LANDFILL MANAGEMENT PLAN
FORMER YALE LANDFILL

Albuquerque, New Mexico

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March 31, 2014

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ABBREVIATIONS AND ACRONYMS

µg/L	micrograms per liter
ABCWUA	Albuquerque Bernalillo County Water Utility Authority
AEHD	City of Albuquerque Environmental Health Department
AGIS	Albuquerque Geographic Information System
BMPs	Best Management Practices
CFR	Code of Federal Regulations
CO	certificate of occupancy
COA	City of Albuquerque
COCs	constituents of concern
CO_2	carbon dioxide
DBS&A	Daniel B. Stephens & Associates
DCE	dichloroethene
DCM	methylene chloride
EDR	Environmental Data Resources Inc.
ft	feet *or* foot
HAZWOPER	Hazardous Waste Operation and Emergency Response
INTERA	INTERA Incorporated
Interim Guidelines	Interim Guidelines for Development within City Designated Landfill Buffer Zones
LEL	lower explosive limit
LFG	landfill gas
LMP	landfill management plan
Mg	megagrams
MS4	Municipal Separate Storm Sewer System
MSW	Municipal Solid Waste
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMOC	non-methane organic compound
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standard

O&M	operation and maintenance
OMMP	Operation Maintenance and Monitoring Plan
OSHA	Occupational Safety and Health Administration
PCE	tetrachloroethene
PE	Professional Engineer
ppm	parts per million
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
TCE	trichloroethene
UEL	upper explosive limit
USGS	U.S. Geological Survey
VOCs	volatile organic compounds
WEP	Waste Excavation Plan
YALF	Yale Landfill

1.0 INTRODUCTION

This landfill management plan (LMP) for the former City of Albuquerque (COA) Yale Landfill (YALF) has been prepared by INTERA Incorporated (INTERA) on behalf of the COA Environmental Health Department (AEHD). The purpose of this LMP is to mitigate risks associated with the decomposition of waste in the unlined landfill. Much of the LMP is dedicated to the monitoring and control of landfill gas (LFG), since it poses the most acute risk to property and public welfare. The AEHD has developed routine monitoring activities that this LMP documents and develops into a written action plan. In addition to on-site LFG management, this LMP specifies engineering controls and protocols to implement to abate LFG exposure and safety risks. These controls and protocols include property development procedures, public use restrictions, and public use preparation guidelines.

AEHD has monitored groundwater quality in the vicinity of the YALF since 1982. Since the YALF is unlined, opportunities for contamination to migrate to the groundwater are conceivable. This LMP will document current monitoring results and identify the future direction of the monitoring program.

1.1 Landfill Description and History

The former YALF was owned and operated by the City of Albuquerque from 1948 to 1965. The YALF is located in southeast Albuquerque, west of the Albuquerque International Sunport (**Figure 1**). The original landfill consisted of two areas, a larger area between University Boulevard and Yale Boulevard, and a smaller area east of Yale Boulevard surrounding the Sheraton Albuquerque Hotel (formerly Wyndham Hotel) (**Figure 2**).

Prior to its use as a landfill, the site contained several scattered gravel pits. The original area of the landfill was 137.3 acres. The landfill is unlined and has a minimum 2-foot (ft) soil cover. Upon closing, the waste in place was estimated to be 1.11 million tons. The waste depth is in the range of approximately 4.5 to 26.5 ft (Geo-Test, 2000). It is reported that material placed at the site was mainly residential and commercial waste. Historically, at least three underground fires have occurred which burned for undetermined periods of time. These areas were located on the west-central portion of the YALF near University Boulevard and George Road. It is believed these areas were flooded with water to extinguish the fires (Nelson, 1997). **Table 1** provides a summary of landfill characteristics.

The current landfill configuration is composed of four distinct fill areas: the northern, central, southern, and Wyndham Hotel (now Sheraton Albuquerque Airport Hotel) fill areas (**Figure 3**). Several construction projects have led to the excavation of waste at various locations around the site. All waste was excavated from beneath the airport terminal exit road between the airport and the former Wyndham Hotel parking lot (phone conversation with Jim Hinde, 2001). In 1988, approximately 400,000 cubic yards of waste were removed for construction of a post office (Nelson, 1997). Waste was removed from the footprint of the building and relocated directly west on the slope of the existing landfill. A minimum of 2 ft of structural fill cover was placed over the waste.

Also, from 1995 through 1997, approximately 285,000 tons of waste were removed from the YALF during the construction of Sunport Boulevard. During this project, both George Road and University Boulevard were relocated and all waste beneath them was removed (Nelson, 1997). The remaining YALF fill areas now have a combined total area of approximately 114.4 acres. The current waste in place is estimated to be 0.97 million tons (DBS&A, 2002). Most of the waste found at the site consists of soil, glass, paper, plastic, wood, metal, green waste, cloth, and cardboard (DBS&A, 2002).

1.2 Landfill Area Geology

In 2003 and 2006, INTERA installed shallow (approximately 30 ft deep) LFG monitoring wells around the site (**Figure 3**). The shallow soils encountered at the site were consistent with soils classified as: poorly graded gravels or gravel-sand mixtures with little or no fines, well-graded gravels or gravel sand mixtures with little or no fines, inorganic silts and very fine sands, silty or clayey fine sands or clayey silts with slight plasticity, silty sands and sand-silt mixtures, poorly graded sands or gravelly sands with little or no fines, well-graded sands or gravelly sands with little or no fines, and inorganic clays of low to medium plasticity, gravelly clays, sandy clays, and lean clays.

Sand, both fine- to medium-grained (with subangular grain structure) and loose, was the predominant soil type encountered across the site. This type of material is consistent with wind-blown and finer-fraction alluvial deposits common in the area. The gravel materials encountered in certain soil borings were consistent with water erosion of the immediate native materials. No major separations of strata were observed. The moisture content of the majority of the subsurface materials encountered was damp. Groundwater was not encountered in any of the soil borings during drilling operations (INTERA, 2003).

The site geology is also described on the Albuquerque West U.S. Geological Survey (USGS) 7.5-minute quadrangle geologic map performed by Connell (2006). The map includes the footprint of the former YALF located west and north of the Albuquerque International Sunport. According to Connell, the site is underlain by members of the Santa Fe Group, a major groundwater-bearing unit in the Albuquerque area. Specifically the site consists of (1) disturbed land and/or artificial fill (modern-historic) – excavations and areas of artificially deposited fill and debris; (2) the Sierra Ladrones Formation, axial-fluvial member (Quaternary, Miocene (?), Pliocene-lower Pleistocene) – light-gray to yellowish-brown sand, pebbly to cobbly sand, and sparse interbedded mud; clasts dominated by rounded othoquartzite and volcanic rocks; deposits associated with the ancestral Rio Grande; (3) the Sierra Ladrones Formation, piedmont member (Quaternary, Miocene (?), Pliocene-lower Pleistocene) – reddish- to yellowish-brown conglomerate, sandstone, and minor mudstone; contains weakly developed paleosols and upward-fining sequences of gravel, sand, and mud; contains limestone, sandstone and granite clasts; generally poorly consolidated; (4) the Ceja Formation, upper sand and gravel member (Pliocene-lowest Pleistocene(?)) – pale-brown to yellowish-brown cobbly sand and gravel with scattered boulders; top is defined by Llano de Albuquerque surface (Connell, 2006).

Depth to groundwater varies from 179 to 425 ft below ground surface depending on well location (elevation). The Miles No. 1 supply well is located about 100 yards northwest of the YALF. Groundwater flow direction as measured in 1983 (Fox, 1986) was to the north-northeast.

1.3 Applicable or Relevant and Appropriate Regulations

Landfills, by nature of their content and associated risks, are subject to multiple regulations. Because of the age and closure date of the YALF, many federal and state regulations for landfills are not applicable. There are still, however, regulations and laws that impact how the COA maintains and manages the former YALF. This section identifies some of the more pertinent regulations that apply to the landfill and how compliance is achieved. In several instances, federal regulations are enforced by state or local regulatory agencies.

1.3.1 Clean Air Act

Landfills are regulated on the federal level by regulations promulgated in 40 Code of Federal Regulations (CFR). There are two important federal standards that require Municipal Solid Waste (MSW) landfills to capture and control LFG: the Clean Air Act's New Source Performance Standard (NSPS) for MSW Landfills (40 CFR 60 subpart WWW) and the Mandatory Greenhouse Gas Reporting for MSW Landfills (40 CFR 98 HH).

The landfill NSPS requires landfills that have a design capacity of 2.5 million cubic meters or greater and 2.5 million megagrams (Mg) or greater and that commenced construction, reconstruction, or modification on or after May 30, 1991, to capture and control the LFG if the non-methane organic compound (NMOC) emissions exceed 50 Mg per year. Because the YALF had a smaller design capacity, was closed in 1965, and has not received waste since that time, there are no regulatory requirements for LFG collection.

The Mandatory Greenhouse Gas Reporting for MSW Landfills exempts landfills that accepted waste after January 1, 1980, and which emit less than 25,000 metric tons carbon dioxide (CO_2)

equivalent from reporting. As of 2014, the CO_2 equivalent for the YALF is calculated at 2,612 metric tons.

1.3.2 Resource Conservation and Recovery Act

Resource Conservation and Recovery Act (RCRA) Subtitle D specifies safety standards for MSW landfills (40 CFR 257.3-8). These safety standards specify that LFG may not exceed an accumulation of 25% of the lower explosive limit (LEL) for methane (12,500 parts per million [ppm]) within structures (buildings, vaults, culverts, etc.) near the facility, and may not exceed the LEL at the property boundary. These safety standards apply to landfills that received waste after October 9, 1991, which excludes the YALF; however, these standards have been used to develop action levels in this LMP.

1.3.3 New Mexico Environment Department Solid Waste Regulations

The New Mexico Environment Department (NMED) Solid Waste Bureau regulations (Title 20, Chapter 9, and Part 2 of the New Mexico Administrative Code [NMAC]) provide requirements for municipal landfills. Because of the closure date of the YALF, certain NMED regulations do not apply to the YALF, as explained below:

- LFG monitoring is not required by the Solid Waste Bureau at landfills closed prior to 1993 (20.9.5.9 NMAC).
- Post closure requirements do not apply to landfills that stopped accepting waste prior to 1989 (20.9.6.8 NMAC).
- Groundwater monitoring and control plans (20.9.9.8 NMAC) are not required by the Solid Waste Bureau for Category 1 landfills.

The closure of the YALF was completed over a period of years after the landfill closed. Some earthwork was completed as late at 1997 during construction of Sunport Boulevard. The YALF meets older requirements regarding minimum cover and special requirements pertaining to the excavation of waste from the landfill. Excavation of waste is prohibited without written approval from NMED unless for maintenance purposes or during emergency situations (20.9.2.10 NMAC).

1.3.4 Worker Health and Safety

Because this site falls under RCRA, workers involved with operations and maintenance (O&M) at the YALF are subject to the requirements of Occupational Safety and Health Administration (OSHA) Standard 1910.120 "Hazardous Waste Operation and Emergency Response" (HAZWOPER). This Standard requires that employers develop and implement a written health and safety program designed to identify, evaluate, and control health and safety hazards, and prepare employees for any emergency response situations that may occur at the site.

1.3.5 Clean Water Act

The National Pollutant Discharge Elimination System (NPDES) Stormwater Program regulates stormwater discharges from three potential sources: municipal separate storm sewer systems, construction activities, and industrial activities. The U.S. Environmental Protection Agency is the permitting authority in the State of New Mexico. Activities at the YALF are considered ongoing maintenance activities, and as a COA-owned property, these activities are covered by the COA's Municipal Separate Storm Sewer System (MS4) NPDES Permit. AEHD requires that Best Management Practices (BMPs) that minimize the discharge of pollutants from earth disturbing activities be designed and installed to maintain erosion for each construction activity.

1.3.6 Groundwater Quality

Although the NMED Solid Waste Bureau regulations exempt the YALF from having to implement a groundwater monitoring and control plan, groundwater impacts are still regulated by the NMED Ground Water Quality Bureau under New Mexico Water Quality Control Commission Regulations 20.6.2 NMAC. The AEHD has implemented an annual groundwater monitoring program for the YALF. Eight groundwater monitoring wells have been constructed at the YALF. The monitoring well installations were permitted through the Office of the State Engineer.

2.0 IDENTIFICATION OF YALF MANAGEMENT ISSUES

Most of the landfill management strategies recommended for the YALF have been developed based on the need to control recognized hazards and environmental risks. The YALF appears to be little more than an undeveloped parcel of land when viewed from the street. The actual hazards associated with the landfill are mostly related to the buried waste and its decomposition. Physical hazards at the surface are easily identified as objects that may have worked through the cap or have been excavated during utility installation. Items like glass, metal, or medical waste have the potential to cause injury or damage to equipment. The hazards with the greatest potential for significant risks are those that cannot be seen and are associated with the decomposition of the waste. LFG has the potential to be highly flammable, resulting in explosive conditions that can cause catastrophic damage and/or injury. Other chemical compounds derived from the waste have the potential to impact the environment. Control of LFG and hazardous chemical compounds released to the environment from the waste has been, and will continue to be, a primary landfill maintenance and management issue for the COA.

2.1 Description of LFG and Associated Risks

LFG is predominantly a product of the anaerobic decomposition of organic waste and is comprised of a variety of different components. For landfills containing mostly household waste, the typical steady-state composition of LFG in decreasing concentrations are methane, carbon dioxide, nitrogen, oxygen, hydrogen sulfide, and volatile organic compounds (VOCs). Of these constituents, methane has the highest explosive potential. The concentration level at which a gas has a potential to explode is called the explosive limit. The potential for a gas to explode is determined by its LEL and its upper explosive limit (UEL). The LEL and UEL are measures of the percent of gas in the air by volume. Methane has an LEL of 5% and a UEL of 15%. While methane levels in the YALF may be greater than the UEL, this does not mean that the potential for explosion is less. At a point of exposure to LFG, methane will rapidly mix with ambient air and pass through the explosive range; for this reason any exposure to levels exceeding the LEL are considered hazardous, and the UEL will not be referred to again in this LMP.

The amount of methane produced by a landfill is dependent on a variety of conditions including landfill age, the mass of organic material, and moisture. For newer landfills, methane concentrations typically range between 45% and 75% by volume, with a gradual reduction in concentration over time. In 2002, Daniel B. Stephens & Associates, Inc. (DBS&A) prepared a study of the YALF to determine Landfill Gas Generation Projection (**Figure 4**). The quantity and quality of gas peaked in 1966, and the predicted flow has decreased by half in nearly 50 years. LFG by volume is made up of methane, carbon dioxide, and a balance consisting of nitrogen and small amounts of oxygen, sulfides, and NMOCs such as chlorinated compounds and petroleum hydrocarbons. These LFG mixtures may vary dramatically across the YALF.

When production of LFG is significant, the landfill can become pressurized, forcing LFG outward beyond the boundaries of the landfill. Migrating LFG follows the path of least resistance, which includes utility corridors, deposits of sand and gravel, or areas of prior excavation that have not been properly compacted. There have been documented instances at other landfills where LFG has been detected at distances of over 1,000 ft from a landfill. For this reason, there is a potential danger associated with development activities near closed landfills. The presence of the LFG constituent methane also presents a risk to development (i.e., structures, utility conduits, vaults, etc.) occurring at the surface of a former landfill, where migration of methane beneath the surface and through the surface cover of the landfill can occur, with methane potentially accumulating in confined spaces and buildings. LFG is most likely to be released through the surface of the landfill near penetrations (well locations, excavation locations, etc.), settlement cracks, or areas of thin soil cover. The concentration of LFG is highest at the point of release (i.e., ground surface) and dissipates rapidly as it mixes with ambient air.

In addition to potentially being combustive, LFG may also present a health hazard due to other common LFG compounds such as carbon dioxide, hydrogen sulfide, and VOCs. Carbon dioxide is an asphyxiant, hydrogen sulfide is flammable and extremely toxic, and VOCs present a range of hazards including the potential for exposure to constituents which are known human carcinogens.

Asphyxiant gases displace oxygen in confined spaces or low-lying areas. Although LFG typically exhibits a distinguishable odor attributed to waste decomposition, gases like methane (also an asphyxiant, though its flammability presents a more acute risk) and carbon dioxide alone are odorless and can only be confirmed to be present or absent with appropriate instrumentation. For this reason, health and safety procedures have been put in place to set protocols for entering confined spaces, trenches, or other excavated areas. Although asphyxiants are presented here as gases that displace oxygen, it should be understood that the biological degradation of waste also results in the consumption of oxygen, and atmospheres in the waste prism will likely be oxygen deficient for that reason.

Hydrogen sulfide gas, commonly associated with the decomposition of gypsum-based drywall, is a highly toxic compound. When inhaled, this compound inhibits cellular respiration and the uptake of oxygen, causing biochemical suffocation. Health impacts can be observed at relatively low concentrations (as low as 10 ppm, or 0.001% in air), and at levels exceeding 200 ppm, collapse, coma, and death due to respiratory failure can occur within seconds after only a few inhalations. Hydrogen sulfide can be sensed more readily than other LFG constituents (a strong rotten egg smell); however, it will rapidly fatigue the human sense of smell, causing the temporary loss of this sense. Hydrogen sulfide was detected in low levels at the time of the DBS&A (2002) study, but no hydrogen sulfide has been detected during routine quarterly monitoring of the perimeter wells; however, hydrogen sulfide is likely present in the YALF.

