Countywide Recycling & Disposal Facility
Division of Republic Waste Services of Ohio
3619 Gracemont Street S.W.
East Sparta, Ohio 44626
Phone: 330-874-3855
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May 22, 2008

James E. Augustyn, On-Scene Coordinator
U.S. Environmental Protection Agency
77 W. Jackson Blvd.
Chicago, IL 60604-3950

RE: AMBIENT AIR MONITORING WORK PLAN
SETTLEMENT AGREEMENT NO. V-W08-C-897
COUNTYWIDE RECYCLING AND DISPOSAL FACLILITY
EAST SPARTA, OHIO

Dear Mr. Augustyn:

Three copies of Ambient Air Monitoring Work Plan are attached. In addition, we have shipped a copy of this letter and revised Work Plan directly to Mr. Ed Gortner, Mr. Paul Ruesch, and Ms. Michelle Colledge.

As you know, this Work Plan is the result of an interactive dialogue with many stakeholders, and so we hope that it meets your expectations. We did receive your email with comments for consideration yesterday morning. The attached Work Plan addresses all of those comments except for a few, for which we propose the following:

- Several hundred thousand landfill gas quality data points reside in a database for the facility. Lawhon mined relevant and representative data in the preparation of this Work Plan. Additional queries and tabulation of data can be done following this Work Plan submittal, or in response to further questions/comments as you wish.

- Lawhon is currently working with potential equipment vendors and laboratories to develop the QA/QC plans/protocols for the work. We will submit this information as it is developed, and by June 2, 2008.

- We would be pleased to work with Mr. Ruesch to evaluate data from other dross-affected sites and make program adjustments as appropriate.

Please do not hesitate to call me at (330) 874-3855 if you have any questions or comments.

Sincerely,

Countywide Recycling and Disposal Facility

Tim Vandersall, P.E.
General Manager

cc: Paul Ruesch, USEPA, Chicago
Michelle Colledge, USEPA, Chicago
Ed Gortner, OEPA-CO
Michael Beaudoin, Earth Tech

Countywide Recycling & Disposal Facility
Final Report
May 22, 2008

Work Plan to Perform
Ambient Air Monitoring for Countywide Recycling & Disposal Facility (Countywide)

Pursuant to:
ADMINISTRATIVE SETTLEMENT AGREEMENT AND ORDER ON CONSENT FOR REMOVAL ACTION (AOC), April 11, 2008
Docket No. V-W-08-C-897

Republic Services of Ohio II, LLC
Countywide Recycling & Disposal Facility
3619 Gracemont Street SW
East Sparta, Ohio 44262

Prepared by:

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Work Plan to Perform
Ambient Air Monitoring for Countywide Recycling & Disposal Facility (Countywide)
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Work Plan to Perform
Ambient Air Monitoring for Countywide Recycling & Disposal Facility (Countywide)

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May 22, 2008

1.0 PURPOSE

On behalf of Republic Services of Ohio II, LLC (Republic), its subcontractor, Lawhon & Associates, Inc., (L&A) proposes to perform a phased program of additional ambient air monitoring designed to comply with the provisions of the AOC. USEPA has identified two major goals for the additional ambient air monitoring, as follows:

- *To yield data which can be used to assess potential exposures in the community; and*
- *Demonstrate the effectiveness of the implemented control technologies.*

This work plan is designed to systematically evaluate airborne constituents associated with the landfill and the potential for exposures in the community. It has been prepared to be consistent with the USEPA *Guidance for Evaluating Landfill Gas Emissions from Closed or Abandoned Facilities (2005).* As part of this work, L&A will:

- monitor ambient air using real-time monitors to identify excursions in ambient air concentrations;
- confirm the nature of the constituents causing these excursions through the use of TO-15 sampling;
- evaluate the found constituent concentrations against health-based criteria, including Agency for Toxic Substances and Disease Registry (ATSDR) acute Minimal Risk Levels (MRLs), November 2007;
- correlate the results of the real-time monitoring (including any TAGA bus and/or open-path UV-DOAS monitoring) with the TO-15 results to measure the nature and extent of landfill gases and determine if these results provide a basis for an effective continuous monitoring program;
- set up real-time or supplemented real-time monitoring at points of maximum impact and also in the vicinity of the to-be-performed remedial measures; and
- monitor the ambient air at the perimeter of the remediation area before, during, and after remedy implementation.

2.0 BACKGROUND

Republic has been monitoring landfill gases and ambient air in the vicinity of the landfill as required by the Ohio EPA's DFFO (Director's Final Findings and Orders) to evaluate the potential for unacceptable exposures in the community to Volatile Organic Compounds (VOCs) emanating from the landfill. USEPA is concerned that the current, every-six-day, 24-hour sampling may be diluting or missing short-term high concentrations of VOCs and other constituents that could be associated with acute health effects.

In addition, several remedial measures are required of Republic at the landfill with the purpose of reducing / eliminating fugitive landfill gas emissions. The proposed monitoring has as an additional goal to establish current levels of VOCs in ambient air and, if such levels are contributed by the landfill, document decreases as the remedial efforts are implemented.

This Work Plan describes a phased approach designed to achieve these goals.

3.0 PROJECT APPROACH

The first part of the investigation seeks to evaluate the potential for exposures in the community (including any potential for acute health effects) from exposure to landfill gas constituents. L&A proposes to meet this goal with a phased deployment of real-time monitoring equipment at or near the fenceline, supplemented by short-term grab samples (SUMMA) with off-site analysis. This effort will be implemented to confirm the conceptual site model for the landfill and identify any potential threats from landfill gases. Our specific objectives of this effort are to:

- Identify constituents of potential concern that are present in landfill gas;
- Determine the concentrations of each of these constituents at which they could pose an unacceptable chronic or acute threat;
- Determine the locations of maximum expected impact of landfill gases at or near the fenceline;
- Determine which of the constituents of concern could be present at above-target levels of concern; and
- Deploy a proven monitoring system that will monitor for all of the constituents of concern to assess both acute and chronic impacts.

The first four phases of the project described below will be used to fulfill the AOC requirement of: "*To yield data which can be used to assess potential exposures in the community",* as follows:

- **Phase 1. Identify near-fenceline locations of greatest impact through manual survey.** L&A is updating the air dispersion model to use the shortest time frame (1-hour average) to identify the most-likely locations of short-term maximum impact. Beginning at these locations, L&A will conduct a serpentine walkover survey using a portable PPB-PID (or equal) monitor (photoionization detectors with part-per-billion sensitivity) to determine locations of greatest impact. If excursions are noted, L&A will collect SUMMA samples and submit them for TO-15 analysis. L&A will integrate the real-time monitor readings over the SUMMA sampling event(s).

  If no excursions are noted during surveys near the fenceline, L&A will conduct a serpentine survey back toward the landfill gas source(s) until excursions are detected. L&A will collect SUMMA samples to support the real-time monitoring results.

  If the TAGA bus is deployed to the site, L&A will accompany the TAGA bus and collect PPB-PID data and TO-15 sampling during excursions recorded by the TAGA bus. These results will be used to augment the survey and confirm the results but will not be relied on as a necessary component of this effort.

- **Phase 2. Manually monitor for short-term excursions.** L&A will continue to use meteorological data for a given day, the air dispersion modeling results, odor complaints,

and the historical monitoring results to deploy PPB-PID monitors (and/or other monitors) at location(s) of maximum expected impact. These monitors will be set up to monitor the ambient air. As short-term excursions are noted, SUMMA samples will be collected and submitted for TO-15 analysis.

L&A will correlate TO-15 results to PPB-PID data and compare concentrations of detected compounds to health-based values, including ATSDR acute MRLs.

- **Phase 3. Set-up real-time monitoring; automatic supplement w/grab sample.** Set up the real-time monitoring system at point(s) of maximum impact to trigger collection of a SUMMA sample during a short-term excursion. These samples may be supplemented with upwind real-time monitors and/or near-contemporaneous sampling. As needed, L&A will move monitors, revise locations, or revise methodologies to complete the correlation. L&A believes that the PPB-PID monitor will effectively monitor excursions and the TO-15 analyses will effectively describe the nature of any airborne constituents.

- **Phase 4. Design and deploy real-time monitoring.** If the correlation demonstrates that a PPB-PID or other secondary indicator of VOCs is effective at monitoring landfill-emitted VOCs at concentrations of potential concern, the system will be adapted as needed to provide continuous monitoring at one or more locations. This extended program will employ solar/wind power for the instrument and wireless telemetry to provide real-time monitoring. This system will be supplemented with short-term SUMMA monitoring on a routine basis to confirm readings.

Phase 5 is designed to meet the AOC objective to: *"Demonstrate the effectiveness of the implemented control technologies",* as follows:

- **Phase 5. Use monitoring system to assess effectiveness** of the remedial measures. Set up real-time monitors supplemented by SUMMA samples at the fenceline or at locations closer to (and downwind of) remedial activities. Output at each station will be used in conjunction with the meteorological data and compared to readings collected before, during, and after construction to assess the effectiveness of the remedial measures.

Work will be conducted in accordance with the in-place Health & Safety and Quality Assurance programs for the site, as adapted to include an air monitoring Job Safety Analysis and as updated to incorporate ambient air monitoring procedural plans.

Throughout the program, L&A will evaluate collected data and report findings on the potential for unacceptable short-term or chronic health impacts. L&A will correlate the found results (and the information gained from the SUMMA samples and other monitoring) to odor complaints, meteorology, and PPB-PID readings to better understand the nature and patterns of occurrence of the odor complaints and potential for off-site impacts from landfill gas emissions.

Should excursions with the potential for community impacts be detected, L&A will deploy additional sampling stations upwind and downwind of the real-time monitors to determine the potential for constituents to migrate to the community.

4.0 DISCUSSION OF IMPLEMENTATION APPROACH

This section discusses the basis for the proposed approach and the decision tree that will be used to ensure the work meets project goals, as follows:

- *To yield data which can be used to assess potential exposures in the community; and*
- *Demonstrate the effectiveness of the implemented control technologies.*

4.1 Phase 1. Identify locations of greatest impact through manual survey

Modeling: L&A is in the process of updating the air dispersion model to use the shortest time frame (1-hour average) to identify the most-likely locations of short-term maximum impact. Previous modeling has indicated three locations of maximum impact from both point sources and area sources:

- Along the eastern edge of the landfill, just west of the wetland;
- Along the northern edge of the property; and
- Along the western edge.

These locations all have a swale as a common feature: thus, the model's incorporation of downwash drives these locations to be points of maximum impact. L&A will use this information and the wind direction on a given day to identify where to begin its walkover survey to monitor near-perimeter locations of greatest impact.

Walkover Survey Instruments: L&A will conduct a walkover survey using instruments to determine if any of these instruments (singly or in combination) can identify landfill-gas-related excursions:

- PPB-PID: ppb-RAE (10.6 eV) or equal;
- Photovac mini-FID (or equal);
- Q-Trak (or equal) Carbon Dioxide (CO_2) meter.

PID: Landfill-gas-related excursions at the property boundary are expected to have concentrations for Non-Methane Organic Compounds (NMOCs) of ~30 ppb (See Attachment A and Attachment B). Thus, a ppb-PID is needed. The goal of the monitoring is to determine if any NMOCs are present at greater than acceptable levels. The four NMOCs found in greatest concentration in the landfill gas have ionization potentials of:

- 9.54 eV: 2-butanone
- 9.24 eV: benzene
- 9.69 eV: acetone
- 9.45 eV: THF

Thus, a 10.6 eV lamp will be appropriate. The PID has several advantages over other monitors in that it has a low power consumption, is already set up to log data, is monitoring the class of compounds of interest, and requires no other materials. However, the PID will not speciate NMOCs nor will it differentiate landfill-gas-related components from NMOCs from other sources.

A preliminary walkover survey at the Countywide landfill using a *ppb-RAE plus* showed most on-landfill areas did not have any detectable concentrations of NMOCs. However, locations just downwind of the temporary liner had periodic, detectable, short-term (1-5 second) excursions of

NMOCs that were typically accompanied by a brief odor. Thus, it appears that the ppb-RAE does successfully identify short-term landfill gas excursions from the reaction area. However, at other locations on site, encountering odors did not coincide with any ppb-RAE response.

FID: The principal value of an FID is that it will measure methane concentrations. Methane concentrations are expected to be 1-2 orders of magnitude greater than total NMOC concentrations (and thus, easier to detect) and methane is a better indicator of landfill gas than total NMOCs. However, FID monitors need a continuous supply of fuel and thus provide a challenge to deploy on a continuous basis.

CO_2: A CO_2 monitor has the benefit of being easy to use, works in a comfortable range (ppm levels), requires no fuel, and is commercially available with data logging capability. It would measure a constituent of landfill gas; however, other sources of carbon dioxide (vehicle exhaust) would also be recorded.

L&A's plan is to conduct a manual walkover survey using these three instruments. These surveys will be conducted during at least two days each when the wind is blowing toward expected locations of maximum impact. Identified excursions would be subjected to SUMMA sampling/TO-15 analysis. In addition to fenceline monitoring, L&A would extend the walkover survey to nearer source areas, locations of odor complaints, the community sampling locations, and roads located outside the perimeter of the site. Locations where excursions are noted or samples are collected will be measured using a GPS system.

If the TAGA bus or the UV-DOAS equipment is deployed at the site, L&A will conduct a walkover survey to correlate TAGA and UV-DOAS results to our approach.

SUMMA Sampling Time: If excursions are noted, L&A will collect SUMMA grab samples and/or ~15 minute integrated grab samples and submit for TO-15 analysis. L&A will integrate the real-time monitor reading over the sampling event(s). Should the real-time monitors indicate excursions that last significantly shorter (or longer) times, the SUMMA sampling time will be adjusted. At a minimum, SUMMA samples will be collected <u>both</u> during times when odors are only intermittently noted and also at times when odors are persistent.

Data Quality Objectives: The data quality objectives for this phase of the project are:

- Identify NMOC excursions at concentrations greater than 50 ppb using the ppb-RAE.
- Identify benzene concentrations of 5 ppb or greater using Method TO-15.
- Identify VOC concentrations of other TO-15 constituents at concentrations of 10 ppb or greater;
- Identify the top 10 Tentatively Identified Compounds (TICs) in ambient air samples.
- Identify locations of collected samples within 15' using GPS

Phase 1 Review: L&A will review the results from the three instruments and the TO-15 analyses and identify which monitor (or combination) is the best surrogate for monitoring landfill-related ambient air NMOCs excursions.

4.2 Phase 2. Manually monitor

L&A will continue to use meteorological data for a given day, the air dispersion modeling results, odor complaints, and the historical monitoring results to manually deploy the monitor(s) selected in Phase 1 at location(s) of maximum expected impact. These monitors will be set up to monitor the ambient air. As short-term excursions are noted, SUMMA samples will be collected and submitted for TO-15 analysis.

L&A will correlate TO-15 results to the real time data and compare concentrations of detected compounds to health-based values, including ATSDR acute MRLs. L&A will repeat as needed under differing wind directions to ensure monitoring of locations of maximum impact on days that these locations are downwind of the site.

During this phase, L&A will supplement the fenceline monitoring with additional upwind or downwind monitoring/samples to identify the source locations and to confirm the degree of dispersion downwind and/or in the community.

Phase 2 Review: L&A will review the monitor data against the SUMMA results to determine:

- If the nature of the collected sample changes based upon the total NMOC concentration;
- If the SUMMA results can be reliably correlated to the real-time monitor data;
- The range of duration of detected excursions and if they vary depending upon meteorological conditions or other observations; and
- If any constituents are present at greater than health-based levels.

4.3 Phase 3. Set-up real-time monitoring; automatic supplement w/grab sample

L&A will set up the real-time monitoring system at point(s) of maximum impact to trigger collection of a SUMMA sample. Depending upon the Phase 2 results, this sample will be collected during a short-term excursion or at a pre-determined frequency. These samples may be supplemented with upwind real-time monitors and/or near-contemporaneous sampling. L&A will optimize this phase by moving monitors, revising locations or methodologies to complete the correlation. This Phase will also be supplemented with near-source or community monitors to extend the correlation of the on-site results.

Depending upon Phase 1/Phase 2 results, we may switch to battery-operated transmitters such as:

- RAEGuard PID (sensitivity down to 10 ppb)
- VAISALA GMT220 Carbon Dioxide transmitter
- Photovac Voyager (PID/Auto GC).

to monitor given locations and trigger automatic SUMMA sampling of excursions to support the development of a correlation between monitor results and the SUMMA results. These instruments do not have the sensitivity of the handheld instruments, but are already set up for near-continuous operation, data download, and/or telemetry, and provide a signal that can be set up to trigger collection of a SUMMA sample.

4.4 Phase 4. Design and deploy real-time monitoring

Phase 3 and Phase 4 may be combined. If the correlation demonstrates that a PPB-PID or other secondary indicator of VOCs are effective at monitoring landfill-emitted VOCs *at concentrations of potential concern*, the system will be adapted to provide continuous monitoring at one or more locations. This will employ solar/wind power for the instrument (if practical) and wireless telemetry to provide real-time monitoring. This system will be supplemented with short-term SUMMA monitoring on a routine basis to confirm readings.

4.5 Phase 5. Use monitoring system to assess effectiveness

of the remedial measures. Set up real-time monitors supplemented by SUMMA samples at the fenceline or at locations closer to (and downwind of) remedial activities. Output at each station will be used in conjunction with the meteorological data and compared against the comparable pre-construction results to verify the effectiveness of the remedial measures.

5.0 DISCUSSION OF CHALLENGES

L&A has proposed the above approach because there is no single constituent, unambiguously-attributable to the landfill, that can be continuously monitored at levels that could pose an unacceptable health impact. Thus, L&A has identified a flexible program that seeks to monitor a surrogate parameter of total landfill gas emissions and confirm the nature of the airborne constituents using short-term SUMMA samples that will confirm the presence (or absence) of unacceptable concentrations of constituents from the landfill gases. This approach will monitor for TO-15 parameters that could pose an acute or chronic threat.

L&A developed this approach through a review of the Countywide landfill gas monitoring results. As part of the sampling done per the OhioEPA March 28, 2007, Findings and Orders, a tremendous amount of data has been generated from sampling landfill gas within the reaction area. Within this area, samples are taken from individual gas wells and also from gas that is routed from the individual gas wells, through a pipe collection system and then to the flares (where the gas is sampled and analyzed ***prior*** to combustion). In this document, when Countywide landfill gas is referenced, it will always refer to the uncontrolled, reaction-impacted landfill gas.

5.1 Landfill Gas Constituents: There is no Single Parameter

Results of landfill gas monitoring have identified only four constituents that are typically detected at greater than 1% of the landfill gas VOC concentration: acetone, benzene, 2-butanone (MEK), and tetrahydrofuran. Other constituents that are also typically detected (but at lower concentrations) are 1,2,4-trimethylbenzene, ethyl acetate, ethylbenzene, heptane, toluene, and xylenes. However, several of these constituents are also present in significant concentration in vehicle exhaust (except for tetrahydrofuran and ethyl acetate).

Although tetrahydrofuran (glues, inks, etc.) and ethyl acetate (fermentation) have other non-landfill sources; they do not have a significant vehicle-related source and they are not found at these concentrations in typical MSW landfill gas.. Thus, they could be used as markers for *Countywide* landfill gas migration.

In addition, there are several other constituents present at lower concentrations that have been detected in landfill gas. Thus, the monitoring program has been designed to ensure that

constituents of potential concern will be detected at levels of potential concern, if present, through the use of SUMMA sampling and analysis.

5.2 Other Sources of VOCs

The major VOC constituents in landfill gas have potential non-landfill sources. As noted above, acetone, benzene, MEK, 1,2,4-trimethylbenzene, ethylbenzene, heptane, toluene, and xylenes are present in vehicle exhaust; thus, I-77 has the potential to contribute VOCs to the ambient air in the vicinity of Countywide at levels of concern. In addition, other activities like coal mining, farming, trucking, etc., may generate localized pockets of detectable VOCs. The planned ambient air monitoring seeks to identify the nature, concentration, and extent of found VOC constituents to determine whether any pose an unacceptable threat. A second purpose of the monitoring is to identify the source(s) of those constituents so that appropriate remedial measures may be implemented to control any unacceptable threats.

5.3 No Single-Parameter Monitoring Effective

To date we have not identified any continuous monitoring instrument than can be set up to measure tetrahydrofuran or ethyl acetate – the only constituents primarily related to landfill gas and present at significant concentrations – at levels of potential concern. The THF and the ethyl acetate are currently present in Countywide landfill gas; however the presence of THF (and to a lesser extent, ethyl acetate) are apparently related to the current Countywide conditions and are not typically present at these concentrations in ordinary landfill gas emissions.

The UV-DOAS instrument could be set up to measure benzene; but monitoring for this single constituent would be confounded by the other local and regional sources contributing concentrations greater than that from the landfill gases. In addition, benzene (or other single-constituent) monitoring requires instruments with lower detection limits and will not monitor the other constituents present in landfill gases.

5.4 Typical Emissions from Landfills Well-Characterized

Both the major and minor constituents of potential concern from landfill gas (LFG) have been well-characterized (USEPA, 2005; MSW Mgt. 2002). However, it is apparent that the reaction (or related conditions [e.g., temperature, pH, etc.]) occurring at Countywide have resulted in non-typical conditions that are affecting the microbiological processes. Attachment A summarizes the composition of a typical MSW landfill gas and contrasts it with the information from Countywide.

5.5 Air Dispersion Modeling Shows Benzene Contribution from Landfill Flares Small

Air dispersion modeling at Countywide (L&A 2007) estimated the locations of maximum potential impact from three scenarios. The modeling is being updated to identify the locations of maximum potential impact for a 1-hour averaging time. Attachment B summarizes the implications of the air dispersion model on the concentrations anticipated at the perimeter of the landfill. A copy of the 2007 modeling report with updated 1-hour figures appended is provided as an Appendix. The model indicates that the greatest potential for an acute impact at the fenceline is associated with uncontrolled landfill gas migrating from area source. Our approach will be effective at identifying uncontrolled landfill gas sources using just the real time instruments.

5.6 UV-DOAS Monitor

The UV-DOAS monitor has not been set up to monitor either tetrahydrofuran or ethyl acetate. It can monitor down to 2-3 ppb benzene in ambient air along a 250m line. This will be useful to identify locations on the landfill where landfill gas is venting. And it will be effective at monitoring excursions of benzene emissions.

USEPA has indicated that a UV-DOAS monitor may be available for one or more days. We will set it up sequentially upwind and downwind of the source(s) and correlate the results to the real-time monitoring results. Once these two locations have been monitored, we will redeploy the machine at various locations across the landfill to identify cover breaches / uncontrolled landfill gas vents or other benzene sources.

5.7 Total Hydrocarbon Monitor (PPB-PID)

Use of a PPB-PID may be more indicative of short-term excursions than any compound-specific monitor. First, the total hydrocarbon concentration in landfill gas is typically an order of magnitude higher than the concentration of benzene in landfill gas. These hand-held instruments are available, battery operated, and can be set up for data logging.

