APPENDIX B:

METHODOLOGY FOR ASSESSING IMPACTS ON AIR QUALITY FROM CONSTRUCTION AND OPERATION OF AN ACWA PILOT TEST FACILITY

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Air quality modeling analysis consists of estimating emission rates and calculating concentration levels at receptor locations for a series of varying meteorological conditions. Air emissions from construction and operation of neutralization/biotreatment (Neut/Bio), neutralization/supercritical water oxidation (Neut/SCWO), neutralization/gas-phase chemical reduction/transpiring wall supercritical water oxidation (Neut/GPCR/TW-SCWO), and electrochemical oxidation (Elchem Ox) pilot facilities were estimated on the basis of available standard references and site-specific data. These estimates were used to model air concentrations that might occur at potential off-post (general public) and on-post (worker) receptor locations. Estimating emissions associated with construction and operation of an ACWA test facility is discussed in Section B.1, and the air model used, model input data, and assumptions are discussed in Section B.2.

B.1 EMISSION FACTORS AND ASSUMPTIONS USED IN ESTIMATING EMISSIONS

The selection of emission factors and the method of emissions estimating associated with construction and operation of an Assembled Chemical Weapons Assessment (ACWA) pilot test facility are briefly presented. Detailed background information is provided in Kimmel et al. (2001).

B.1.1 Construction-Related Emissions

To determine potential impacts on ambient air quality from fugitive dust emissions during earth-moving activities, emissions of PM_{10} and $PM_{2.5}$[1] were estimated by using an average fugitive dust emission factor of 1.2 tons/acre/month (Section 13.2.3 of EPA 2000a) and the acreage of land expected to be disturbed during construction.

For each ACW destruction system proposed for pilot testing, the land disturbance for construction of the proposed pilot facility and supporting infrastructure was estimated. Fugitive dust emissions were estimated on the basis of the assumption that a phased approach would be used for construction. Construction of utility lines would most likely occur during the first phase of construction, but only a small area would be worked on at any particular time. The construction of utility lines would be followed by the construction of the pilot test facility.

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[1] PM = particulate matter. PM_{10} = coarse, inhalable PM with a mean aerodynamic diameter of 10 µm or less. $PM_{2,5}$ = fine, inhalable PM with a mean aerodynamic diameter of 2.5 µm or less.

Fugitive dust emissions during this latter period of construction, when more land surface would be disturbed at one time, were analyzed in the air quality modeling.

It was assumed that 30% of the estimated fugitive dust emissions would be PM_{10} (EPA 1988) and 15% would be $PM_{2.5}$ (Kinsey and Cowherd 1992). It was also assumed that conventional dust control measures (e.g., frequent sprinkling of water over disturbed areas) would reduce emissions by about 50% (EPA 2000a).

B.1.2 Operational Emissions

To determine potential impacts on air quality resulting from operation of the proposed ACWA pilot test facility, emissions of criteria pollutants and volatile organic compounds (VOCs) from boilers and emergency generators, along with those from the process gas burner in the case of Neut/GPCR/TW-SCWO, were estimated.

The emission rates of criteria pollutants and VOCs for the operational period were estimated on the basis of the estimated annual consumption rates of fuels. These annual consumption rates of fuel (assumed to be natural gas) required to operate the various ACWA technologies in turn were estimated on the basis of the unit quantity needed to dispose each munition type and agent, and annual throughput capacity of an ACWA facility at each site.

The emission rates of criteria pollutants and VOCs for normal boiler operations were estimated with the FIRE 6.22 emission factor program for large wall-fired boilers with greater than 100 million Btu/h of heat input (EPA 2000b).

The emission rates of criteria pollutants and VOCs for emergency generator operations were estimated with the FIRE 6.22 emission factor program for reciprocating diesel engines (EPA 2000b) and the fuel consumption rate. The annual consumption rate for emergency generators was estimated by assuming (1) 600 hours of generator operations per year and (2) the hourly consumption for actual generator operations at Aberdeen Proving Ground (1997).

In the case of Neut/GPCR/TW-SCWO, emissions of criteria pollutants and VOCs from the product gas burner were estimated on the basis of data on the flue gas composition measured during demonstration testing and data on the flow rate from the stack exit derived from the disposal rates of ACWs (Kimmel et al. 2001).