NMOCs typically make up a very small portion of LFG. Their occurrence is evidence of the disposal of industrial waste, chemicals in household waste, and the degradation of synthetic materials (e.g., plastic). Regulated VOCs that have been detected in YALF LFG, soil gas, and groundwater include chlorofluorocarbons (commonly used as chemical propellants, refrigerants, and solvents), chlorinated compounds (commonly used solvents), and petroleum hydrocarbons. Some of these compounds are known carcinogens, but health impacts typically result from chronic exposures (e.g., daily occupational exposures) or very acute exposure (e.g., direct exposure or ingestion of concentrated product). Even though VOCs constitute a small part of LFG (less than 2% at most landfills [SWANA, 2002]), they can persist in the environment for many years, and contamination of soil and groundwater is difficult and costly to remediate

Although the LFG generation rate is decreasing with time, managing it in a way that will be protective of the public and the environment will be a necessary commitment by the COA for years to come. Additionally, controls placed on use and development of the YALF and surrounding properties are necessary to mitigate LFG hazards.

2.2 Other Recognized Environmental Conditions

The area surrounding the YALF is mainly zoned for aviation and industrial land uses. The South Valley Superfund site is located south and east of the YALF and has been considered a potential groundwater contaminator in the vicinity of the YALF. In addition, several industries using chemical solvents are located near the YALF. The adjacent Albuquerque International Sunport has several tenants that may have used chemical solvents in the past. The current Environmental Data Resources Inc. (EDR) Radius Map Report with GeoCheck dated January 24, 2014, is available for review in the AEHD offices.

West of the YALF, north of Sunport Boulevard, I-25 bisects the Schwartzman landfill, a private landfill. In 2013, the east property was identified for development, and a detailed site investigation was initiated by Terracon, Inc., on the behalf of the property developer. This investigation found that the waste was construction-related and determined that no remediation was required for LFGs. Early USGS maps of the area identify a shooting range located in the area of the Schwartzman landfill. Anecdotal discussions with area residents revealed that the shells were shot into an earthen slope face. NMED required the developer to determine if lead was causing groundwater contamination at the site, and the developer entered into a Voluntary Remediation Program. Based on a site excavation in the area where the shooting range was believed to have been located and the results of groundwater sampling of two wells installed on the site, the NMED cleared the site for development.

3.0 LFG MONITORING PLAN

Since the landfill closure work in 1965, several site investigations, LFG abatement actions, and subsurface remediation efforts have been performed at the YALF. This section focuses on highlights of work that has been completed regarding LFG monitoring at the YALF as well as the criteria that trigger the requirement for LFG monitoring and installation options for any additional LFG monitoring wells. The LFG Monitoring Plan has been developed based on previously collected LFG data at the landfill.

3.1 LFG Monitoring Infrastructure and Data

LFG monitoring probes were installed at the perimeter and outside of the YALF boundary during the period from 1997 to 2005 (**Figure 3**). Generally, LFG probe installations correspond with the following events:

- Initial site characterization activities.
- Screening of LFG levels in 2002 related to the DBS&A study.
- Perimeter monitoring initiated in 2003.
- Installation by entities other than the COA as a result of development within the landfill buffer zone.

During the construction of Sunport Boulevard in 1997, Geo-Test, the consultant for the City's Aviation Department, installed 18 monitoring wells adjacent to Sunport Boulevard and George Road. The wells were located near the right-of-way boundaries. Each LFG well was completed with two nested air sampling probes at approximately 20 ft deep and 30 ft deep, excepting MW-17 and MW-18, which have only one air sampling probe each at approximately 15 ft deep.

In 2000, Geo-Test installed an additional three (3) monitoring wells along Spirit Drive, which is the southern boundary of the YALF. Geo-Test completed each well with three nested air sampling probes constructed of schedule 40 polyvinyl chloride (PVC) screened at 5 to 10 ft, 15 to 20 ft, and 25 to 30 ft. Each monitoring point consists of 1-inch diameter, 0.020-inch slot, schedule 40 PVC screen (Geo-Test, 2000).

Between 2003 and 2006, INTERA installed 36LFG monitoring wells at the YALF as depicted on **Figure 3.** LFG monitoring wells were located around the perimeter of the Wyndham Hotel (now Sheraton Albuquerque Airport Hotel) fill area and along the western edge of the northern, central, and southern fill areas within University Boulevard, where the majority of the private development occurs. Each LFG monitoring well was completed with three air sampling probes constructed of schedule 80 PVC with a 3-ft screen interval at the base of each probe; the bottom 6 inches of each screen is blank casing. The probes are at staggered intervals of depth and are labeled S (shallow), M (middle), and D (deep). Each screen interval is machine-slotted with 0.20-millimeter openings, and each probe is fitted with a laboratory-grade valve/sample port (**Figure 5**).

The COA's consultant performs LFG probe readings from the YALF perimeter on a quarterly basis. Methane is routinely detected in several of the LFG probes located within waste or very near the perimeter of the waste. Refer to **Table 2** for LFG probe construction details and **Table 3** for methane detection data from LFG monitoring conducted during the years 2009-2013.

In addition to the COA's perimeter LFG probes, LFG probes have been installed in conjunction with land development within the landfill buffer zone. These probes were installed as part of the developer's LFG assessment and as part of the facility's operations monitoring and maintenance plan. The COA is not responsible for monitoring probes installed during property development. The developer is responsible for providing monitoring data to the City. LFG has not been detected in any of the developer-installed probes.

3.2 Requirement for LFG Monitoring and Reporting

LFG monitoring will be required for any property on the landfill where a building or parking lot is constructed, unless a qualified Professional Engineer (PE) makes a determination that monitoring wells are not necessary and AEHD approves that proposal. For example, if a building is constructed on a lot where all of the waste is removed from the lot prior to construction and there is passive mitigation in place beneath portions of the parking lot that abut areas where waste is in place, the potential for LFG accumulation may be deemed insignificant and monitoring may not be required. It is important that each development project be handled individually in terms of requirements for LFG monitoring. In the landfill buffer zone, monitoring will generally be required unless a determination is made by a qualified PE that monitoring is not a necessary part of LFG mitigation.

For all properties where LFG monitoring wells are required, a baseline condition for the property will be established by two years of quarterly LFG monitoring. Quarterly monitoring data must be sent to AEHD. If baseline conditions are determined to be reasonably low, LFG monitoring will continue for another eight years, and monitoring may be semi-annual at the discretion of AEHD. At the end of those eight years, AEHD will re-evaluate the monitoring data to determine if continued monitoring is necessary. However, if baseline conditions show high levels of LFG, quarterly monitoring may be required in perpetuity. While LFG monitoring wells belong to individual property owners, they are a part of a larger, landfill-wide LFG monitoring network. Thus even if AEHD makes a determination at some point that LFG monitoring is no longer required in a particular well, AEHD may still require that the LFG monitoring well be maintained and not destroyed. AEHD should have access to all LFG monitoring wells in the event that AEHD decides to perform a landfill-wide monitoring event, or if it is determined that methane levels have reached significant or dangerous concentrations on an adjoining property and additional data are required to protect public safety. Access agreements and Right to Enter documents between the property owner and the COA should be negotiated during the planning process.

All data collected from private LFG monitoring wells must be reported to AEHD within 30 days of data collection, or a written request for extension and reason for the needed extension must be submitted to AEHD. The requirements for data collection and reporting must be specified in each property development plan. These requirements must be made part of any Operation Maintenance and Monitoring Plan (OMMP) submitted by the developer during the development process.

3.3 Criteria for Decreasing or Increasing Future LFG Monitoring Frequency

Future LFG monitoring requirements will be based on the criteria presented in **Table 4.** These criteria address potential safety concerns related to the production and emission of LFG, while recognizing the increased development of areas on and adjacent to the YALF. These criteria are based on the AEHD's observations of LFG levels since 2003 initial soil gas readings and LFG monitoring well data. Action levels for constituents of concern (COCs) are listed in Section 6.3.

3.4 Installation of New Perimeter Monitoring Wells by AEHD

Development on the landfill, such as the construction of buildings and paving, could increase the area of impervious cover, thereby causing LFG to migrate further off-site. In this event, AEHD may need to install new LFG monitoring wells. Several conditions under which new monitoring wells may be required are presented below:

- LFG concentrations become elevated (greater than 100% of the methane LEL) for two or more consecutive monitoring events in existing AEHD perimeter LFG monitoring wells.
- LFG concentrations become elevated (greater than 100% of the methane LEL) in one or more LFG monitoring wells located within the landfill, and it is determined that the perimeter monitoring wells are not properly positioned to assess migration from the landfill.
- New development has taken place on the landfill that could potentially change the volume or migration of LFG, such as impervious paving or the construction of buildings at the former landfill.

The LFG monitoring wells will be installed as follows:

- The LFG monitoring well (**Figure 5**) will be 30.5 ft deep and will be completed with three air sampling probes constructed of 1.0-inch diameter schedule 40 PVC, with a 2.5-ft screen interval (the bottom 6 inches of the probe will be blank casing). The screen interval will be machine-slotted with 0.20-mm openings. Each probe will be fitted with a laboratory-grade valve/sample port.
- The depth of the screened intervals may vary due to the presence of clay layers, waste material, or other considerations. Well construction diagrams must be completed for each well and any variations in the well construction from the proposed specifications should be noted on the diagram.
- The bentonite seal will consist of bentonite pellets. The bentonite should be installed per manufacturer's recommendations. In an effort to ensure that enough bentonite material is placed into the soil boring void space and no caving of the borehole occurs, the quantity of bentonite (by weight) required to fill the void space should always be calculated and weighed prior to emplacement. The weight of bentonite placed in the hole should be compared with depth measurements every 2 ft as the borehole is backfilled.

3.5 LFG Monitoring Wells Installed by Private Entities

A qualified PE may recommend the installation of LFG monitoring wells as part of the design and construction of any new development on the former landfill or within the landfill buffer zone. AEHD must approve plans for LFG monitoring well construction before the wells are installed. Soil boring logs and construction diagrams for each LFG monitoring well must be provided to AEHD. The design of LFG monitoring wells should be similar to that described in Section 3.4. The private property owner must monitor the LFG well(s) at a frequency approved by AEHD. The required LFG monitoring frequency will vary with each property and may change over time, depending upon monitoring results. All LFG monitoring data must be collected on a schedule agreed to by each property owner and AEHD and the LFG monitoring data must be submitted to AEHD within 30 days of collection.

3.6 General Sampling Methodology

LFG sampling in the perimeter monitoring wells will be performed with a landfill industry-approved LFG analyzing instrument. Calibration must be performed according to the instrument manufacturer's recommendations, and the calibration process must be documented by the operator prior to operation. The LFG analyzer must be capable of measuring percent LEL, percent methane, percent carbon dioxide, percent oxygen, and percent nitrogen as a balance gas. The LFG analyzer must be calibrated with span gas each day of sampling. At a minimum, the instrument should be calibrated twice a day if the instrument is used continuously for more than a four-hour period. Calibration should be rechecked if problems are observed with instrument readings.

The LFG analyzer should be connected by rubber hose to each LFG monitoring probe. LFG readings should be observed for stability, which generally takes up to 5 minutes. Record should be made of the sampling technician, type of sampling port, sampling time, instrument readings, and weather conditions at the time of sampling.

3.7 Surface LFG Emissions Monitoring

Surface LFG emissions are not currently being monitored at the YALF. As the surface of the landfill changes as a result of continued development, surface emissions monitoring may be considered because the current relatively unconsolidated soil cover material will be converted to harder surfaces (building concrete slabs, asphalt parking areas, etc.). The more impervious surfaces will results in a change of LFG migration patterns both horizontally and vertically within the landfill and through the landfill surface. The monitoring of surface emissions should be linked to the results of other types of LFG monitoring. If LFG is detected at levels that approach the LEL (5% in air) in LFG monitoring wells or subsurface structures and there is a pathway to the surface, then surface monitoring at designated points on the surface of the landfill should be incorporated into the quarterly monitoring activities.

Surface emissions monitoring can be conducted by either using direct reading field instruments or by collecting samples for laboratory analysis. Direct reading field instruments can be combustible gas meters (suitable for somewhat confined areas with revised air transfer) or flame ionizing detectors (e.g., produced by Landtec or Trimble). Flame ionizing detectors have a lower detection limit and are more suitable for measuring emissions from the ground surface.

Collection of discreet samples for laboratory analyses has the benefit of providing data from a point in time or a representative sample over a period of time. Samples are typically collected using Summa canisters or an equivalent sample container. Summa canisters can be deployed in low-lying areas and to collect ambient air samples if deemed necessary. The Summa canister samples can be analyzed for the presence of LFG.

3.8 Monitoring Indoor Air Quality

Structures on the YALF will likely require the installation and maintenance of indoor gas detectors and alarms. These detectors and alarms must be maintained in perpetuity. An OMMP for the site must guide the building owner and occupants in the proper use and maintenance of methane monitoring systems. The OMMP must be detailed enough to specify the following:

- How to understand the operation and purpose of the methane sensors.

- Maintenance and calibration requirements (must be in accordance with manufacturer's recommendations).
- Replacement requirements.
- Frequency and methods for confirmation monitoring of indoor air quality.
- Frequency of reporting of maintenance, calibration, and monitoring data to AEHD.
- Procedures to follow in the event the sensors detect methane and an alarm condition occurs.
- The hierarchy of emergency/alarm notification with contact information (immediate reporting to AEHD in the event of an alarm condition shall be mandatory).

Methane monitors should be mounted in accordance with manufacturer's recommendations in a location where accidental damage is unlikely, but where access for servicing and calibration is convenient. Preferences in sensor location should include consideration of confined areas and/or where utilities, drains, etc., penetrate the slab.

Field monitoring with a gas analyzer of indoor air quality must be initiated if the presence of LFG is suspected in any structure whether or not an indoor gas detection system is installed.

3.9 Potential LFG to Energy Opportunities

Closed landfills are becoming a focus of attention with regard to developing a beneficial use of the extracted LFG. Most beneficial uses of LFG involve either the generation of electricity through combustion of the gas, or supplementing fuel used by equipment (e.g., boilers). In 2011, the AEHD commissioned a Landfill Gas to Energy Feasibility Study for selected closed landfills in Albuquerque. The potential for LFG production in the quantity and quality needed to produce energy at the YALF is poor due to the very old age of the waste, the unlined boundary conditions of the landfill, the relatively small cell areas, and the shallow waste of mass of low to moderate temperature. Based on the available information, LFG to energy is not recommended.

4.0 GUIDELINES FOR DEVELOPMENT

Decisions to approve various types of development on the YALF and within its associated landfill buffer zone are guided by the requirements of the *Interim Guidelines for Development within City Designated Landfill Buffer Zones (Interim Guidelines)* (COA, 2004b). The *Interim Guidelines* provide a description of all required components of a development plan for properties on a landfill and/or within the buffer zone. *The Guidance for Compliance with the COA AEHD Interim Guidelines* is intended to assist developers and their agents through the COA's approval process (COA, 2004a).

4.1 Key Requirements of the *Interim Guidelines*

The *Interim Guidelines* (COA, 2004b) is the primary guidance document that describes the document submittal, approval, and certification process for development on a landfill or within a landfill buffer zone. The required documents for a development project within the landfill buffer zone must be stamped by a New Mexico PE who meets all AEHD requirements for rendering a qualified opinion on LFG issues. According to the *Interim Guidelines*, an LFG Assessment Report must accompany the Site Development Plan. The requirements of the LFG Assessment Report are presented in detail in the *Interim Guidelines*. The qualified PE is fully responsible for evaluating LFG risk and establishing any and all LFG mitigation measures. The AEHD maintains review authority over the qualified PE's findings and recommendations.

For construction within the buffer zone, LFG monitoring and mitigation measures (e.g., trench venting, conduit seals, passive ventilation systems,) may be required. The primary potential avenues of LFG exposure are either their proximity to landfill waste material or the potential for transport along utility corridors or similar conveyances. AEHD has the primary responsibility to ensure that reports and plans submitted by the qualified PE meet all of the requirements of the *Interim Guidelines* prior to development approval.

A qualified New Mexico-licensed PE must inspect development during construction to ensure that LFG mitigation measures have been implemented as planned. It is required that contractors working on development within the boundaries of the YALF provide to AEHD all waste quantities, waste qualifications (plastic, green, etc.), waste removal manifests, and a figure (site plan and cross-section, stamped by Qualified PE) showing the past and current locations of waste.

4.2 Planning and Zoning on the Landfill and within the Buffer Zone

The YALF is located in the southern portion of Albuquerque adjacent to the Albuquerque International Sunport. The landfill and buffer zone area is in the Albuquerque Geographic Information System (AGIS) Zone Atlas areas M15, M16, N15, and N16. The YALF is currently zoned SU-1 for Aviation. Area zoning information is shown on **Figure 6.** The zoning designations within the landfill buffer zone include IP for hotel, IP for food service, IP for offices, R-1 for park and community center, C-2 for airport parking, and SU-1 for water well and reservoir.

4.3 Development on the Landfill

The landfill parcel is owned by the COA. Current development on the YALF includes various utilities owned by the COA or the Albuquerque Bernalillo County Water Utility Authority (ABCWUA). Any development within the boundaries of the YALF will most likely be necessary infrastructure related to Aviation Department uses or maintenance of the landfill itself. Other development purposes are discouraged. Development on the landfill has a significant potential to encounter LFG, as well as to sustain structural damage from surface subsidence due to waste decomposition. Therefore, careful consideration must be given to historical and current data concerning the distribution of waste, the location of potential subsurface migration pathways, the locations of methane detections, and changes to the surface of the landfill when decisions are made concerning development and required mitigation. All projects requiring waste removal must meet NMED Solid Waste Division requirements. Requirements for a Waste Excavation Plan (WEP) can be found on the NMED website.

A qualified New Mexico-licensed PE must inspect development during construction to ensure that LFG mitigation measures have been implemented as planned. A Qualified PE must certify any waste excavation and removal from the property. As part of the certification process, the AEHD will require written and photographic documentation of the location and approximate volume of waste remaining (if any) after construction is complete from any contractor involved in the work. If the land over the landfill is developed, it is important that this information is transmitted to the AEHD so that the COA can update its records regarding the areal extent of the waste and the dimensional/physical characteristics of the waste. The precise limits and thicknesses of the waste prism are poorly understood and should be documented when encountered. It is required that contractors working on development within the boundaries of the YALF provide to AEHD all waste quantities, waste qualifications (plastic, green, etc.), waste removal manifests, and a figure (site plan and cross-section, stamped by Qualified PE) showing the past and current locations of waste.

