinas Cement Plant is not authorized for natural gas. Neither the LaFarge Plant nor the Universal Plant are authorized to fire biomass. The Carolinas Cement Plant proposed to utilize biomass to the extent practical depending on performance, availability, and economic viability.

EX Balcones



Frio Test Site
SECARB
Phase II&II
Cranfield
SECARB
SSEB
Pipelines for naturally occuring CO_2
NEW MEXICO
OKLAHOMA
ARKANSAS
MISSISSIPPI
ALABAMA
TEXAS
FLORIDA
Pennsylvanian
Ft. Worth-Dallas
Travis Peak-Hosston
Cotton Valley-Smackover
Natural CO_2 source
Austin
Houston
San Antonio
Eocene
Miocene
Oligocene
SACROC
Southwest
Partnership
NM Tech
0 100 200 miles
0 300 kilometers
CO_2-EOR candidate reservoirs
Existing CO_2 pipelines
Additional oil-production area with CO_2-EOR production and potential
Major oil plays
QAd4485ax

6.0 OTHER PSD REQUIREMENTS

6.1 IMPACTS ANALYSIS

An impacts analysis is not being provided with this application in accordance with EPA's recommendations:

> *Since there are no NAAQS or PSD increments for GHGs, the requirements in sections 52.21(k) and 51.166(k) of EPA's regulations to demonstrate that a source does not cause contribute to a violation of the NAAQS are not applicable to GHGs. Therefore, there is no requirement to conduct dispersion modeling or ambient monitoring for CO_2 or GHGs.*[16]

6.2 GHG PRECONSTRUCTION MONITORING

A pre-construction monitoring analysis for GHG is not being provided with this application in accordance with EPA's recommendations:

> *EPA does not consider it necessary for applicants to gather monitoring data to assess ambient air quality for GHGs under section 52.21(m)(1)(ii), section 51.166(m)(1)(ii), or similar provisions that may be contained in state rules based on EPA's rules. GHGs do not affect "ambient air quality" in the sense that EPA intended when these parts of EPA's rules were initially drafted. Considering the nature of GHG emissions and their global impacts, EPA does not believe it is practical or appropriate to expect permitting authorities to collect monitoring data for purpose of assessing ambient air impacts of GHGs.*[17]

6.3 ADDITIONAL IMPACTS ANALYSIS

A PSD additional impacts analysis is not being provided with this application in accordance with EPA's recommendations:

> *Furthermore, consistent with EPA's statement in the Tailoring Rule, EPA believes it is not necessary for applicants or permitting authorities to assess impacts from GHGs in the context of the additional impacts analysis or Class I area provisions of the PSD regulations for the following policy reasons. Although it is clear that GHG emissions contribute to global warming and other climate changes that result in impacts on the environment, including impacts on Class I areas and soils and vegetation due to the global scope of the problem, climate change modeling and evaluations of risks and impacts of GHG emissions is typically conducted for changes in emissions orders of magnitude larger than the emissions from individual projects that might be analyzed in PSD permit reviews. Quantifying the exact impacts attributable to a specific GHG source obtaining a permit in specific places and points would not be possible with*

[16] EPA, *PSD and Title V Permitting Guidance For Greenhouse Gases* at 48-49.
[17] *Id.* at 49.

current climate change modeling. Given these considerations, GHG emissions would serve as the more appropriate and credible proxy for assessing the impact of a given facility. Thus, EPA believes that the most practical way to address the considerations reflected in the Class I area and additional impacts analysis is to focus on reducing GHG emissions to the maximum extent. In light of these analytical challenges, compliance with the BACT analysis is the best technique that can be employed at present to satisfy the additional impacts analysis and Class I area requirements of the rules related to GHGs.[18]