There still may be significant alternative source interferences; however, the monitoring of excursions over extended time periods may allow L&A to identify which of these may properly be attributed to the landfill. In addition, their use will be supplemented by short-term SUMMA sampling. The integrated output from the PPB-PID for the time period when the SUMMA is open, will be correlated with the SUMMA results. Similarly, the integrated output from the PPB-PID over 24 hours will be correlated with the 24-hour SUMMA results over that time frame.

6.0 SCHEDULE

Phase 1 of the work plan will be implemented within one week of approval of that phase.

Other phases of the work will be performed based upon the results achieved in earlier phases and in accordance with the results of conference calls.

Some work has already begun. On May 21, Countywide performed a limited walkover survey using the ppb-RAE, a Carbon Dioxide monitor, and an FID (malfunctioned). On May 28, the TAGA bus will conduct a survey of ambient air at Countywide. L&A personnel will accompany the bus and conduct Phase 1-type evaluations in conjunction with the TAGA bus readings.

7.0 REFERENCES

USEPA, Guidance for Evaluating Landfill Gas Emissions from Closed or Abandoned Facilities, EPA-600/R-05/123a, September 2005

Soltani-Ahmadi, H. A Review of the Literature Regarding Non-Methane and Volatile Organic Compounds in Municipal Solid Waste Landfill Gas, MSW Management, Sept/Oct 2002

USEPA, Compilation of Air Pollutant Emission Factors (AP-42), Fifth Edition, Volume 1: Stationary Point and Area Sources, 11/98. Section 2.3 Municipal Solid Waste Landfills

AIHA Press. Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989

ATSDR. ATSDR Minimal Risk Levels (MRLs), November 2007

ATSDR, Landfill Gas Primer: An Overview for Environmental Health Professionals.

USEPA Region 9. Preliminary Remedial Goals (PRGs)

Cornerstone Environmental. Flare Destruction and Gas Quality Report, Countywide Recycling and Disposal Facility, East Sparta, Ohio, November 2007

USEPA. Fact Sheet. Frequently Asked Questions About Landfill Gas and How it Affects Public Health, Safety, and the Environment, Office of Air and Radiation, October 2006

P. Dalton, PhD, Odor, Annoyance, and Health Symptoms in a Residential Community Exposed to Industrial Odors, Monell Chemical Senses Center. 1997

Lawhon & Associates, Inc., Countywide Recycling & Disposal Facility Air Dispersion Modeling, September 17, 2007. .

ATTACHMENTS:

This work plan has been designed to yield data which can be used to assess potential exposures to constituents from the Countywide landfill gas that migrate to the community at concentrations that exceed risk-based levels. The attachments to this work plan summarize some of the evaluation that supported its development.

These attachments summarize our review of Countywide data and published literature to

- Identify constituents of potential concern that are present in the Countywide landfill gas;
- Compare and contrast the Countywide information to that from other landfills;
- Determine the concentrations of each of these constituents at which they could pose an unacceptable chronic or acute threat;
- Determine the locations of maximum expected impact of landfill gases at or near the fenceline;
- Determine which of the constituents of concern could be present at above-target levels of concern; and
- Determine the locations at which to ***first*** deploy monitoring equipment.

L&A has evaluated data related to the Countywide site. These data are maintained in a database that currently contains more than 1,000,000 entries. L&A presents summaries of a preliminary review of the data in this Attachment. The preliminary review of selected data shows that:

- The major constituents found in Countywide landfill gas are similar in nature to those typically found in landfills; however, some are present at higher concentrations than are typically encountered in MSW landfills;
- Individual landfill gas constituents from Countywide are not expected to be present above low-ppb concentrations at the fenceline.
- Only those constituents present at higher concentrations in landfill gas from Countywide can be detected at the fenceline using real-time monitoring equipment; and thus
- TO-15 analyses are needed to ensure that potentially-present constituents are monitored.

These determinations drive the approach to monitoring which is to:

- Use real-time equipment to monitor total VOCs or VOCs plus methane to identify excursions;
- Sample during those excursions using TO-15 methods to measure concentrations of potential concern;
- Conduct a serpentine walkover survey to find sources of uncontrolled landfill gas. Confirm the nature of the sources with TO-15 methods.

The following attachments summarize the information mined from the collected data:

A. Comparison of Countywide Landfill Gas Composition to Other MSW Sites

The constituents detected in landfill gas at Countywide are similar in nature and concentration to those detected at other landfill sites with a few notable exceptions:

- The landfill gases at Countywide have more acetone, benzene, MEK, MIBK, and chloromethane than typically found in landfill gases.

- The landfill gases at Countywide have high concentrations of tetrahydrofuran and ethyl acetate – two gases not typically found in landfill gas. Ethyl acetate is typically consumed by landfill biological processes.
- The landfill gases have more oxygen and less methane than other landfills of similar age.

These data contribute to our conceptual model for the Countywide site that includes the realization that there is some interference with the biological processes that occur in a typical landfill because all of the Countywide landfill gases that are found at higher-than-normal levels would be largely consumed by microorganisms in a landfill. Instead, they are migrating to the landfill gas vents.

These interferences can be explained by the elevated temperatures found in this section of the landfill. High temperatures would simultaneously reduce microbiological populations (through sterilization) and increase the volatilization of the landfill gases. These gases could then escape the microbiological "reactors" before they are consumed by the microbes. These microbiological reactors are those locations where all the elements necessary for biodegradation are present including viable microbes, substrates, and water.

Tetrahydrofuran and ethyl acetate are not typically found in landfill gas and are not typically found in vehicle exhaust; thus, they are good markers of the Countywide landfill gas.

One additional observation: each of the higher-than-typical landfill gas constituents is very biodegradable and very combustible (e.g., acetone has a flash point of 0^{o}F, tetrahydrofuran has a flash point of 6^{o}F). These findings suggest that once the reaction has run its course and temperatures decrease to those typically found in landfills, the behavior of the Countywide landfill is expected to revert to that seen in other landfills.

B. Implications of Dispersion Modeling

The air dispersion modeling evaluated the point sources (flares) and two sets of area source scenarios using surrogate emission rates and the actual meteorological data from the Akron/Canton Airport (station 14895) for 1986-1990. A copy of the air dispersion model report is appended. This report summarizes findings of the modeling under 24-hour and annual average conditions. The model has recently been re-run to generate comparable information for 1-hour average concentrations. The preliminary results of this modeling update are appended to the 2007 model report. L&A will use the information on the expected locations of maximum impact to identify where to begin the serpentine walkover survey.

L&A also estimated the concentration of benzene expected at the fenceline location of maximum impact and determined that even under worst-case conditions, it is unlikely that we will detect more than 9 ppb of benzene – the ATSDR acute MRL – from migration of landfill gas. This is due to the fact that even with area sources of uncontrolled landfill gases, there is a minimum dispersion of nearly 100,000 times from the source(s) to the fenceline.

The modeling also indicates that if we are to encounter unacceptable 1-hour concentrations at the fenceline, they will occur due to migration of uncontrolled landfill gas from an area source. As a result, our program is designed to detect concentrations of benzene at less than 9 ppb, if encountered. Thus, this program will serve as a check on the results of the modeling.

Uncontrolled VOC landfill gas emissions have concentrations greater than 2,000 ppm. Thus, although concentrations at the perimeter are not expected to have high levels of VOCs, our program is also designed to systematically identify locations of uncontrolled landfill gas venting,

if present, and, in combination with the TO-15 information, differentiate landfill gas vents from other sources of VOCs in ambient air.

C. Countywide Landfill Gas Composition: Implications for Monitoring

There are eight constituents that are typically present in Countywide landfill gas. All but two (chloromethane and ethylbenzene) are present at concentrations within one order of magnitude of the benzene concentration. Thus, if a given ambient sample contains detectable concentrations of benzene *and is the result of migration of uncontrolled* ***Countywide*** *landfill gas emissions*, it should also contain detectable levels of acetone, MEK, MIBK, tetrahydrofuran, and ethyl acetate.

D. Constituents of Potential Concern and Odor

L&A will tabulate all TO-15 results and compare found constituent concentrations (including TICs) to chronic and acute health-based levels, including MRLs, USEPA Region IX preliminary remedial goals (PRGs), and OhioEPA Air Toxics Policy MAGCLs.

L&A continues to evaluate found constituents in ambient air samples against health based values and odor thresholds to better understand the correlation between odor complaints, ambient air concentrations of constituents, and the potential for acute or chronic health effects.

Attachment A. Comparison of Countywide Landfill Gas Composition to Other MSW Sites

As part of the sampling done per the OhioEPA March 28, 2007, Findings and Orders, a tremendous amount of data has been generated from sampling landfill gas within the reaction area. Within this area, samples are taken from individual gas wells and also from gas that is routed from the individual gas wells, through a pipe collection system and then to the flares (where the gas is sampled and analyzed ***prior*** to combustion). In the following section, when Countywide landfill gas is referenced, it will always refer to the reaction-impacted landfill gas.

Figure 2-1 from EPA 2005 summarizes the phases of decomposition encountered with a typical landfill. L&A reviewed the primary constituents of landfill gases from Countywide and determined that a portion of the landfill is just entering Phase II (due to oxygen levels approaching 5%) while other portions are apparently in Phase III (substantial methanogenesis, methane concentrations just under 20%, but nitrogen concentrations ~30%).

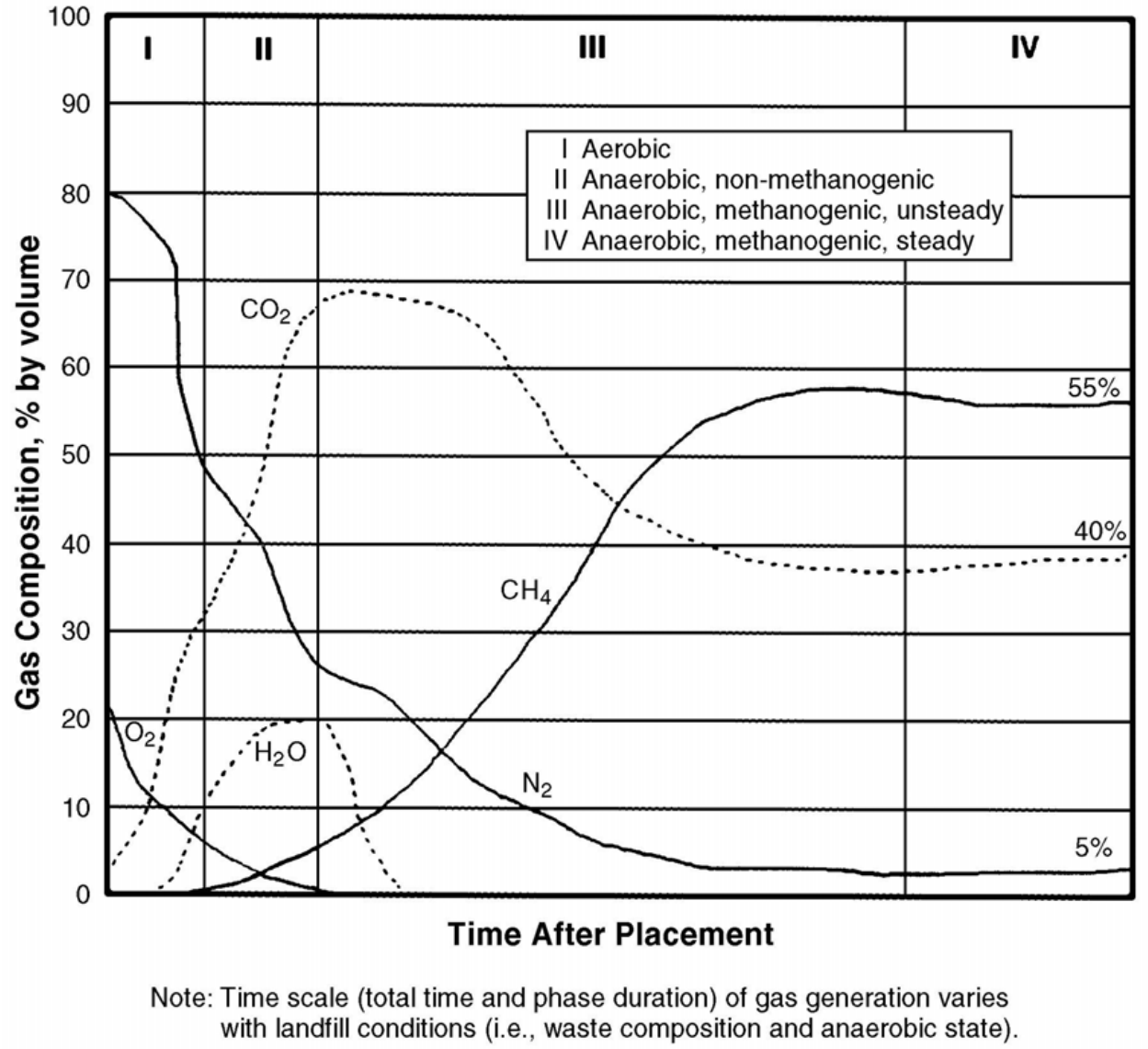

Figure 2-1. Landfill Gas Evolution (Tchobanoglous et al., 1993)

L&A also reviewed the landfill gas emission data for TO-15 compounds.

A review of the flare ***inlet*** landfill gas analyses shows 31 of 57 TO-15 constituents were detected at least once. The maximum concentration of each constituent in Countywide landfill gas is listed in Table A1.

Table A1. Maximum Concentrations of TO-15 Constituents Detected in Countywide Landfill Gas

Parameter Name	Max Value	Units	1ppm= ? mg/m3	Max pppmv
1,2,4-TRIMETHYLBENZENE	12000	ug/m3	5	2.40
1,2-DICHLOROETHANE	8700	ug/m3	4.12	2.11
1,2-DICHLOROTETRAFLUOROETHANE	2300	ug/m3	7.12	0.32
1,3,5-TRIMETHYLBENZENE	4900	ug/m3	5	0.98
1,3-BUTADIENE	8400	ug/m3	2.25	3.73
2-BUTANONE	1600000	ug/m3	3	533.33
2-HEXANONE	23000	ug/m3	4.17	5.52
4-ETHYLTOLUENE	4100	ug/m3	5.04	0.81
4-METHYL-2-PENTANONE	110000	ug/m3	4.21	26.13
ACETONE	2300000	ug/m3	2.42	950.41
BENZENE	980000	ug/m3	3.25	301.54
CARBON DISULFIDE	5400	ug/m3	3.16	1.71
CHLOROETHANE	15000	ug/m3	2.68	5.60
CHLOROMETHANE	30000	ug/m3	2.1	14.29
CIS-1,2-DICHLOROETHENE	2700	ug/m3	4.03	0.67
CYCLOHEXANE	12000	ug/m3	3.5	3.43
DICHLORODIFLUOROMETHANE	18000	ug/m3	5.03	3.58
ETHYL ACETATE	550000	ug/m3	3.66	150.27
ETHYLBENZENE	54000	ug/m3	4.41	12.24
METHYLENE CHLORIDE	5000	ug/m3	3.53	1.42
m-Xylene & p-Xylene	120000	ug/m3	4.41	27.21
N-HEPTANE	49000	ug/m3	4.17	11.75
N-HEXANE	33000	ug/m3	3.58	9.22
O-XYLENE	20000	ug/m3	4.41	4.54
STYRENE	2400	ug/m3	4.33	0.55
TETRACHLOROETHENE	4300	ug/m3	6.89	0.62
TETRAHYDROFURAN	2000000	ug/m3	3	666.67
TOLUENE	220000	ug/m3	3.83	57.44
TRICHLOROETHENE	3900	ug/m3	5.46	0.71
TRICHLOROFLUOROMETHANE	1300	ug/m3	5.72	0.23
VINYL CHLORIDE	2600	ug/m3	2.6	1.00

Landfill gas constituents have been monitored at hundreds of facilities. AP-42 provides estimates of concentrations of commonly found constituents. Table A2 presents a list of the gases typically found in MSW landfill gas, their typical concentrations, and the maximum concentrations found at Countywide. In addition, Table A2 provides a ratio of the maximum concentration found at Countywide (CW) to that listed in AP-42.

Table A2. Comparison of Countywide Landfill Gas to Typical LFG

Parameter Name	Common	Max PPM	AP-42 (ppmv)	WIAC-2 (ppmv)	Ratio CW / AP-42
1,1,1-TRICHLOROETHANE	Yes (Y)	U	0.48	0.168	
1,1,2,2-TETRACHLOROETHANE	Y	U	1.11	0.005	
1,1,2-TRICHLOROTRIFLUOROETHANE	Y*	U	19.7		
1,1-DICHLOROETHANE	Y	U	2.35	0.741	
1,1-DICHLOROETHENE	Y	U	0.2	0.092	
1,2-DICHLOROBENZENE	Y	U	0.21	1.448	
1,2-DICHLOROETHANE	Y	2.11	0.41	0.12	5.15
1,2-DICHLOROPROPANE	Y	U	0.18	0.023	
1,2-DICHLOROTETRAFLUOROETHANE	Y*	0.32	19.70		0.02
1,3-DICHLOROBENZENE	Y*	U	0.21	1.448	
1,4-DICHLOROBENZENE	Y*	U	0.21	1.448	
2-BUTANONE (MEK)	Y	533.33	7.09	12.694	75.22
4-METHYL-2-PENTANONE (MIBK)	Y	26.13	1.87	0.75	13.97
ACETONE	Y	950.41	7.01	7.075	135.58
BENZENE	Y	301.54	11.10	10.376	27.17
BROMODICHLOROMETHANE	Y	U	3.13	ND	
CARBON DISULFIDE	Y	1.71	0.58	0.221	2.95
CARBON TETRACHLORIDE	Y	U	0.004	ND	
CHLOROBENZENE	Y	U	0.25	0.227	
CHLOROETHANE	Y	5.60	1.25	0.448	4.48
CHLOROFORM	Y	U	0.03	0.01	
CHLOROMETHANE	Y	14.29	1.21	0.136	11.81
DICHLORODIFLUOROMETHANE	Y*	3.58	15.7	0.964	0.23
METHYLENE CHLORIDE	Y	1.42	14.30	3.395	0.10
m-Xylene & p-Xylene	Y	27.21	12.10	16.582	2.25
N-HEXANE	Y	9.22	6.57	2.063	1.40
O-XYLENE	Y	4.54	12.10	16.582	0.37
TETRACHLOROETHENE	Y	0.62	3.73	1.193	0.17
TOLUENE	Y	57.44	165.00	37.456	0.35
TRICHLOROETHENE	Y	0.71	2.82	0.681	0.25
TRICHLOROFLUOROMETHANE	Y*	0.23	0.76	0.327	0.30
VINYL CHLORIDE	Y	1.00	7.34	1.077	0.14

* Refers to class of chlorofluorocarbons (Freons)

Of the typical LFG constituents, five (2-butanone, benzene, acetone, MIBK, and chloromethane) are detected at Countywide at more than an order of magnitude above typical LFG (AP-42) concentrations. Table A2 also shows that there were 13 constituents commonly found in landfill gas that were not typically detected in the Countywide landfill gas. However, there were several constituents (summarized in Table A3) that were found in Countywide landfill gas that are not typically found in LFG.

Table A3. Countywide (CW) Constituents not Typically Found in Landfill Gas (LFG)

Parameter	Typical?	CW ppmv
1,2,4-TRIMETHYLBENZENE	No	2.40
1,3,5-TRIMETHYLBENZENE	No	0.98
1,3-BUTADIENE	No	3.73
2-HEXANONE	No	5.52
4-ETHYLTOLUENE	No	0.81
CIS-1,2-DICHLOROETHENE	No	0.67
CYCLOHEXANE	No	3.43
ETHYL ACETATE	No	150.27
ETHYLBENZENE	No	12.24
N-HEPTANE	No	11.75
STYRENE	No	0.55
TETRAHYDROFURAN	No	666.67

Of these, tetrahydrofuran and ethyl acetate are present at the highest concentrations.

Other TO-15 constituents neither typically found in landfill gas nor found in Countywide LFG are summarized in Table A4:

Table A4. TO-15 Constituents not Typically Found in LFG nor in Countywide LFG

Parameter	Typical?	CW ppmv
1,1,2-TRICHLOROETHANE	No	U
1,2,4-TRICHLOROBENZENE	No	U
1,2-DIBROMOETHANE	No	U
BENZENE, (CHLOROMETHYL)-	No	U
BROMOFORM	No	U
BROMOMETHANE	No	U
CHLORODIBROMOMETHANE	No	U
CIS-1,3-DICHLOROPROPENE	No	U
HEXACHLOROBUTADIENE	No	U
METHYL TERT-BUTYL ETHER	No	U
TRANS-1,2-DICHLOROETHENE	No	U
TRANS-1,3-DICHLOROPROPENE	No	U
VINYL ACETATE	No	U

Discussion:

Our review of the Countywide landfill gas data shows some potentially-significant differences in landfill gas composition; however, most of the constituents typically found in landfill gas are found in Countywide landfill gas at similar concentrations.

The presence of acetone, benzene, MEK, MIBK, tetrahydrofuran, and ethyl acetate at substantially-above-typical concentrations, suggests a contribution from the Countywide reaction conditions. It also appears that the Countywide reaction is interfering with some of the biological processes because there is still more oxygen than expected for a capped landfill; and less methane than expected. Methanogenic bacteria, in combination with other bacterial processes, should consume ethyl acetate and the other Countywide landfill gas constituents.

Their elevated presence in Countywide landfill gas may result from the heat of the reaction destroying the microorganisms and/or causing additional volatilization.

Potential Impact of Elevated LFG Constituents:

Of the compounds detected in Countywide LFG, 13 have an ATSDR acute MRL as noted in Table 4. For comparison purposes, the maximum possible concentration present in flare ***exhaust*** is also presented. Benzene is the principal constituent of concern from an acute standpoint because it is potentially present in flare exhaust at 2+ orders of magnitude above the MRL.

Table A5. Thirteen Compounds Detected in Countywide LFG Have Acute MRL

	Parameter Name	Max Result in ug/m3	After 98% removal	Max flare conc in ppb	acute mrl in ppb	fraction of mrl
1	ACETONE	2300000	46000	19008	26000	0.73
2	BENZENE	980000	19600	6031	9	670.09
3	CHLOROETHANE	15000	300	112	15000	0.01
4	CHLOROMETHANE	30000	600	600	500	1.20
5	ETHYLBENZENE	54000	1080	245	10000	0.02
6	METHYLENE CHLORIDE	5000	100	28	600	0.05
7	m-Xylene & p-Xylene	120000	2400	544	2000	0.27
8	O-XYLENE	20000	400	400	2000	0.20
9	STYRENE	2400	48	11	2000	0.01
10	TETRACHLOROETHENE	4300	86	12	200	0.06
11	TOLUENE	220000	4400	1149	1000	1.15
12	TRICHLOROETHENE	3900	78	14	2000	0.01
13	VINYL CHLORIDE	2600	52	20	500	0.04

Thus, the constituent of principal concern from an acute standpoint is benzene. None of the other constituents has a significant potential to cause acute effects.

L&A also compared Countywide LFG constituents to OhioEPA air toxics policy Maximum Acceptable Ground Level Concentrations (MAGLCs) and USEPA Region IX PRGs. Concentrations ***in flare exhaust*** with a nominal (10-fold dilution) are less than the MAGCLs or PRGs except for benzene and trichloroethene (PRGs) and benzene, 2-butanone, and

tetrahydrofuran (MAGLCs). Thus, there is little potential for off-site acute impacts from these constituents from the flares.