4.4 Development within the Buffer Zone

The buffer zone at the YALF currently extends 500 ft from the edges of the landfill. The buffer zone width was based upon known facts concerning the landfill, typical patterns of LFG migration, and potential future scenarios of development on the landfill itself. The buffer zone is designed to be protective of human health with regard to development and occupancy. The buffer zone is reviewed on a regular basis and should be confirmed by reviewing the most current version of the *Interim Guidelines* or viewing the buffer zones on the City's AGIS website.

4.4.1 Current Development within the Buffer Zone

Currently there is a significant level of existing development within the buffer zone of the YALF. Buffer zone development includes hotels, offices, food service, airport parking, and water utilities.

4.4.2 Future Development and Development Restrictions and Requirements

Current and future development on the former landfill must comply with the *Interim Guidelines* (COA, 2004b) or subsequent landfill development ordinances that exist at the time of development. Other future development considerations are as follows:

- Potential restriction of any building on buried landfill material (piers or landfill removal).
- Provision for adequate drainage of surface water runoff away from landfill areas.
- Prohibition of engineered storm water retention and detention basins over and/or adjacent to landfill materials.
- Use of landscape practices that require little or no irrigation or providing means of prohibiting irrigation water from infiltrating and reaching buried landfill materials.
- Removal of landfill material beneath subsurface utilities or adequate design to account for settlement.
- Adequate design to control the migration of LFG away from the landfill and/or off the subject property.
- Development of LFG mitigation measures that are protective of structures, utilities, and personnel.

4.5 Managing Future Land Use

Currently, development plans (building permits) for construction on or within a landfill buffer zone are referred by the COA Planning Department to AEHD for review. The review may be conducted by AEHD or a designated contractor. The initial review is to determine the location of the development relative to the landfill and buffer zone. If the development is within the landfill buffer zone, the developer is notified by AEHD of the need to comply with the *Interim Guidelines* including submittal of an LFG Assessment Report. The AEHD then reviews the developer's LFG assessment and may approve the assessment or may request additional effort/design. Once the assessment is complete, the AEHD will review the plans for mitigation of LFG (if applicable) and grant approval once the requirements are met.

AEHD will continue to communicate with the COA Planning Department to track the current development plans for the area on the YALF or within the landfill buffer zone.

4.6 Operation, Maintenance, and Monitoring

If the recommendations by a New Mexico licensed PE in the LFG assessment include actions to be taken by the owner or its agent after the construction of LFG mitigation measures, or in lieu of constructing LFG mitigation measures, the owner/developer must submit an OMMP to the AEHD for approval during the development process. A typical OMMP contains monitoring procedures, regulatory requirements, engineering specifications, equipment lists, maintenance and inspection instructions, lists of contacts, safety and risk management protocols, and stipulations for ensuring that the information in the OMMP is kept current and technically accurate.

AEHD's objective in requiring the preparation and implementation of an OMMP is the protection of human health, the environment, and public and private property. For users and occupants of properties developed over a landfill or within a City-designated landfill buffer zone, the OMMP may provide the only available description of the LFG risks associated with the property and the ongoing requirements of the measures implemented to mitigate those risks. For this reason, AEHD views proper preparation and use of the OMMP as a critical LFG mitigation measure.

An OMMP should at a minimum include the following content:

- A property description
- A property use description
- A description of the YALF and its relationship to the development
- A plan showing the location of all existing and/or proposed LFG mitigation features at the site, inclusive of mitigation features not specifically covered under the OMMP (e.g., passive trench vent barriers)
- A summary of LFG conditions and risk
- A description of LFG mitigation measures employed at the facility
- Safety and risk management protocols including action levels, detailed response protocols, notification requirements, mitigation measures, evacuation procedures, measures to mitigate ignition sources, identification of key personnel, and reentry procedures
- Regulatory requirements and mitigation milestones
- Contact information for the property owner, AEHD, the Albuquerque Fire Department/ emergency services, the occupant, etc.
- Training requirements
- OMMP review and revision protocols by the developer or property owner

- An LFG Monitoring Plan (as necessary)
- An explanation regarding any variance from LFG assessment recommendations and approval documentation
- A Maintenance Plan (as necessary)

4.7 Data Review by AEHD

AEHD will obtain and review data from private property owners, tenants, developers, or approved agent(s) that are required to collect data within the buffer zone. Data obtained may include data from LFG monitoring wells, data collected from passive and active LFG recovery systems, data from monitoring subsurface vaults and other collection points, and data from building alarms and the monitoring of interior air quality. AEHD will require the following as part of its review:

- A registered New Mexico PE will submit a report or equivalent correspondence to the AEHD to document that the LFG monitoring and mitigation systems in place are constructed and operating in accordance with engineering design plan specifications that were approved by the AEHD during the planning process.
- AEHD will require that LFG monitoring system operators provide monitoring results as specified in the AEHD schedule developed by the qualified PE and approved by AEHD.
- AEHD may require building owners to install LFG monitoring alarms and monitor building interiors according to a specified schedule. Building owners must report records of alarms within 24 hours.
- AEHD will require operator inspection reports, which will include maintenance or repair actions.
- AEHD may conduct periodic inspections of any LFG mitigation measures developed within the landfill buffer zone.

AEHD will review the information provided and may recommend additional LFG mitigation measures, if necessary. These measures may include the installation of passive venting systems, additional sensors in buildings, LFG concentration alarm systems, additional LFG monitoring wells, and other miscellaneous LFG monitoring measures.

4.8 Data Management

All data collected at the YALF must be managed in an integrated manner. Data is maintained by AEHD as the agency for safety measures at the landfill. Data records should also be maintained by property owners, and should include records of interior methane gas alarms, records of LFG data collection within buildings, maintenance or calibration records for established LFG mitigation measures, data collected from LFG monitoring wells on landfill properties, data from passive LFG mitigation systems, and data from sumps and other collection points, as required. Data from perimeter monitoring wells should also be maintained by AEHD on a similar basis. All data submitted to AEHD must include GPS coordinate data for the collection point to facilitate the comparison of the data with data for the surrounding area to identify trends or issues of concern. Data at the AEHD is maintained in a database so that any data of interest can be easily accessed and mapped as needed.

AEHD will review data when it is received to identify any unanticipated detections of LFG that may require immediate action.

5.0 UTILITY PLAN

The information in this section has been compiled from many different utility companies and sources. Due to restrictions on publicly available information regarding utility locations since September 11,, 2001, utility locations listed here may be approximate, inaccurate, or missing.

5.1 Purpose and Use

The objective of the Utility Plan is to identify the locations of current and/or former subsurface trenches that might act as migration pathways for LFG. In addition, the Utility Plan provides a framework for understanding the potential impact of LFG mitigation on new utility corridors. The known subsurface utilities located on the YALF and within the buffer zone are shown on **Figure 7.**

There are two primary reasons for determining the locations of subsurface utilities. First, subsurface utility corridors may act as conduits for LFG migration away from the landfill. These factors may allow LFG to migrate substantial distances away from the landfill, potentially endangering offsite properties. Factors that may contribute to the movement of LFG along utility trenches are as follows:

- The use of non-native fill material that is more porous than native soils.
- Uneven backfilling around the utility that results in bridging or incomplete compaction.
- Backfill material surrounding a subsurface utility that may be less compact than native soil surrounding the trench.

Second, some subsurface utilities such as storm and/or sanitary sewers and water-supply pipelines may leak and hydrate the buried trash in the landfill. The addition of moisture to the underlying waste may accelerate the production of LFG, and thus should be minimized or eliminated.

The following sections of this LMP describe the methods used to identify the locations of subsurface utility lines and the types of subsurface lines that are known to be present under or near the YALF.

5.2 Existing Subsurface Utility Tranches

Trenches for the following types of subsurface utilities have been identified on the landfill or within the buffer zone of the YALF:

- Storm sewer
- Sanitary sewer

- Potable water
- Natural gas
- Overhead and underground electric lines
- Underground communications lines
- Fiber optic lines

Some of these utilities were installed before the *Interim Guidelines* were promulgated; therefore, no LFG mitigation measures were incorporated in their installation. These utilities may have the potential to be LFG migration pathways. Should LFG be detected outside of the YALF property, these unmitigated utilities should be looked at first for LFG conveyance potential.

The utilities that were constructed in the time frame of the Sunport Boulevard expansion from 1996 to 1997 were designed with venting to prevent migration of LFG. These utilities are generally located along Sunport Boulevard, University Boulevard, George Road, and Spirit Drive.

Utility line locations within the buffer zone were obtained from the COA or by contacting individual utility companies and are shown on **Figure 7.**

5.2.1 Storm Sewer/Drainage

Approximately 10.5 acres from the Post Office area drains and terminates on the YALF. This area should be reviewed to promote positive drainage from the site. A detention pond located in the northeast quadrant of University Boulevard and Spirit Drive drains other on-site and offsite flows and may have capacity or may have been intended to accommodate these flows as well.

5.2.2 Future Utility Corridors

Plans for construction of new utility corridors within the YALF or within the buffer zone should account for the potential for LFG migration. These plans must include risk abatement measures that are adequate to address any potential existing and/or future risk from LFG migration.

Any portion of a new utility corridor construction plan dealing with LFG abatement measures shall be certified by a qualified PE as defined by the *Interim Guidelines*. This certification will be noted on plat/site development plans or building permits and reviewed and signed by designated AEHD staff or its designated consultant. The COA will not issue work orders for construction of public infrastructure within the landfill buffer zone until the required certifications and signatures are on the construction plans and AEHD signature approval has been obtained. The COA Planning Department will not issue a Certificate of Occupancy (CO) or a Certificate of Completion until the AEHD has verified that the risk abatement measures have been properly constructed (COA, 2004b).

New underground utilities should be constructed to prevent the migration of LFG into proposed structures. For example, new underground utilities should be designed to avoid contact with the landfill whenever possible, unless there is no reasonable alternative route. Any “wet” utilities should be prohibited over or adjacent to buried waste or designed to prevent fluids from entering the landfill. Utilities that are to be transferred to COA infrastructure as part of property development are prohibited from being placed over waste (as specified by the Planning Department). Exceptions to this ordinance have been obtained under rare conditions and only with very stringent design controls. Details of any proposed LFG barrier(s), such as utility corridor plugs or other proposed LFG mitigation measures to be installed within the landfill buffer zone, must be provided to AEHD for review. Design details may vary depending on whether utility lines are placed beneath hard surfaces such as asphalt (which may be resistant to LFG and water leakage) or soft surfaces such as turf (which may be more susceptible to LFG and water leakage).

6.0 LONG-TERM LFG MONITORING PLAN

The current surface of the YALF is dry soil cover. The distribution and/or migration of subsurface LFG may change should development occur. These changes would be difficult to assess without ongoing, long-term LFG monitoring. As long as the surface of the YALF is in this dynamic state, there should be periodic review of the Long-Term LFG Monitoring Plan to ensure that it is adequate to identify problems and protect human health and safety.

6.1 Long-Term LFG Monitoring Decision

Decisions concerning long-term LFG monitoring shall be made based upon the ongoing review of LFG data collected at the YALF. LFG data collected on a regular schedule and intermittently are both important for understanding changes that might occur in the distribution of subsurface LFG. If changes to the LFG extraction system operation are made, a temporary increase in the monitoring activity should be implemented which may include monitoring for LFG as follows:

- In LFG monitoring probes
- In sumps, utility vaults, and other low spots
- As part of a recovery or other mitigation system
- Within the interior of buildings

If LFG is detected at any of these types of monitoring locations at concentrations near the established action levels, then decisions must be made about what additional data may be needed to assess the location, potential migration, and potential impacts of the LFG.

6.2 Monitoring Perimeter LFG Monitoring Wells

Based on data from quarterly LFG monitoring at the YALF, the following determinations have been made: methane has either not been detected, or has been detected intermittently at relatively low concentrations in the LFG monitoring wells that are located closest to current development (**Table 3**). All LFG monitoring wells should continue to be monitored on a quarterly basis at the YALF to assess potential accumulation and/or migration of LFG offsite.

6.3 Action Levels for COCs

Should methane levels for the perimeter wells be greater than the LEL or 5% in air, the AEHD should consider increasing LFG monitoring to a monthly schedule. Surface emissions monitoring may be considered. The AEHD may inform existing developments near areas of elevated methane concentrations so that precautions can be taken if necessary.

If methane is detected in a building at concentrations exceeding 10% of the LEL, then the COA Fire Department must be notified. The Fire Department will be responsible for any required evacuation actions.

7.0 GROUNDWATER MONITORING PLAN

AEHD installed nine groundwater monitoring wells in the vicinity of the YALF (**Figure 7**). One well, YALEMW-2, was abandoned in 1997 during the installation of the Sunport Boulevard/I-25 interchange. The remaining eight wells are currently sampled annually. Refer to **Table 5** for groundwater monitoring well construction details.

7.1 Past Studies

The COA has not presented any formal studies of the well monitoring results; however, in 2008, NMED did initiate a Preliminary Assessment in the area of Randolph Road and University Boulevard. This initial assessment was inconclusive as to the origin of the groundwater contaminants in the area, but found potential sources for the contamination to include a dry cleaning facility, service stations, and auto repair shops (NMED 2008). The area is zoned primarily IP for industrial purposes, and the EDR Radius Map Report (EDR, 2014) identifies a number of businesses in the area that use a variety of volatile organic chemicals in their manufacturing processes.

7.2 Sampling and Monitoring

The eight YALF groundwater monitoring wells have been sampled annually since 1989 for organics, inorganics, metals, and field parameters. The water levels are collected manually each quarter, and the AEHD has initiated water level data collection daily using transducers. Current water levels are shown on **Figure 8.** Once the ABCWUA reduced groundwater pumping, water levels have increased by approximately 3 ft in the area of the YALF. The general groundwater flow direction is toward the east.

7.3 Groundwater Monitoring Results

Current sampling results for typical COCs including tetrachloroethene (PCE), trichloroethene (TCE), dichloroethene (DCE), methylene chloride (DCM), chloride, and Total Dissolved Solids are shown as time series plots on **Figures 9** to **14.** PCE has been detected in YALEMW-4 since sampling was initiated in 1988. PCE concentrations gradually increased to 10 micrograms per liter (µg/L) in 1995, then dropped to 4 µg/L in 2004; however, since then, the concentration has steadily increased and is currently 8.3 µg/L. PCE was not initially detected in YALFMW-9, but concentrations increased during the period from 2004 to 2009 and then leveled off to the current concentration of 4.2 µg/L.

7.4 Long-Term Groundwater Monitoring Plan

Annual sampling will continue at YALF to determine the trend for PCE in YALFMW-4 and YALFMW-8. AEHD will continue to take the lead in groundwater sampling for these wells and will determine if any changes in the sampling plan should occur based on future results.

8.0 REFERENCES

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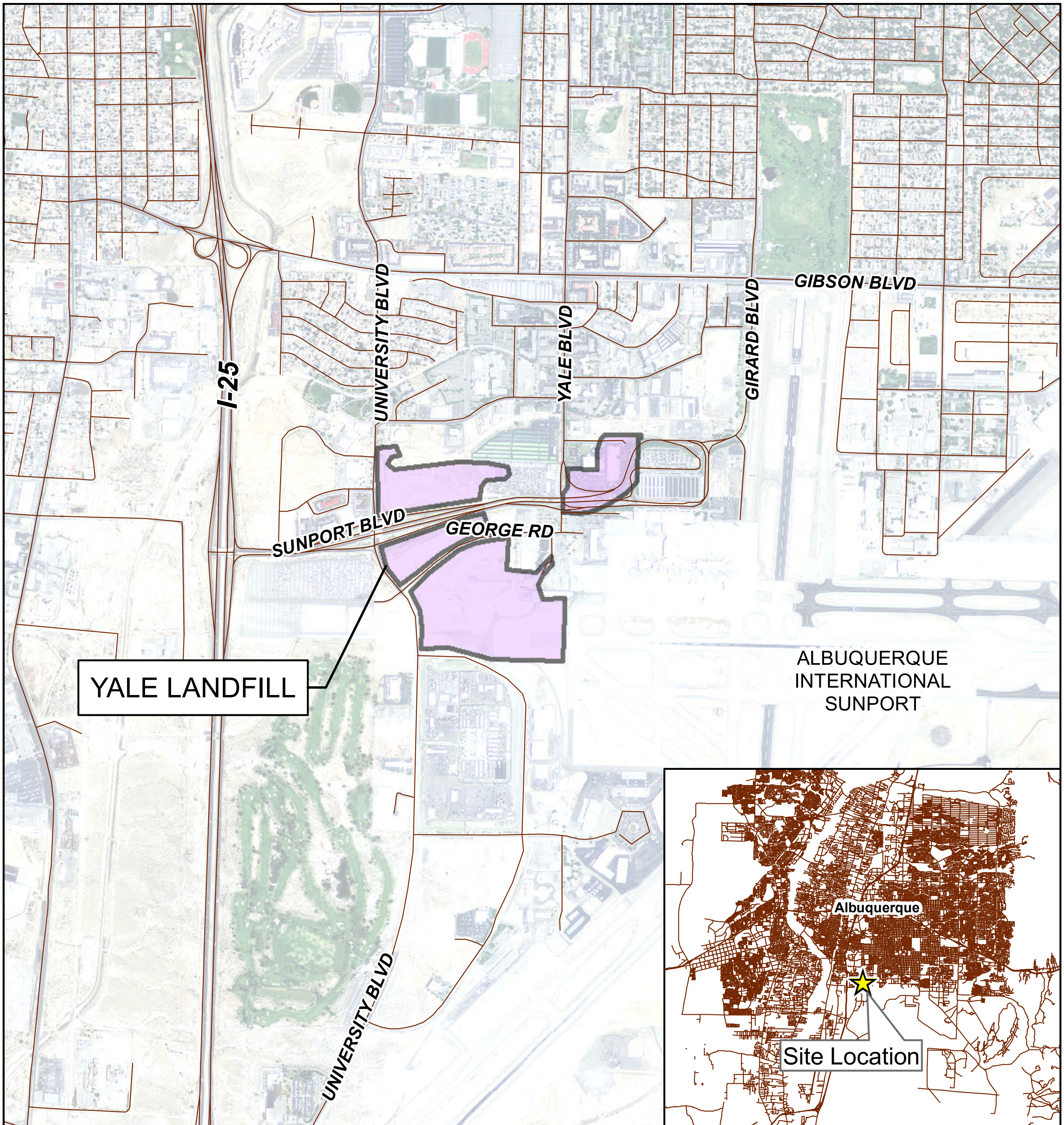
FIGURES