B.2 AIR QUALITY MODEL, MODEL INPUT DATA, AND ASSUMPTIONS USED IN AIR QUALITY IMPACT ANALYSIS

B.2.1 Air Quality Model

The Industrial Source Complex Short-Term 3 (ISCST3) model (version 00101; EPA 1995), a steady-state Gaussian plume dispersion model recommended by EPA for use in a wide range of regulatory applications, was used to estimate potential impacts on ambient air quality. All regulatory default options (e.g., stack-tip downwash, buoyancy-induced dispersion, final plume rise) were selected for the analysis. In accordance with EPA's requirements, direction-specific building dimensions were included for all building downwash algorithms using EPA's building profile input program (BPIP) (EPA 1993). Building information for a proposed facility was obtained from the technology provider report (Kimmel et al. 2001).

B.2.2 Meteorological Data

Meteorological data used in air quality modeling included surface data (wind direction and speed, ambient temperature, atmospheric stability) and twice-daily mixing-height data. These meteorological data were preprocessed with the EPA's PCRAMMET program for use in short-term dispersion models (EPA 1999).

On-site surface meteorological data were available for all four sites (Anniston Army Depot [ANAD], Blue Grass Army Depot [BGAD], Pine Bluff Arsenal [PBA], and Pueblo Chemical Depot [PCD]) from Demil and/or Chemical Stockpile Emergency Preparedness Program (CSEPP) towers (Rhodes 2000). The Demil towers meet U.S. Environmental Protection Agency (EPA) siting criteria, and their instrumentation and associated data were checked for quality assurance/quality control (QA/QC). The QA/QC procedures for the data from CSEPP towers are not as comprehensive as those for the Demil towers. Accordingly, Demil tower data collected at a 10-m level were used for the modeling analysis for ANAD, BGAD, and PCD. Because the PBA has no Demil tower, the surface meteorological data collected from the Little Rock/Adams Field Airport at the 6.1-m level were used for the analysis. The hourly surface data for the PBA used were those from the hourly U.S. weather observations (HUSWO) CD-ROM available from the National Climatological Data Center in Asheville, North Carolina.

The Demil tower data contain two types of stability class data — one using wind fluctuation statistics (σ_E) methodology and the other using solar radiation/delta-T (SRDT) methodology. The EPA has not expressed any preference between the two. To be consistent with previous studies, the former was used in the modeling analysis for this assessment.

Twice-daily mixing height data collected at the nearest station in a climatological regime similar to the site of concern were processed for the same period as surface meteorological data. Locations and years for mixing height and surface meteorological data used in the modeling analysis are presented in Table B.1.

B.2.3 Receptor Location Data

Three types of receptors were defined — on-site receptors, site boundary receptors, and off-site receptors. On-site receptors were established to assess air quality impacts for on-site workers resulting from routine emissions of hazardous air pollutants (HAPs). Site boundary and off-site receptors were established to assess air quality impacts to the general public from routine HAPs emissions and construction and operation emissions of criteria pollutants. Irregularly spaced Cartesian receptor grids were developed for on-site and off-site receptors up to 31 mi (50 km) from the center of the proposed pilot test facility. The grid intervals range from 164 ft (50 m) around the ACWA facility to 3.1 mi (5 km) outside the 6.2-mi (10-km) radius from the center of the ACWA facility (see Figures B.1 through B.4). In addition, receptors were set at 328 ft (100 m) apart along the site boundary near the ACWA facility and 984 to 1,640 ft (300 to 500 m) apart along the site boundary far from the ACWA facility.

B.2.4 Terrain Data

To reflect the effects of terrain features, the terrain data for the source and receptor locations were input to the model. Elevations for source and receptor locations were read from the electronic data in the U.S. Geological Survey (2001) 1:24,000 scale (7.5-minute series) digital elevation model (DEM).