In addition, the instruments to be used to monitor VOCs at the perimeter of the landfill will detect any of the constituents with an acute MRL at levels of potential concern.

Summary:
Our review of the landfill gas information from the Countywide site indicates a somewhat different "fingerprint" of landfill gas emissions from that of a typical MSW landfill. Concentrations of acetone, benzene, MEK, MIBK, tetrahydrofuran, and ethyl acetate are higher than expected. Of these, benzene is the constituent with the greatest potential for health impact.

Each of these landfill gas constituents is easily biodegradable. Their presence in landfill gas suggests:

- There may be some interference with biological processes (perhaps due to elevated temperatures); or
- The higher-than-typical landfill temperatures causes these constituents to volatilize before they can be biodegraded.

The next attachment provides an estimate of the expected dispersion and the maximum landfill gas concentrations at the fenceline.

Attachment B. Implications of Dispersion Modeling

Lawhon & Associates, Inc., conducted air dispersion modeling for the Countywide Site to identify the locations of maximum expected impact of airborne constituents emanating from the facility. L&A used ISC-AERMOD (07026), the model currently recommended by USEPA and OhioEPA, under 3 scenarios:

- SCEN1: Area source from cells 1, 3, 4A, 4B, 6A (surrogate emission rate of 1ug/s/m^2)
- SCEN2: Area source from cells 1, 2, 3, 4A, 4B, 5A, 5B, 5C, 5D, 6A, 7 (surrogate emission rate of 1ug/s/m^2)
- FLARES: Point sources at locations of Flares 1, 2, 4, 5, 6, 7, 8 (each of 7 flares @ 1g/sec surrogate emission rate)

These were modeled using three averaging times:

- Annual average
- 24-hour average
- 1 hour average (shortest averaging time available w/model, in process)

The model predicts the maximum fenceline concentration of benzene under each scenario as shown in Table B1 below: The modeled concentrations were derived using a surrogate emission rate of 1 g/sec for each flare and 1ug/s/m^2 for each area source. Each of the surrogate maximum concentrations are related to actual concentrations as measured in the Countywide landfill gas in Table B1.

The actual concentrations were calculated based upon worst case benzene concentrations in uncontrolled flare gas times the actual flare gas inlet volume of 6,500 scfm. This emission rate was multiplied by 0.02 to account for the 98% minimum flare destruction efficiency. This assumption is conservative, in part because the benzene and the other constituents in landfill gas are very combustible.

Similarly, the area flux was estimated by assuming that the landfill gas collection system collects only 75% of the total landfill gas, per AP-42. This is also a very conservative assumption in that most of the landfills do not have the extensive cover system employed at Countywide and do not have the density of wells, nor the operational information that shows that the flares typically maintain a slight vacuum on the landfill gas collection wells.

Thus, only if the worst case assumptions are realized, fenceline concentrations of benzene are expected to only occasionally exceed 9 ppb – the acute MRL for benzene (and the only acute MRL of concern amongst the Countywide landfill gases; See Table A5) – even using a 1-hour averaging time.

Table B1. Summary of Countywide Air Dispersion Modeling

Scenario	Average Time	Surrogate Emission Rate in g/sec	Location of max Conc.	Max Benzene Emission Rate g/sec	Surrogate Max Conc.	Actual Max Conc. ug/m3	Actual max Benzene Conc in ppb
Scen1, Area Source	annual	0.17	E	0.392	0.45	1.038	0.3193
Scen1, Area Source	24-hour	0.17	E**, N, W, S	0.392	2.5	5.765	1.7738
Scen1, Area Source	1-hour	0.17	E	0.392	20.1	46.348	14.2610
Scen2, Area Source	annual	0.433	E	1	1.02	2.356	0.7248
Scen2, Area Source	24-hour	0.433	E**, N, W, S	1	4.1	9.469	2.9135
Scen2, Area Source	1-hour	0.433		1	48.1	111.085	34.1801
Flares, 7 point sources	annual	7	E	0.06	4.85	0.042	0.0128
Flares, 7 point sources	24-hour	7	E**, W, N	0.06	30.4	0.261	0.0802
Flares, 7 point sources	1-hour	7	N	0.06	18.7	0.160	0.0493

*preliminary
** Highest concentration
SCEN1 = 42 acres = 169,974 ug/sec = 0.169 g/sec surrogate emission rate
At 75% capture, actual emission rate = 42/107 * 0.25 * 4 g/sec = 0.392 g/sec;
3g/sec = 75%. 100% = 4 g/sec
SCEN2 = 107 acres = 433,029 ug/sec = 0.433 g/sec surrogate emission rate
At 75% capture over the entire 107 acres = 0.25 * 4 g/sec per AP-42

Example: the Flares scenario assumed a mass emission rate of 1g/sec of a generic gas from each of 7 flare stacks. The model output from this scenario indicated a fenceline point of maximum impact along the eastern edge of the facility. The maximum 24-hr concentration at this location under this emission rate was 30.4 ug/m^3 (compare against the modeled maximum annual average concentration at this location of 4.8 ug/m^3).

Actual emissions from the flares would be less than 1% of the modeled 7 g/sec. Thus, the maximum concentration expected at the fenceline under this scenario is 0.261 ug/m^3 = 0.08 ppb. L&A used this information to estimate the potential for finding unacceptable VOC impacts at the fenceline due to migration of uncontrolled landfill gas emissions and determined that there is no possible mechanism for enough landfill gas to escape the flares (or be vented through the cover under current conditions) to cause unacceptable fenceline VOC impacts.

Example. The constituent of greatest potential concern is benzene due to its presence in landfill gas and its toxicity. The maximum concentration of benzene detected in *uncontrolled landfill gas* (flare inlet) is 980,000 ug/m^3. There are three flares that routinely operate to yield ~6,500 scfm (=184 m^3/min = 3.07 m^3/sec). The mass emission rate of benzene that would be exhausted if the seven flares did NOT destroy any benzene would be:

980,000 ug/m^3 x 3.07 m^3/sec x 1g/1E06ug = 3.0 g/second for all flares

The dispersion modeling assumed seven flares exhaust 1 g/second each (total of ~16,700 scfm). Thus, the modeled emission rate is 2.3 times greater than the *uncontrolled landfill gas*

emission rate under Scenario 3. And with a 98% destruction efficiency, the actual emission rate would be 3 * 0.02 = 0.06 g/s

The modeling report shows that the *maximum concentration of benzene at the fenceline would be 30.4 ug/m^3* if all the flares failed and the exhausted 7 g/sec of benzene (as modeled) were to be emitted. Note that the point of maximum impact is ~300 feet downwind of the closest flare.

However, we know that the actual maximum emission rate for benzene from the flares is 0.06 g/second. Thus, the maximum point of impact (24 hr average) would be:

0.06/7 * 30.4 ug/m^3 = **0.26 ug/ m^3** * 1 mg/1000 ug * 1 ppm/3.25 mg/m^3 = **0.08 ppb**

Thus, any continuous monitoring device would have to have a sensitivity of lower than 0.08 ppb to reliably detect the actual 24-hour landfill-gas-generated concentrations from the flares.

Summary:

The air dispersion modeling demonstrates that there is so much dispersion even in an area source scenario that uncontrolled landfill gas emissions will result in concentrations at the fenceline in the low-ppb range.

However, that same level of dispersion should allow successful identification of significant uncontrolled landfill gas emissions because uncontrolled landfill gas has concentrations of VOCs greater than 2,000 ppm. Thus, a serpentine walkover survey that begins at the downwind fenceline and works back toward the source should be able to identify significant uncontrolled landfill gas emissions.

Attachment C. Countywide Landfill Gas Composition: Implications for Monitoring

There are eight constituents that are typically present in Countywide landfill gas. All but two (chloromethane and ethylbenzene) are present at concentrations within one order of magnitude of the benzene concentration as shown in Table C1. Thus, if a given ambient sample contains detectable concentrations of benzene *and is the result of migration of uncontrolled* ***Countywide*** *landfill gas emissions*, it should also contain detectable levels of acetone, MEK, MIBK, tetrahydrofuran, and ethyl acetate.

Table C1. Ratio of benzene concentration to other seven LFG principal constituents

#	Parameter Name	Number of LFG Samples	**Ratio of Benzene Conc, to**	Max ratio	Min ratio	std dev	mean +2sd
1	2-BUTANONE	1699	**1.293**	10.462	0.100	1.150	3.59
2	ACETONE	1699	**0.899**	6.753	0.100	0.906	2.71
3	BENZENE	1699	**1.000**	1.000	1.000	0.000	1.00
4	CHLOROMETHANE	1699	**304.490**	72549.020	2.097	2601.597	5507.68
5	ETHYL ACETATE	1699	**7.579**	173.684	0.254	14.216	36.01
6	ETHYLBENZENE	1699	**15.398**	69.444	0.681	11.905	39.21
7	TETRAHYDROFURAN	1699	**1.433**	10.833	0.230	1.394	4.22
8	TOLUENE	1699	**4.502**	16.154	0.143	2.715	9.93

Attachment D. Constituents of Potential Concern and Odor

L&A will tabulate all TO-15 results and compare found constituent concentrations (including TICs) to chronic and acute health-based levels, including MRLs, USEPA Region IX preliminary remedial goals (PRGs), and OhioEPA Air Toxics Policy MAGCLs.

L&A continues to evaluate found constituents in ambient air samples against health based values and odor thresholds to better understand the correlation between odor complaints, ambient air concentrations of constituents, and the potential for acute or chronic health effects.

Thus, this program is designed to determine if there are any correlations of detectable odors and unacceptable potential for community exposure.

Countywide Recycling & Disposal Facility
Air Dispersion Modeling

May 22, 2008

To Fulfill the Requirements Set Forth in Order 5.A. of the Ohio EPA Director's Findings and Orders Dated March 28, 2007

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Introduction

Air dispersion modeling was performed at the Countywide Recycling & Disposal Facility located north of Bolivar, Ohio in Stark County. The purpose of the modeling was to provide information on the locations of expected maximum concentrations due to air emissions from the facility. This information will be used in selecting one or more monitoring sites. This modeling analysis was done to fulfill requirements set forth in Order 5.A. of the Ohio EPA Director's Findings and Orders dated March 28, 2007.

This report presents the technical approach that was followed in performing the required air dispersion modeling as well as the modeling results. The report is organized into sections that describe the model used, the location of the site being modeled, source parameters, Good Engineering Practice (GEP) stack height/building downwash considerations, modeling scenarios, terrain data, meteorological data, receptor locations, and results. Figures are located at the end of the document. In figures showing receptor locations or modeling results, the numbers along the left side and bottom are Universal Transverse Mercator (UTM) coordinates.

Modeling was done following the procedural policies of USEPA (USEPA 2005a) and Ohio EPA (Ohio EPA 2003). With some exceptions, the modeling was done as described in the protocol approved by Ohio EPA (Lawhon, 2007). Exceptions to the protocol methodology were made in response to Ohio EPA comments (Hodanbosi, 2007) and to correct errors or eliminate computational problems. All methodology changes are clearly noted throughout the report in text boxes labeled Protocol Exception. Modeling input and output files for this project will be supplied on compact disc.

Model Selection

Modeling was done using AERMOD (07026), which is the model currently recommended by USEPA and Ohio EPA for regulatory use (USEPA 2005a). AERMOD is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources, including point, area, and volume sources (USEPA 2004a, 2006a). The Lakes Environmental software package ISC-AERMOD View (version 5.6.0) was used to prepare the AERMOD input files and process output data for presentation. Current versions of the USEPA AERMAP and AERMET programs were used to process some of the input files for AERMOD. The use of these programs is discussed below in sections describing terrain and meteorological data.

AERMOD was run in its default, regulatory mode to compute ground-level air concentrations. Deposition was not considered.

Location

As shown on Figure 1, the facility is a landfill located just east of Interstate 77 and approximately 2 km north of Bolivar, Ohio. Terrain in the area around the landfill is hilly. Much of the surrounding land is undeveloped farmland with small forested areas scattered within, and the remainder is primarily residential. Several residences are located nearby. As shown in Figure 1, the area within 3 km of the site is predominantly rural for modeling purposes.

Source Description

The facility consists of an 88.2-acre municipal solid waste landfill. An aerial map of the site showing property lines and the area that has been used as a landfill is shown on Figure 2. The landfill area is divided into cells as shown on Figure 3. Landfill cells 1 through 6A constitute the original landfill area. Cells 7 and 8A have been used more recently, and the remainder of the cells will be used in the future. In addition to the landfill cells, seven flares that are used to burn off landfill gas from the gas collection system were also modeled. All the modeled sources are listed in Table 1 and shown on Figure 3.

In Table 1, landfill cells are designated as the source type AREAPOLY, which is the AERMOD designation for an area source that is non-rectangular. Both area sources were modeled with release heights set to zero and with initial vertical dispersion parameters also equal to zero.

Table 1. Summary of sources to be modeled

Source ID	Description	Source Type
SCEN1	Affected Area: Cells 1, 3, 4A, 4B, and 6A	AREAPOLY
SCEN2	Cells 1, 2, 3, 4A, 4B, 5A, 5B, 5C, 5D, 6A, and 7	AREAPOLY
FLARE1	Flare Station #1	POINT (flare)
FLARE2	Flare Station #2	POINT (flare)
FLARE4	Flare Station #4	POINT (flare)
FLARE5	Flare Station #5	POINT (flare)
FLARE6	Flare Station #6	POINT (flare)
FLARE7	Flare Station #7	POINT (flare)
FLARE8	Flare Station #8	POINT (flare)

Protocol Exception

- Individual cells shown in the protocol were replaced with combined area sources in response to comments from Ohio EPA (Hodanbosi, 2007).
- The list of flares to be modeled was modified to reflect information from Republic Services that FLARE3 is no longer operated and FLARE8 was constructed and is operating. These changes are also reflected on Figure 3.

As noted in Table 1, the flares are modeled as point sources. Because flares have open flames instead of a typical stack exhaust, "equivalent" point source parameters were assumed or computed for modeling purposes using the following procedure (Ohio EPA, 2003):

1. Compute the equivalent release height from

$$Height_{equiv.} = Height_{actual} + 0.944(Q)^{0.478} \quad (1)$$

Where the heights are in units of meters and Q is the heat release rate in MMBtu/hour.

2. Assume temperature of 1273 K.

3. Assume exit velocity of 20 m/s.

4. Compute the equivalent diameter in units of meters from

$$Diameter_{equiv.} = 0.1755(Q)^{0.5} \quad (2)$$

Values for Q were computed from flare design flow rates using the following equation:

$$Q = Flow \times HV \times 60 / 1{,}000{,}000 \quad (3)$$

Where Flow = design flow rate through flare in units of standard cubic feet per minute (scfm)

HV = heat content in units of Btu/scf of landfill gas, taken as 200 Btu/scf based on the average measured values for January through March, 2007.

The constants convert units from Btu/min to MMBtu/hr.

Substituting the value for HV and simplifying yields

$$Q = 0.012 \times Flow \quad (4)$$

Values for modeling parameters for the flares are listed in Table 2.

Table 2. Flare specifications used for modeling.

Source ID	Flow (scfm)	Q (MMBtu/hr)	$Height_{actual}$ (m)	$Height_{equiv}$ (m)	Velocity (m/s)	Temperature (K)	$Diameter_{equiv}$ (m)
FLARE1	3,000	36.0	10.1	15.29	20.0	1273	1.05
FLARE2	2,100	25.2	10.6	14.98	20.0	1273	0.88

FLARE4	3,014	36.2	13.1	18.30	20.0	1273	1.06
FLARE5	1,350	16.2	8.7	12.31	20.0	1273	0.71
FLARE6	2,100	25.2	10.2	14.57	20.0	1273	0.88
FLARE7	3,014	36.2	13.1	18.30	20.0	1273	1.06
FLARE8	2,131	25.6	10.2	14.61	20.0	1273	0.89

Good Engineering Practice (GEP) Stack Height/Building Downwash

No buildings are located near enough to the flares to need to be included in the modeling. Therefore, GEP stack height and building downwash are not important in this study.

Modeling Scenarios

As specified in Zima (2007), the following three source scenarios were modeled: (1) Cells 1 through 6A, (2) the entire landfill area, and (3) the flares. For all scenarios, both 24-hour and annual averaging times were modeled. Sources and emission rates modeled in each scenario are described below.

Scenario 1 (Affected Area)

In this scenario, landfill Cells 1, 3, 4A, 4B, and 6A were modeled as a single area source. A surrogate emission rate of 1 millionth of a gram/second/square meter (10^{-6} g/s/m^2) were used for all sources.

Scenario 2 (Cells 1-7)

In this scenario, landfill cells 1, 2, 3, 4A, 4B, 5A, 5B, 5C, 5D, 6A, and 7 were modeled as a single area source. As in Scenario 1, the source was modeled using a surrogate emission rate of 10^{-6} g/s/m^2.

Scenario 3 (Flares)

In this scenario, only the seven flares listed in Table 1 were included in the modeling. As directed in Zima (2007), each flare was modeled using a surrogate emission rate of 1 g/s.

Protocol Exception

- The definitions of which landfill cells to include in Scenarios 1 and 2 and how they were to be modeled (individual cells vs. all cells grouped into a single area source) were changed from the protocol in response to Ohio EPA comments (Hodanbosi, 2007).

- The surrogate emission rate used in modeling area sources was reduced from the 1 g/s/m^2 proposed in the protocol and suggested in Ohio EPA comments to (10^{-6} g/s/m^2 in order to prevent numerical format errors in the output files and to produce output concentrations in a more convenient numerical range for plotting purposes.

Meteorological Data

National Weather Service (NWS) meteorological data for the years 1986 through 1990 were used in the modeling analysis. These are the most recent five years of data available on the USEPA's SCRAM internet site. Surface data for the Akron/Canton Airport (station 14895) and upper air data for the Pittsburgh Airport (station 94823) were obtained from the internet site http://www.webmet.com/ and processed for use in AERMOD using the preprocessing program AERMET (06341) (USEPA 2004b, 2006b).

In using AERMET to prepare the meteorological data for AERMOD, three surface characteristics must be provided as inputs, the surface roughness (z_o), the Albedo (r), and the Bowen ratio (B_o). In this case, values for all three parameters were selected based on an urban setting around the Akron/Canton airport where meteorological data were obtained.

AERMET allows the values of micrometeorological parameters to vary seasonally or monthly and by wind direction sector. For this project, values were adjusted seasonally, but not by wind direction. The values used in processing meteorological data for this project are shown in Table 3.

A wind rose diagram is given in Figure 4 showing the frequencies of wind speeds and directions over the 5-year period 1986 through 1990. As shown, the wind blows predominantly toward the northeast.

Protocol Exception

The approach to defining micrometeorological parameters that was proposed in the protocol was changed in response to a comment from Ohio EPA (Hodanbosi, 2007). Specifically, all values are defined for the area around the meteorological station rather than the site, and no wind sectors were used in defining the parameters.

Table 3. Meteorological parameter values.

Season	Albedo, r	Bowen Ratio, B_o	Surface Roughness, z_o (m)
Winter	0.35	1.5	0.5
Spring	0.14	1.0	1.0
Summer	0.16	2.0	1.3
Autumn	0.18	2.0	0.8

Note: Values of r, z_o, and B_o are based on an urban land use around the Akron-Canton Regional Airport. B_o values are for average wetness conditions. All values are taken from USEPA (2004b).

Receptors

Receptors were placed at the locations of nearby residences and in grids around the landfill at intervals sufficient to find the 24-hour and annual points of maximum concentration for each scenario. Receptors were placed every 50 feet along the property line as shown on Figure 5. A 1-kilometer (km) grid was placed around the property to a distance of 16 km (Figure 6), and a 100-meter grid was positioned to cover the nearest 1 km around the property line (Figure 7).

Protocol Exception

- A 1-km receptor grid to a distance of 16 km (approximately one mile) was added in response to a comment from Ohio EPA (Hodanbosi, 2007).
- The receptor spacing around the property line was changed from 100 meters to 50 meters in response to Ohio EPA comments.

Initial modeling was done using the property line, 100-meter, and 1-km receptor grids. Then, 10-meter grids were added to further refine the locations of the maximum concentrations. One 10-meter grid was defined to the east of the property line that covered a distance of approximately 500 meters around the maximum receptors for the different scenarios and averaging times. This grid is shown on Figure 8. For one combination of scenario, averaging time, and year, the maximum concentration occurred to the west instead of to the east. For that combination, another similar 10-meter grid was added to the west of the property line to a distance of 500 meters. The western 10-meter grid is shown on Figure 9.

Terrain Data

Digital terrain data files were obtained from the internet site (http://data.geocomm.com/catalog/US/61070/807/group4-3.html). These 24-Minute Digital Elevation Model (DEM) files were processed using the program SDTS2DEM (Version 0.018, April 29, 2002), a utility program by Mr. Sol Katz, available on the internet at http://data.geocomm.com/dem/sdts2dem.html. Receptor elevations and terrain height scales needed for AERMOD were determined from the DEM files using the terrain preprocessor program AERMAP (06341) (USEPA 2004c, 2006c). In order to cover the same 2 mile by 2 mile area over which receptors were placed, DEM files were obtained and used for the following USGS quadrants: Bolivar, Canton East, Canton West, Dellroy, Dover, Malvern, Massilon, Mineral City, Navarre, Robertsville, Strasburg, and Waynesburg.

Results

As discussed above, the model was set to generate concentrations at all receptors for two averaging times (24-hour and annual) and three scenarios. The desired results of this modeling study were locations of maximum impact rather than predicted concentration values. Because of this, surrogate emission rates were used in the modeling. Concentration values are shown on the results figures discussed below, but these values are only useful in comparing the relative

concentrations of different locations within a single scenario. Comparisons of the concentration impact of one scenario versus another are not valid, nor are comparisons with any concentration standard, toxicity limit, or odor threshold.

Separate mode runs were made for each of five years of meteorological data. Each year's results are tabulated for all scenarios and averaging times in Table 4 with the year producing the highest maximum concentration highlighted. As shown, 1986 meteorological data produced the highest concentrations for all scenarios except the annual averaging time for the flares scenario (Scenario 3). For that combination, the 1990 meteorological data set yielded the highest concentrations.

Table 4. Maximum modeling results for each year, averaging time, and scenario.