N

Legend

Landfill Extent

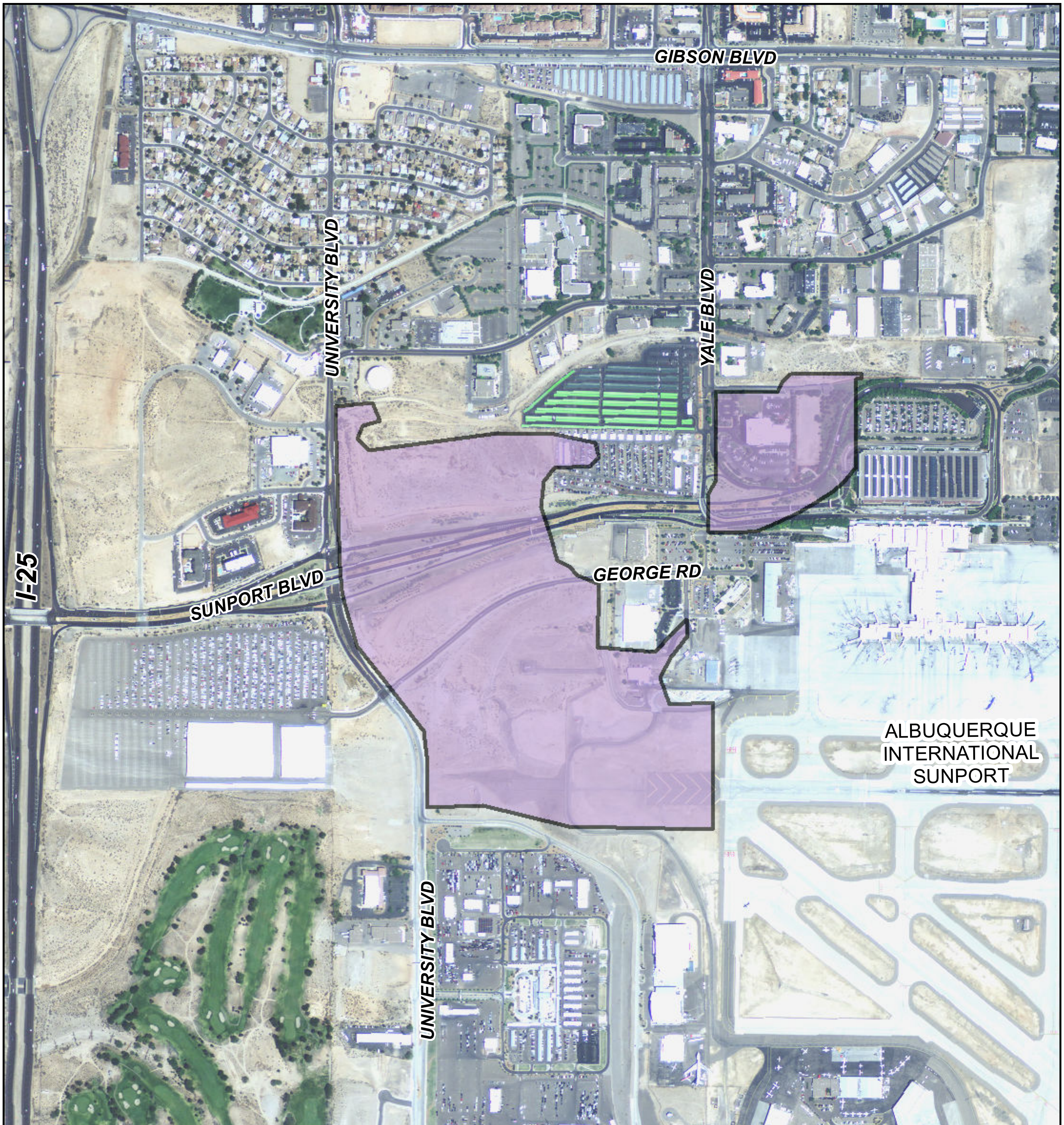
0 1,000 2,000 4,000
Feet

Projection: State Plane NAD83, feet, Central Zone

INTERA

Sources:
Roads/Aerial (2011) – RGIS website

Figure 1
Site Location Map
COA - Yale Landfill
Landfill Management Plan



N

Legend

Original Landfill Boundary

0 500 1,000 2,000 Feet

Projection: State Plane NAD83, feet, Central Zone

INTERA

Sources:
Roads/Aerial (2011) – RGIS website

Figure 2
Original Landfill Boundary
COA - Yale Landfill
Landfill Management Plan

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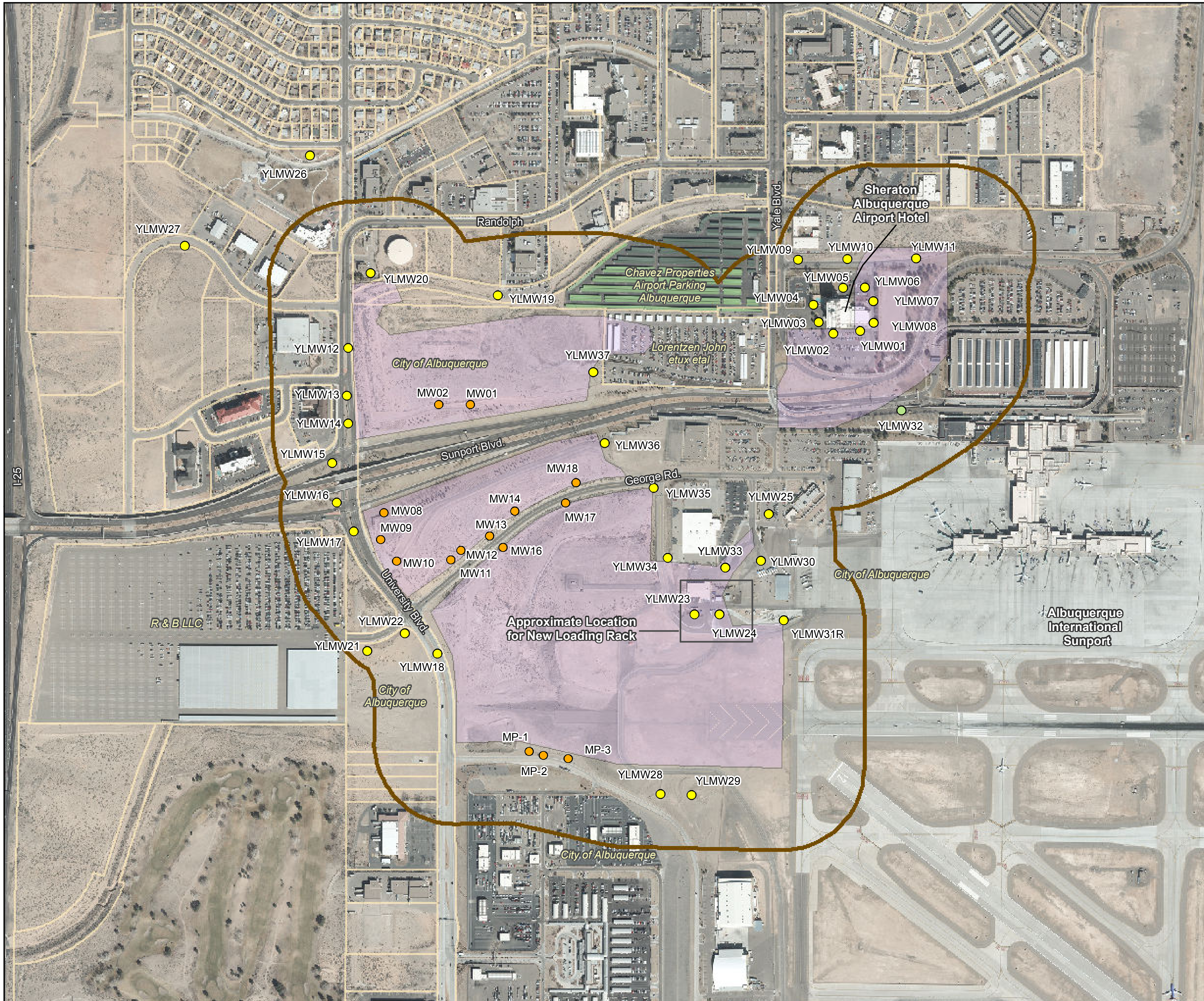

INTERA

N

0 300 600 1,200 Feet

Projection: State Plane NAD83, feet, Central Zone

Data Source(s): Aerial – Bernalillo County GIS, 2012;
Landfill extents – Daniel B. Stephens & Assoc., 2002

Legend

- Installed Monitoring Wells - INTERA
- Installed Monitoring Well - Vinyard & Assoc.
- Installed Monitoring Wells - COA
- Landfill Extent
- 500 ft Landfill Buffer Zone
- Land Parcel Delineation

Notes:
1). Location information of COA Monitoring Wells was provided by the COA Project Manager.

Figure 3
COA Landfill Gas Probe Location Map
COA - Yale Landfill
Landfill Management Plan

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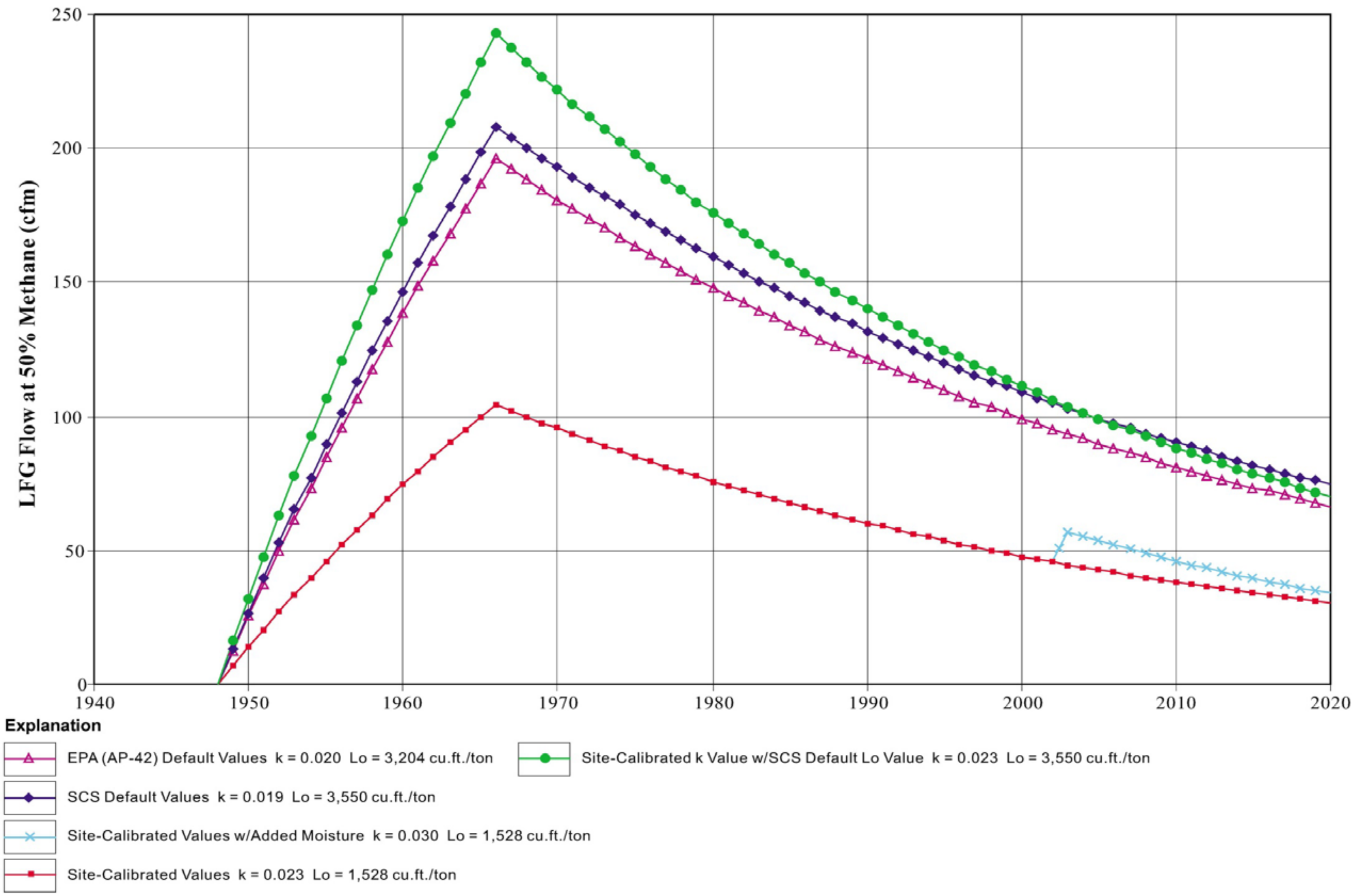
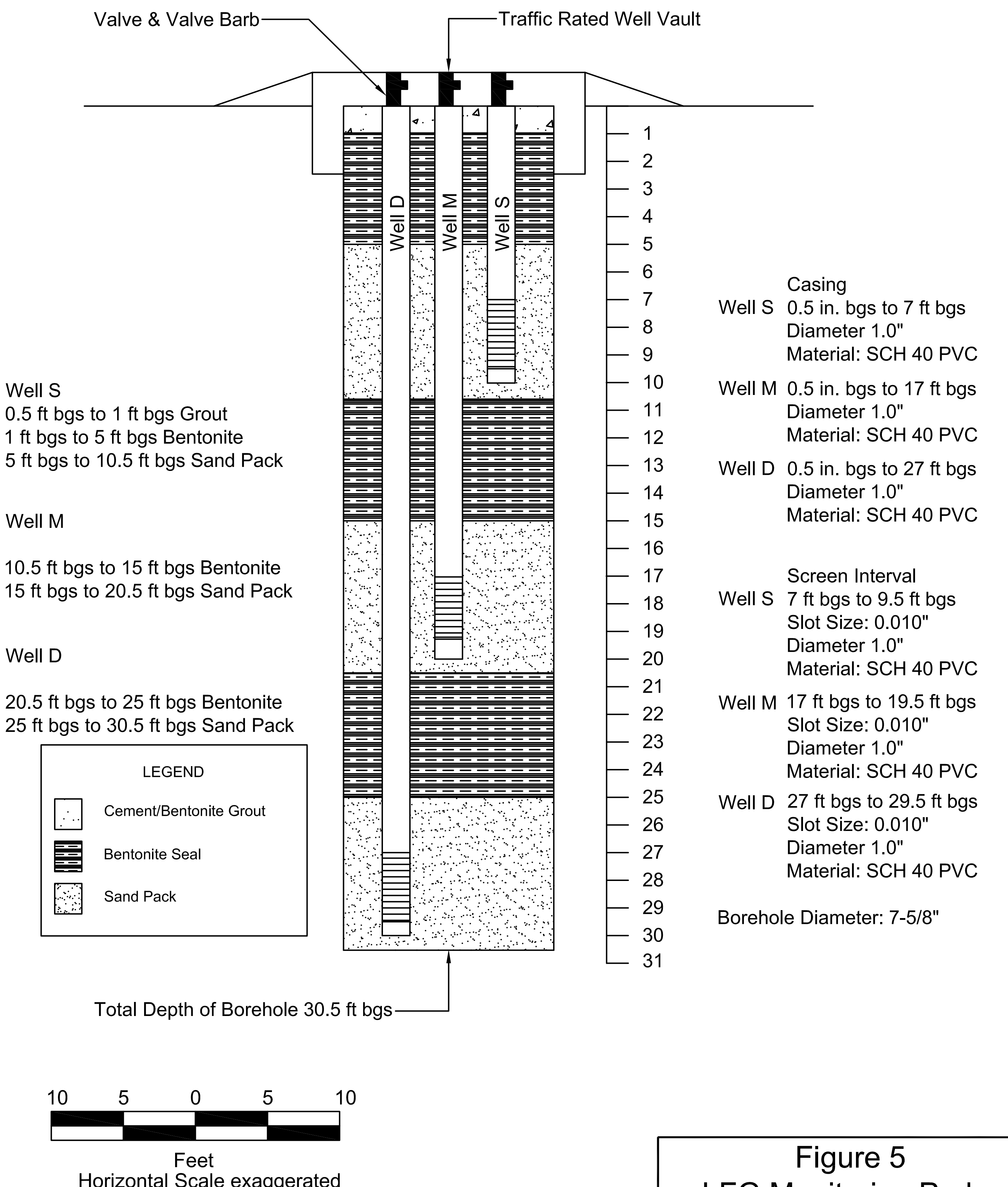