[18] *Id.*

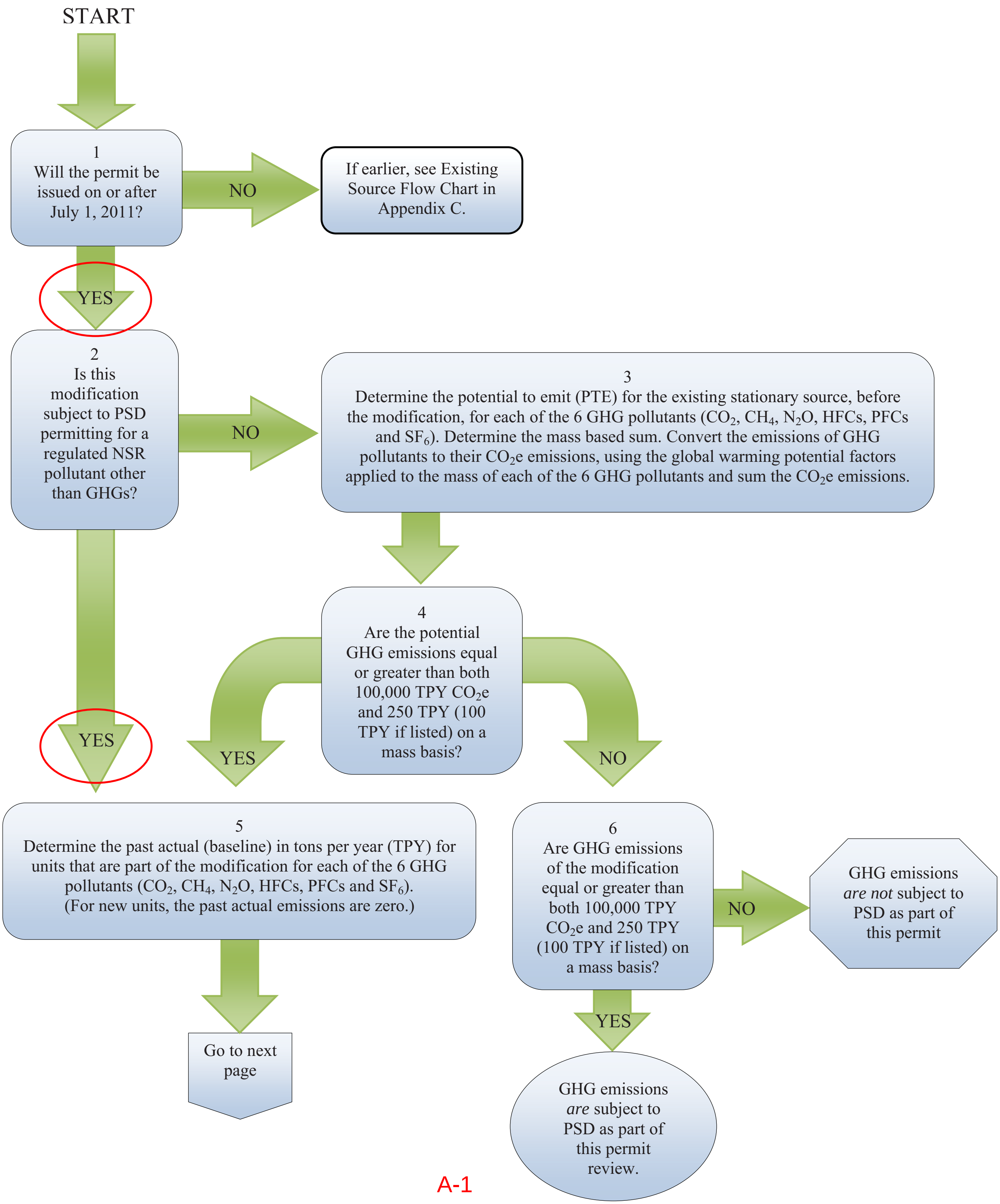
7.0 PROPOSED GHG MONITORING PROVISIONS

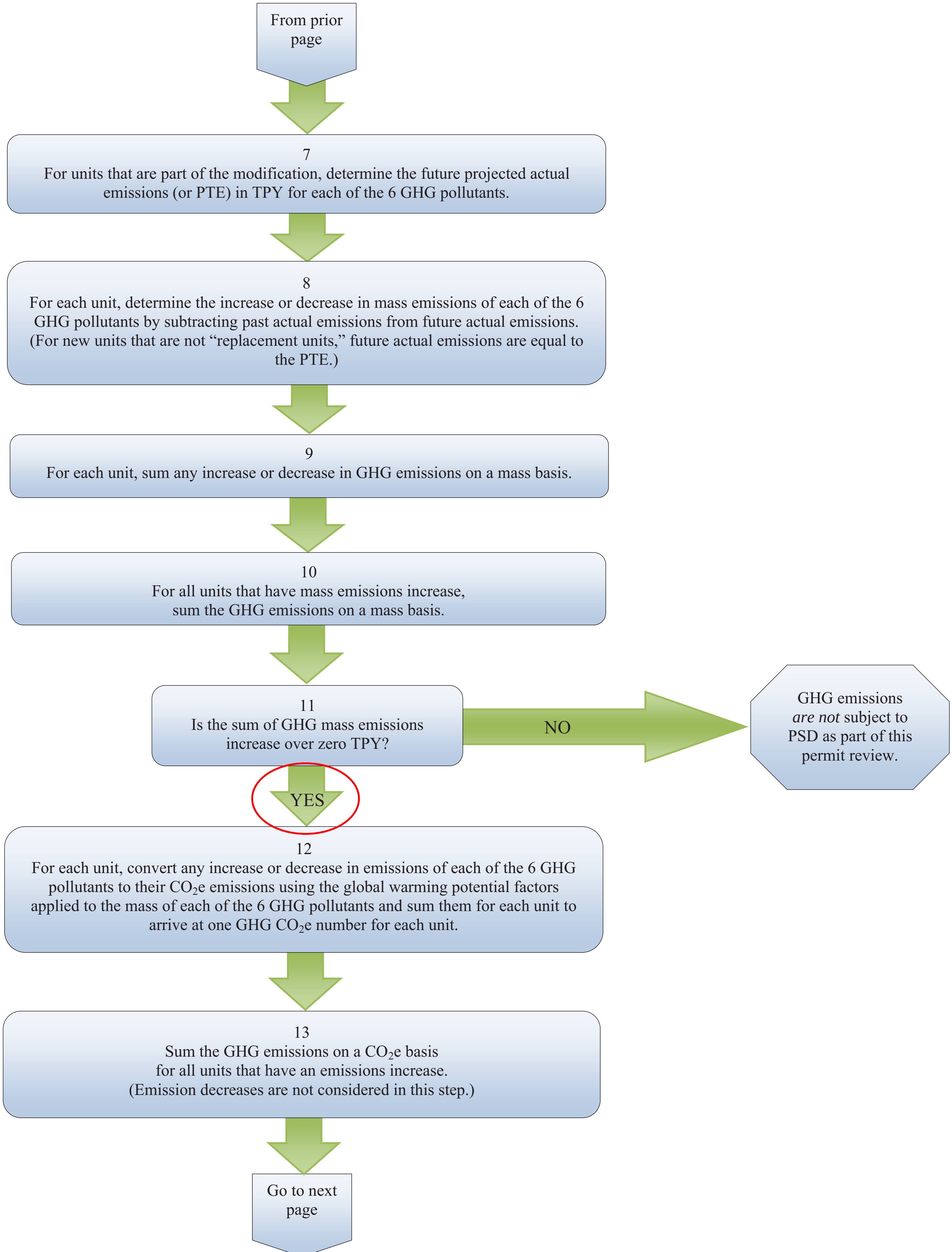
Kilns 1 and 2 currently have CO_2 continuous emission monitors that measure CO_2 emissions in the kiln stacks. Emissions of CH_4 and N_2O are calculated based on measured fuel inputs for each of the authorized fuels and multiplying by fuel specific emission factors from Table C-2 of the Mandatory Greenhouse Gas Reporting Rules, 40 CFR 98, Appendix C.