Scenario	Averaging Time	Year	Concentration	UTM Coordinates (m) x	UTM Coordinates (m) y
1 (Affected Area)	24 hours	1986	2.5	464361.25	4502902.50
1 (Affected Area)	24 hours	1987	2.15	464379.81	4502857.50
1 (Affected Area)	24 hours	1988	1.82	464361.25	4502902.50
1 (Affected Area)	24 hours	1989	1.76	464379.81	4502857.50
1 (Affected Area)	24 hours	1990	2.09	464379.81	4502857.50
1 (Affected Area)	Annual	1986	0.45	464379.81	4502857.50
1 (Affected Area)	Annual	1987	0.42	464379.81	4502857.50
1 (Affected Area)	Annual	1988	0.43	464379.81	4502857.50
1 (Affected Area)	Annual	1989	0.36	464379.81	4502857.50
1 (Affected Area)	Annual	1990	0.40	464361.25	4502902.50
2 (Cells 1-7)	24 hours	1986	4.11	464416.94	4502767.50
2 (Cells 1-7)	24 hours	1987	3.70	464435.50	4502722.50
2 (Cells 1-7)	24 hours	1988	3.95	464420	4502760
2 (Cells 1-7)	24 hours	1989	3.29	463294.34	4503112.50
2 (Cells 1-7)	24 hours	1990	3.69	464420	4502760
2 (Cells 1-7)	Annual	1986	1.02	464420	4502760
2 (Cells 1-7)	Annual	1987	0.92	464420	4502760
2 (Cells 1-7)	Annual	1988	0.98	464420	4502760
2 (Cells 1-7)	Annual	1989	0.82	464420	4502760
2 (Cells 1-7)	Annual	1990	0.93	464420	4502760
3 (Flares)	24 hours	1986	30.4	464520	4502520
3 (Flares)	24 hours	1987	27.9	464540	4502470
3 (Flares)	24 hours	1988	28.0	464520	4502520
3 (Flares)	24 hours	1989	25.3	464491.16	4502587.50
3 (Flares)	24 hours	1990	24.0	464540	4502480
3 (Flares)	Annual	1986	4.59	464500	4502590
3 (Flares)	Annual	1987	4.38	464520	4502570
3 (Flares)	Annual	1988	4.80	464520	4502560
3 (Flares)	Annual	1989	4.29	464510	4502570
3 (Flares)	Annual	1990	4.85	464480	4502620

In all combinations of scenario, year, and averaging time, maximum concentrations occurred at or very near the property line. In all but one case, the maximum concentration was on the eastern side of the landfill. The exception occurred in 1989 when the maximum 24-hour concentration for Scenario 2 occurred to the west of the property line. As a result, an additional model run was done for that year with a 10-meter receptor grid located to the west of the property as discussed above and shown on Figure 9. To save execution time, the western 10-meter grid was not modeled in any other run.

Modeling results for the years yielding the maximum concentrations for each scenario are presented graphically in this report as concentration isopleths overlaid on an aerial photo. Isopleths are lines of constant concentration that were generated by the ISC-AERMOD View software from the receptor locations and concentrations predicted by AERMOD.

They provide a visual representation of how maximum concentrations predicted by the model vary spatially. Bands between the isopleth lines are shaded in different colors to show at a glance where similar concentrations occur. In this report, the red areas denote areas with concentrations above approximately 75 percent of the maximum concentration found anywhere. The concentration value of the lowest isopleth was set at approximately 10 percent of the maximum concentration. Areas that are not colored are either inside the property line where no concentrations were computed or are beyond the lowest isopleth line and have concentrations of less than about 10 percent of the maximum.

For Scenario 1 (Impacted Area), 24-hour concentration isopleths for the year 1986 are shown on Figure 10. Figure 11 shows a close-up view of the maximum impact area with predicted concentrations posted at each receptor location. Similarly, annual concentration isopleths for 1986 are shown on Figure 12, with a close-up view of the maximum concentration area shown on Figure 13. As shown, the locations of the maximum concentrations for both averaging times for this scenario occur in the same vicinity just east of the property line.

For Scenario 2 (Cells 1-7), 24-hour concentration isopleths for the year 1986 are shown on Figure 14. Figure 15 shows a close-up view of the maximum impact area with predicted concentrations posted at each receptor location. Similarly, annual concentration isopleths for 1986 are shown on Figure 16, with a close-up view of the maximum concentration area shown on Figure 17. As shown, the locations of the maximum concentrations for both averaging times for this scenario occur in the same vicinity just east of the property line. In 1989, maximum 24-hour results occurred west of the plant. However, as shown in Table 4, the 1989 maximum was lower than the maximum concentration predicted to the east in 1986. Thus, only the 1986 data are presented graphically.

For Scenario 3 (Flares), 24-hour concentration isopleths for the year 1986 are shown on Figure 18. Figure 19 shows a close-up view of the maximum impact area with predicted concentrations posted at each receptor location. Similarly, annual concentration isopleths for 1990 are shown on Figure 20, with a close-up view of the maximum concentration area shown on Figure 21. As shown, the locations of the maximum concentrations for both averaging times for this scenario occur in the same vicinity as each other just east of the property line.

In summary, the area showing the maximum concentration varies somewhat by scenario and averaging time, but all occur at or near the eastern edge of the property. The maximum impact area of the two landfill scenarios is very similar, and the maximum impact area for the flares scenario is just south of the landfill scenarios.

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Ohio EPA (2003) *Air Dispersion Modeling Guidance*, Division of Air Pollution Control, Air Quality Modeling and Planning Section, Engineering Guide #69.

USEPA (2004a) *Users Guide for the AMS/EPA Regulatory Model - AERMOD*, EPA-454/B-03-001, September.

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USEPA (2006c) *Addendum: Users Guide for the AERMOD Terrain Preprocessor (AERMAP)*, EPA-454/B-03-003, December.

Zima, Bryan (2007) Letter from Ohio EPA to Jason Perdion, Baker & Hostetler, LLP, March 28.

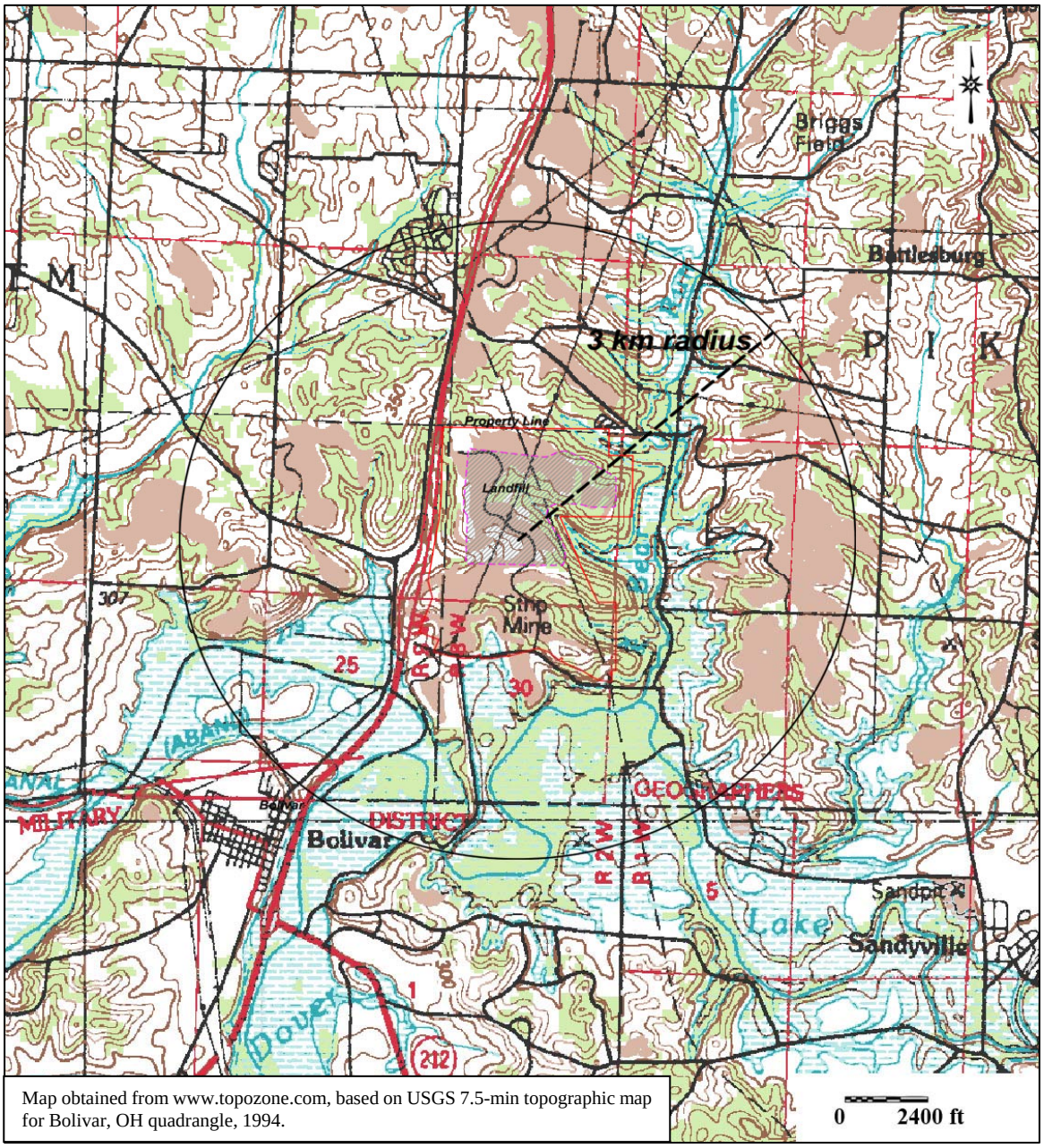


Figure 1. USGS topographic map showing location of Countywide Facility with 3-km circle.

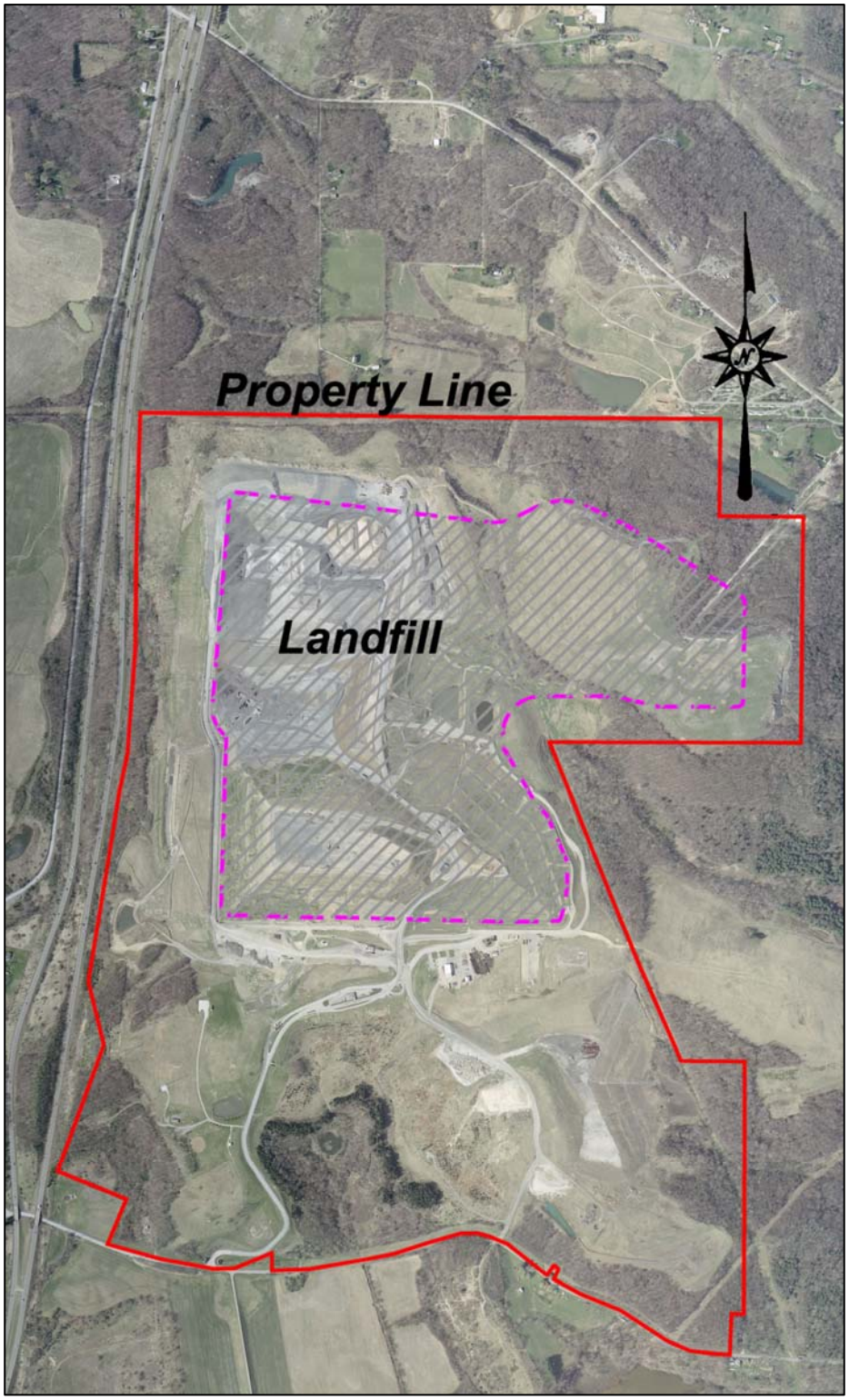


Figure 2. Aerial Map showing property line of the Countywide Facility.

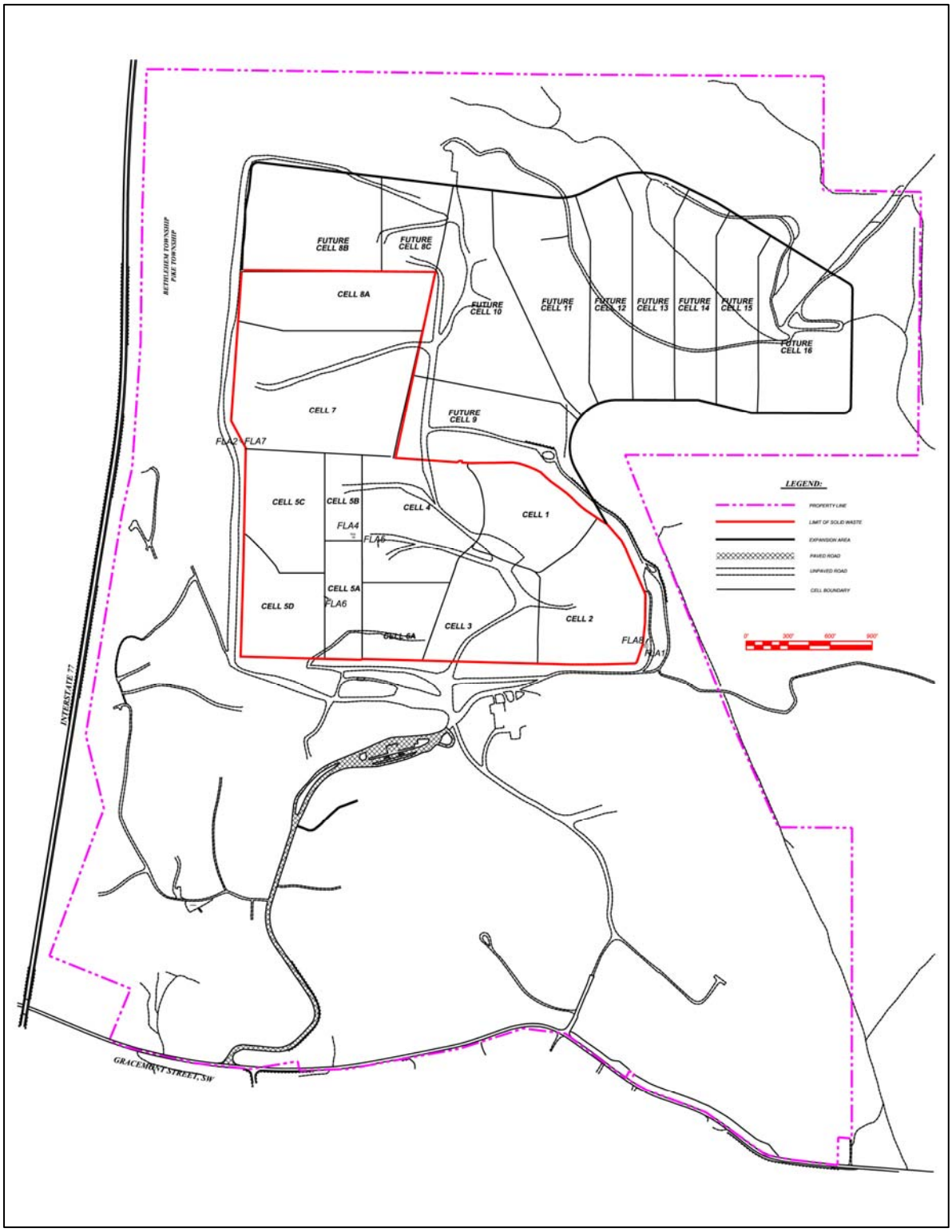


Figure 3. Site map of the Countywide Facility showing modeled sources.

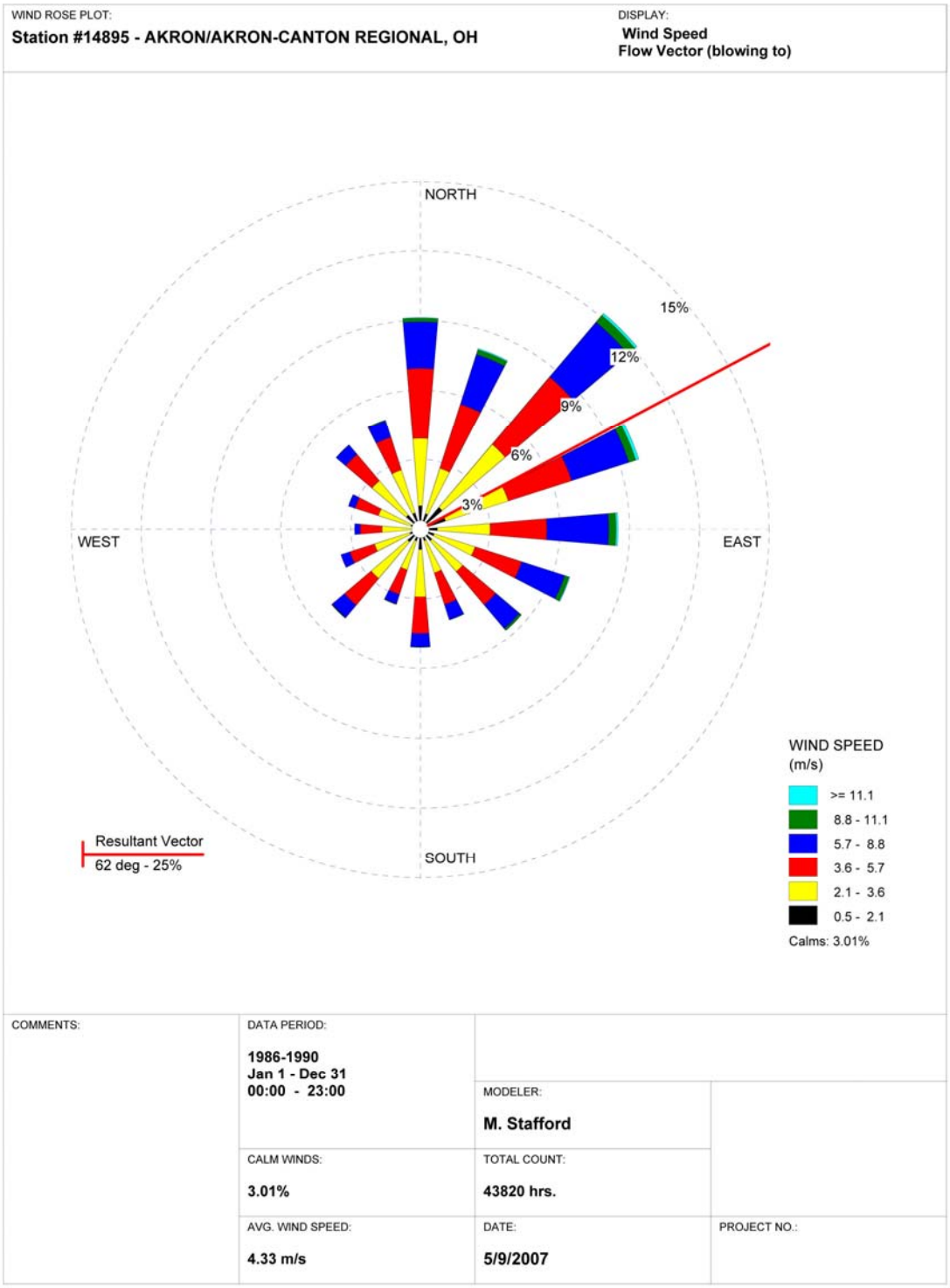


Figure 4. Wind Rose for Akron-Canton Airport.

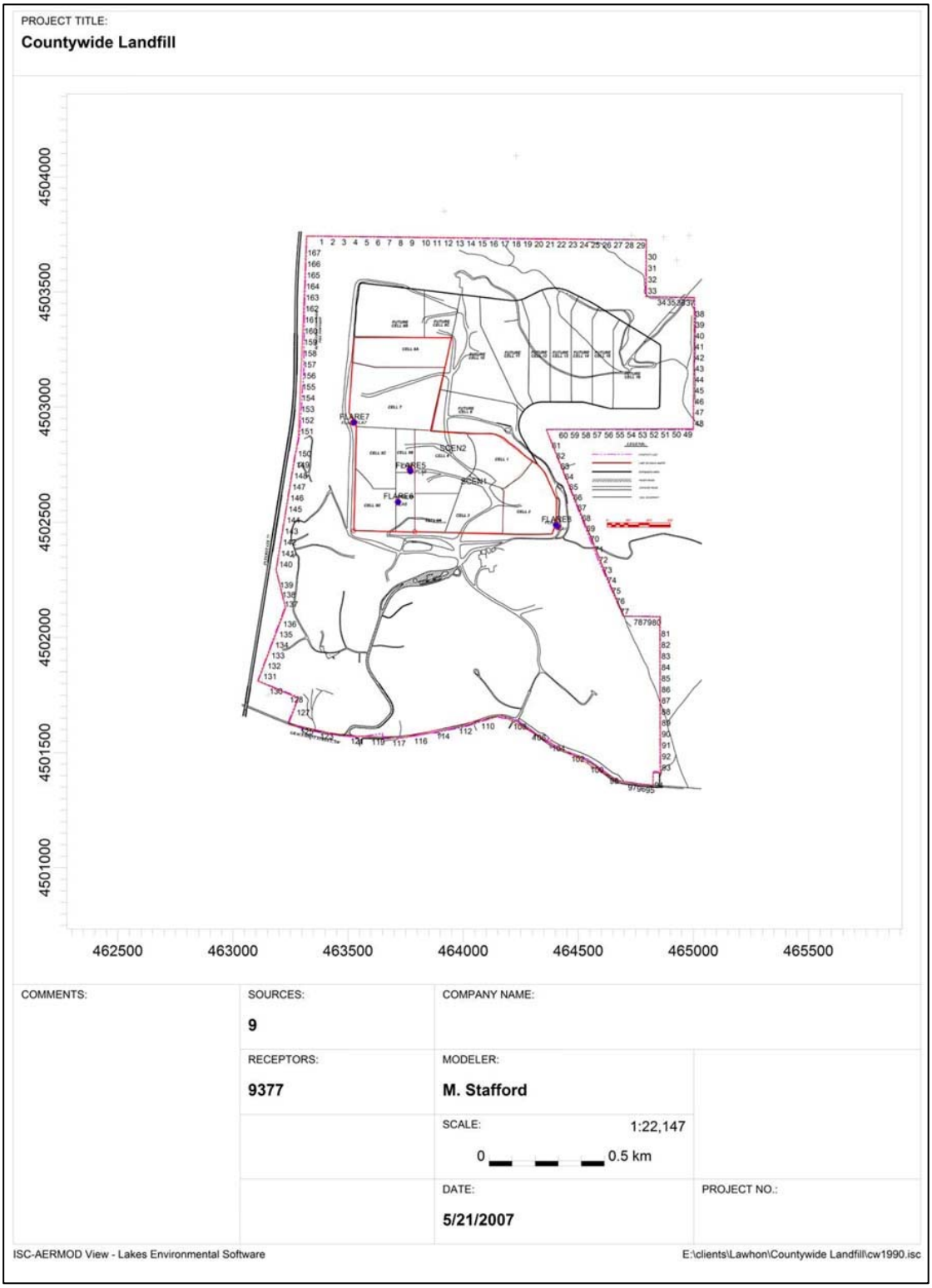


Figure 5. Fenceline (50-m) receptor grid.