Source: DBS&A; SCS Engineers

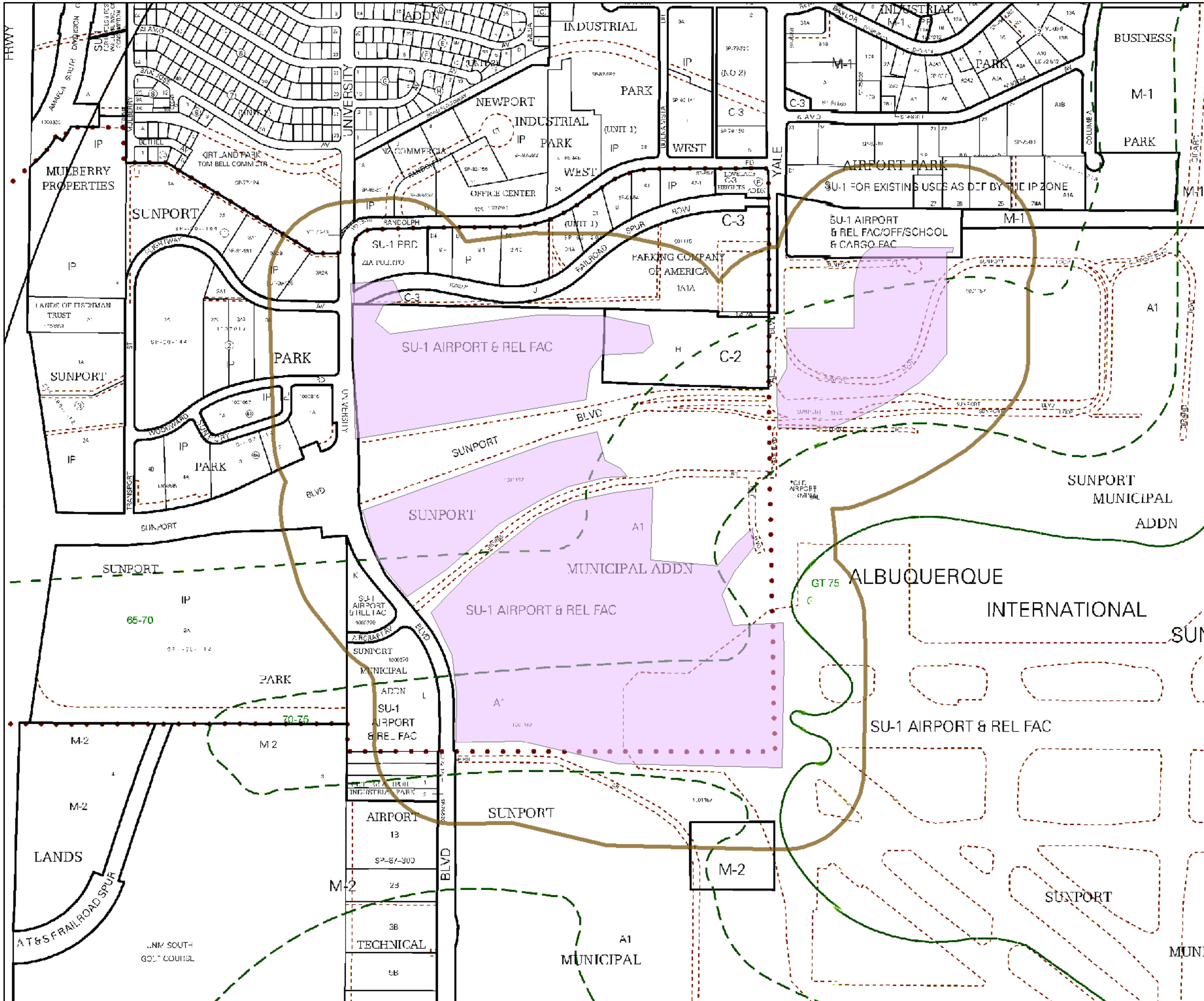
INTERA

Figure 4
LFG Generation Projection
COA - Yale Landfill
Landfill Management Plan



INTERA

Figure 5
LFG Monitoring Probe
Construction Schematic
COA - Yale Landfill
Landfill Management Plan



N

0 300 600 1,200 Feet

Projection: State Plane NAD83, feet, Central Zone

Data Source(s): Zone mapl – COA Zone Atlas Pages (M-15, M-16, N-15, N-16)

Legend

Landfill Extent

500 ft Landfill Buffer Zone

Note(s):

1). See City Zone Atlas for zoning definitions and map keys.

Figure 6

Area Lot, Parcel and Zoning Information

COA - Yale Landfill

Landfill Management Plan

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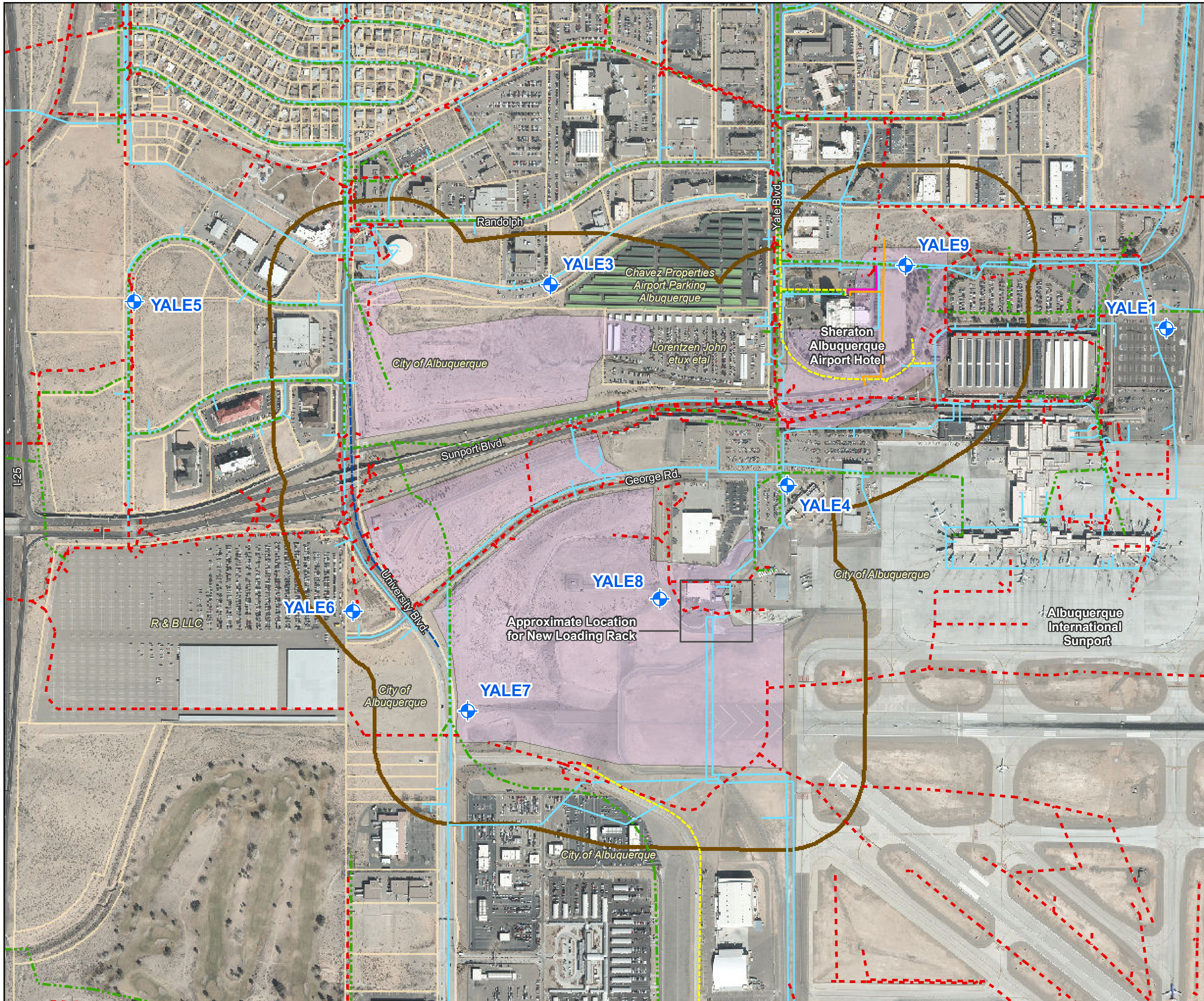

INTERA

N

0 300 600 1,200 Feet

Projection: State Plane NAD83, feet, Central Zone

Data Source(s): Aerial – Bernalillo County GIS, 2012;
Sewer and water lines – Bernalillo County Assessors Office;
Landfill extents – Daniel B. Stephens & Assoc., 2002;
Electric lines – PNM;
Communication lines – Time Warner.

Legend

- COA Groundwater Well
- Electric
- Cable TV
- Natural Gas
- Storm Sewer
- Sanitary Sewer
- Potable Water
- Traffic Signal
- Landfill Extent
- 500 ft Landfill Buffer Zone
- Land Parcel Delineation

Notes:
1). Pipelines and above/below ground utility lines shown on these drawings are approximate schematic locations only, based on the information provided to INTERA by field observations, and individual utility line markings provided by "One Call," the City of Albuququerque (COA), and the COA GIS Plans. This information may be inaccurate or incomplete. Additionally, underground lines may exist that are not shown.
2). Location information of COA Monitoring Wells was provided by the COA Project Manager.

Figure 7
Utility Plan and Groundwater Well Location Map
COA - Yale Landfill
Landfill Management Plan

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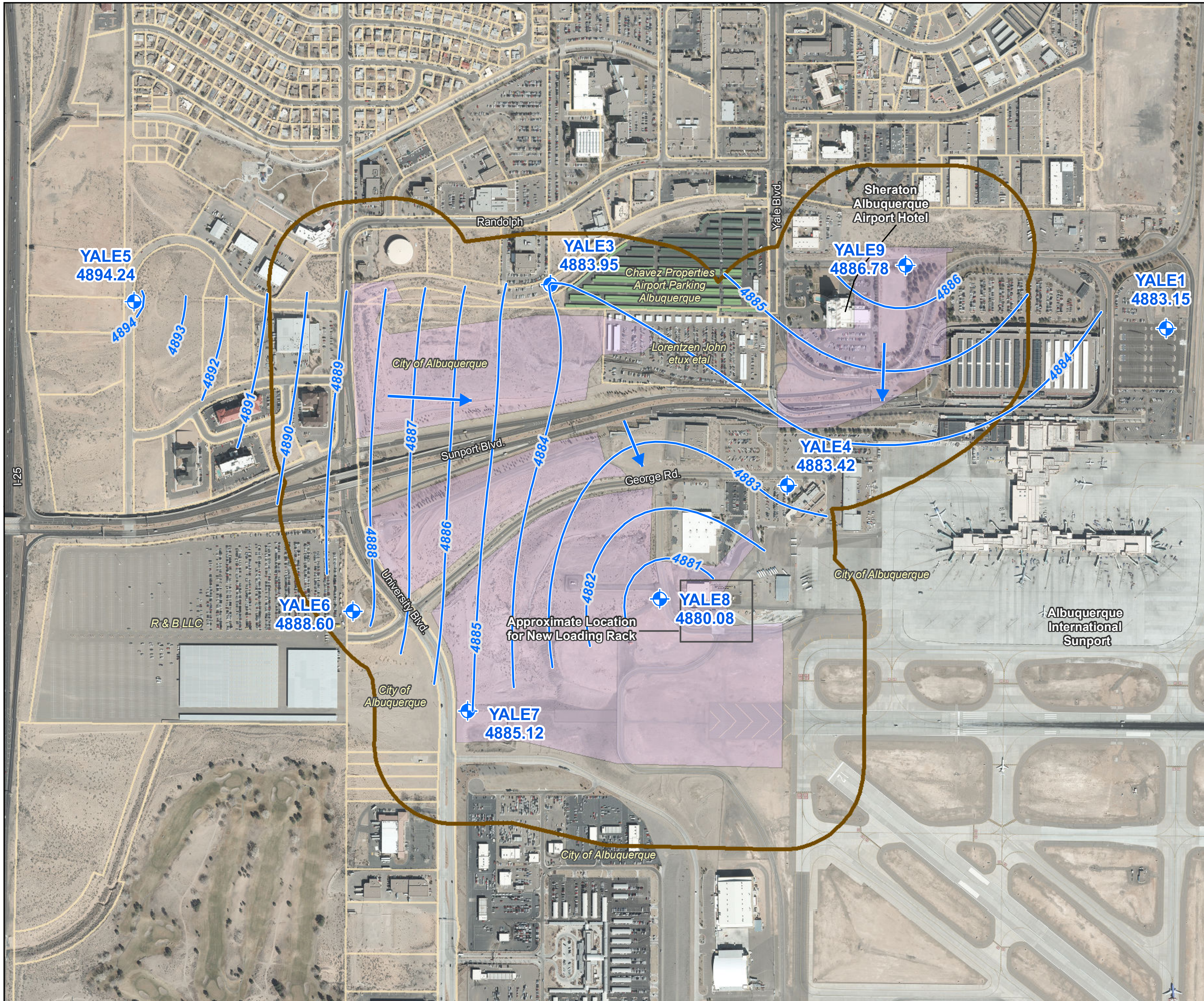


INTERA

N

0 300 600 1,200 Feet

Projection: State Plane NAD83, feet, Central Zone

Data Source(s): Aerial – Bernalillo County GIS, 2012;
Landfill extents – Daniel B. Stephens & Assoc., 2002

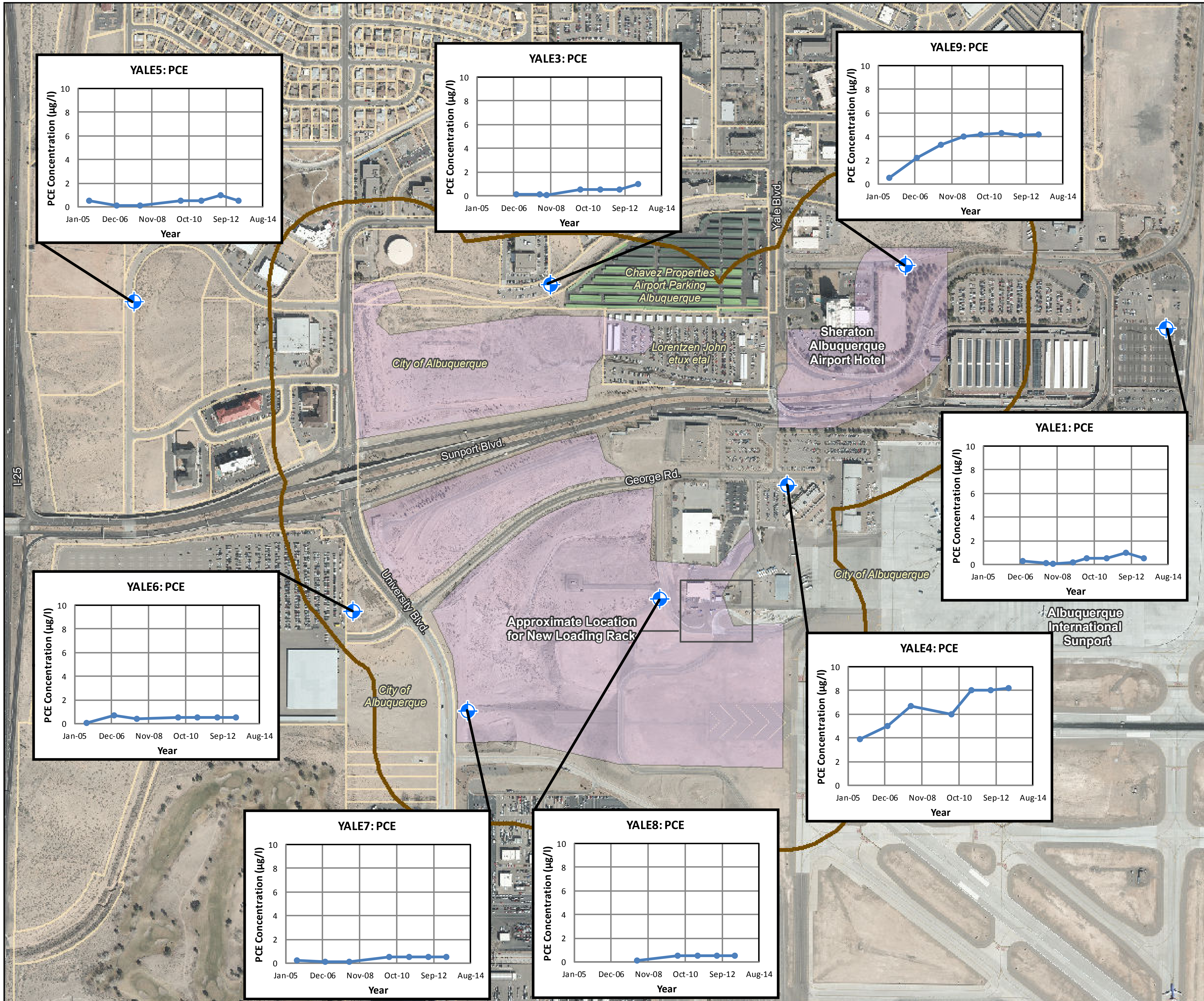
Legend

- COA Groundwater Well
- Groundwater Elevation Contour, Sept. 1, 2013 (ft, amsl)
- Groundwater Flow Direction
- Landfill Extent
- 500 ft Landfill Buffer Zone
- Land Parcel Delineation

Notes:
1). Location information of COA Monitoring Wells was provided by the COA Project Manager.