TABLE B.1 Locations and Years of Surface Meteorological Data and Mixing Height Data Used in Air Quality Modeling

Location	Surface Data Site	Mixing Height Data Site	Year
ANAD	On site	Birmingham, Ala.	1999
BGAD	On site	Wilmington, Ohio	1999
PBA	Little Rock, Ark.	N. Little Rock, Ark.	1991–1995
PCD	On site	Denver Stapleton Int’l. Airport, Colo.	1998

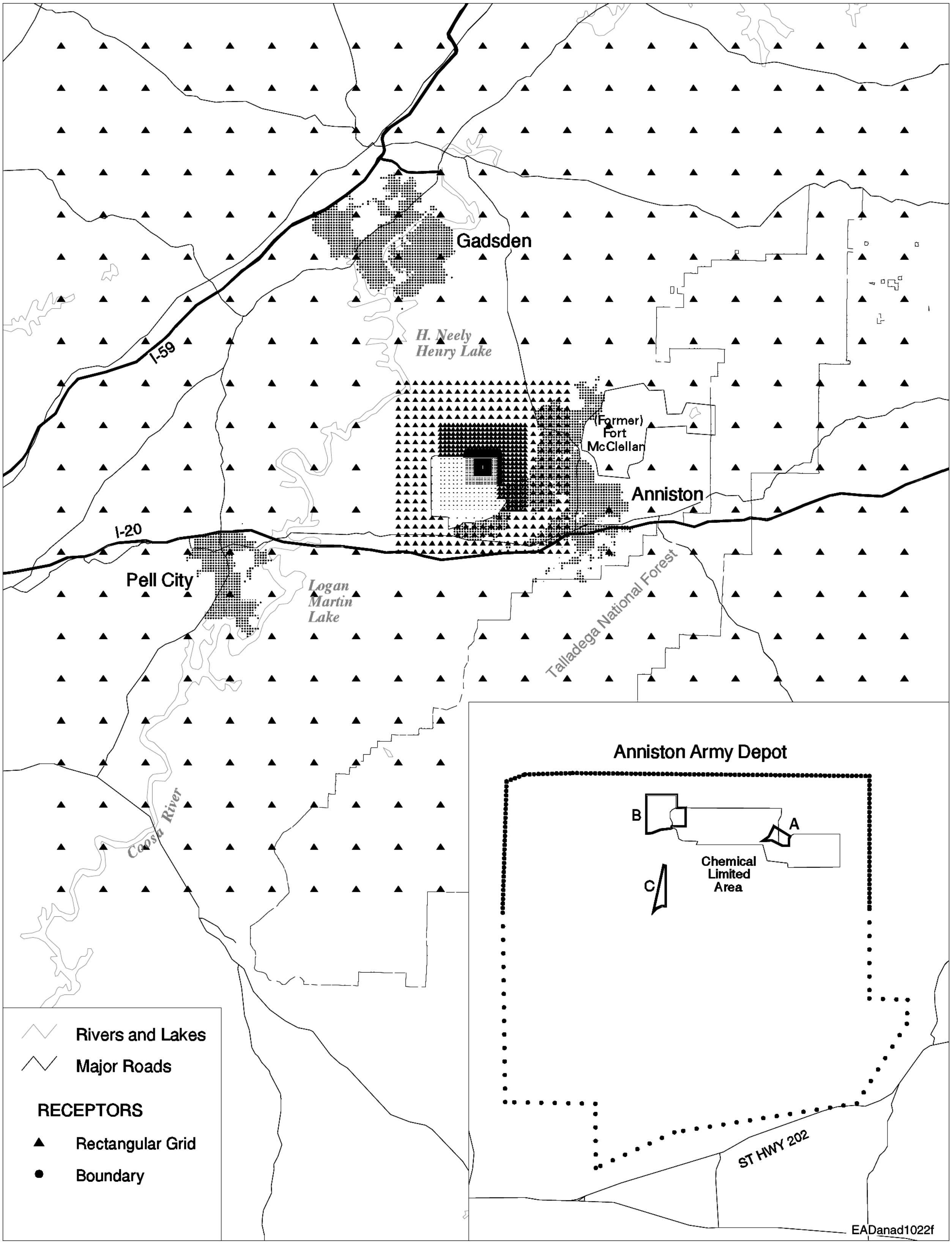

FIGURE B.1 Locations of Receptors Used in Air Quality Modeling at ANAD