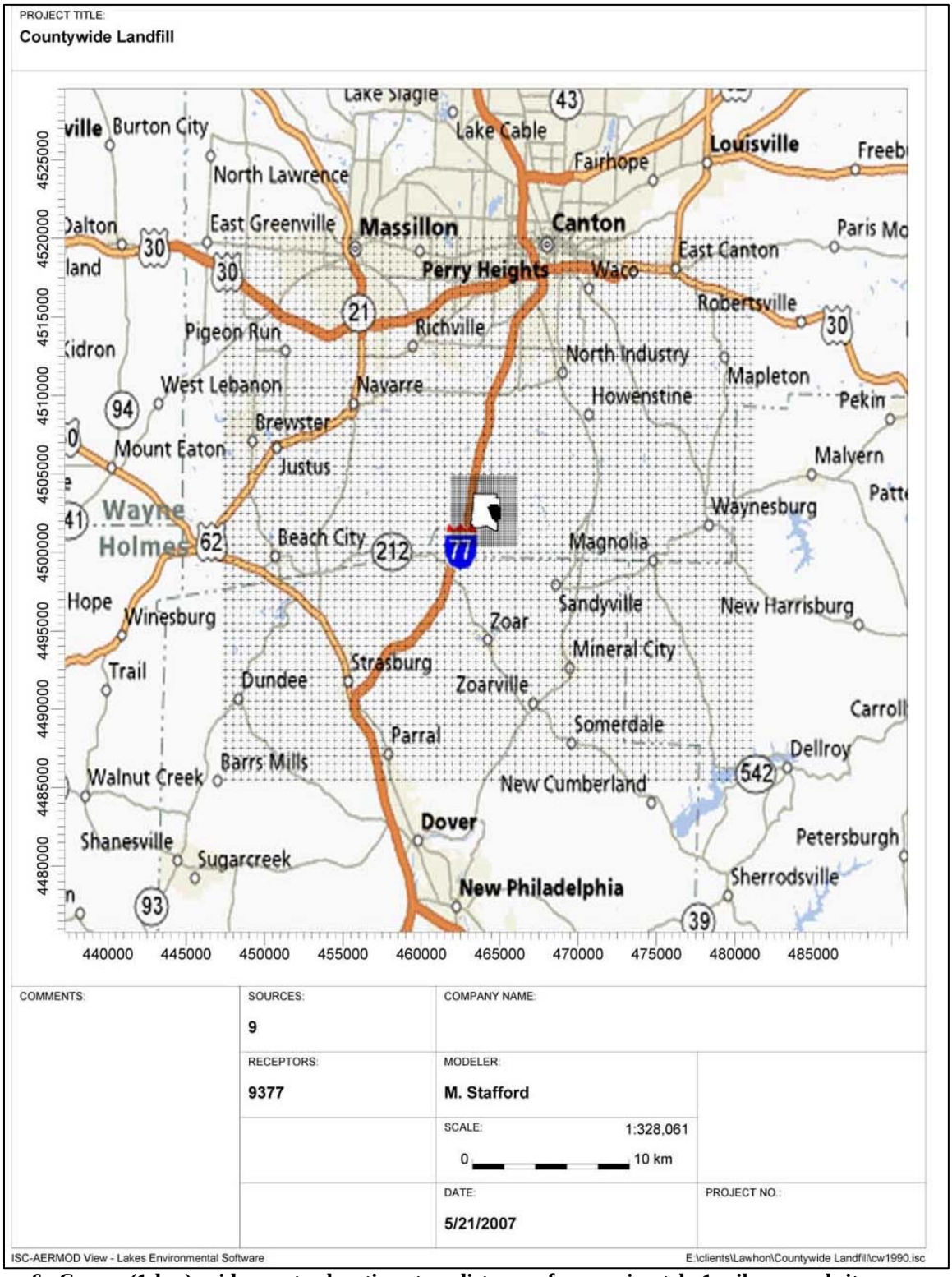


Figure 6. Coarse (1-km) grid receptor locations to a distance of approximately 1 mile around site.

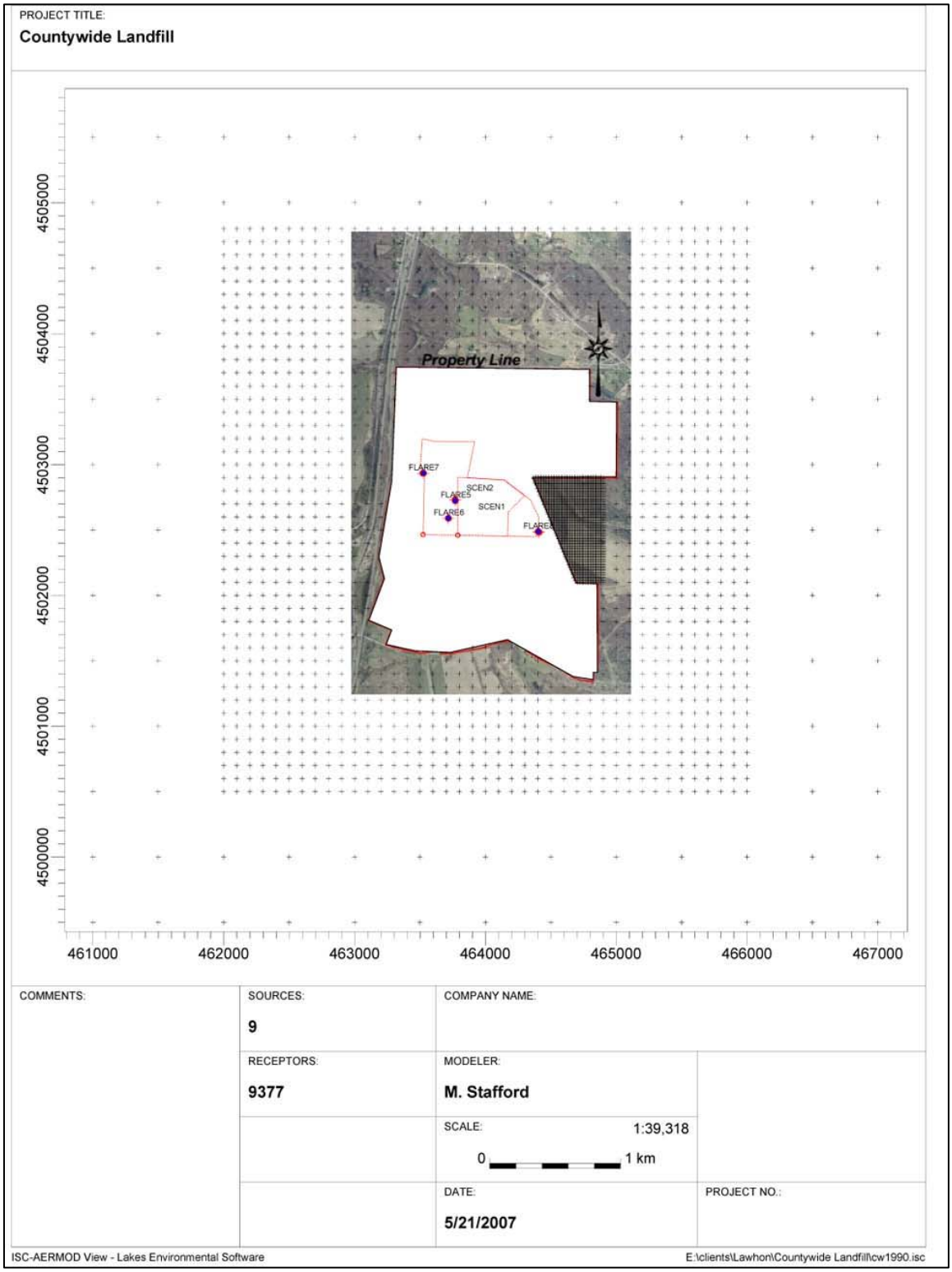


Figure 7. Medium (100-m) receptor grid to a distance of approximately 1 km from site.

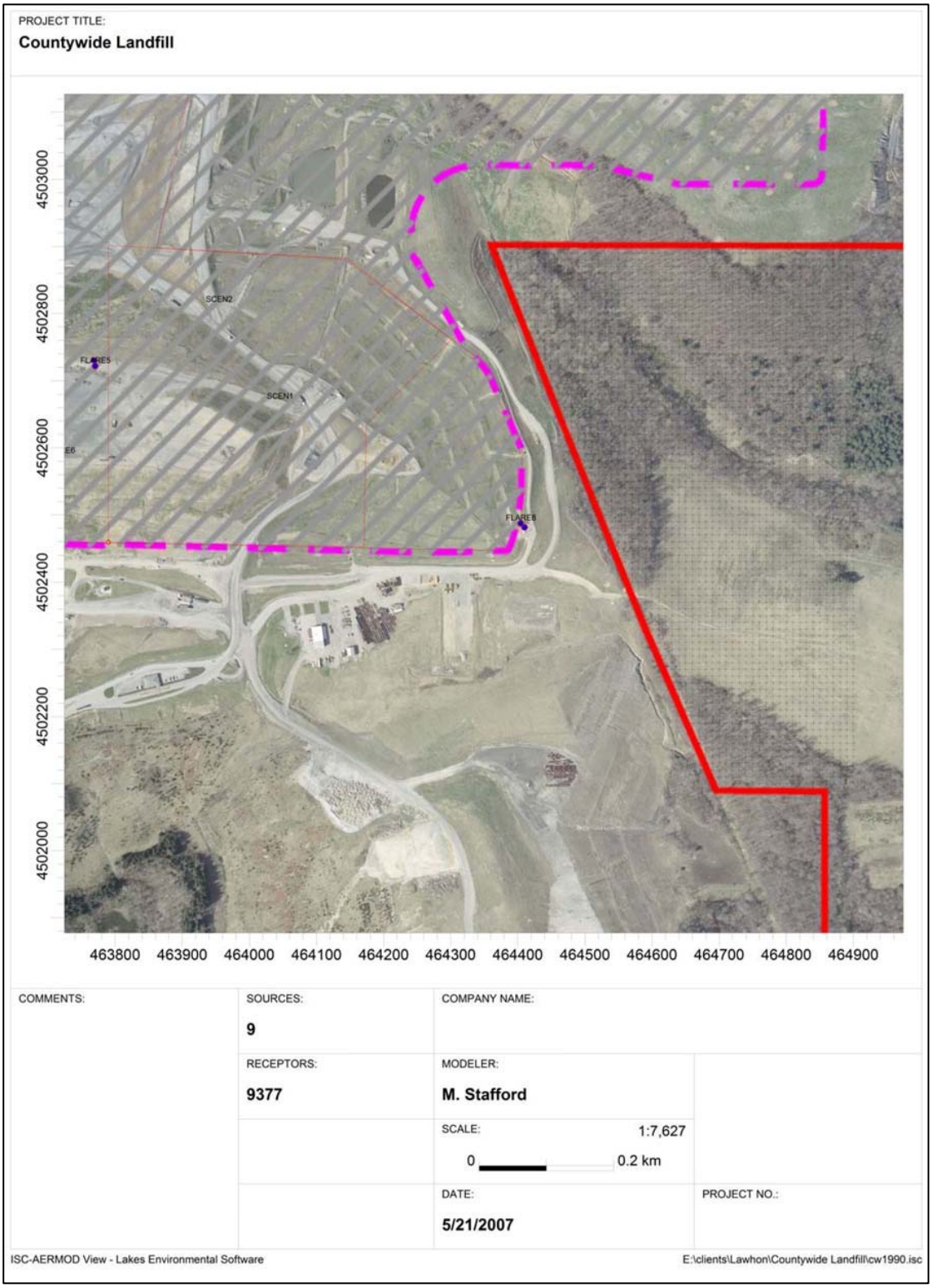


Figure 8. Fine (10-m) receptor grid used to locate eastern point of maximum concentration.

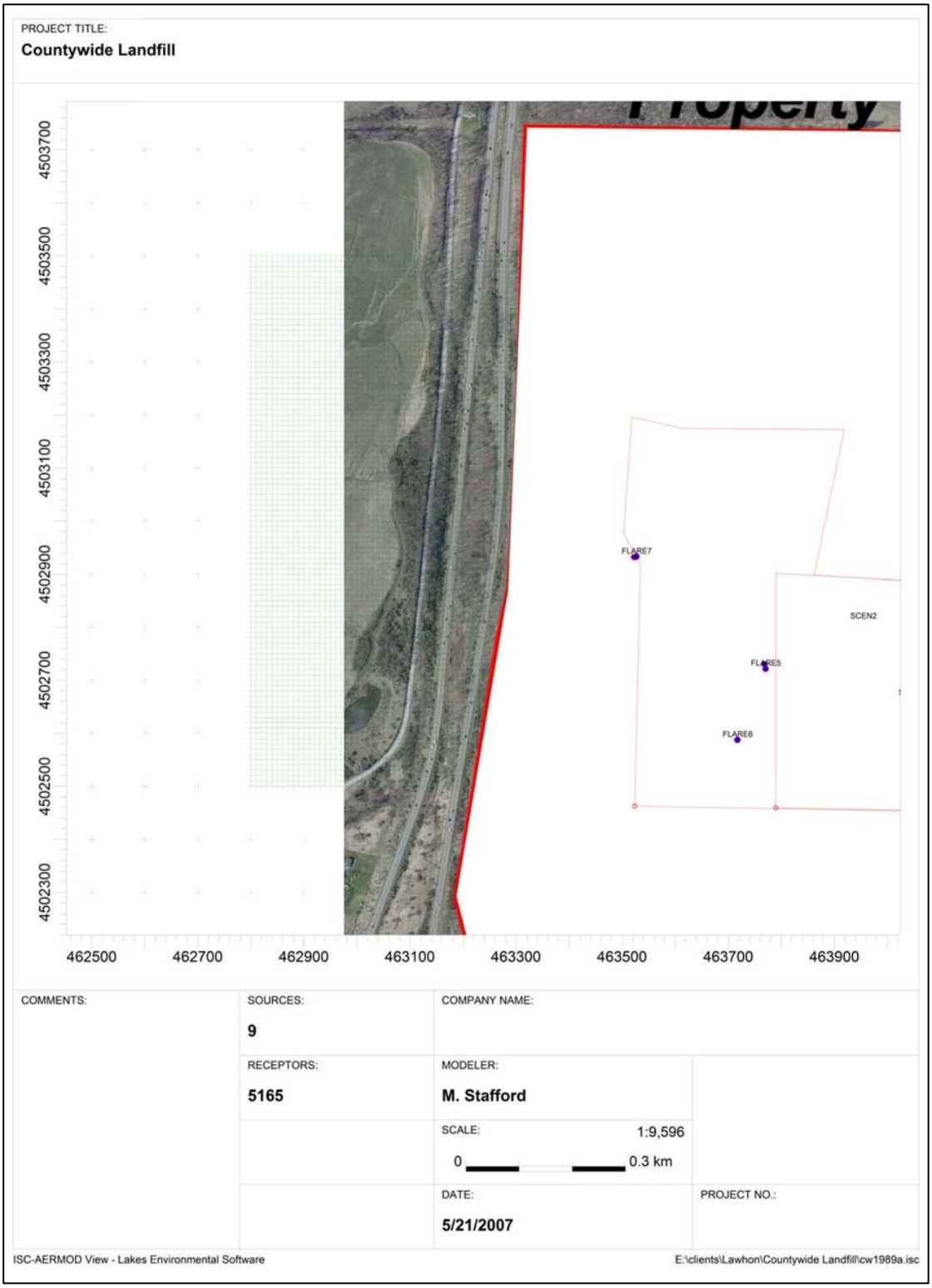


Figure 9. Fine (10-m) receptor grid used to locate western point of maximum concentration.

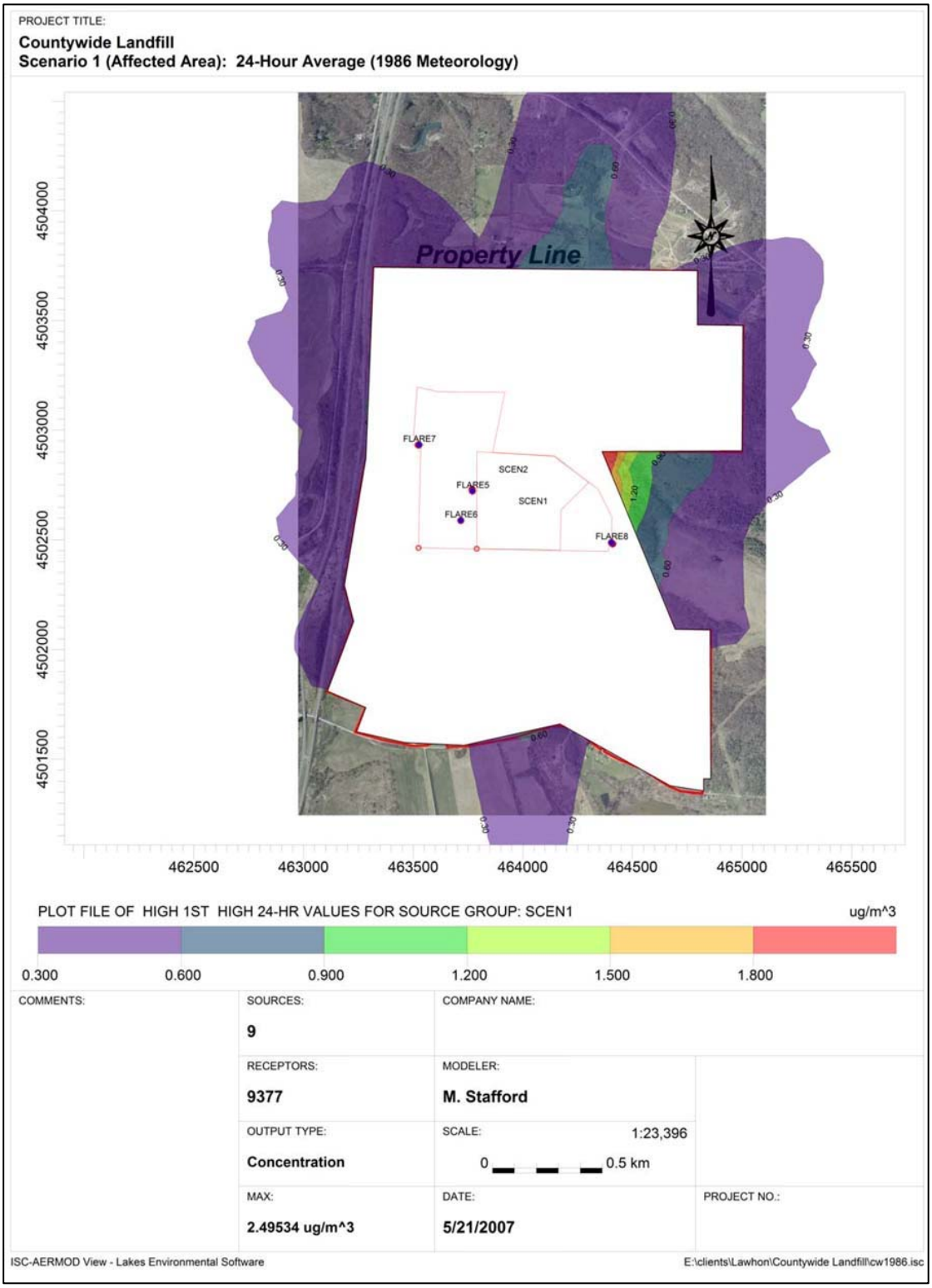


Figure 10. Coarse Grid (1-km) results for Scenario 1 (24-hour average).

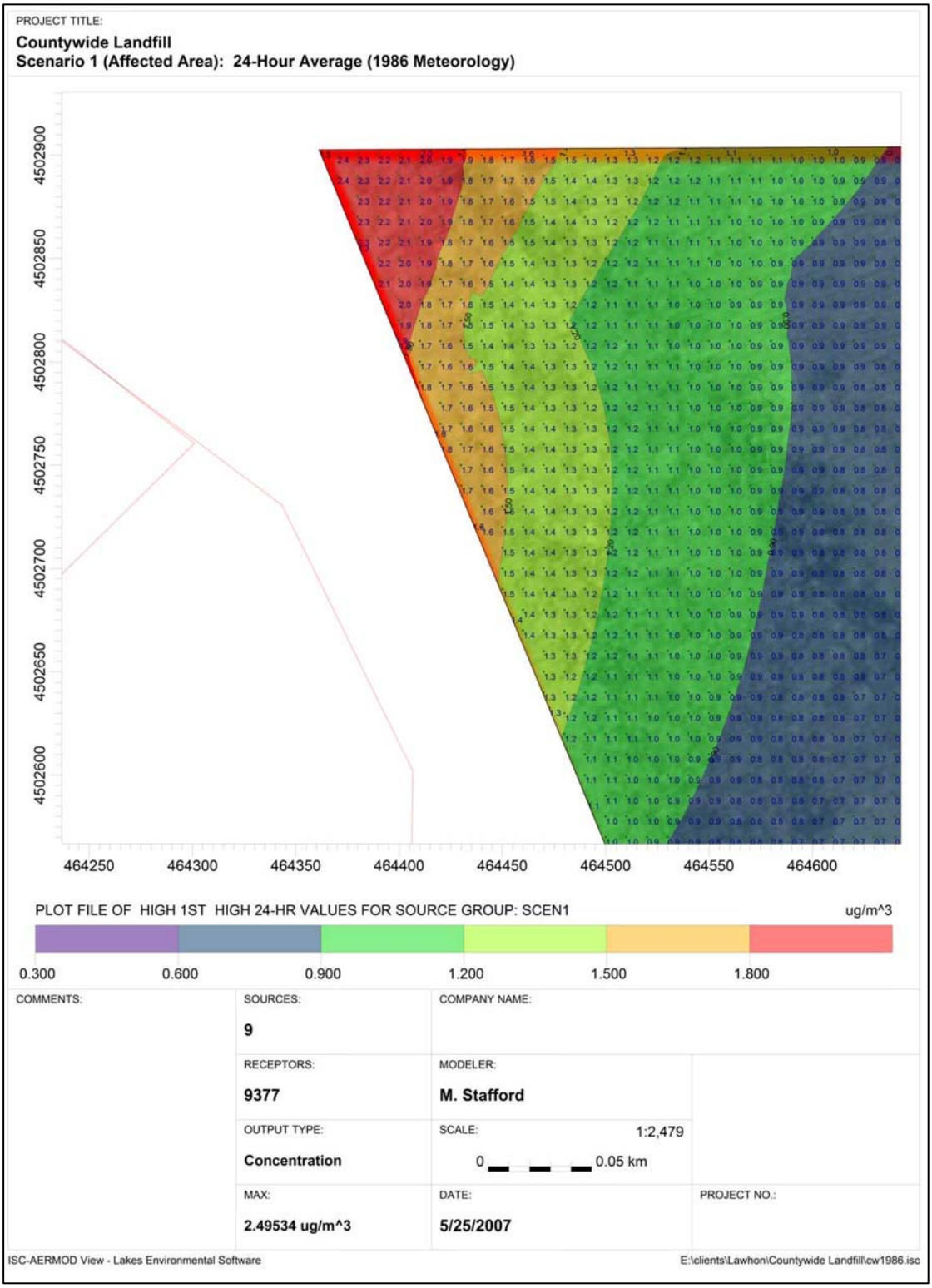


Figure 11. Fine Grid (10-m) results for Scenario 1 (24-hour average).