Figure 8
Water Levels,
September 1, 2013
COA - Yale Landfill
Landfill Management Plan

FILE: S:\Projects\COA On-Call 2012\Task 7 EHD Engineering Support\Yale LF MP\Graphics\MapDocs\LMP2014\LMP_Fig08_GWelevContours20140901.mxd 3/27/2014



INTERA

N

0 300 600 1,200 Feet

Projection: State Plane NAD83, feet, Central Zone

Data Source(s): Aerial – Bernalillo County GIS, 2012

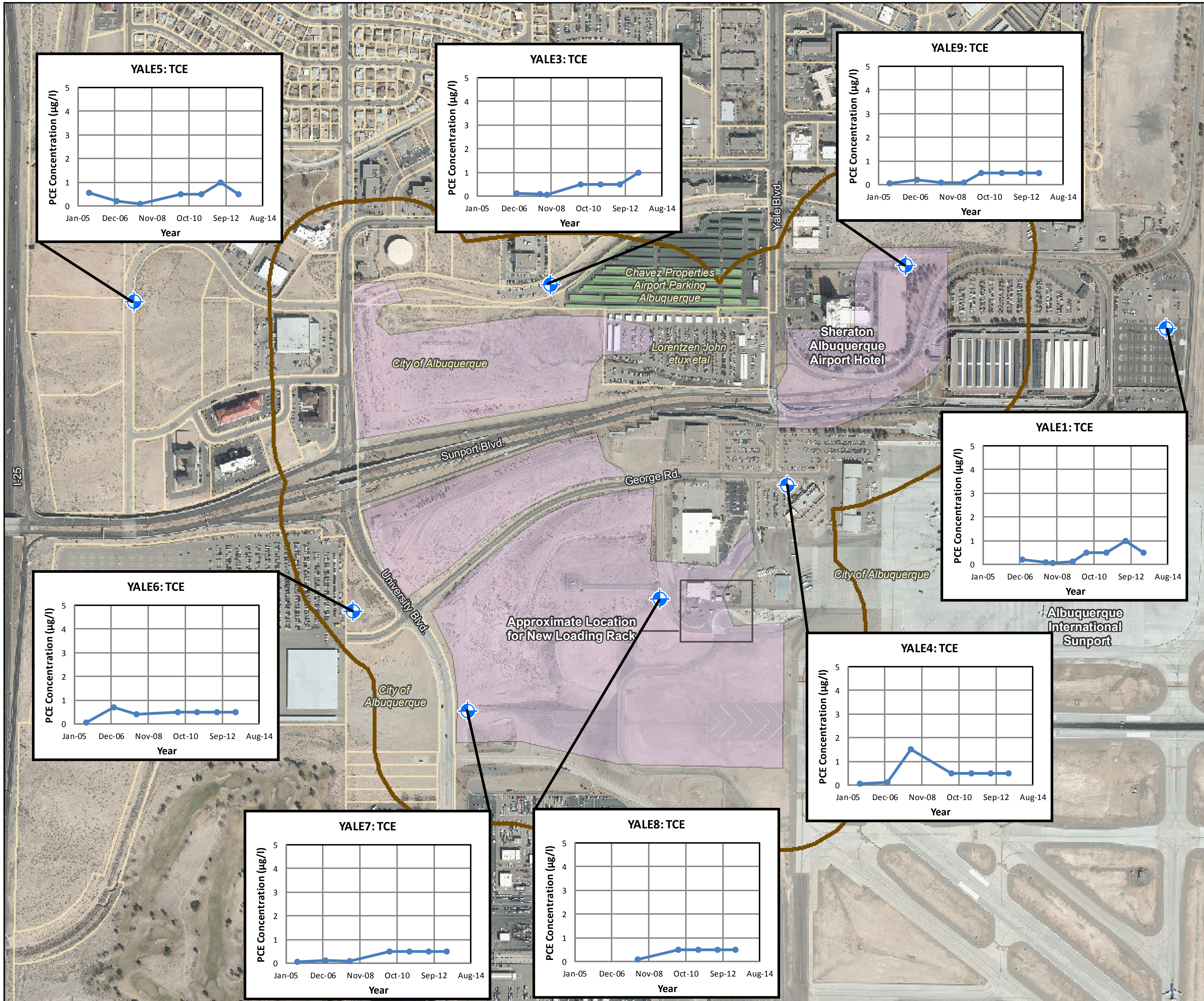
Legend

- COA Groundwater Well
- Landfill Extent
- 500 ft Landfill Buffer Zone
- Land Parcel Delineation

Notes:
1). Location information of COA Monitoring Wells was provided by the COA Project Manager.

Figure 9
Tetrachloroethene (PCE) Time Series
COA - Yale Landfill
Landfill Management Plan

FILE: S:\Projects\COA On-Call 2012\Task 7 EHD Engineering Support\Yale LF MP\Graphics\MapDocs\LMP2014\LMP_Fig09_PCEgraphs.mxd 3/21/2014



INTERA

N

0 300 600 1,200 Feet

Projection: State Plane NAD83, feet, Central Zone

Data Source(s): Aerial – Bernalillo County GIS, 2012

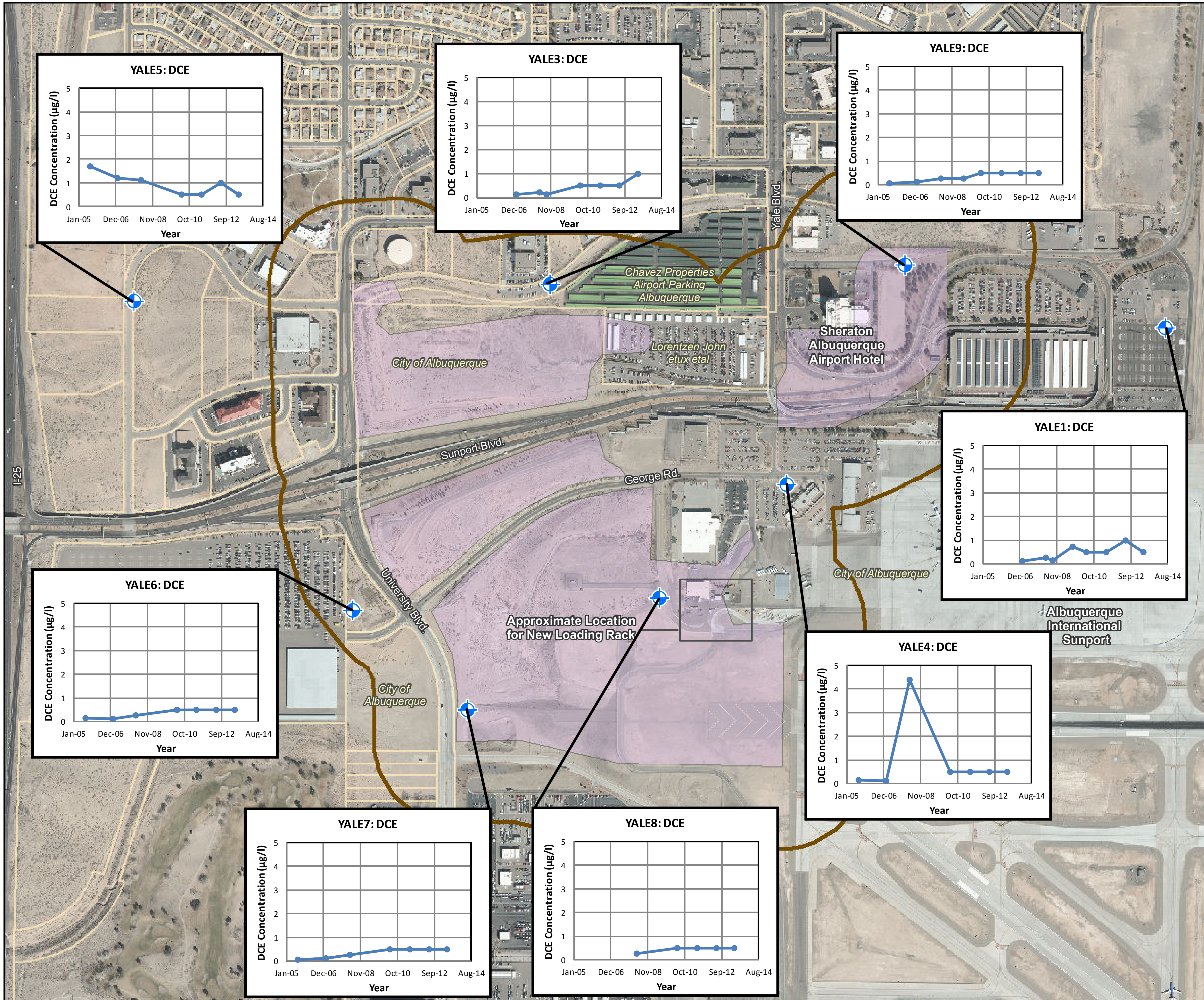
Legend

- COA Groundwater Well
- Landfill Extent
- 500 ft Landfill Buffer Zone
- Land Parcel Delineation

Notes:
1). Location information of COA Monitoring Wells was provided by the COA Project Manager.

Figure 10
Trichloroethene (TCE) Time Series
COA - Yale Landfill
Landfill Management Plan

FILE: S:\Projects\COA On-Call 2012\Task 7 EHD Engineering Support\Yale LF MP\Graphics\MapDocs\LMP2014\LMP_Fig10_TCEgraphs.mxd 3/20/2014



INTERA

N

0 300 600 1,200 Feet

Projection: State Plane NAD83, feet, Central Zone

Data Source(s): Aerial – Bernalillo County GIS, 2012

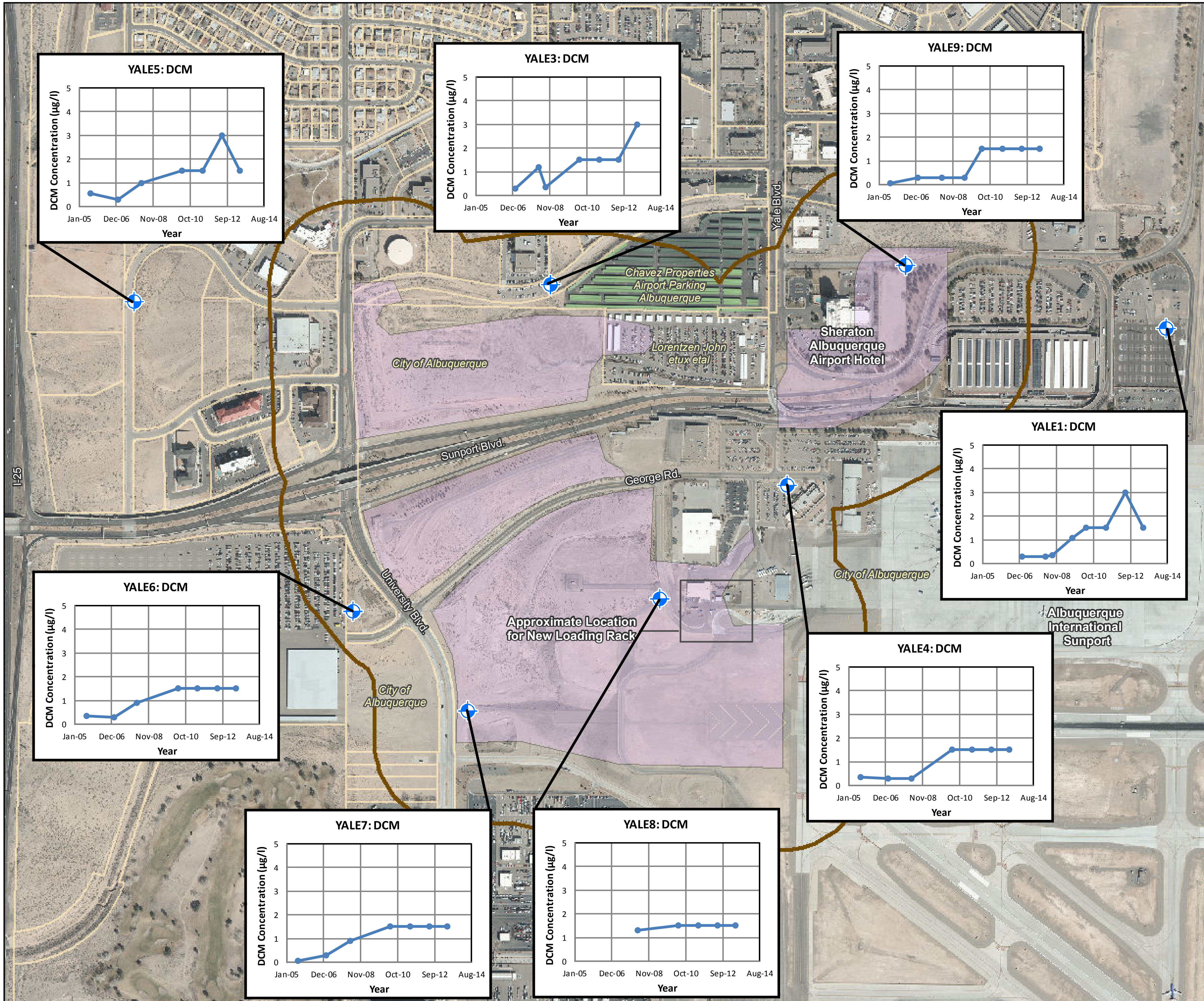
Legend

- COA Groundwater Well
- Landfill Extent
- 500 ft Landfill Buffer Zone
- Land Parcel Delineation

Notes:
1). Location information of COA Monitoring Wells was provided by the COA Project Manager.

Figure 11
Dichloroethene (DCE) Time Series
COA - Yale Landfill
Landfill Management Plan

FILE: S:\Projects\COA On-Call 2012\Task 7 EHD Engineering Support\Yale LF MP\Graphics\MapDocs\LMP2014\LMP_Fig11_DCEgraphs.mxd 3/20/2014



INTERA

N

0 300 600 1,200 Feet

Projection: State Plane NAD83, feet, Central Zone

Data Source(s): Aerial – Bernalillo County GIS, 2012

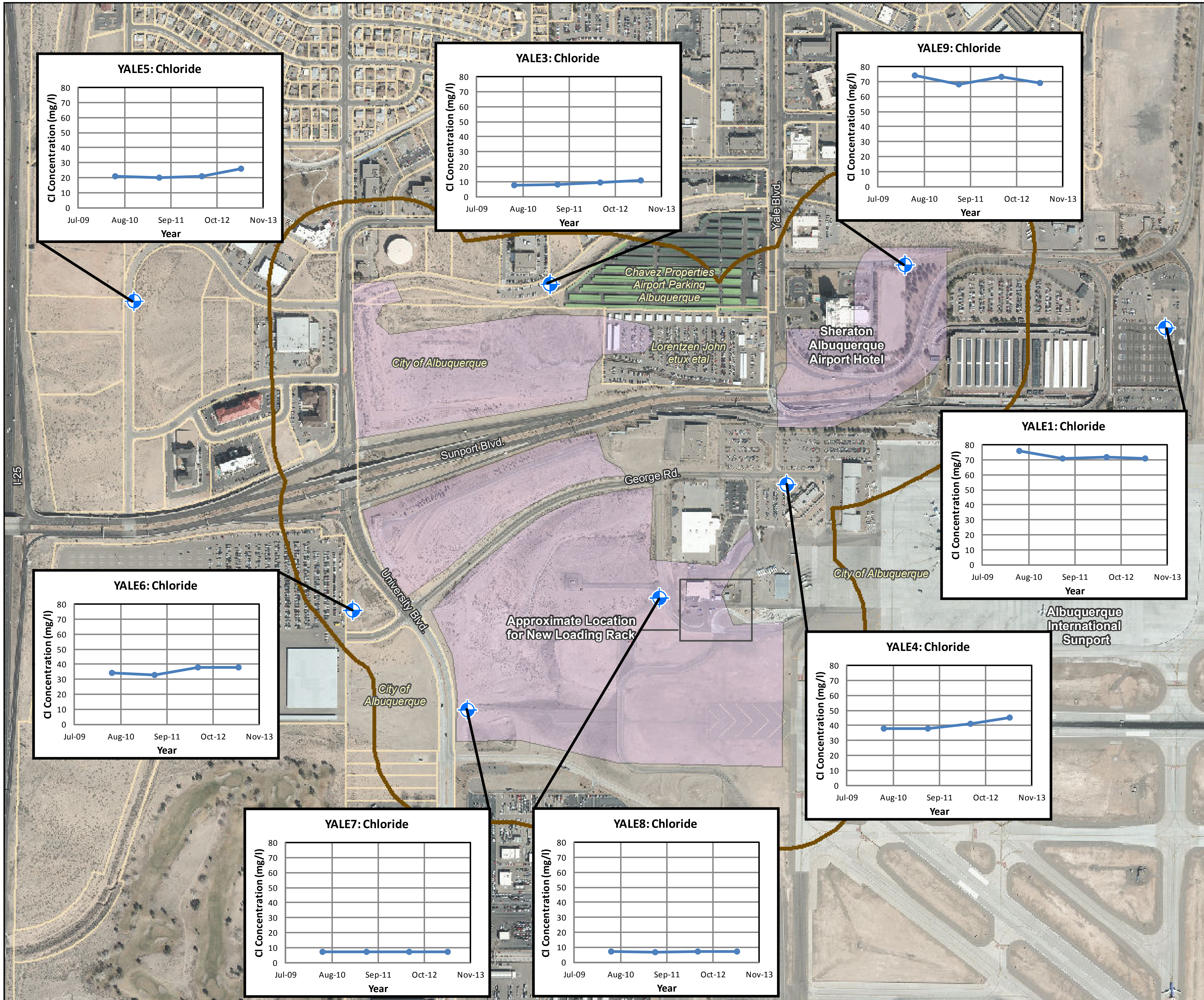
Legend

- COA Groundwater Well
- Landfill Extent
- 500 ft Landfill Buffer Zone
- Land Parcel Delineation

Notes:
1). Location information of COA Monitoring Wells was provided by the COA Project Manager.