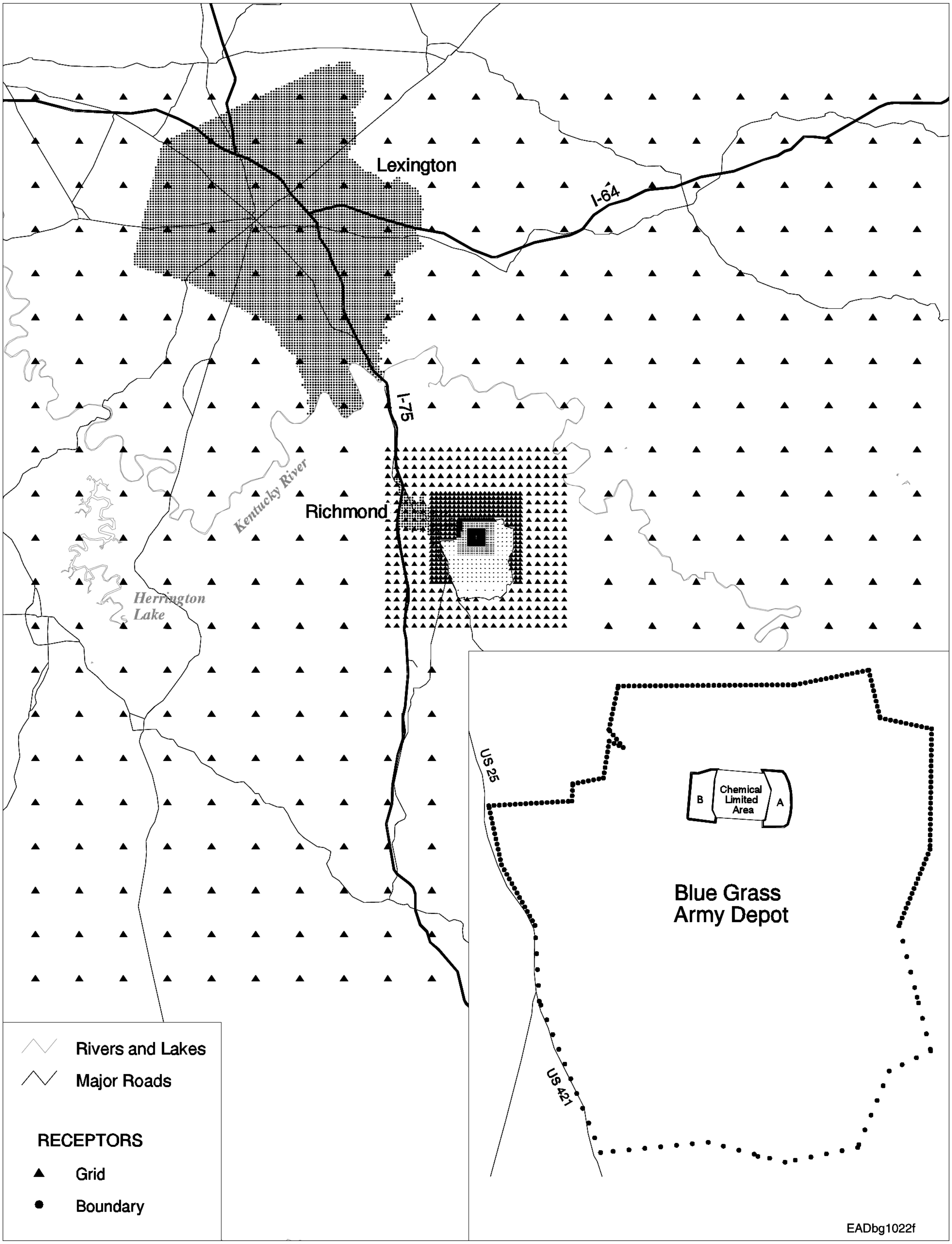

FIGURE B.2 Locations of Receptors Used in Air Quality Modeling at BGAD

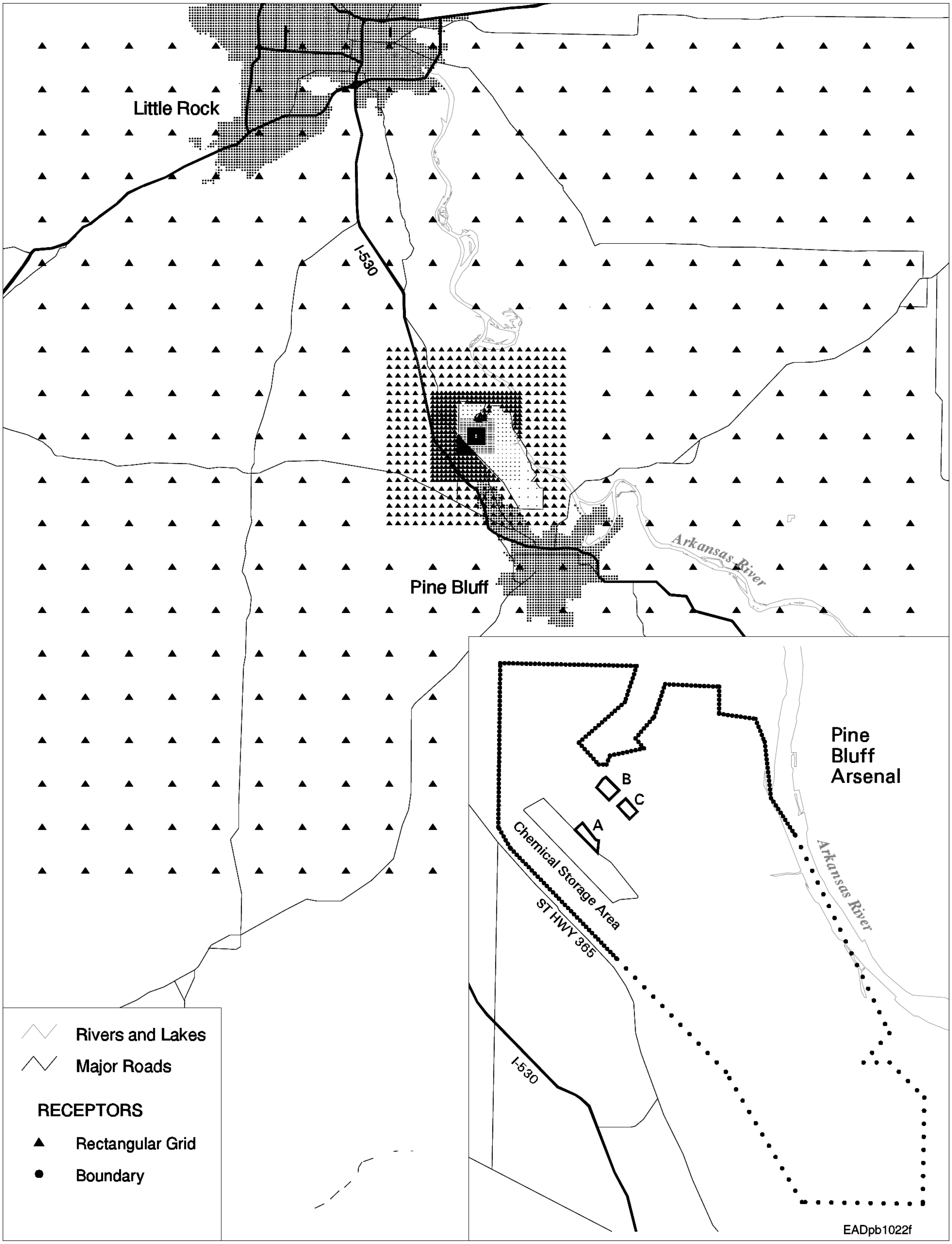

FIGURE B.3 Locations of Receptors Used in Air Quality Modeling at PBA

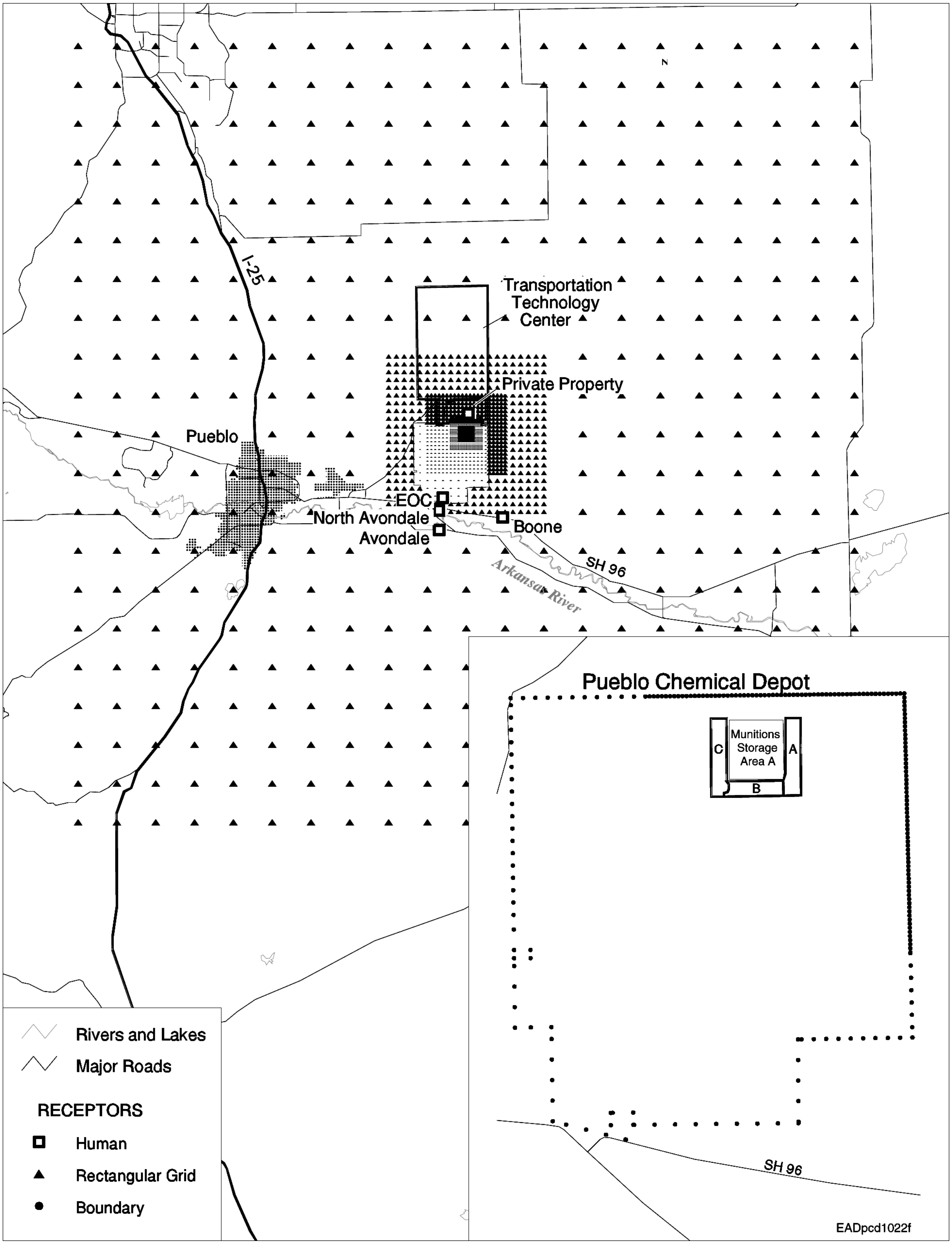

FIGURE B.4 Locations of Receptors Used in Air Quality Modeling at PCD

B.2.5 Other Assumptions

For modeling potential air quality impacts during construction and/or operational periods, the following assumptions were made:

- Construction activities would occur during one daytime 8-hour shift (8 a.m.–noon and 1 p.m.–5 p.m.).
- Rates of dust emissions from the construction site would be constant over the construction area and time.
- Settling of airborne particles due to gravity and removal by dry/wet deposition would be negligible.
- Areas between the pilot test facility site and receptor locations would be in a “rural” setting.

For the operational periods, short-term average (1-hour, 3-hour, 8-hour and 24-hour) pollutant concentrations were conservatively estimated by assuming that boiler and emergency diesel generators (and the process gas burner in case of the Neut/GPCR/TW-SCWO) would operate simultaneously at their peak load. For long-term (annual) average concentrations, annual average emission rates for these emissions sources were used.

B.3 REFERENCES FOR APPENDIX B

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