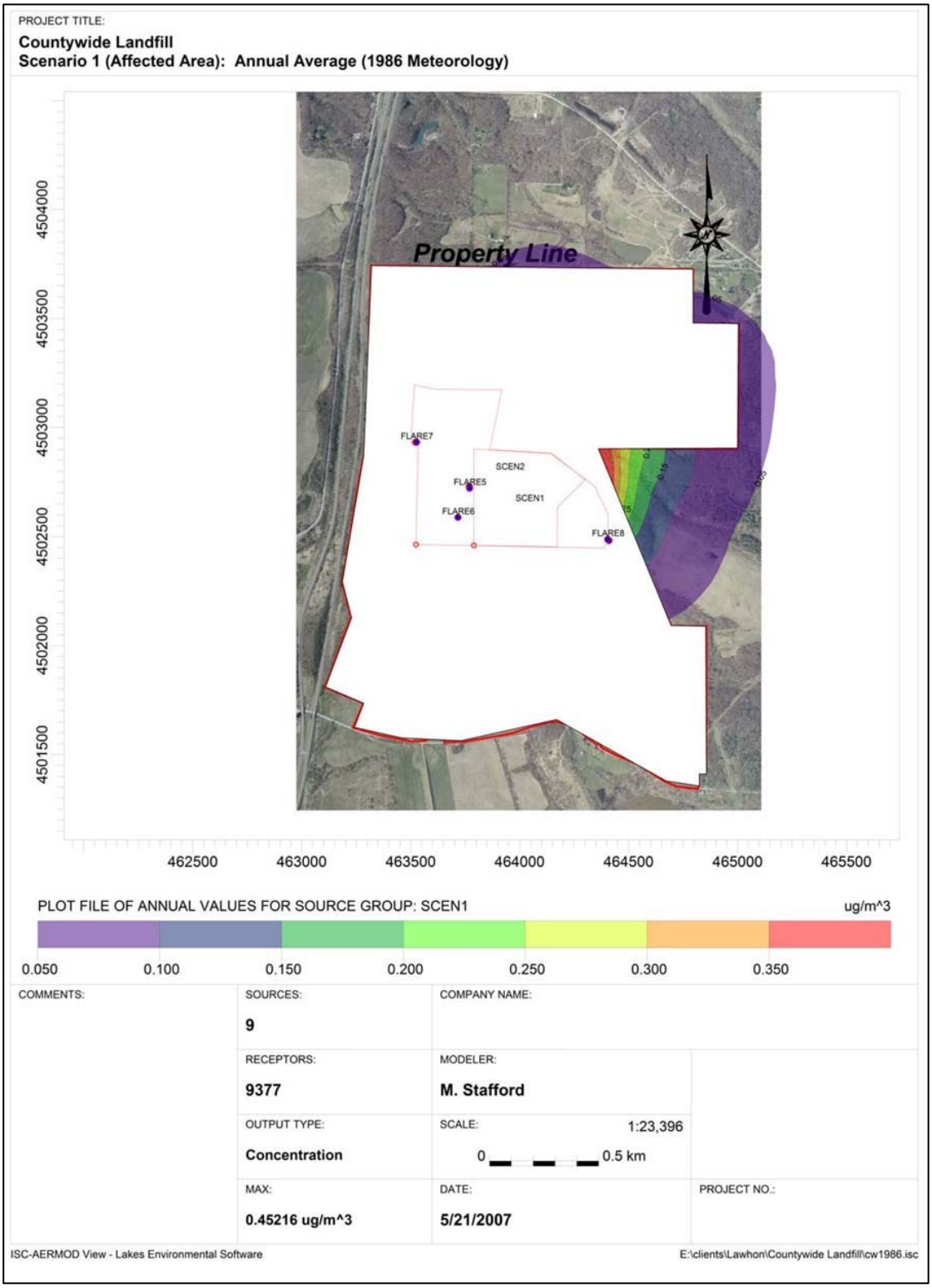


Figure 12. Coarse Grid (1-km) results for Scenario 1 (annual average).

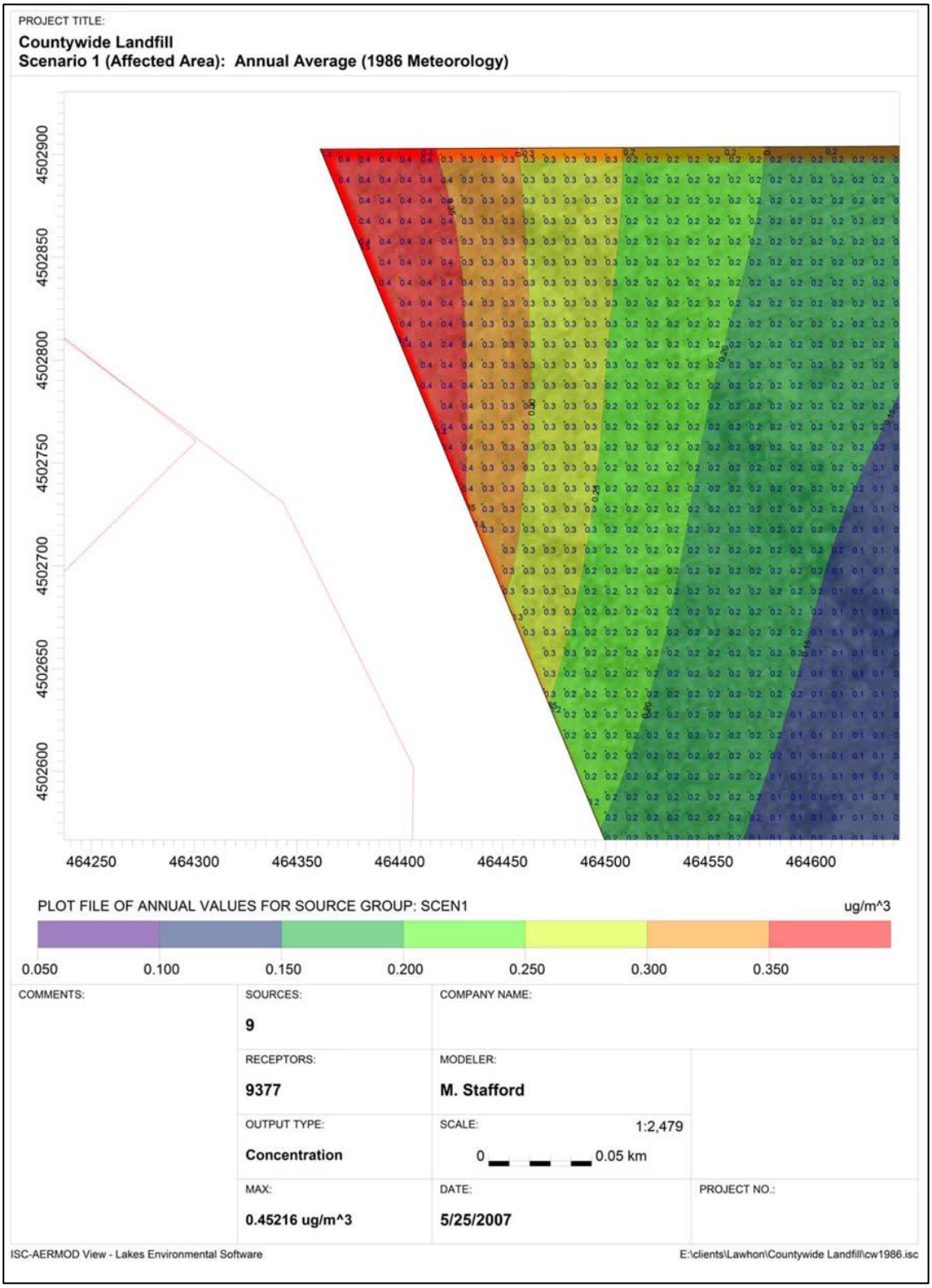


Figure 13. Fine Grid (10-m) results for Scenario 1 (annual average).

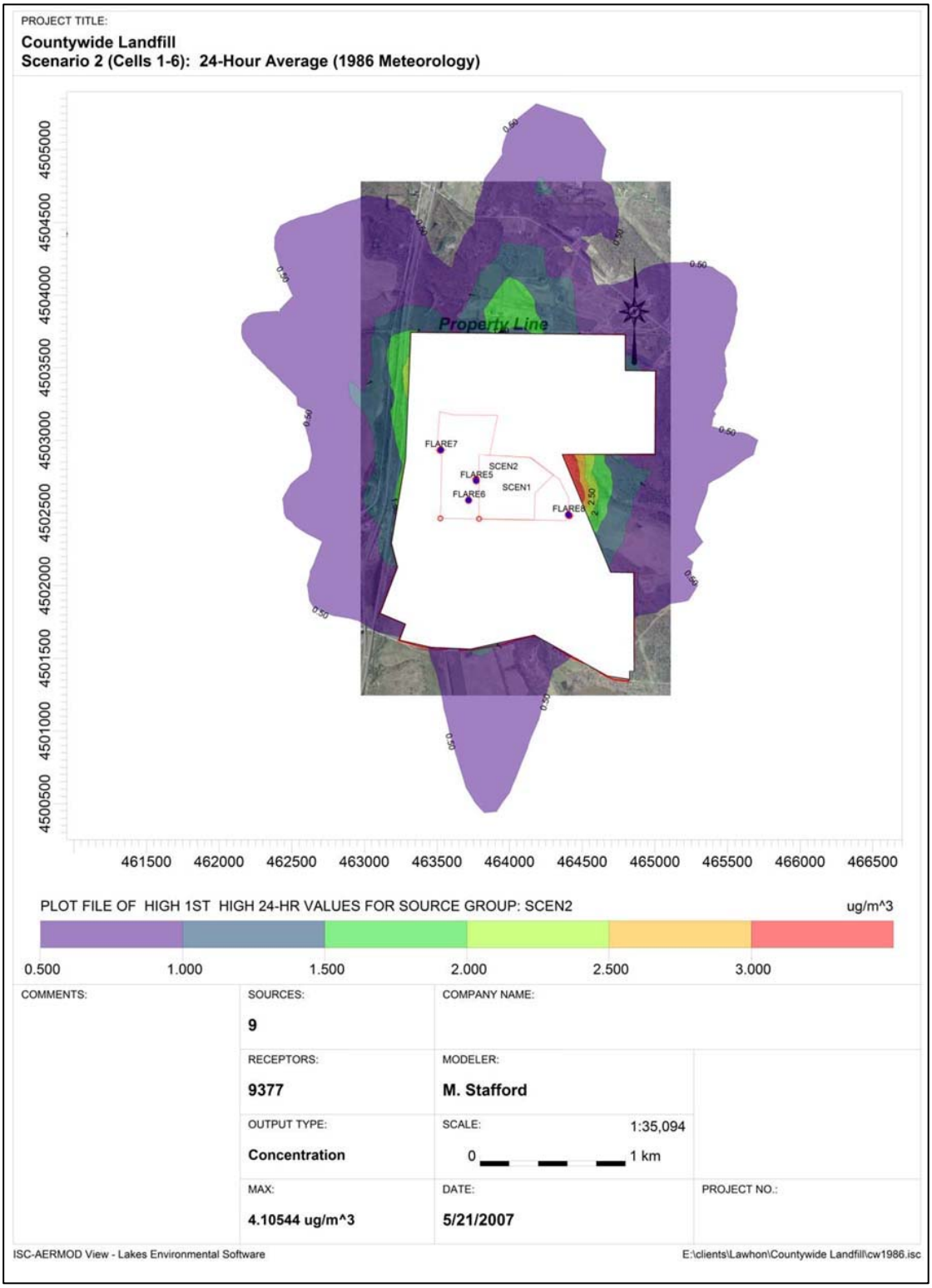


Figure 14. Coarse Grid (1-km) results for Scenario 2 (24-hour average).

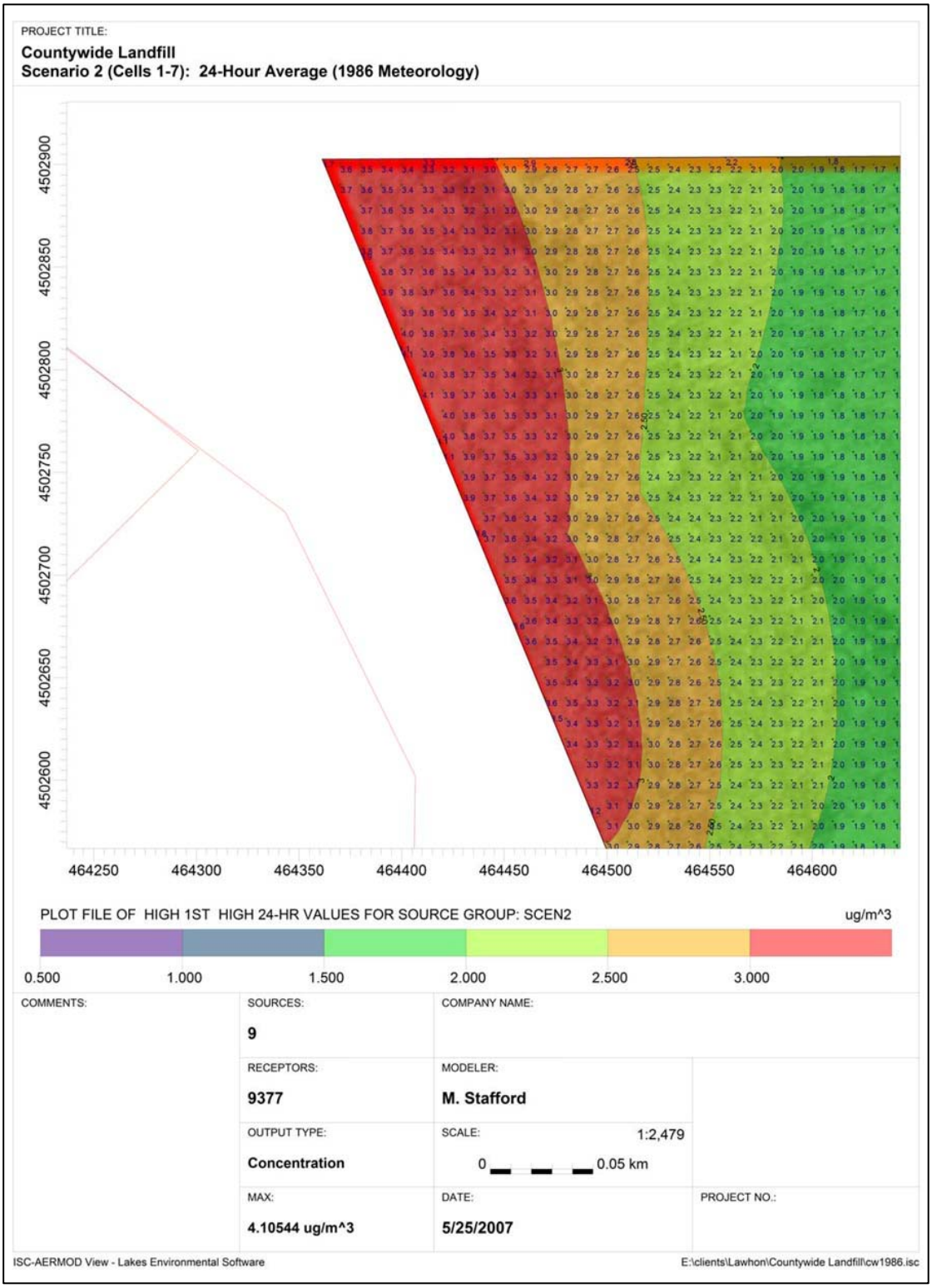


Figure 15. Fine Grid (10-m) results for Scenario 2 (24-hour average).

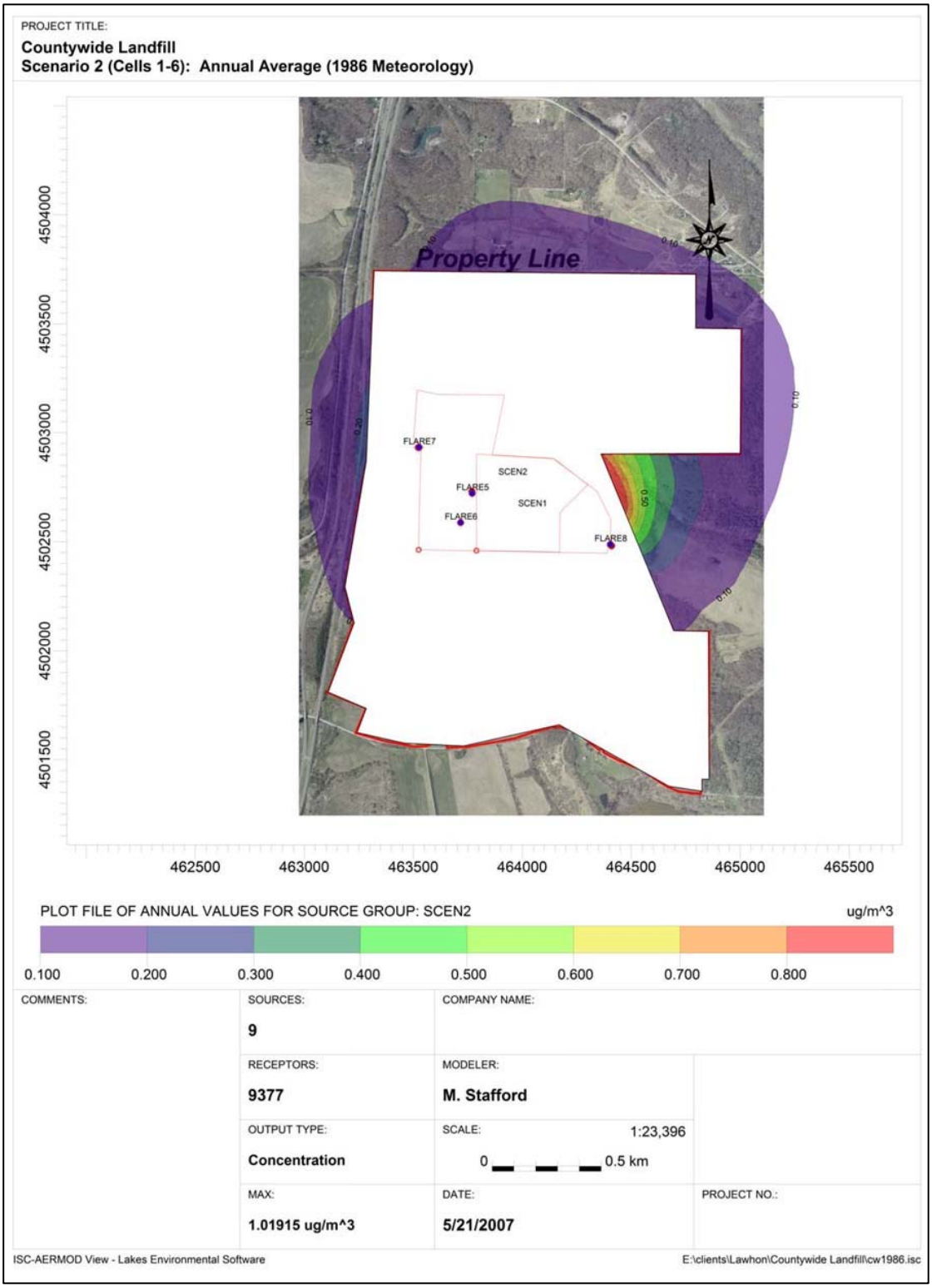


Figure 16. Coarse Grid (1-km) results for Scenario 2 (annual average).

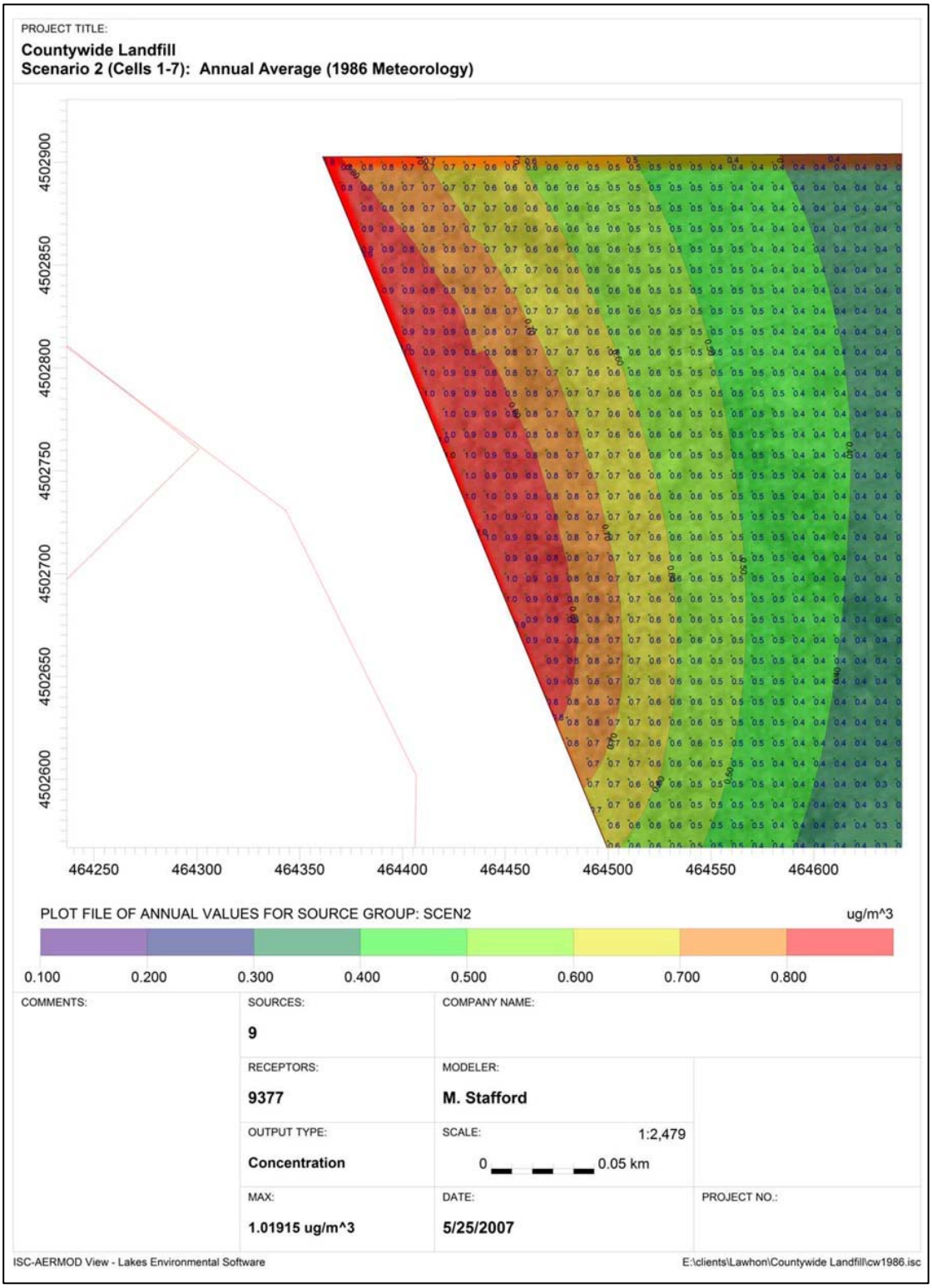


Figure 17. Fine Grid (10-m) results for Scenario 2 (annual average).