Figure 12
Methylene Chloride (DCM) Time Series
COA - Yale Landfill
Landfill Management Plan

FILE: S:\Projects\COA On-Call 2012\Task 7 EHD Engineering Support\Yale LF MP\Graphics\MapDocs\LMP2014\LMP_Fig12_DCMgraphs.mxd 3/20/2014



INTERA

N

0 300 600 1,200 Feet

Projection: State Plane NAD83, feet, Central Zone

Data Source(s): Aerial – Bernalillo County GIS, 2012

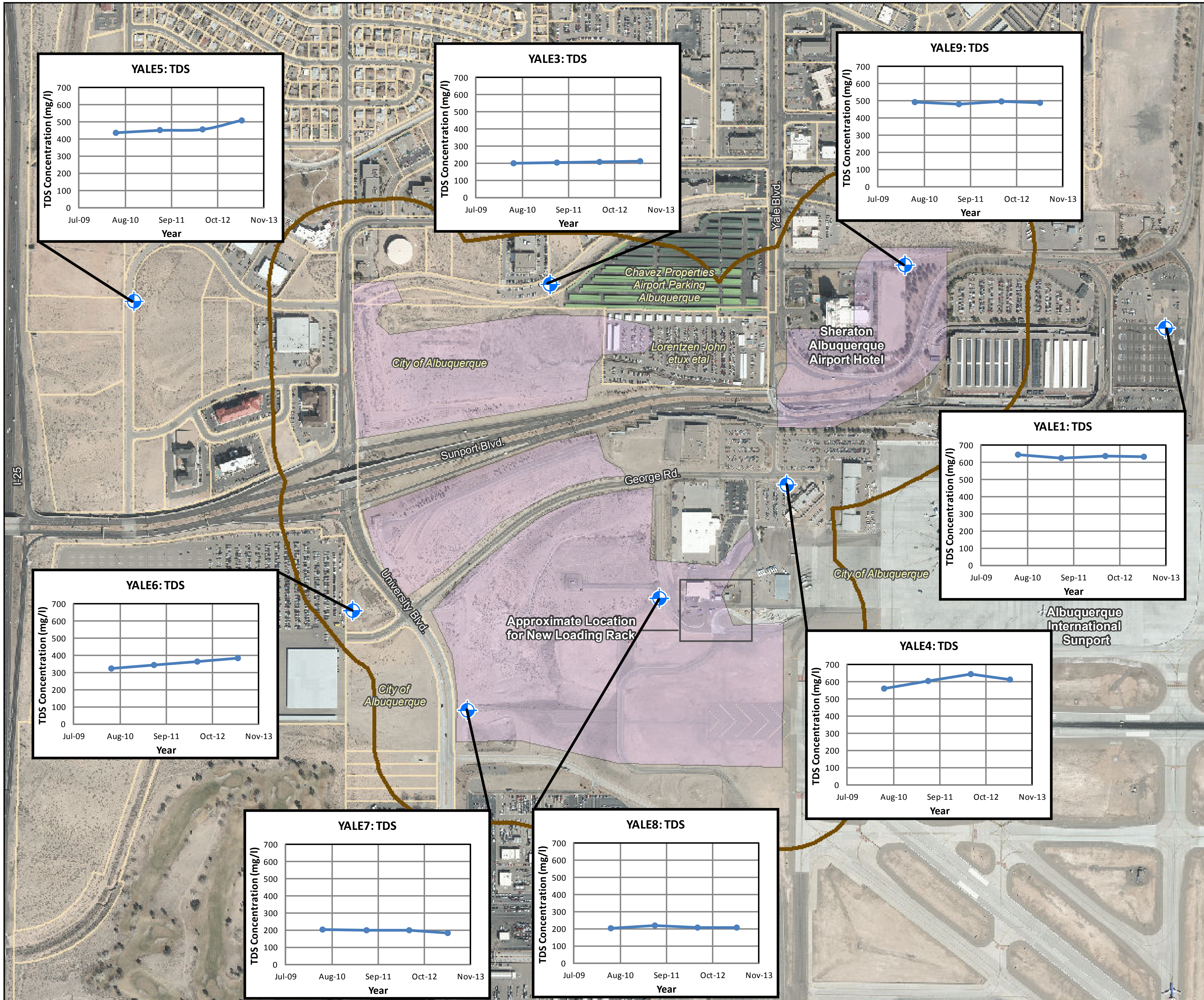
Legend

- COA Groundwater Well
- Landfill Extent
- 500 ft Landfill Buffer Zone
- Land Parcel Delineation

Notes:
1). Location information of COA Monitoring Wells was provided by the COA Project Manager.

Figure 13
Chloride Time Series
COA - Yale Landfill
Landfill Management Plan

FILE: S:\Projects\COA On-Call 2012\Task 7 EHD Engineering Support\Yale LF MP\Graphics\MapDocs\LMP2014\LMP_Fig13_Chloridegraphs.mxd 3/20/2014



N

0 300 600 1,200 Feet

Projection: State Plane NAD83, feet, Central Zone

Data Source(s): Aerial – Bernalillo County GIS, 2012

Legend

- COA Groundwater Well
- Landfill Extent
- 500 ft Landfill Buffer Zone
- Land Parcel Delineation

Notes:
1). Location information of COA Monitoring Wells was provided by the COA Project Manager.

Figure 14
Total Dissolved Solids (TDS) Time Series
COA - Yale Landfill
Landfill Management Plan

FILE: S:\Projects\COA On-Call 2012\Task 7 EHD Engineering Support\Yale LF MP\Graphics\MapDocs\LMP2014\LMP_Fig14_TDSgraphs.mxd 3/20/2014

TABLES

TABLE 1
Landfill Physical Data Summary
Yale Landfill Management Plan, Former Yale Landfill, Albuquerque, New Mexico

Period of Operation	1948-1965
Size	114 acres
Depth of Waste	4.5-26.5 feet
Type of Waste	Residential, Commercial, and Construction/Demolition
Depth to Groundwater	179-425 feet
Number of City-Installed LFG Monitoring Wells	58
Number of City-Installed Groundwater Monitoring Wells	8
Maximum Methane Concentration, 4th Quarter 2014	6.6%
Original Landfill Size	137.3 acres
Post Office Construction Waste Removal 1988	400,000 cubic yards
Sunport Boulevard Construction Waste Removal (1995-1997)	285,000 tons
Wyndham Hotel Construction Waste Removal	Unknown quantity

TABLE 2
Landfill Gas Probe Construction Details
Yale Landfill Management Plan, Former Yale Landfill, Albuquerque, New Mexico

Probe ID	Location		Probe Depth/Screen Intervals (feet)		
MW-1	1527216.131130	1473583.590130	19	31	
MW-2	1527023.086090	1473583.958660	16.5	20	
MW-8	1526686.543140	1472920.298120	17	23	
MW-9	1526667.362730	1472756.592770	22	33	
MW-10	1526763.539630	1472625.567800	21	32	
MW-11	1527095.798130	1472633.039960	22	30	
MW12	1527157.673820	1472690.673570	24	33	
MW-13	1527335.494480	1472778.439990	19	29	
MW-14	1527489.017880	1472931.446730	20	29	
MW-16	1527416.043960	1472708.984210	26	33	
MW-17	1527798.083860	1472980.504890	15		
MW-18	1527862.005680	1473105.099380	18		
MP-1	1527576.843610	1471460.749480	10	15	30
MP-2	1527661.759400	1471436.771910	10	15	30
MP-3	1527814.033370	1471415.816110	10	15	30
YLMW-1	1529603.217330	1474034.063900	9	20	30
YLMW-2	1529438.845440	1474017.095840	9	20	30
YLMW-3	1529349.801430	1474087.210160	9	20	30
YLMW-4	1529316.160810	1474192.545630	8	20	30
YLMW-5	1529499.504640	1474298.351050	10	22	45
YLMW-6	1529630.733560	1474299.995760	9	20	30
YLMW-7	1529683.489540	1474214.943660	9	20	30
YLMW-8	1529685.427620	1474083.509140	9	20	30
YLMW-9	1529222.829220	1474469.751990	10	22	45
YLMW-10	1529525.025750	1474473.100280	10	22	45
YLMW-11	1529944.663570	1474477.730070	10	22	45
YLMW-12	1526468.992760	1473928.964920	9	20	30
YLMW-13	1526459.529260	1473636.816880	9	20	30
YLMW-14	1526468.228710	1473466.301970	9	20	30
YLMW-15	1526369.527980	1473225.535260	9	20	30
YLMW-16	1526398.816170	1472983.091330	9	20	30
YLMW-17	1526502.738470	1472807.207290	9	20	30
YLMW-18	1527014.143790	1472058.933030	9	20	30
YLMW-19	1527383.687000	1474252.145750	9	20	30
YLMW-20	1526604.360000	1474386.480000	9.5	19.5	29.5
YLMW-21	1526583.879110	1472075.482500	9.5	19.5	29.5
YLMW-22	1526814.669080	1472183.665300	9.5	19.5	29.5
YLMW-23	1528588.867010	1472299.060290	9.5	19.5	29.5
YLMW-24	1528740.322930	1472299.060290	9.5	19.5	29.5
YLMW-25	1529043.234770	1472912.096160	9.5	19.5	29.5
YLMW-26	1526235.189340	1475107.886350	9.5	19.5	29.5

Probe ID	Location		Probe Depth/Screen Intervals (feet)		
YLMW-27	1525467.669910	1474556.261680	9.5	19.5	29.5
YLMW-28	1528380.587980	1471198.055530	9.5	19.5	29.5
YLMW-29	1528571.076660	1471193.127590	9.5	19.5	29.5
YLMW-30	1528995.474860	1472627.892000	9.5	19.5	29.5
YLMW-31R	1529134.915620	1472262.188870	9.5	19.5	29.5
YLMW-32	1529854.298960	1473546.385530	9.5	20	29.5
YLMW-33	1528777.367730	1472585.977730	9.5	19.5	29.5
YLMW-34	1528424.289180	1472644.167080	9.5	19.5	29.5
YLMW-35	1528339.448600	1473073.217980	9.5	19.5	29.5
YLMW-36	1528038.539430	1473347.416420	9.5	19.5	29.5
YLMW-37	1527968.515740	1473781.712370	9.5	19.5	29.5

TABLE 3
Landfill Gas Monitoring Results (2010-2013)
(Methane Detections Only)
Yale Landfill Management Plan, Former Yale Landfill, Albuquerque, New Mexico

Well	Sample date	CH_4 (% by vol)	CO_2	O_2	Balance
MP-1D	6/17/10	0.1	6.3	8.1	85.5
MP-1D	12/11/13	0.2	0.1	22	77.7
MP-1M	12/11/13	0.1	0.1	21.9	77.9
MP-1S	6/17/10	0.1	0.6	16.4	82.9
MP-1S	6/17/10	0.1	1.2	16.2	82.5
MP-1S	12/11/13	0.2	0.1	22.1	77.6
MP-2D	6/17/10	0.1	1.3	17.6	81
MP-2M	6/17/10	0.2	0.6	17.2	82
MP-2M	12/14/12	0.1	1.4	18.1	80.4
MP-2M	12/11/13	0.1	0.1	21.9	77.9
MP-2S	6/17/10	0.1	2.4	13.7	83.8
MP-3D	6/17/10	0.1	0.3	17.8	81.8
MP-3D	9/14/10	0.1	1.1	17	81.8
MP-3D	12/14/12	0.1	2.2	17.4	80.3
MP-3D	12/11/13	0.1	0.1	21.7	78.1
MP-3M	6/17/10	0.1	0.4	17.9	81.6
MP-3M	9/14/10	0.1	2.7	15.5	81.7
MP-3M	12/14/12	0.1	0.2	19.4	80.3
MP-3S	6/17/10	0.1	0.3	17.7	81.89
MP-3S	3/8/11	0.4	0.8	20.1	78.69
MP-3S	12/11/13	0.1	0.1	21.8	78
MW01D	12/14/10	0.4	5.3	15.3	78.99
MW01D	6/9/11	1.8	13.2	4	81
MW01D	12/14/12	2	17	4.3	76.7
MW01D	12/11/13	0.1	0.3	20.3	79.3
MW01S	3/18/10	0.1	2.2	18.6	79.1
MW01S	12/14/10	7.5	18.6	0	73.9
MW01S	6/9/11	1.9	8.5	10	79.6
MW01S	10/4/11	2.8	3.7	13.2	80.3
MW01S	12/8/11	4.4	9.4	8.5	77.7
MW01S	3/21/12	5.1	16.5	0.3	78.1
MW01S	12/14/12	2.9	9.5	10.8	76.8
MW01S	9/12/13	2.4	5.8	13.2	78.6
MW01S	12/11/13	2.2	7.1	13.8	76.9
MW02D	6/9/11	0.9	21.6	0	77.5
MW02D	10/4/11	1	8.2	10.2	80.6
MW02D	12/8/11	0.7	8.5	9.9	80.9

Well	Sample date	CH_4 (% by vol)	CO_2	O_2	Balance
MW02D	11/5/12	0.1	0.8	18.7	80.4
MW02D	9/12/13	1	22.5	1.1	75.4
MW02S	6/9/11	0.1	20.1	0.4	79.4
MW02S	12/8/11	0.1	7.9	11.2	80.8
MW02S	11/5/12	0.6	21.9	0.6	76.9
MW02S	12/14/12	0.1	1.7	19	79.2
MW08D	6/7/11	1.4	11.7	2.2	84.7
MW08D	12/8/11	1.4	16.8	3.8	78
MW08S	3/18/10	0.6	14.7	5	79.7
MW08S	12/14/10	3.2	22.3	0.8	73.69
MW08S	6/7/11	1.8	22.9	0.4	74.9
MW08S	12/8/11	0.4	6.7	15.4	77.5
MW09D	9/14/10	0.1	0	19	80.9
MW09D	6/7/11	13.4	26.9	0.7	59
MW09D	12/8/11	0.9	5.2	16.8	77.1
MW09S	12/14/10	0.8	1.7	19.4	78.1
MW09S	6/7/11	13.7	21	0.5	64.8
MW09S	12/8/11	4.8	4.3	12.6	78.3
MW10D	12/14/10	2.1	15.9	3.5	78.5
MW10D	6/7/11	2.2	19.4	0.7	77.7
MW10D	12/8/11	0.3	7.1	12.7	79.9
MW10D	9/26/12	0.2	4.1	15.3	80.4
MW10D	12/11/12	0.1	4.1	17.5	78.3
MW10S	6/16/10	1	21.3	0.1	77.6
MW10S	12/14/10	0.2	5.3	15.9	78.6
MW10S	6/7/11	1.3	22	0.3	76.4
MW10S	12/8/11	0.4	8.1	11.6	79.9
MW10S	9/26/12	0.4	6.8	13.2	79.6
MW10S	12/11/12	0.3	6.7	14.6	78.4
MW10S	3/28/13	0.1	8.6	10.2	81.1
MW11D	6/16/10	14.2	20.6	0.1	65.1
MW11D	12/14/10	7.4	19.6	0.3	72.69
MW11D	6/7/11	22.9	18.9	0.4	57.8
MW11D	12/11/12	13.6	14.6	8.1	63.7
MW11D	12/27/12	22	23.3	0	54.7
MW11S	12/14/10	17.5	22.7	0	59.8
MW11S	6/7/11	13.3	21.7	0.3	64.7
MW11S	12/27/12	13.1	23.1	0	63.8
MW12D	12/14/10	9.6	22.4	0	68
MW12D	6/7/11	11.9	22.1	0.2	65.8
MW12D	12/7/11	10	10.9	7.8	71.3

Well	Sample date	CH_4 (% by vol)	CO_2	O_2	Balance
MW12S	6/16/10	1.8	1.4	17.1	79.69
MW12S	12/14/10	11.8	22.6	0	65.6
MW12S	6/7/11	13.2	22.4	0.2	64.2
MW12S	12/7/11	11.2	21	0.6	67.2
MW12S	12/11/12	0.2	0.2	20.4	79.2
MW13D	12/14/10	0.7	22.1	0.8	76.4
MW13D	6/7/11	0.1	19.5	0.8	79.6
MW13S	12/14/10	0.4	23.8	0	75.8
MW13S	6/7/11	0.1	14.7	4	81.2
MW14D	12/14/10	6.5	18.6	0.3	74.6
MW14D	6/7/11	0.1	0.3	20.1	79.5
MW14D	12/7/11	4.1	7.6	8.3	80
MW14S	12/14/10	6.4	21.8	0	71.8
MW14S	6/7/11	0.8	13.8	1.5	83.9
MW14S	12/7/11	2.1	8.2	11.4	78.3
MW14S	3/21/12	5	19.8	0.1	75.1
MW14S	12/11/12	3.1	11	11	74.9
MW14S	9/12/13	0.4	0.1	19	80.5
MW14S	12/11/13	3.2	20.7	0.9	75.2
MW16D	6/7/11	1	1	15	81
MW16D	12/11/13	0.1	0	20.5	79.4
MW16S	3/18/10	8.4	22.7	0	68.89
MW16S	9/14/10	4	7.9	12.1	76
MW16S	6/7/11	2.7	8.1	11.9	77
MW17S	12/14/10	0.1	2.3	13.6	84
MW18S	6/7/11	0.1	8	10.2	81.7
YLM033RD	4/7/11	0.6	4.4	6.2	88.8
YLM033RD	3/21/12	0.1	17.8	0.4	81.7
YLM033RD	12/14/12	1.3	21	0.2	77.5
YLMW-10D	9/14/10	0.1	0.3	18.5	81.1
YLMW-10M	9/14/10	0.2	0.8	17.1	81.9
YLMW-10S	9/14/10	0.1	0.8	17.2	81.89
YLMW-11D	9/26/12	0.1	1.1	19	79.8
YLMW-11D	6/12/13	0.1	0.8	18	81.1
YLMW-11M	9/14/10	0.1	2.9	15.3	81.69
YLMW-11S	9/14/10	0.1	1.8	16.6	81.5
YLMW-11S	3/28/13	0.1	0	19.7	80.2
YLMW-12D	6/17/10	0.1	1.4	16.7	81.8
YLMW-12D	6/7/11	0.1	2.3	17.2	80.4
YLMW-12D	12/14/12	0.1	0.4	20.3	79.2
YLMW-12M	6/17/10	0.1	1	17.5	81.4