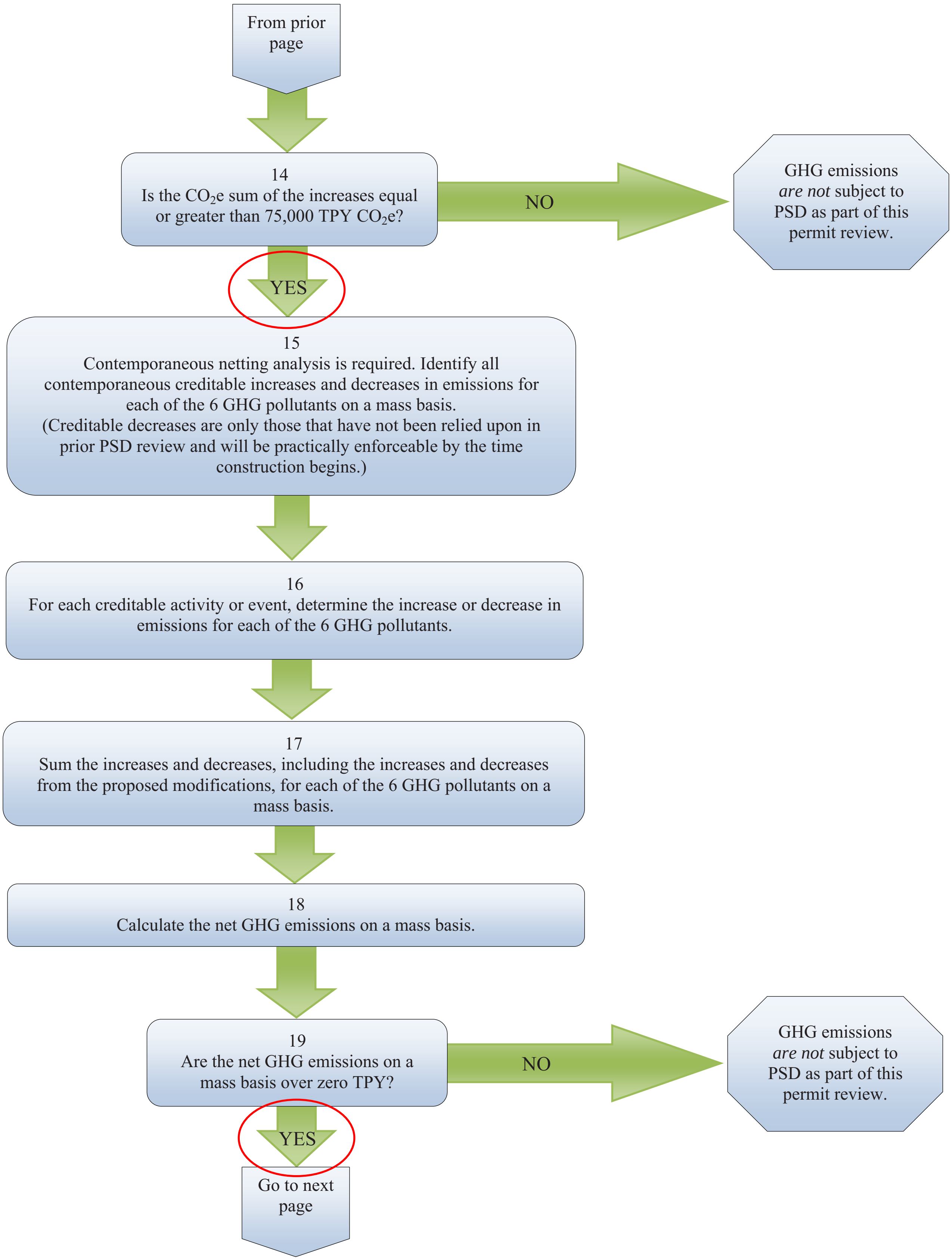
APPENDIX A

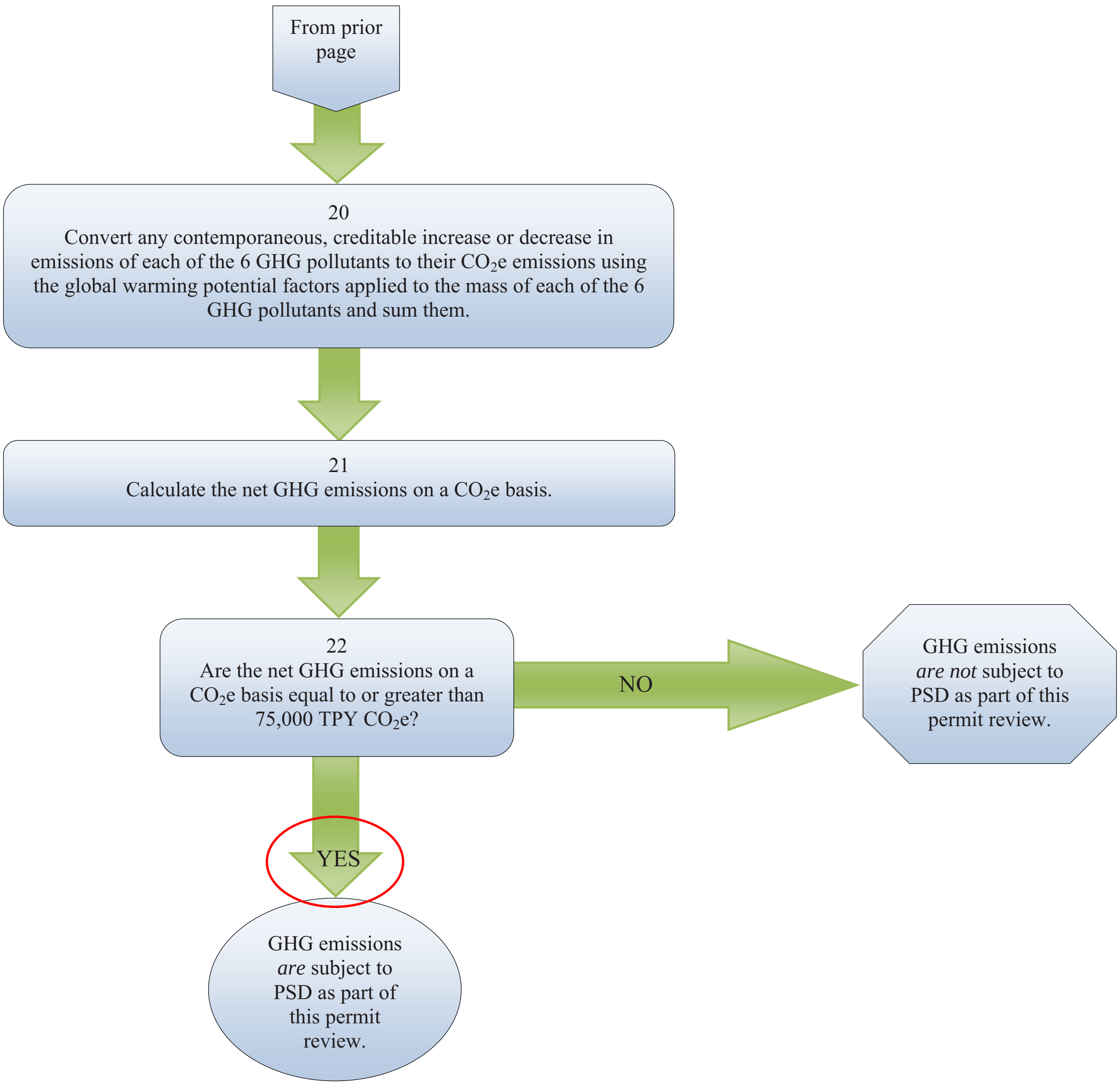
GHG PSD APPLICABILITY FLOWCHART – EXISTING SOURCES

GHG Applicability Flowchart – Modified Sources
(On or after July 1, 2011)




From prior page
7
For units that are part of the modification, determine the future projected actual emissions (or PTE) in TPY for each of the 6 GHG pollutants.
8
For each unit, determine the increase or decrease in mass emissions of each of the 6 GHG pollutants by subtracting past actual emissions from future actual emissions. (For new units that are not "replacement units," future actual emissions are equal to the PTE.)
9
For each unit, sum any increase or decrease in GHG emissions on a mass basis.
10
For all units that have mass emissions increase, sum the GHG emissions on a mass basis.
11
Is the sum of GHG mass emissions increase over zero TPY?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
12
For each unit, convert any increase or decrease in emissions of each of the 6 GHG pollutants to their CO_2e emissions using the global warming potential factors applied to the mass of each of the 6 GHG pollutants and sum them for each unit to arrive at one GHG CO_2e number for each unit.
13
Sum the GHG emissions on a CO_2e basis for all units that have an emissions increase. (Emission decreases are not considered in this step.)
Go to next page


From prior page
14
Is the CO_2e sum of the increases equal or greater than 75,000 TPY CO_2e?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
15
Contemporaneous netting analysis is required. Identify all contemporaneous creditable increases and decreases in emissions for each of the 6 GHG pollutants on a mass basis.
(Creditable decreases are only those that have not been relied upon in prior PSD review and will be practically enforceable by the time construction begins.)
16
For each creditable activity or event, determine the increase or decrease in emissions for each of the 6 GHG pollutants.
17
Sum the increases and decreases, including the increases and decreases from the proposed modifications, for each of the 6 GHG pollutants on a mass basis.
18
Calculate the net GHG emissions on a mass basis.
19
Are the net GHG emissions on a mass basis over zero TPY?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
Go to next page


From prior page
20
Convert any contemporaneous, creditable increase or decrease in emissions of each of the 6 GHG pollutants to their CO_2e emissions using the global warming potential factors applied to the mass of each of the 6 GHG pollutants and sum them.
21
Calculate the net GHG emissions on a CO_2e basis.
22
Are the net GHG emissions on a CO_2e basis equal to or greater than 75,000 TPY CO_2e?
NO
GHG emissions *are not* subject to PSD as part of this permit review.
YES
GHG emissions *are* subject to PSD as part of this permit review.