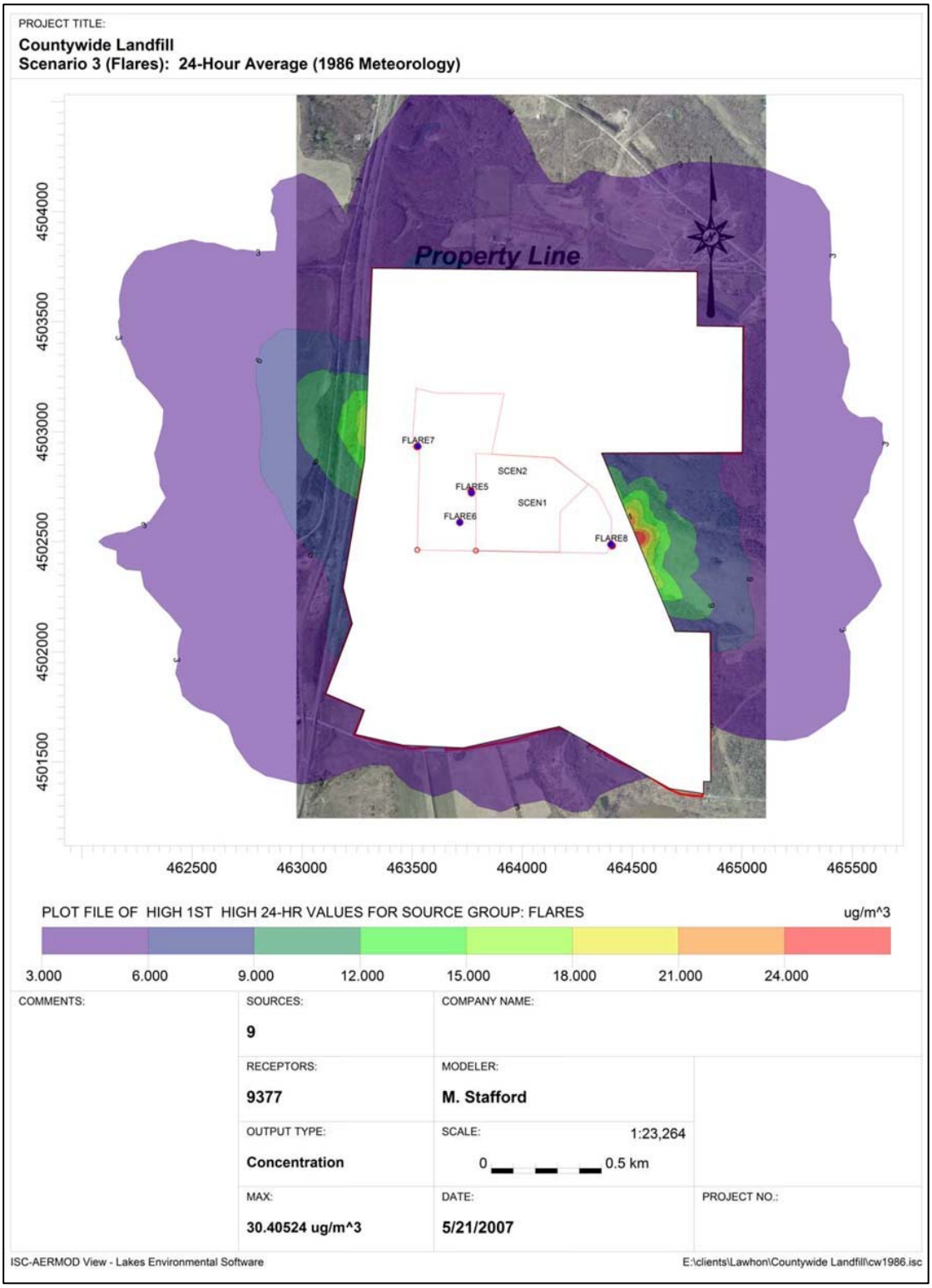


Figure 18. Coarse Grid (1-km) results for Scenario 3 (24-hour average).

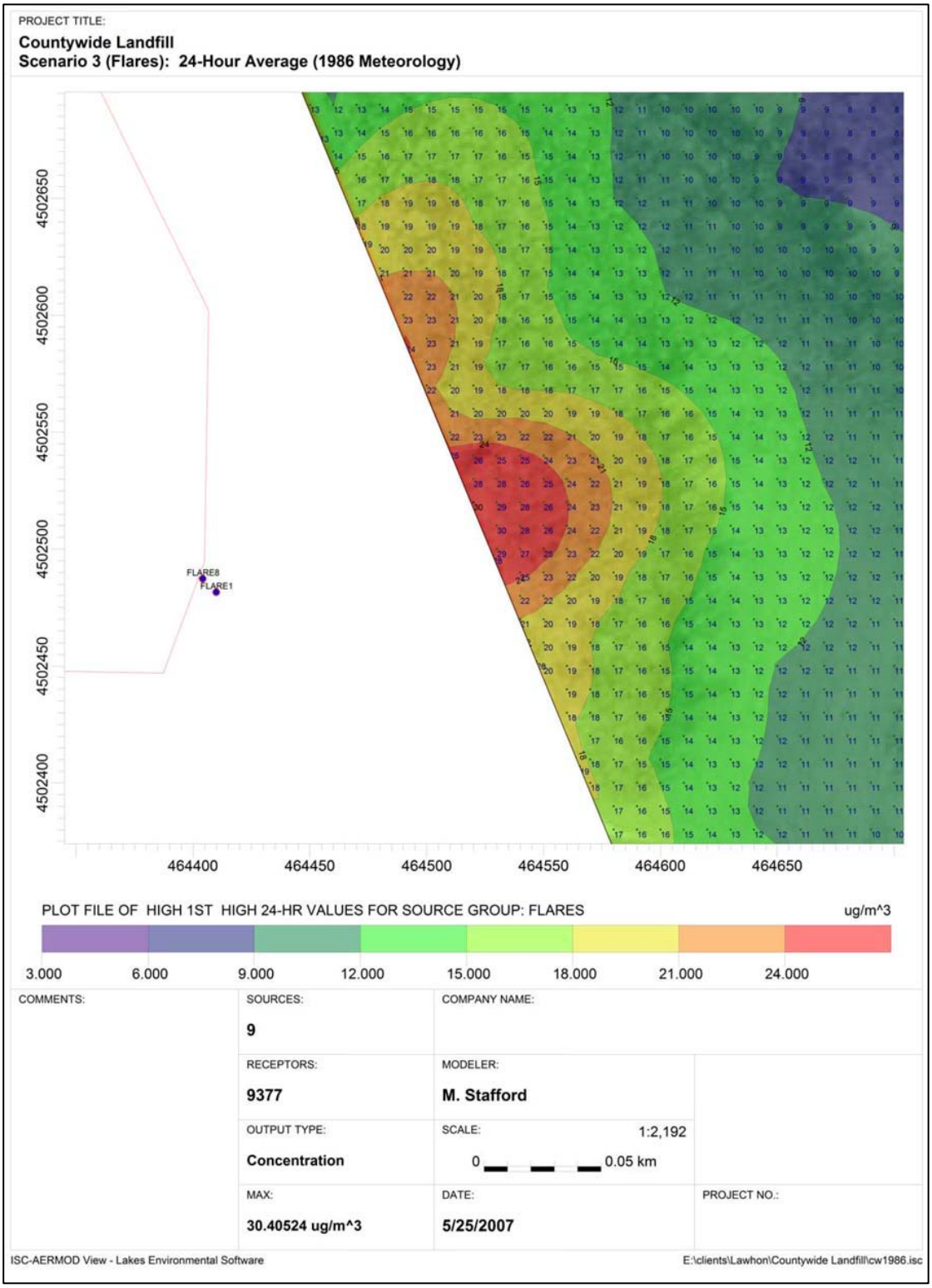


Figure 19. Fine Grid (10-m) results for Scenario 3 (24-hour average).

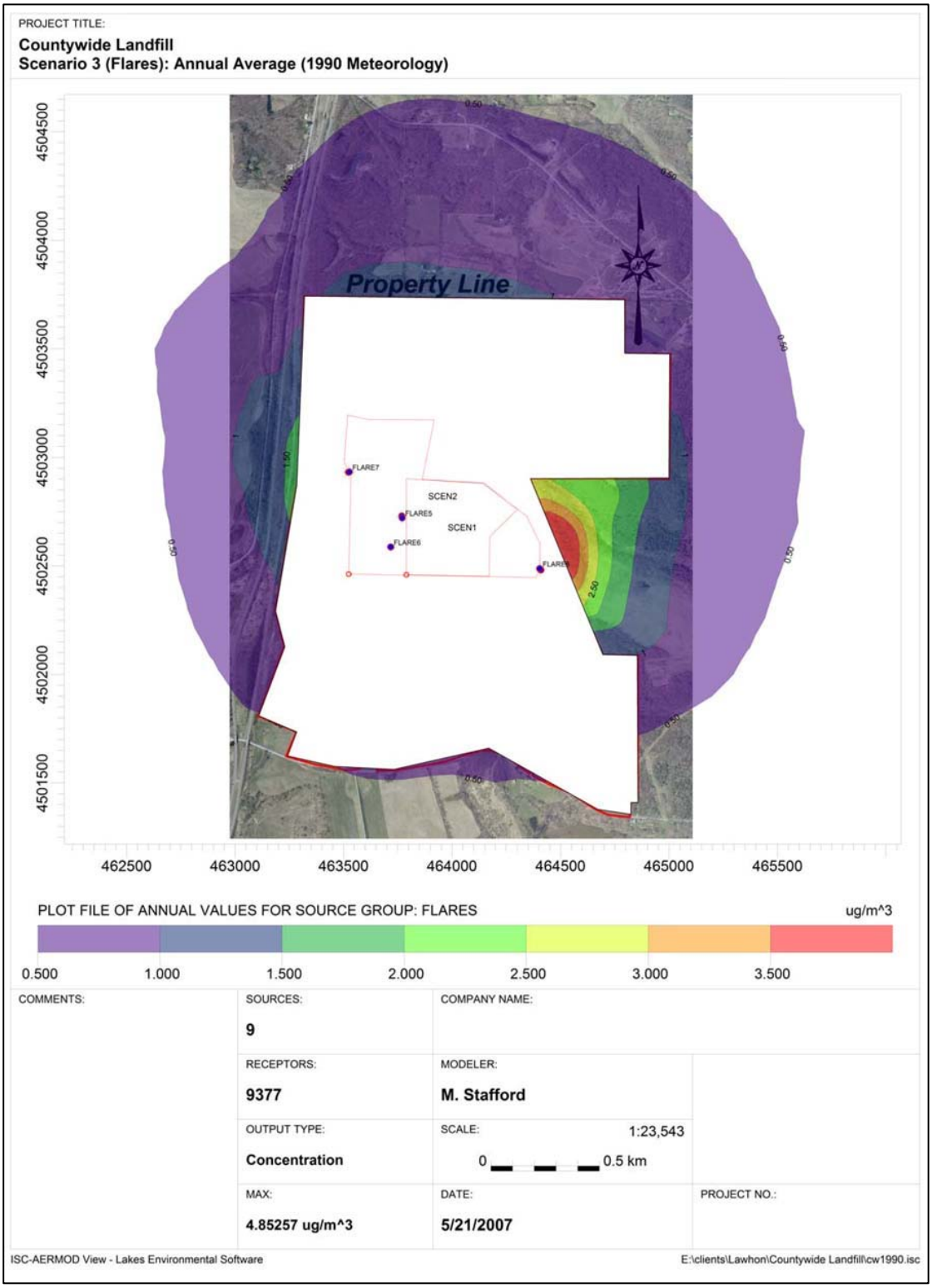


Figure 20. Coarse Grid (1-km) results for Scenario 3 (annual average).

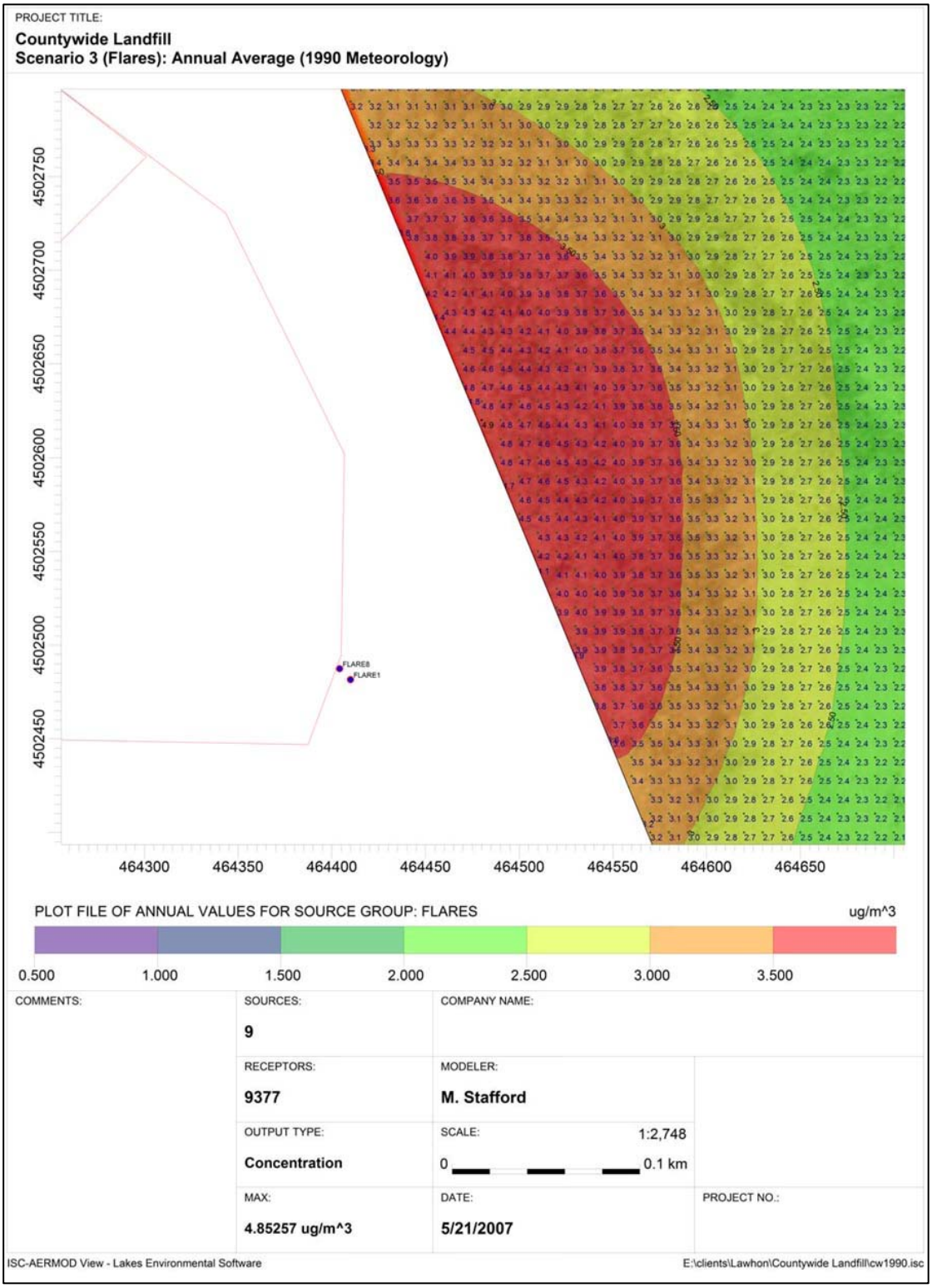
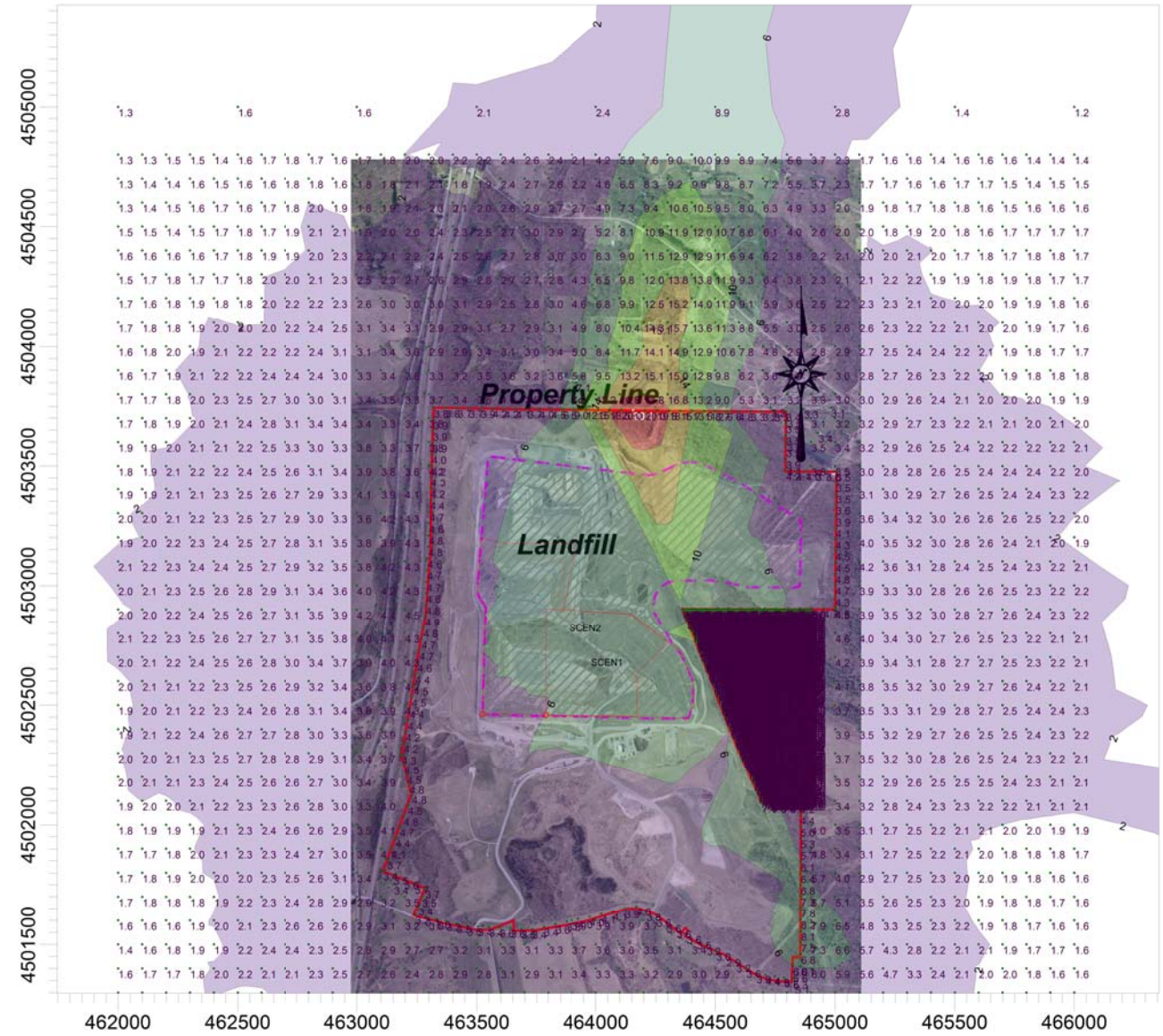


Figure 21. Fine Grid (10-m) results for Scenario 3 (annual average).