Well	Sample date	CH_4 (% by vol)	CO_2	O_2	Balance
YLMW-12M	6/7/11	0.2	2.4	17.4	80
YLMW-12S	6/17/10	0.1	1.4	16.8	81.69
YLMW-12S	6/7/11	0.2	1.9	17.9	80
YLMW-12S	12/14/12	0.1	0.6	20.3	79
YLMW-13D	6/17/10	0.1	1.6	16.1	82.2
YLMW-13D	6/7/11	0.2	2.3	17.1	80.4
YLMW-13M	6/17/10	0.1	2.1	15.9	81.9
YLMW-13M	6/7/11	0.1	2.5	17.2	80.2
YLMW-13S	6/17/10	0.1	0.6	17.9	81.4
YLMW-13S	6/7/11	0.2	2	17.8	80
YLMW-13S	6/12/13	0.2	0.8	14.1	84.9
YLMW-14D	9/14/10	0.1	0.6	18.3	81
YLMW-14D	6/7/11	0.2	1.4	18.4	80
YLMW-14M	6/7/11	0.2	1.1	18.6	80.1
YLMW-14S	9/14/10	0.1	1.2	16.8	81.9
YLMW-14S	6/7/11	0.2	0.9	18.9	80
YLMW-14S	12/14/12	0.1	1.4	19.3	79.2
YLMW-15D	6/17/10	0.2	0.1	17.6	82.1
YLMW-15D	6/7/11	0.2	0.3	20	79.5
YLMW-15M	6/7/11	0.3	0.3	19.4	80
YLMW-15S	6/17/10	0.2	0.1	17.8	81.9
YLMW-15S	6/7/11	0.2	0.3	19.4	80.1
YLMW-16D	6/7/11	0.2	1.7	17.9	80.2
YLMW-16M	6/7/11	0.2	1.7	18.2	79.9
YLMW-16S	6/7/11	0.3	1.5	18.4	79.8
YLMW-17D	6/17/10	0.1	4.3	12.5	83.1
YLMW-17D	6/7/11	0.1	5.3	13.3	81.3
YLMW-17M	6/17/10	0.1	2.1	16.6	81.2
YLMW-17M	6/7/11	0.1	5	15.2	79.7
YLMW-17S	6/7/11	0.1	3	17.5	79.4
YLMW-17S	12/14/12	0.1	3.8	15.9	80.2
YLMW-18D	6/17/10	0.2	0.4	18.1	81.3
YLMW-18D	9/14/10	0.1	0	18.7	81.19
YLMW-18D	6/7/11	0.2	0	20.2	79.6
YLMW-18M	6/17/10	0.1	0.2	18	81.7
YLMW-18M	6/7/11	0.2	0	20.3	79.5
YLMW-18S	6/17/10	0.1	1.8	17.2	80.89
YLMW-18S	6/7/11	0.1	0	20.1	79.8
YLMW-18S	6/12/13	0.1	0.4	14.4	85.1
YLMW-19D	6/7/11	0.3	0.9	19.1	79.7
YLMW-19D	12/11/13	0.1	0.1	20.5	79.3

Well	Sample date	CH_4 (% by vol)	CO_2	O_2	Balance
YLMW-19M	6/7/11	0.2	1.1	19.3	79.4
YLMW-19M	12/11/13	0.1	0.1	20.5	79.3
YLMW-19S	6/17/10	0.1	0	17.9	82
YLMW-19S	6/7/11	0.1	0.7	19.6	79.6
YLMW-19S	12/11/13	0.1	0.3	20.4	79.2
YLMW-1S	6/15/10	0.4	22.6	0	77
YLMW-1S	6/16/11	0.2	21.4	0	78.4
YLMW-1S	12/7/11	0.1	17	0	82.9
YLMW-1S	3/21/12	0.1	16.9	2.3	80.7
YLMW-1S	9/12/13	0.7	19.9	0	79.4
YLMW-20D	6/7/11	0.1	0.8	19.3	79.8
YLMW-20M	6/17/10	0.1	0	18.2	81.69
YLMW-20M	6/7/11	0.2	0.9	19.3	79.6
YLMW-20M	9/26/12	0.1	1.1	18.7	80.1
YLMW-20S	6/17/10	0.1	0.5	17.6	81.8
YLMW-20S	12/11/13	0.1	0.1	20.5	79.3
YLMW-21D	6/17/10	0.1	0	18.1	81.8
YLMW-21D	6/7/11	0.2	0.8	19.7	79.3
YLMW-21D	6/12/13	0.1	0	14.9	85
YLMW-21M	9/14/10	0.1	0	18.3	81.6
YLMW-21M	6/7/11	0.1	0.2	20.1	79.6
YLMW-21M	6/12/13	0.1	0	14.8	85.1
YLMW-21S	6/17/10	0.1	0	18.2	81.69
YLMW-21S	6/7/11	0.1	0.1	20.3	79.5
YLMW-21S	12/11/13	0.1	0	20.5	79.4
YLMW-22D	6/17/10	0.1	0	18.1	81.8
YLMW-22D	6/7/11	0.1	0	20.2	79.7
YLMW-22D	9/26/12	0.1	0	19.4	80.5
YLMW-22D	12/14/12	0.1	0.3	20.7	78.9
YLMW-22M	6/17/10	0.1	0	18.1	81.8
YLMW-22M	9/14/10	0.1	0.1	18.2	81.6
YLMW-22M	6/7/11	0.1	0	20.2	79.7
YLMW-22S	6/17/10	0.2	0.1	18	81.7
YLMW-22S	6/7/11	0.1	0	20.2	79.7
YLMW-23D	9/16/10	0.1	0.4	18.2	81.3
YLMW-23D	12/11/13	0.1	3.9	17.1	78.9
YLMW-23M	12/11/13	0.1	0.3	20.9	78.7
YLMW-23S	12/11/13	0.1	0.1	21	78.8
YLMW-24M	12/11/13	0.1	0.1	21.1	78.7
YLMW-25D	12/11/13	0.3	0.1	20.9	78.7
YLMW-25M	9/14/10	0.1	0.1	19.2	80.6

Well	Sample date	CH_4 (% by vol)	CO_2	O_2	Balance
YLMW-26D	6/7/11	0.2	1.3	19.3	79.2
YLMW-26D	12/14/12	0.1	2.9	18.5	78.5
YLMW-26M	6/7/11	0.3	1.4	19.1	79.2
YLMW-26M	5/31/12	0.1	1.4	18.6	79.9
YLMW-26M	10/2/12	0.1	2.9	16.5	80.5
YLMW-26S	6/7/11	0.2	1.3	19.1	79.4
YLMW-26S	10/2/12	0.1	2.8	16.9	80.2
YLMW-27D	9/14/10	0.1	0.5	17.8	81.6
YLMW-27D	6/7/11	0.1	0.6	19.4	79.9
YLMW-27D	12/14/12	0.1	0.8	20.5	78.6
YLMW-27D	12/11/13	0.2	0.1	20.6	79.1
YLMW-27M	6/7/11	0.1	0.7	19.1	80.1
YLMW-27S	6/7/11	0.2	0.7	19.2	79.9
YLMW-28D	6/17/10	0.1	3.7	13.2	83
YLMW-28D	6/7/11	0.1	0.7	19.9	79.3
YLMW-28M	6/17/10	0.1	1	17.7	81.19
YLMW-28M	6/7/11	0.1	0.1	20.1	79.7
YLMW-28S	6/7/11	0.1	0	20.1	79.8
YLMW-28S	12/11/13	0.1	0	20.4	79.5
YLMW-29D	6/7/11	0.1	0	20.1	79.8
YLMW-29M	6/17/10	0.2	8.4	7.9	83.5
YLMW-29M	9/14/10	0.1	10.6	7.1	82.2
YLMW-29M	6/7/11	0.1	6	12.4	81.5
YLMW-29S	6/17/10	0.1	0	16.7	83.2
YLMW-29S	6/7/11	0.1	4.2	15.2	80.5
YLMW-2D	9/26/12	0.4	4.3	16	79.3
YLMW-2M	9/14/10	0.1	3.5	15.3	81.1
YLMW-2M	9/26/12	0.3	4.3	16.2	79.2
YLMW-2S	9/14/10	0.1	2.2	16.7	81
YLMW-30D	9/14/10	0.1	0.4	18.9	80.6
YLMW-30D	6/7/11	0.2	4.7	16.3	78.8
YLMW-30M	6/7/11	0.1	3	17.2	79.7
YLMW-30S	6/7/11	0.1	2.5	17.9	79.5
YLMW-32D	9/14/10	0.1	3.2	14.7	82
YLMW-32D	6/7/11	0.2	2.8	16.3	80.7
YLMW-32M	9/14/10	0.2	4.7	13.4	81.7
YLMW-32M	6/7/11	0.1	4.2	15.3	80.4
YLMW-32S	9/14/10	0.1	4	13.9	82
YLMW-32S	6/7/11	0.1	2	18.2	79.7
YLMW-32S	10/2/12	0.1	5.5	13.6	80.8
YLMW-32S	12/14/12	0.1	5	15.4	79.5

Well	Sample date	CH_4 (% by vol)	CO_2	O_2	Balance
YLMW33RM	6/7/11	0.5	19.4	0.2	79.9
YLMW33RM	10/6/11	1.9	20.8	0	77.3
YLMW33RM	12/8/11	1.2	16.9	1.2	80.7
YLMW-33RM	4/7/11	0.6	18.9	0	80.5
YLMW-33RM	5/31/12	0.2	17.4	0.4	82
YLMW-33RM	10/26/12	0.1	0.3	20.1	79.5
YLMW-33RM	12/14/12	1.4	21	0	77.6
YLMW-33RM	9/12/13	1.2	19	0.3	79.5
YLMW-33RM	12/11/13	0.3	0.1	20.6	79
YLMW-33RS	4/7/11	0.8	16.9	0	82.3
YLMW-33RS	5/31/12	0.2	17.1	4.3	78.4
YLMW-33RS	12/14/12	1.5	19.6	0	78.9
YLMW-33RS	12/11/13	0.1	0	20.7	79.2
YLMW-34D	3/18/10	0.2	2.4	16.3	81.1
YLMW-34D	10/4/11	0.9	5.3	12.3	81.5
YLMW-34D	12/7/11	0.2	1.7	17.8	80.3
YLMW-34D	5/30/12	0.1	0.2	20	79.7
YLMW-34D	9/26/12	0.8	3.6	14.4	81.2
YLMW-34D	12/14/12	1.2	6.4	12.2	80.2
YLMW-34D	9/12/13	0.5	1.4	15.8	82.3
YLMW-34M	3/18/10	0.2	2.4	16.3	81.1
YLMW-34M	10/4/11	0.1	12.6	3.8	83.5
YLMW-34M	12/7/11	0.3	10	6	83.7
YLMW-34M	9/26/12	0.1	8.8	9.1	82
YLMW-34M	12/14/12	0.1	8	11	80.9
YLMW-34M	9/12/13	0.1	12.3	5	82.6
YLMW-34S	12/14/12	0.1	5.1	13.6	81.2
YLMW-35M	12/11/13	0.1	4.5	15.7	79.7
YLMW-36D	6/7/11	0.1	4.2	12.7	83
YLMW-36M	6/7/11	0.1	2.9	17.3	79.7
YLMW-36S	6/7/11	0.1	1.3	19	79.6
YLMW-37D	6/16/10	5.7	15.8	0.3	78.19
YLMW-37D	3/8/11	2.8	1	10.7	85.5
YLMW-37D	3/8/11	3.6	2.2	8.9	85.3
YLMW-37D	6/9/11	4.6	14.8	3.8	76.79
YLMW-37D	10/4/11	3.1	10.6	8.6	77.7
YLMW-37D	12/8/11	3.8	12	6.8	77.4
YLMW-37D	3/21/12	3.6	16.6	3.1	76.7
YLMW-37D	5/31/12	2.4	8	10.1	79.5
YLMW-37D	9/26/12	2.8	10	8.7	78.5
YLMW-37D	12/14/12	3.5	12.5	8.6	75.4

Well	Sample date	CH_4 (% by vol)	CO_2	O_2	Balance
YLMW-37D	3/28/13	2.3	10.8	9	77.9
YLMW-37D	6/12/13	1.8	7	9.5	81.7
YLMW-37D	9/12/13	2.4	8.1	10.2	79.3
YLMW-37D	12/11/13	2.1	8	13.3	76.6
YLMW-37M	6/16/10	5.8	18	0.2	76
YLMW-37M	9/14/10	5.6	10.1	5.6	78.7
YLMW-37M	12/14/10	0.4	0.7	18.8	80.1
YLMW-37M	3/8/11	5.2	7.7	5	82.1
YLMW-37M	6/16/11	5.6	18.7	0	75.7
YLMW-37M	10/4/11	6.8	18.1	1.6	73.5
YLMW-37M	12/8/11	7.7	21.2	0.4	70.7
YLMW-37M	3/21/12	6.1	19.6	0.3	74
YLMW-37M	5/31/12	5.4	15.4	3	76.2
YLMW-37M	9/26/12	3.6	10.4	8.9	77.1
YLMW-37M	12/14/12	6.9	20.9	0.6	71.6
YLMW-37M	3/27/13	4.9	15.5	4.7	74.9
YLMW-37M	6/12/13	3.9	11.7	5.4	79
YLMW-37M	9/12/13	4.7	15.5	4.3	75.5
YLMW-37M	12/11/13	6.6	17.2	4.7	71.5
YLMW-37S	9/14/10	0.8	14.6	4.7	79.9
YLMW-37S	12/14/10	0.5	3.9	16.1	79.5
YLMW-37S	3/8/11	7.3	12	0	80.69
YLMW-37S	6/9/11	0.1	16.9	13.6	69.4
YLMW-37S	10/4/11	0.3	17.7	2.9	79.1
YLMW-37S	12/8/11	6	20.7	0.3	73
YLMW-37S	3/21/12	1.2	15.2	3.4	80.2
YLMW-37S	5/31/12	0.8	14.1	6	79.1
YLMW-37S	9/26/12	1.4	15.4	4.8	78.4
YLMW-37S	12/14/12	3	16.7	4.1	76.2
YLMW-37S	3/28/13	1.3	14.2	5.4	79.1
YLMW-37S	6/12/13	0.2	9.4	7.2	83.2
YLMW-37S	9/12/13	0.3	15.7	3.7	80.3
YLMW-37S	12/11/13	1.5	16.2	4.5	77.8
YLMW-3D	9/14/10	0.1	1.1	17.4	81.4
YLMW-3M	9/14/10	0.1	0.9	17.7	81.3
YLMW-3S	9/14/10	0.1	1.4	17.2	81.3
YLMW-3S	3/8/11	0.1	0	20.4	79.5
YLMW-3S	6/12/13	0.1	0	19.6	80.3
YLMW-4D	9/14/10	0.1	0.8	17.7	81.39
YLMW-4M	9/14/10	0.1	0.9	17.5	81.5
YLMW-4S	9/14/10	0.1	1.1	17.3	81.5

Well	Sample date	CH_4 (% by vol)	CO_2	O_2	Balance
YLMW-5D	9/14/10	0.1	0.9	17.5	81.5
YLMW-5M	9/14/10	0.1	3.1	14.9	81.9
YLMW-5S	9/14/10	0.1	2.9	15.4	81.6
YLMW-6M	9/14/10	0.1	4.6	13.7	81.6
YLMW-6S	9/14/10	0.1	2.7	15.8	81.4
YLMW-7M	9/26/12	0.1	2.9	16.4	80.6
YLMW-7S	10/4/11	1.7	20.8		
YLMW-8M	12/8/11	1.2	15.5	4	79.3
YLMW-8M	9/26/12	0.1	0.1	20	79.8
YLMW-9M	9/14/10	0.1	0.2	18.6	81.1

TABLE 4
Landfill Gas Monitoring Criteria
Yale Landfill Management Plan, Former Yale Landfill, Albuquerque, New Mexico

Criteria	Outcome
If landfill gas monitoring results are <1% of the LEL over four quarters	AEHD will consider decreasing the monitoring frequency to twice per year (semiannually).
If landfill gas monitoring results in all wells remain<1% of the LEL	AEHD will consider reducing the number of landfill gas wells monitored semiannually.
If landfill gas monitoring results are >10% of the LEL	AEHD may require the developer to install additional landfill gas monitoring wells.
If landfill gas monitoring results are inconsistent or inconclusive	Provide a landfill gas model. AEHD will evaluate the need for continued landfill gas monitoring by applying the landfill gas model results.
Increased development on or near landfill	AEHD will evaluate landfill gas monitoring frequency.
Increased moisture/ponding on landfill	AEHD will watch for increased landfill gas concentrations during landfill gas monitoring. Such an increase in landfill gas may be caused by increased moisture.

TABLE 5
Groundwater Monitoring Well Construction Details
Yale Landfill Management Plan, Former Yale Landfill, Albuquerque, New Mexico

Well Name	X Coordinate	Y Coordinate	Surface Elevation	Screen Top	Screen Bottom	Longitude	Latitude
YALE1	1531495	1474025	5305.78	400	464	-106.614	35.05099
YALE3	1527681	1474339	5196.07	300	340	-106.627	35.05169
YALE4	1529187	1473297	5306.85	398	438	-106.622	35.04833
YALE5	1525148	1474199	5072.11	170	210	-106.635	35.05137
YALE6	1526514	1472284	5169.06	283	323	-106.631	35.04619
YALE7	1527206	1471701	5197.18	305	345	-106.628	35.04452
YALE8	1528362	1472371	5295.67	410	450	-106.624	35.04641
YALE9	1529882	1474439	5268.39	382	422	-106.619	35.05204