PROJECT TITLE:

Countywide Landfill
Scenario 1: One-Hour Average (1986-90 Meteorology)



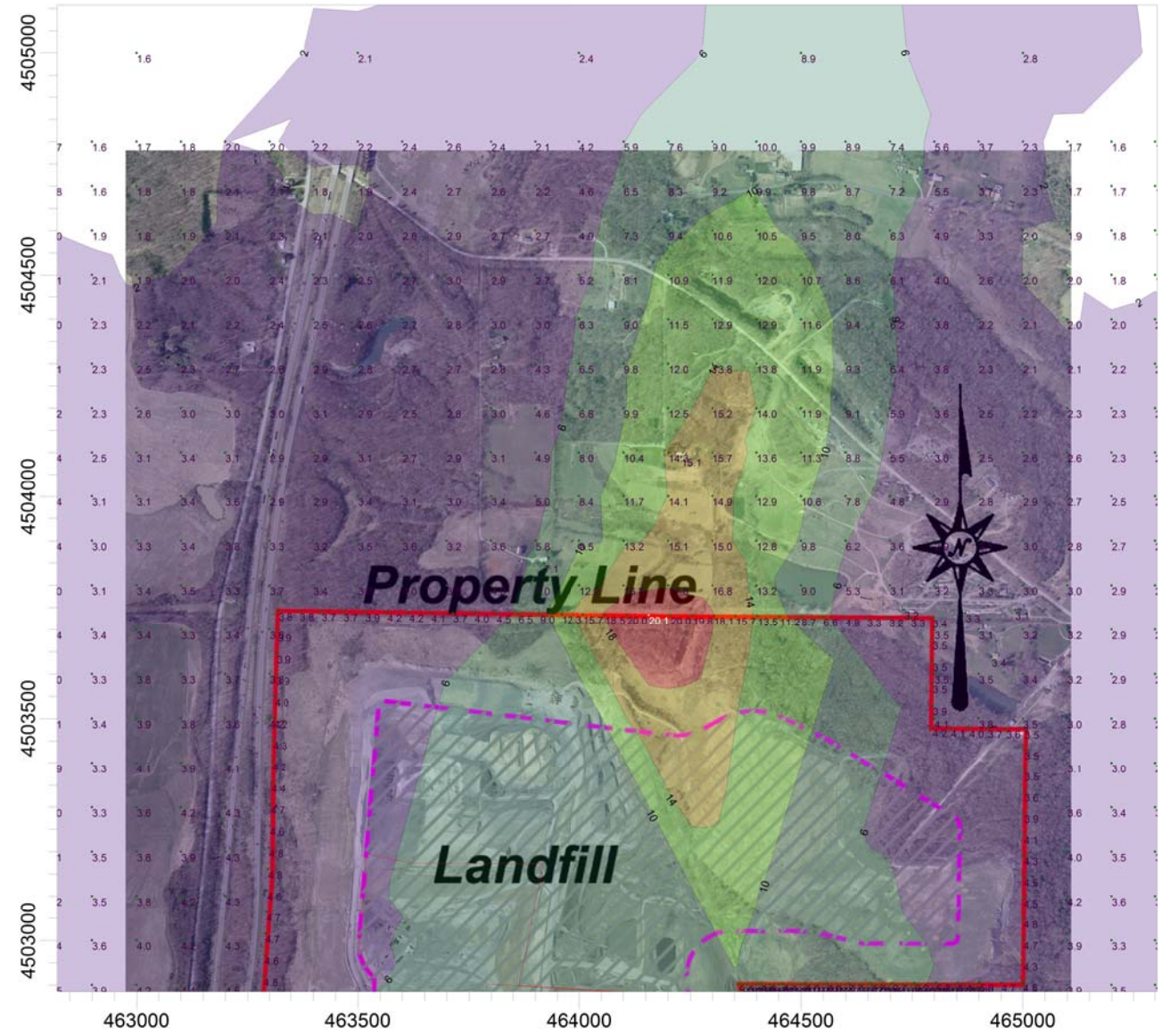
PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: SCEN1 ug/m^3

2.000 6.000 10.000 14.000 18.000

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **9377**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:28,140 (0 — 1 km)	
	MAX: **20.12515 ug/m^3**	DATE: **5/21/2008**	PROJECT NO.:

PROJECT TITLE:

Countywide Landfill - Northern Max
Scenario 1: One-Hour Average (1986-90 Meteorology)



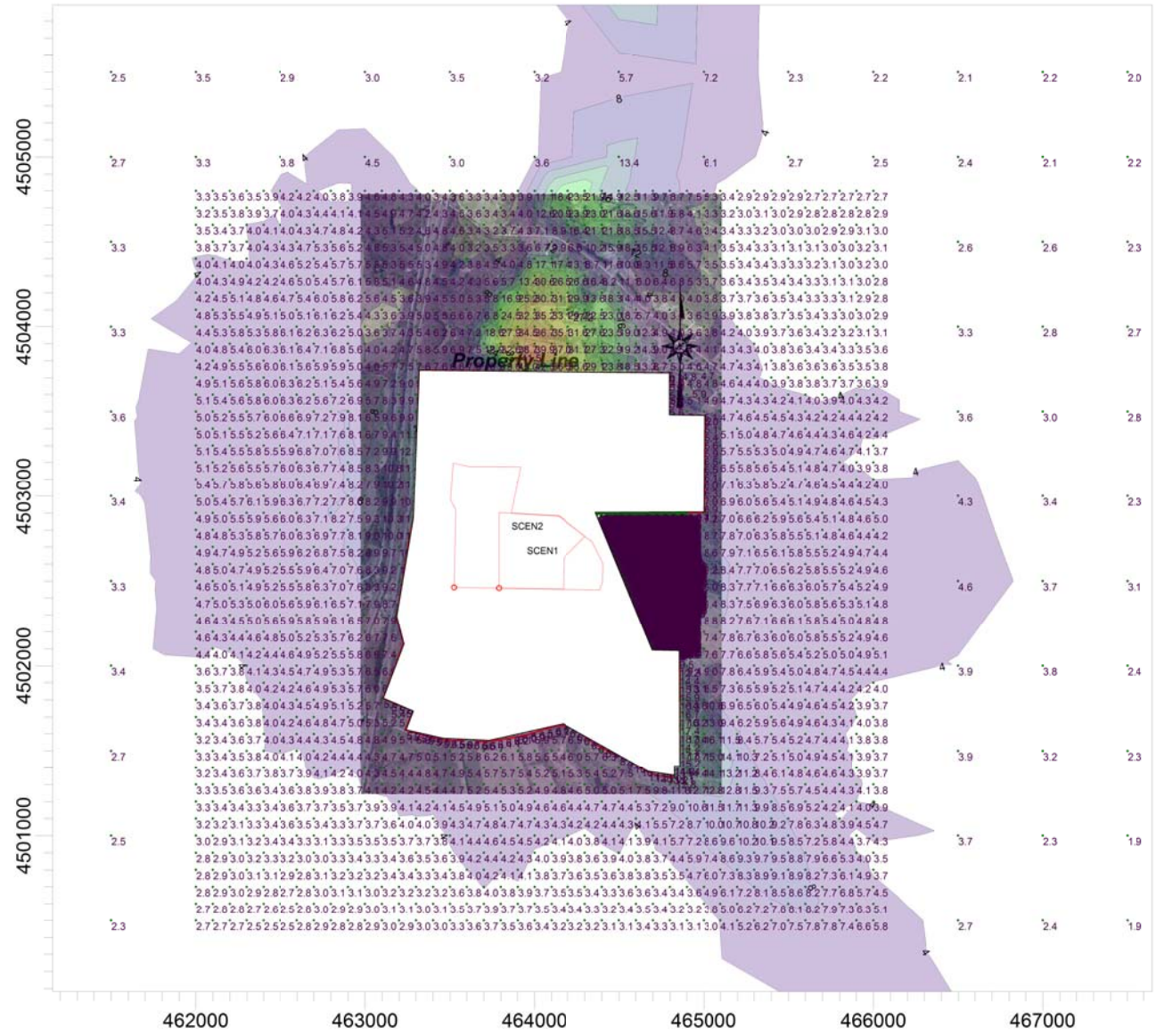
PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: SCEN1 ug/m^3

2.000 6.000 10.000 14.000 18.000

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **9377**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:15,152 — 0 — 0.5 km	
	MAX: **20.12515 ug/m^3**	DATE: **5/21/2008**	PROJECT NO.:

PROJECT TITLE:

Countywide Landfill
Scenario 2: One-Hour Average (1986-90 Meteorology)



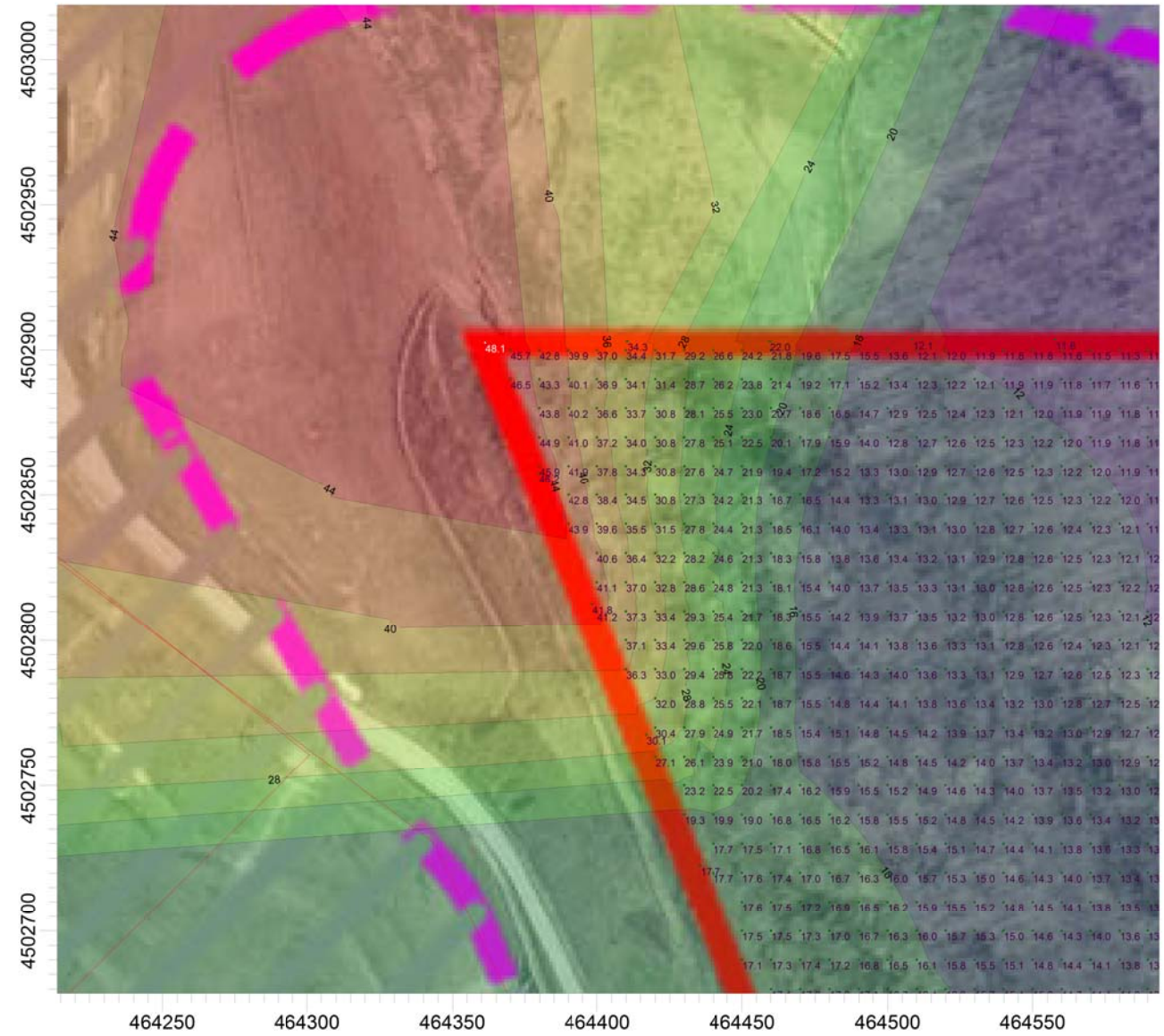
PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: SCEN2 ug/m^3

4.000 8.000 12.000 16.000 20.000 24.000 28.000 32.000 36.000 40.000 44.000

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **9377**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:39,621 0 1 km	
	MAX: **48.12274 ug/m^3**	DATE: **5/21/2008**	PROJECT NO.:

PROJECT TITLE:

Countywide Landfill-eastern maximum
Scenario 2: One-Hour Average (1986-90 Meteorology)



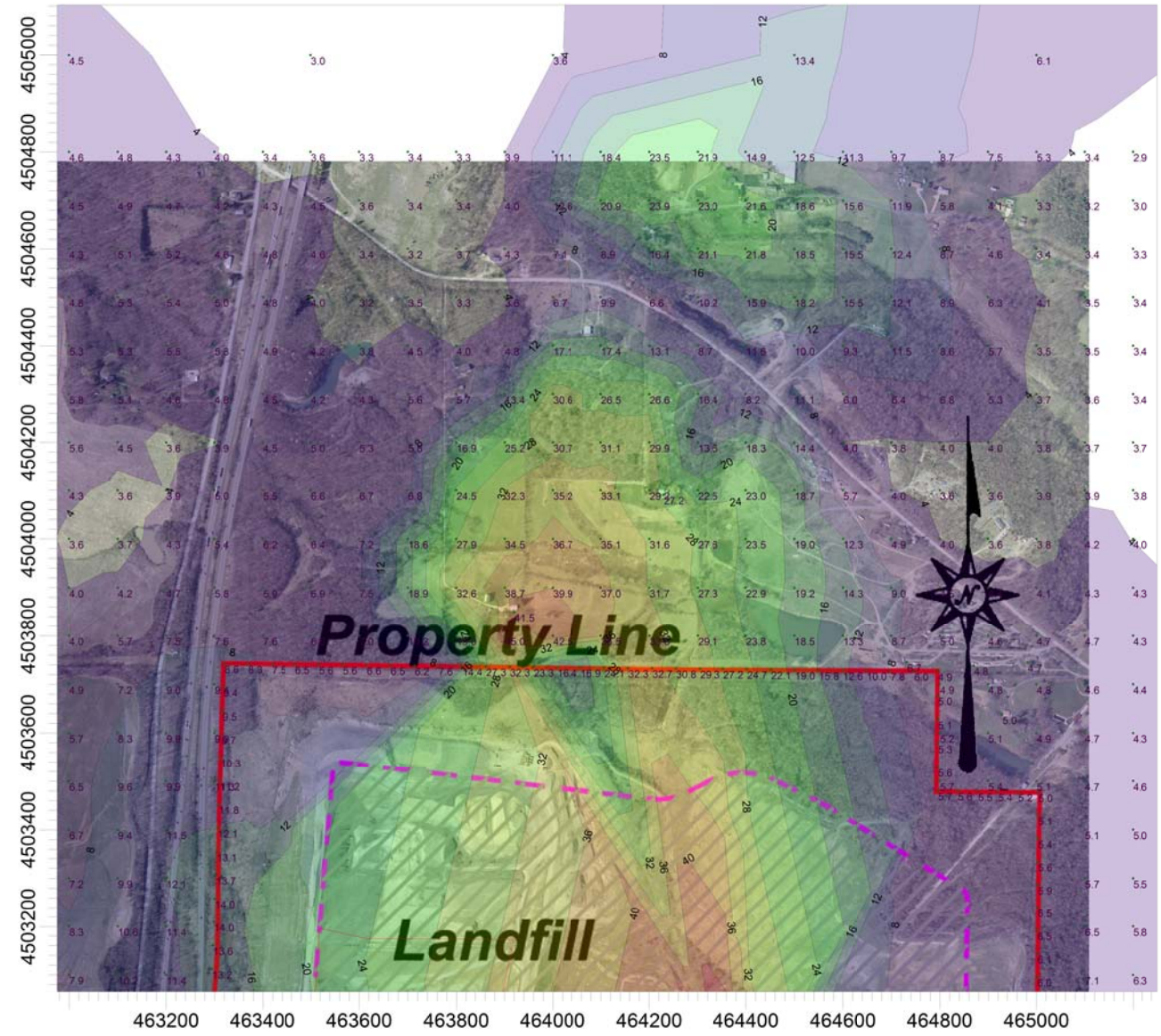
PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: SCEN2 ug/m^3

4.000 8.000 12.000 16.000 20.000 24.000 28.000 32.000 36.000 40.000 44.000

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **9377**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:2,319 — 0 — 0.05 km	
	MAX: **48.12274 ug/m^3**	DATE: **5/21/2008**	PROJECT NO.:

PROJECT TITLE:

Countywide Landfill
Scenario 2: One-Hour Average (1986-90 Meteorology)



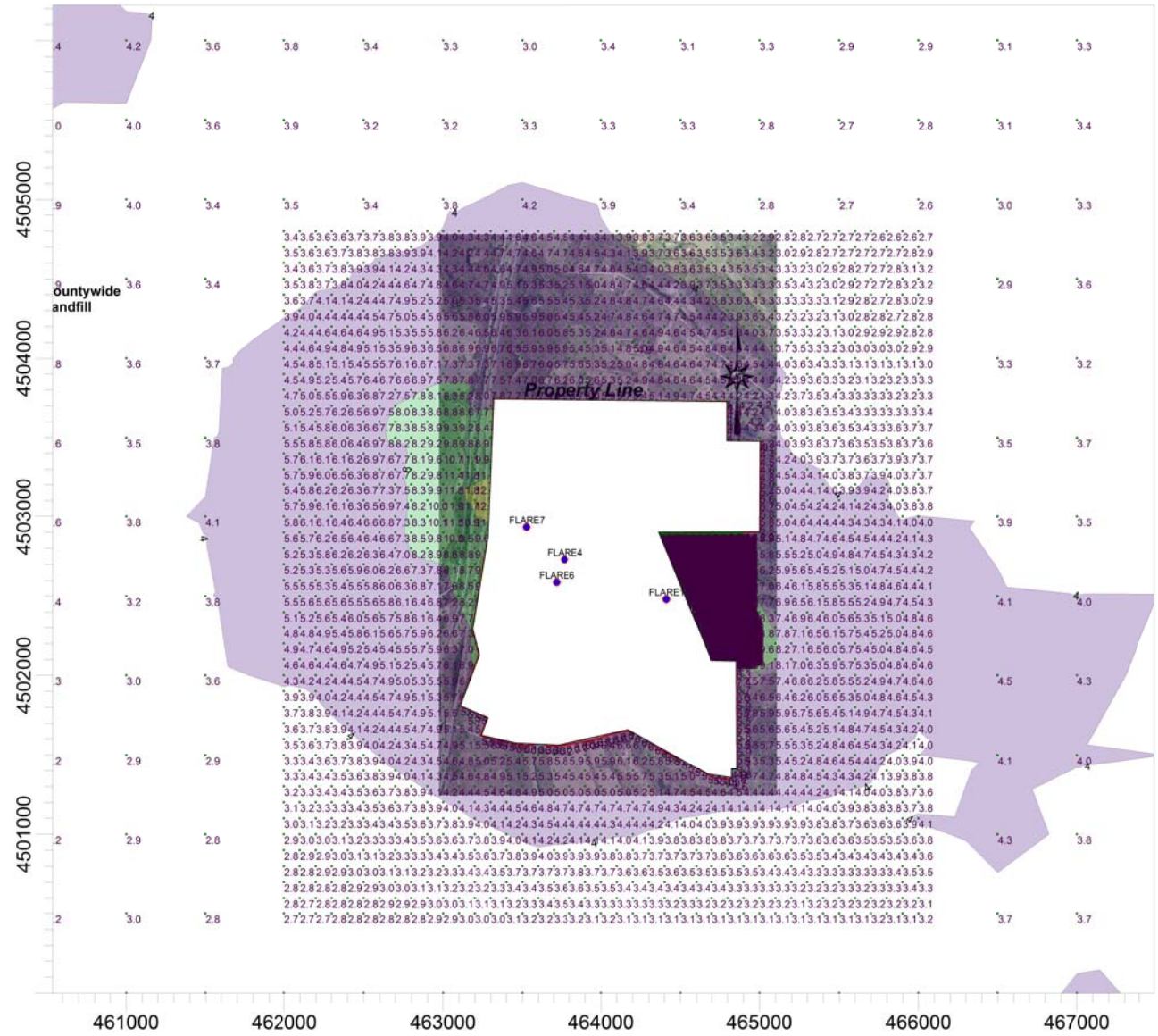
PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: SCEN2 ug/m^3

4.000 8.000 12.000 16.000 20.000 24.000 28.000 32.000 36.000 40.000 44.000

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **9377**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,887 — 0 — 0.5 km	
	MAX: **48.12274 ug/m^3**	DATE: **5/21/2008**	PROJECT NO.:

PROJECT TITLE:

Countywide Landfill
Scenario 3 (Flares): 1-Hr Average (1986-90 Meteorology)



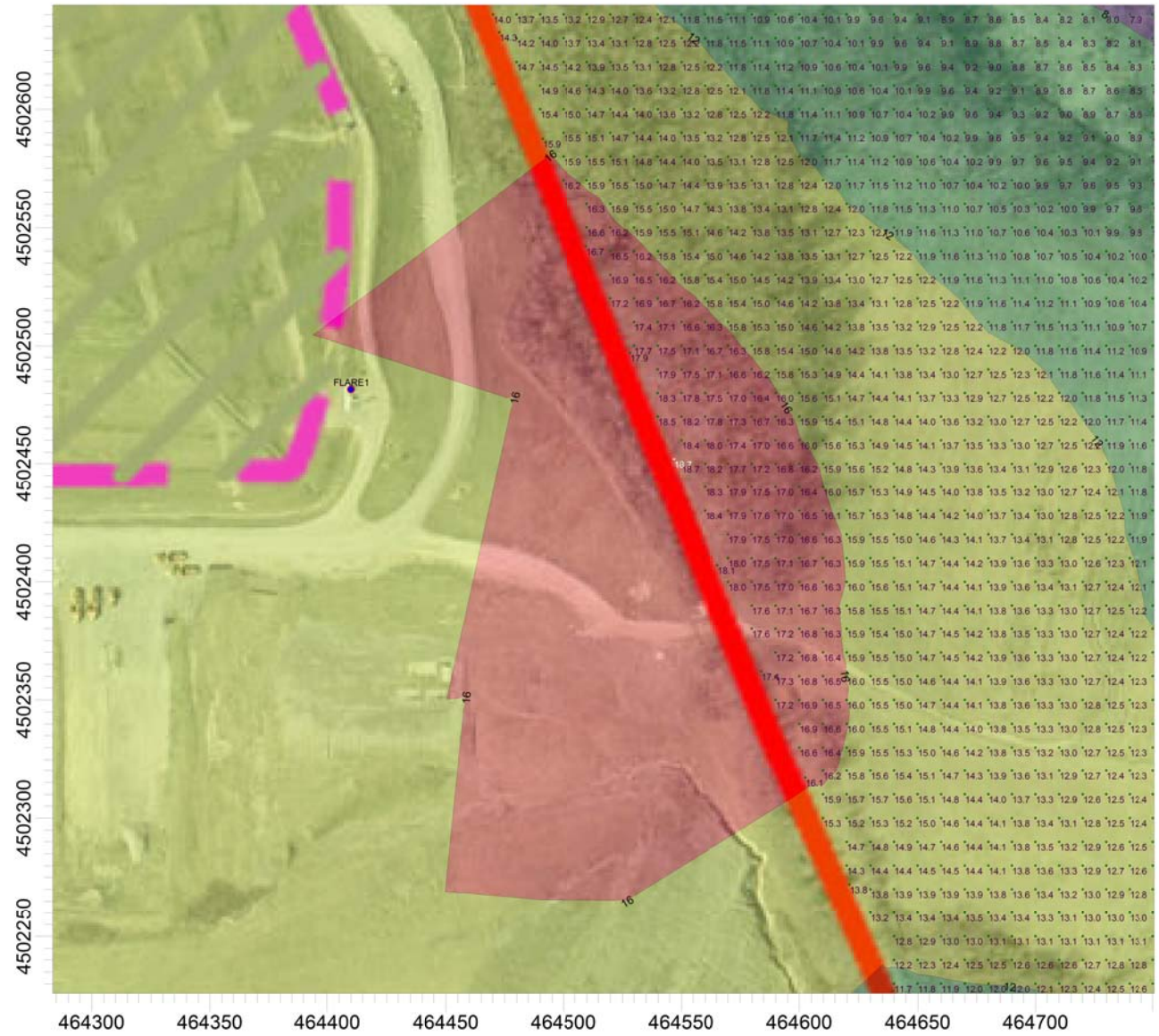
PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: FLARES ug/m^3

4.000 8.000 12.000 16.000

COMMENTS:	SOURCES: **4**	COMPANY NAME:	
	RECEPTORS: **9377**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:42,433 (0 — 1 km)	
	MAX: **18.73828 ug/m^3**	DATE: **5/21/2008**	PROJECT NO.:

PROJECT TITLE:

Countywide Landfill - Eastern Max
Scenario 3 (Flares): 1-Hr Average (1986-90 Meteorology)



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: FLARES ug/m^3

4.000 8.000 12.000 16.000

COMMENTS:	SOURCES: **4**	COMPANY NAME:	
	RECEPTORS: **9377**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:2,850 (0 — 0.1 km)	
	MAX: **18.73828 ug/m^3**	DATE: **5/21/2008**	PROJECT NO.: