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Office of  
Research and Development

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**MEMORANDUM**

TO: Stephen Kroner  
OSWER/OSW/EMRAD

From: Donna Schwede  
ORD/NERL/AMD/AMRB

Subject: Sensitivity of ISCST3 model estimates to distance from source

I performed a study to illustrate the sensitivity of ISCST3 model results to distance from the source for a variety of HWIR source types designed to help identify, together with other information, the study area of interest for the HWIR assessment. ISCST3 was run for a total of 20 HWIR sources occurring at 10 sites. While this isn't a comprehensive analysis, the sources and meteorological stations were selected to be representative of national HWIR sites. The results of the study show that, for the cases run in this analysis, concentration and deposition values do not increase significantly at distances greater than about 3-4 km from the edge of the source. Details of the study are provided in the following sections.

**Background**

The Industrial Source Complex - Short Term (ISCST3) is a steady-state Gaussian plume model for modeling concentration, dry deposition, and wet deposition from point, area, volume, and open-pit sources. The model was modified for use in the Multimedia, Mulipathway and Multireceptor Risk Assessment (3MRA) for HWIR99. Modifications included addition of a revised plume depletion and deposition velocity calculation; an option to sample the long term meteorological record at regular, user-specified intervals and scale the model results at the end of the run to produce the annual average estimates; and an option for output by particle size category. A complete technical description can be found in the user's guide (USEPA, 1999a). ISCST3 (version 99161) was run to provide estimates of the expected annual average concentration and annual dry deposition resulting from HWIR sources as a function of distance. Maximum wet deposition typically is predicted to occur close to the source and was not modeled.

**Modeled Scenarios**

Ten sites were randomly selected from the HWIR database of 201 facilities to represent HWIR sites across the country. There are a total of 20 sources at these sites. A summary of the sites and sources is provided in Table 1. To obtain the input file for ISCST3, the HWIR system was run to the point of completion of the air module for each environmental setting/source combination for a total of 20 runs. The resulting ISCST3 input file, therefore, contains the necessary source specific data (e.g. particle size distribution, corresponding meteorological station, unitized emission rate). The file was then edited to change the receptor grid to a more dense polar grid with receptors along radials at 10° intervals and at distances extending out to approximately 6 kilometers from the edge of the source. The meteorological data for each source was taken from the HWIR hourly meteorological database. Details on the development of the meteorological files can be found in USEPA(1999b). These files typically contain over 10 years of data.

## Results

For each source, the annual average vapor concentration, averaged over the period of record in the meteorological data file, at each receptor was plotted as a function of distance. Graphs for each of the waste management units (WMUs) listed in Table 1 are shown in Figures 1-20. Although results vary some with the size and height of the source, the concentration values decrease significantly and immediately beginning at the edge of the area source. Depending on the type of source, the concentrations taper off and approach zero in the range of about 1000m - 4000m from the edge of the source.

To examine deposition, the results from the ISCST3 were imported into Surfer®. The values were gridded and a spline surface fit to them. Surfaces for the land application units (LAU's), landfills (LFs), and waste piles (WPs) are shown in Figures 20-28. The volume under the surface was calculated and divided by the total emissions to obtain the percent of emitted mass deposited. The gridding, fitting, and volume calculation were repeated for a number of distances from the source. These results are summarized in Table 2 for a subset of the sources and show that for most sources, 30-35% of the emitted mass is deposited by 4 km (from the center of the source) and there is only a few percentage points change when a 6 km radius from the center of the source is considered. The slope of the surface is a bit hard to visualize due to the orders of magnitude difference in deposition as a function of downwind distance. The deposition decrease with distance is more easily seen in Figure 29 which shows a cross-sectional view through the center of the source. Note that dry deposition is not calculated for surface impoundments and aerated tanks.

## References

U.S. Environmental Protection Agency. 1999a. *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models for Use in the Multimedia, Multipathway and Multireceptor Risk Assessment (3MRA) for HWIR99. Volume II: Description of Model Algorithms*. Office of Solid Waste, Washington, DC. June.

U.S. EPA (Environmental Protection Agency). 1999d. *Data Collection for the Hazardous Waste Identification Rule. Section 4.0 Meteorological Data*. Draft Report. Office of Solid Waste, Washington, DC.

Table 1. HWIR sites and sources used in the analysis.

SITE ID	Source Type	Side Length (m)	Height <sup>1</sup> (m)	Meteorological Station ID	Meteorological Station Location
0136703	LAU	522.659		23047	Amarillo, TX
	SI	74.7319			
	AT	3.18562	3.85711		
0233601	SI	6.3616		13741	Roanoke, Va
	AT	3.11723	2.05824		
0531702	LF	298.386		23047	Amarillo, TX
0613402	SI	22.0372		13994	St. Louis, MO
	AT	3.11723	2.05824		
0620604	SI	1101.86		24127	Salt Lake City, UT
	AT	3.18562	3.85711		
0625002	LF	37.0942		03822	Savannah, GA
	SI	30.5092			
	AT	3.11723	2.05824		
0625501	LAU	365.446		12960	Houston, TX
0720506	WP	20.1172		14764	Portland, ME
0722107	WP	15.5827		12842	Tampa, FL
0730914	LF	89.9667		13958	Austin, TX
	WP	7.34575			
	SI	34.8439			
	AT	3.11723	2.05824		

<sup>1</sup>Only applicable for AT.

Table 2. Percent of emitted mass deposited for selected sources.

Site ID	Deposition type	6000 m	4000 m	2500 m	2000 m	1000 m	500 m
LA0625501	dry	40	35	31	30	25	21
	wet	3	2	2	2	1	1
	total	43	38	33	32	26	22
LA0136703	dry	28	25	22	21	18	15
	wet	1	1	1	1	< 1	< 1
	total	29	26	23	22	18	15
LF0625002	dry	31	27	23	21	16	12
	wet	3	3	2	2	1	1
	total	34	30	25	23	17	12
LF0730914	dry	31	28	23	22	16	12
	wet	6	2	1	1	1	1
	total	33	29	24	23	17	12
WP0720506	dry	32	28	23	22	16	12
	wet	4	4	2	2	1	1
	total	36	31	26	24	17	12
WP0722107	dry	32	28	24	22	16	11
	wet	8	2	2	1	1	1
	total	34	30	25	23	17	12

LA0136703

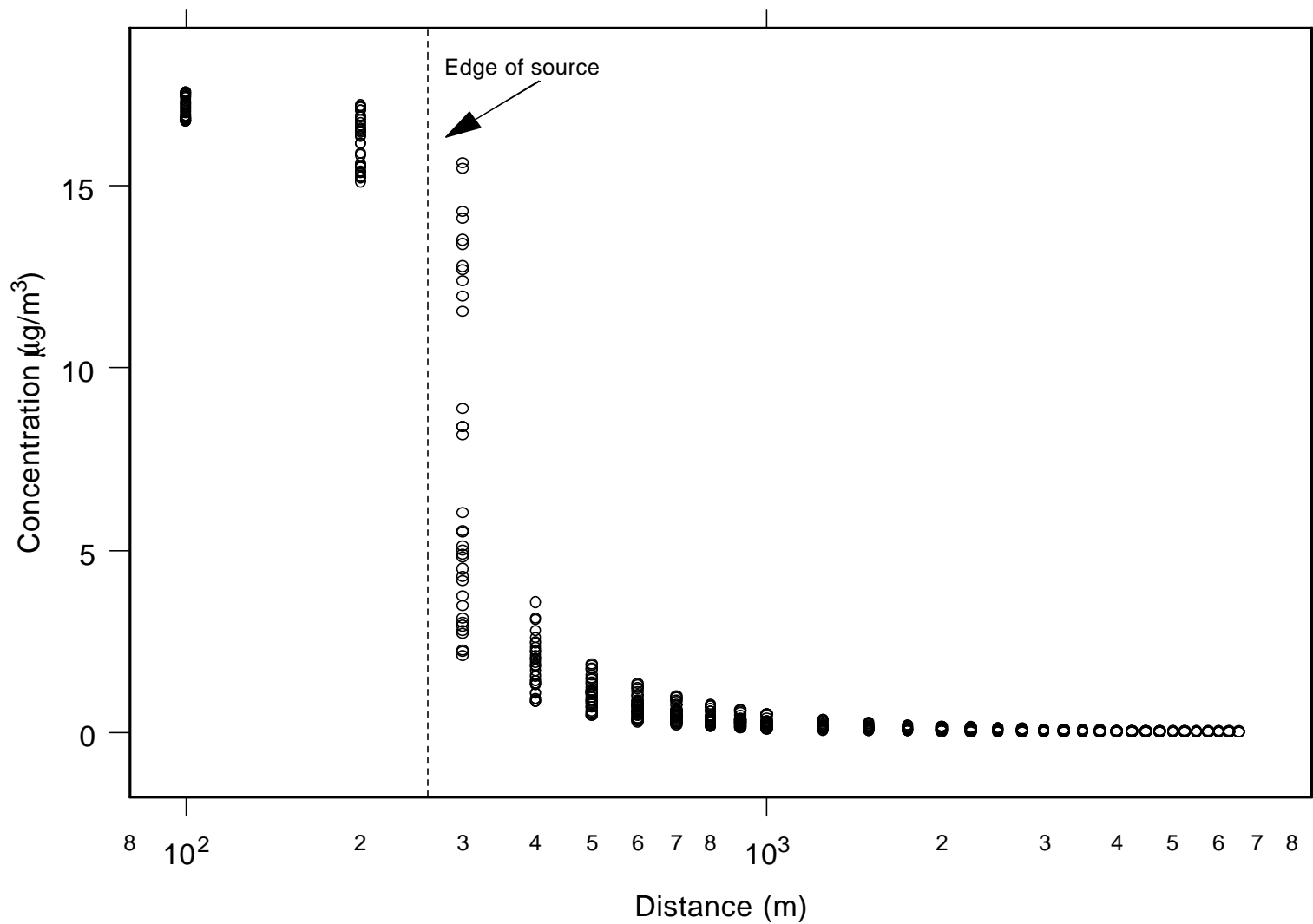


Figure 1. Annual average concentration at all receptors as a function of distance for the land application unit at site 0136703.

SI0136703

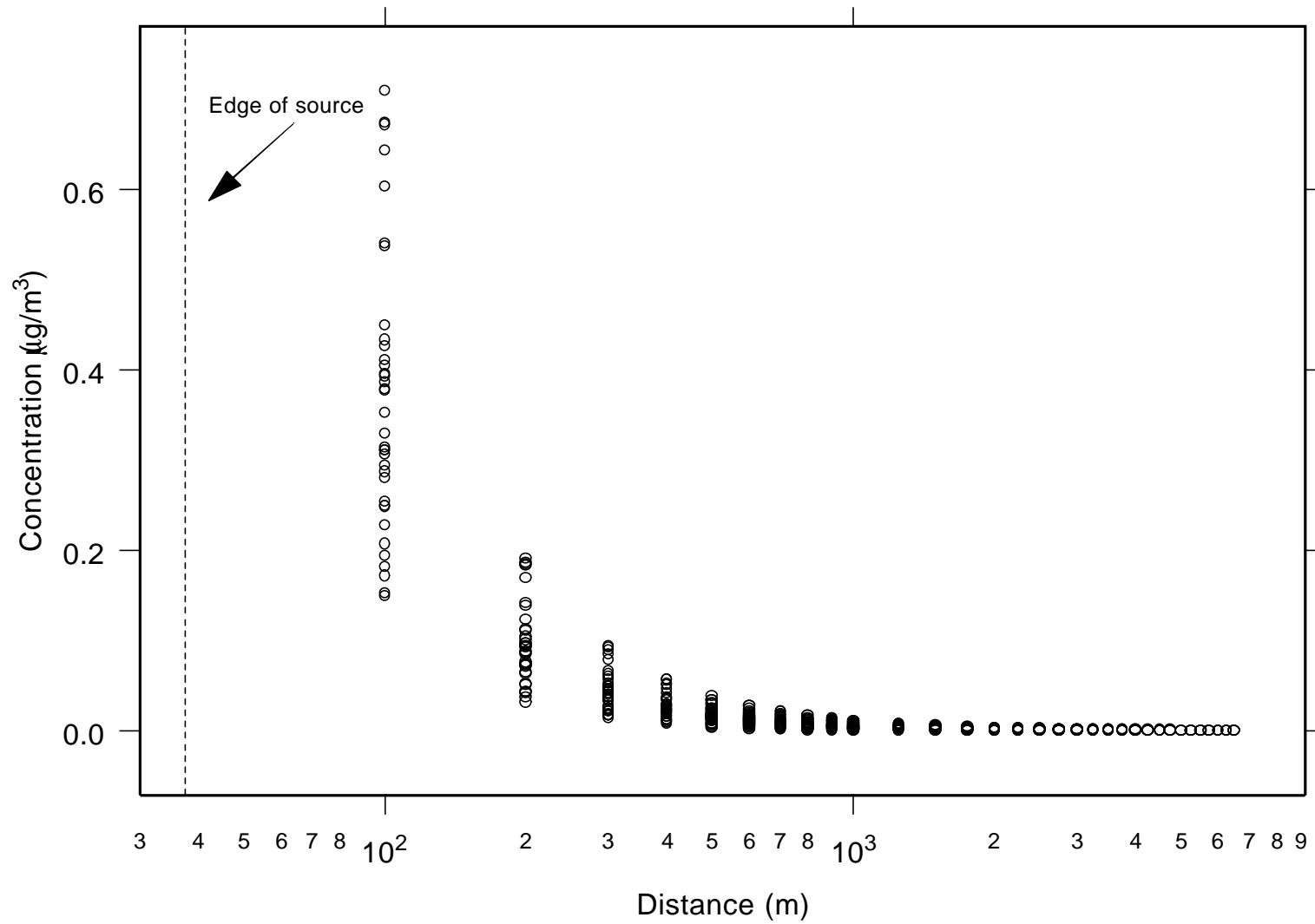


Figure 2. Annual average concentration at all receptors as a function of distance for the surface impoundment at site 0136703.



AT0136703

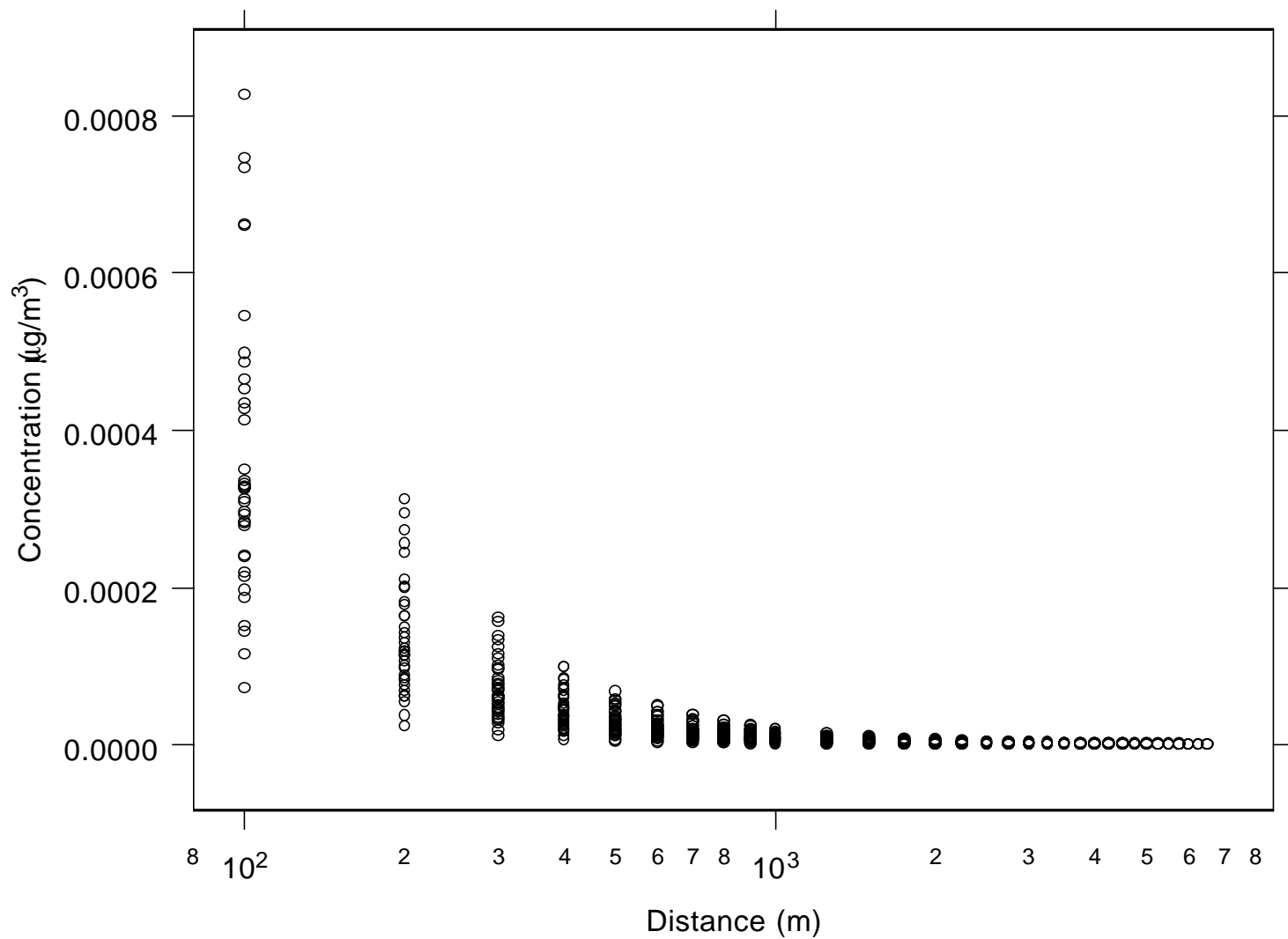
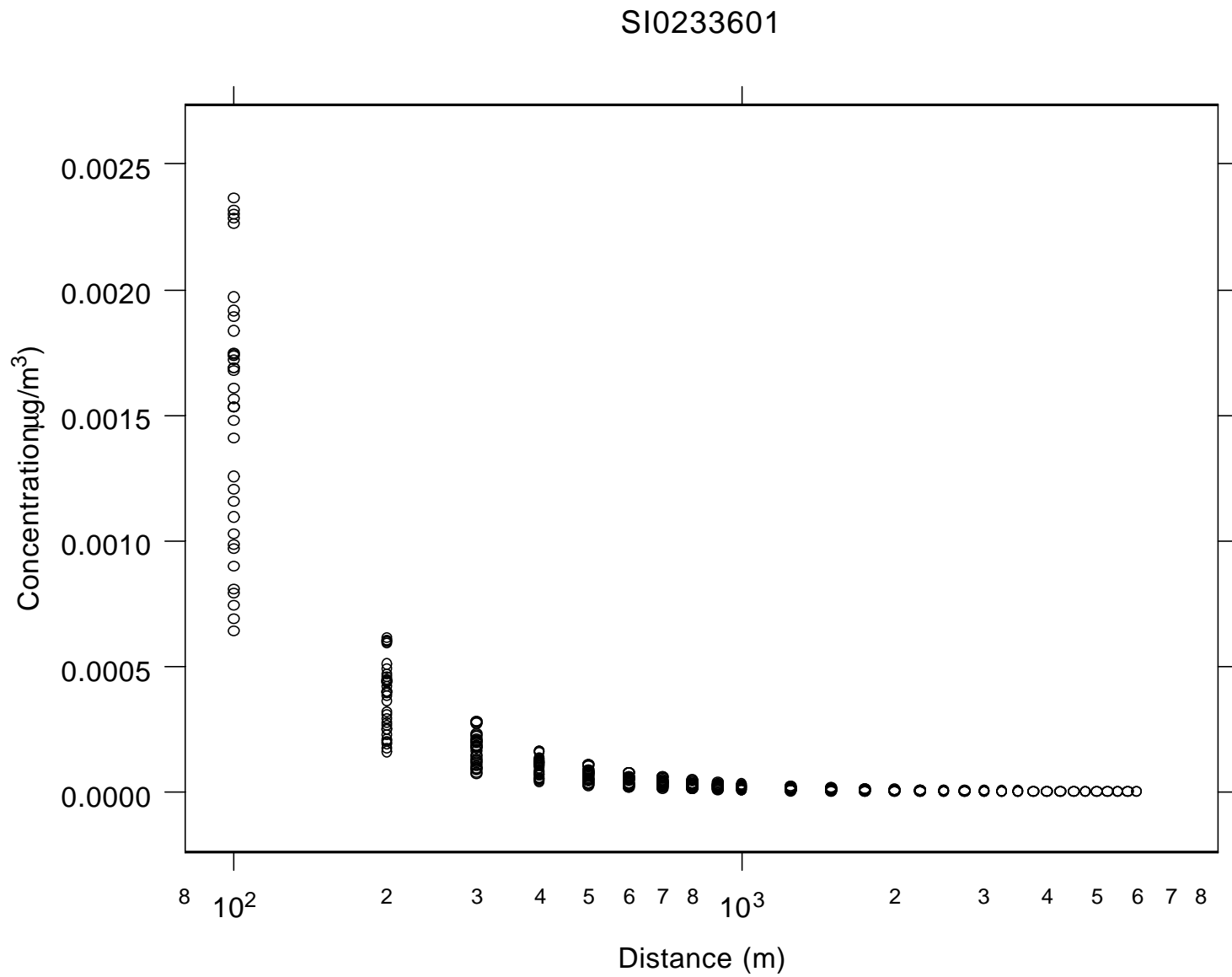


Figure 3. Annual average concentration at all receptors as a function of distance for the aerated tank at site 0136703.



**Figure 4.** Annual average concentration at all receptors as a function of distance for the surface impoundment at site 0233601.

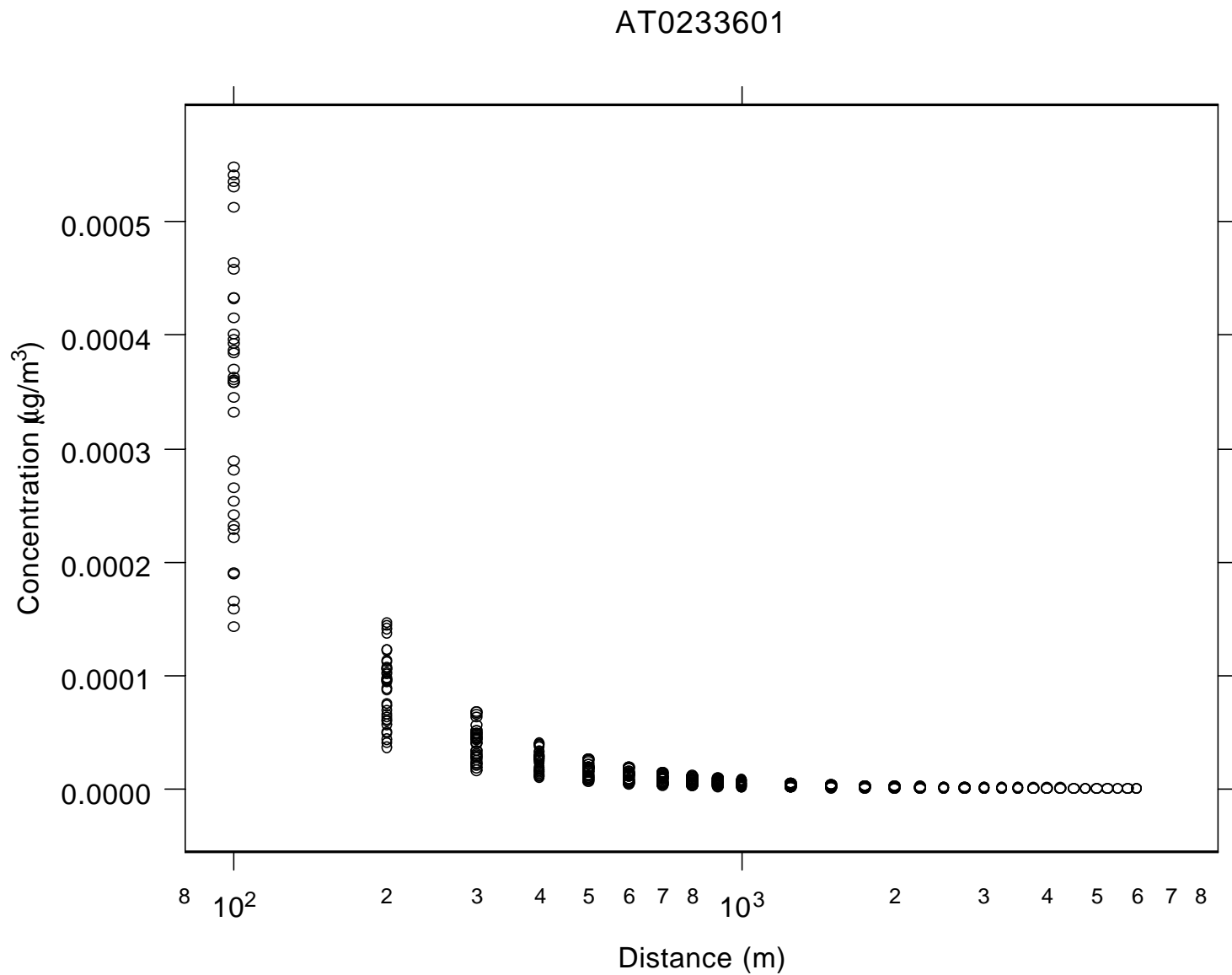


Figure 5. Annual average concentration at all receptors as a function of distance for the aerated tank at site 0233601.

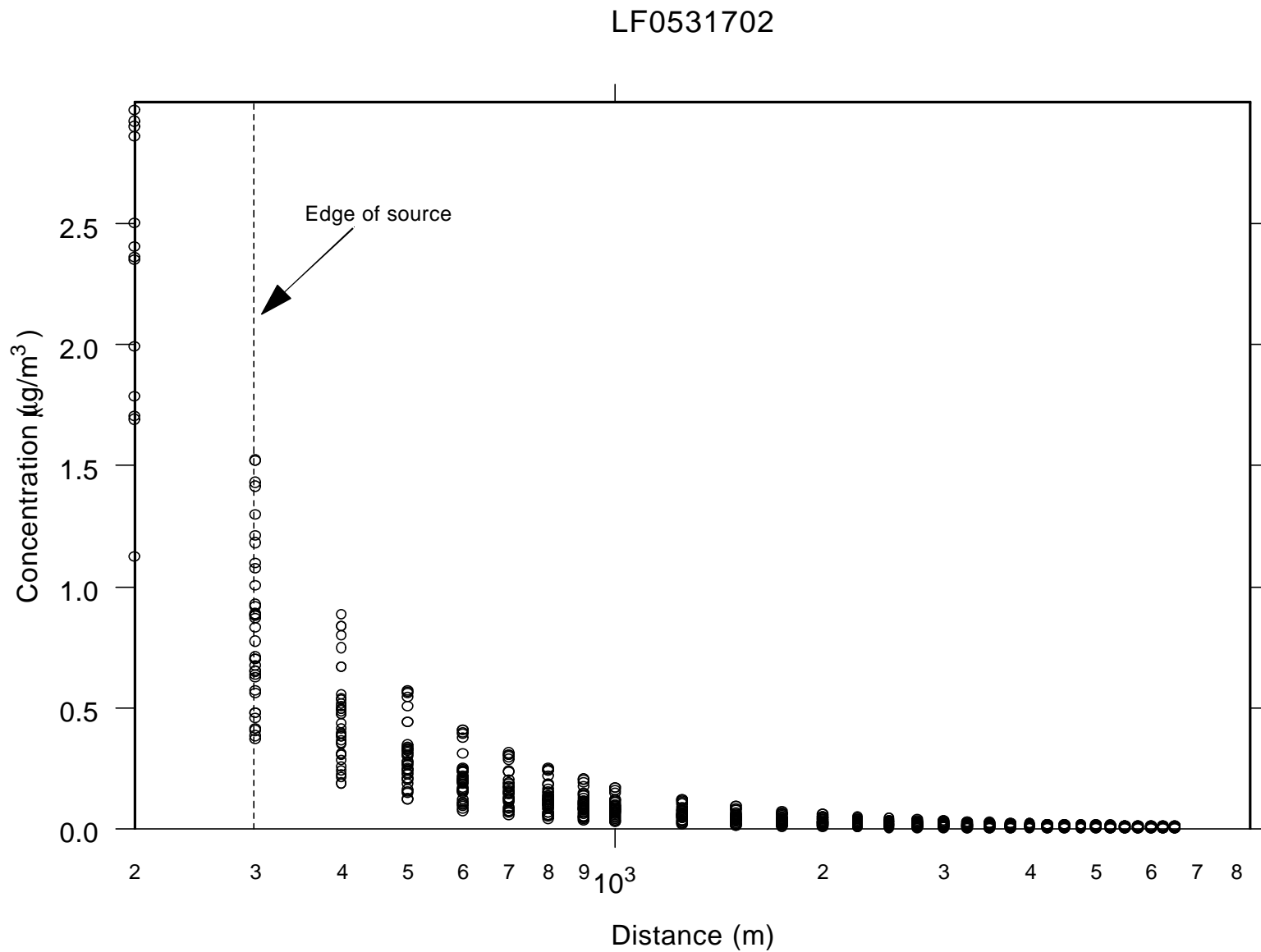


Figure 6. Annual average concentration at all receptors as a function of distance for the landfill at site 0531702.

SI0613402

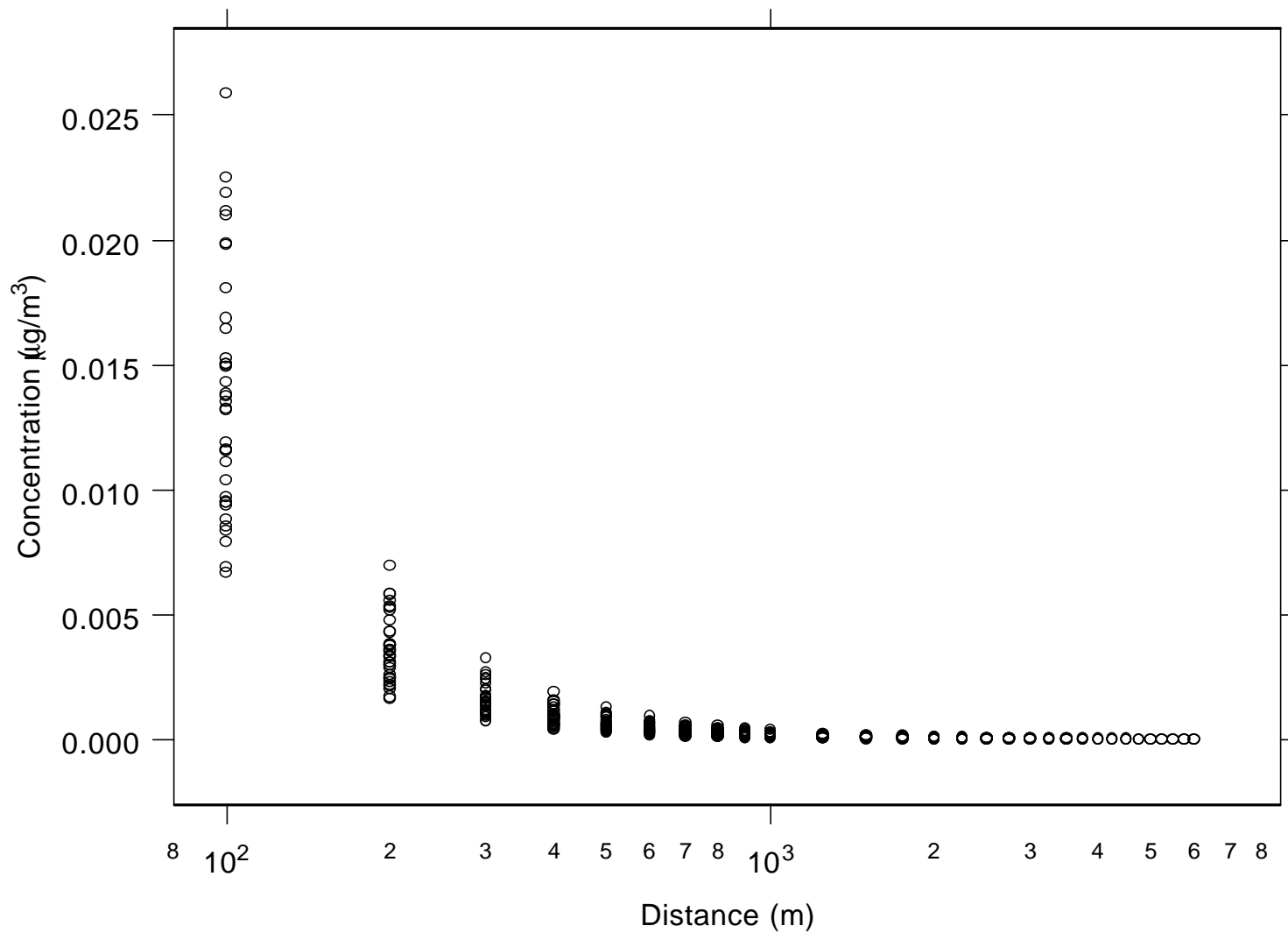


Figure 7. Annual average concentration at all receptors as a function of distance for the surface impoundment at site 0613402.



SI0620604

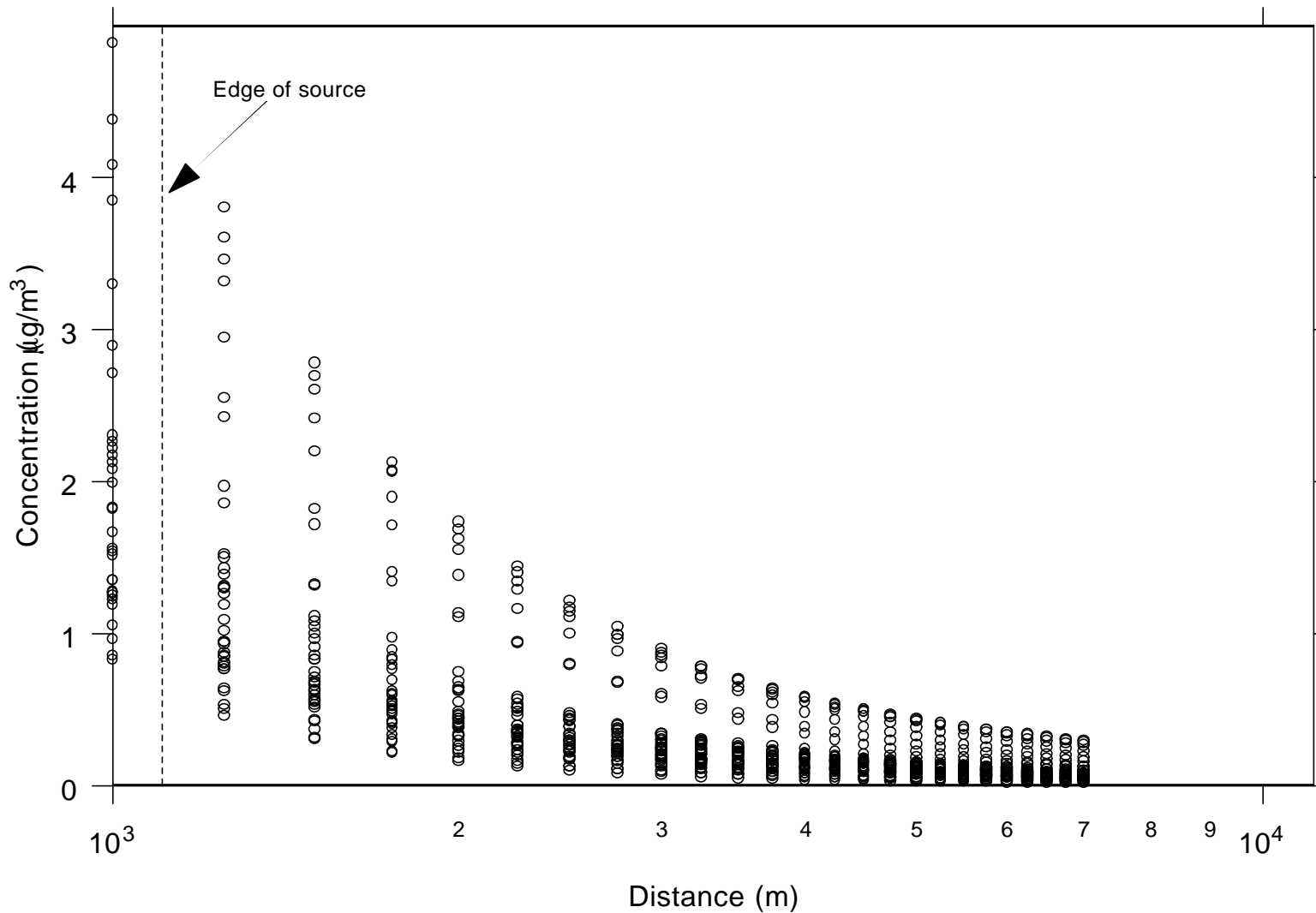


Figure 9. Annual average concentration at all receptors as a function of distance for the surface impoundment at site 0620604.

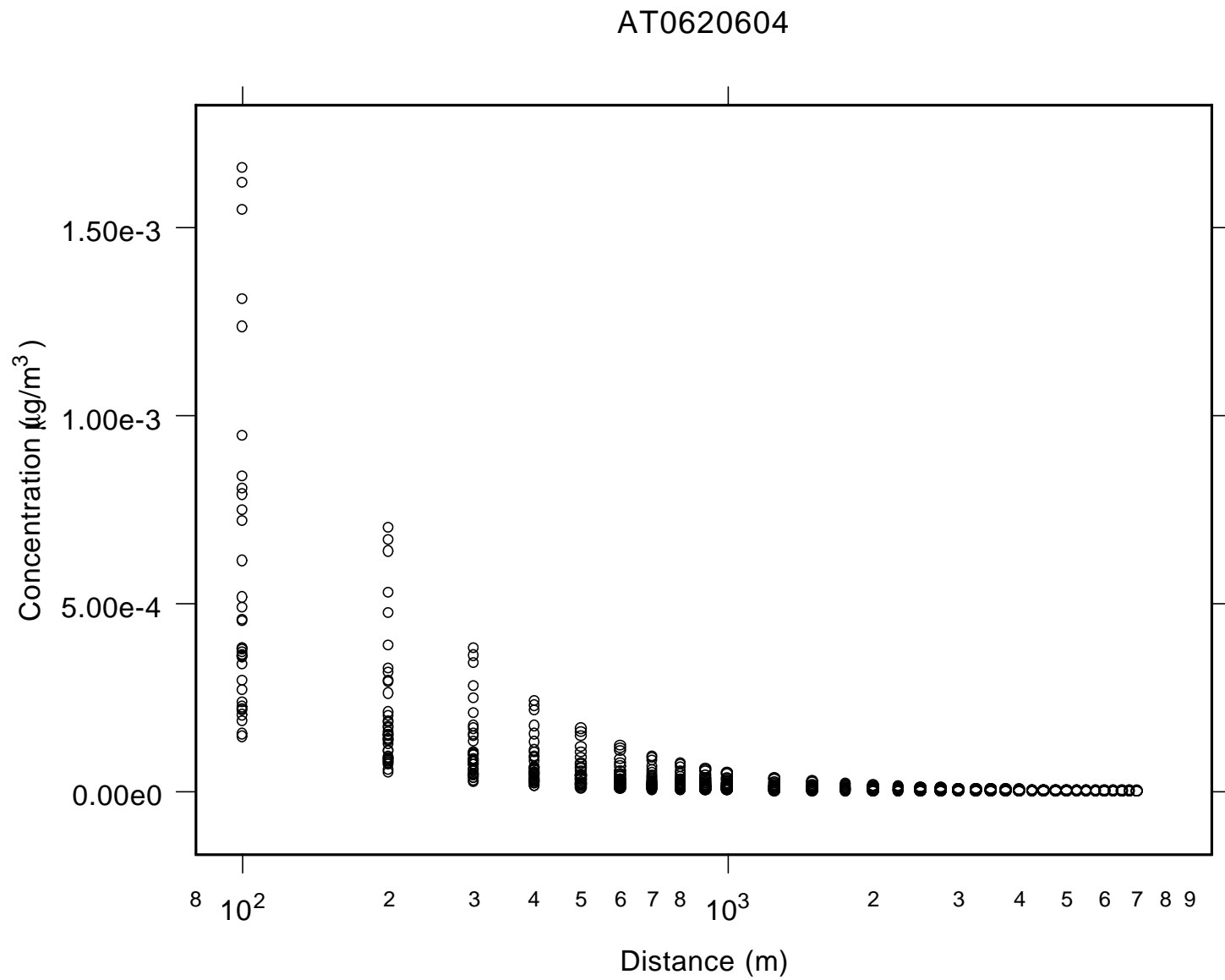


Figure 10. Annual average concentration at all receptors as a function of distance for the aerated tank at site 0620604.



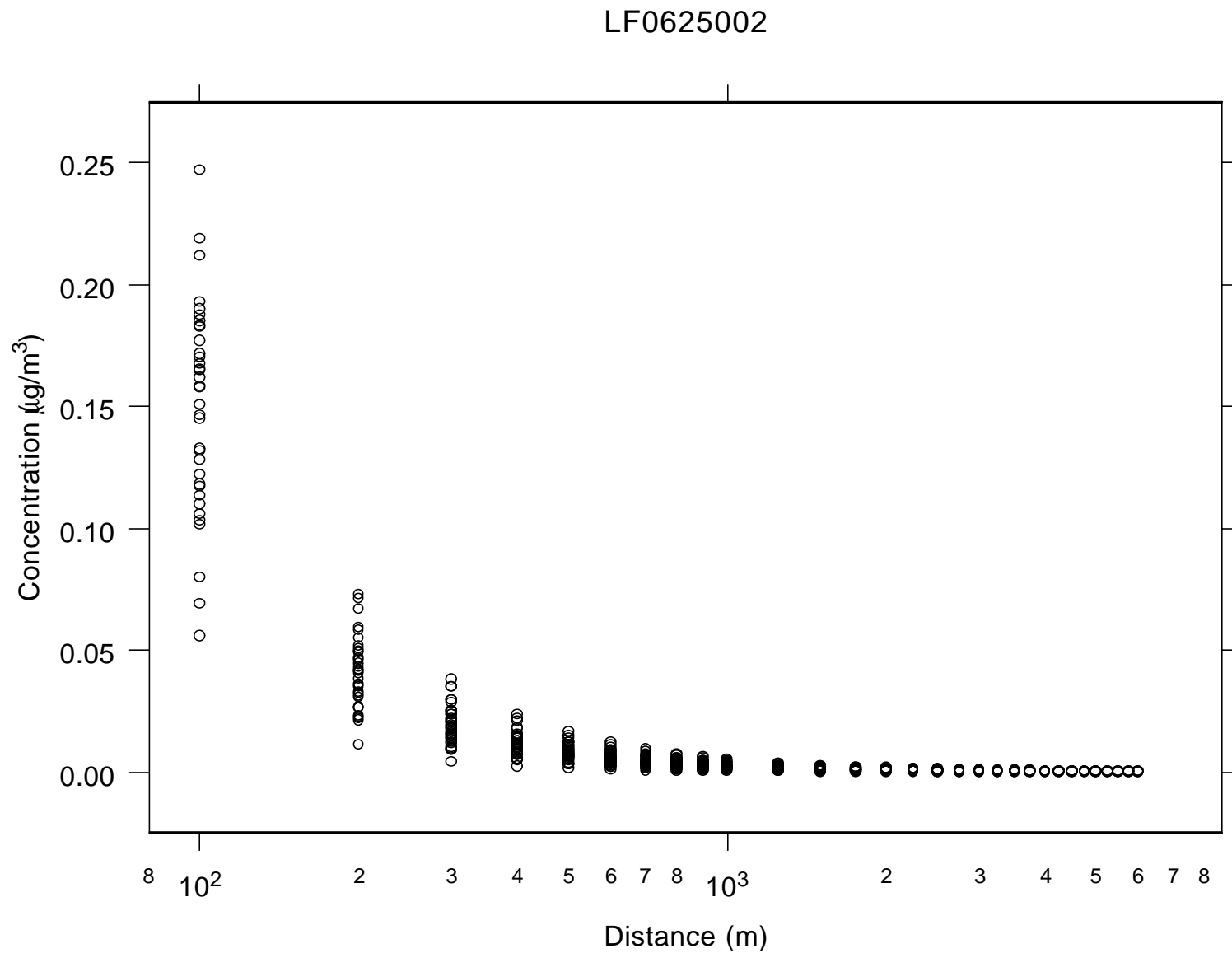
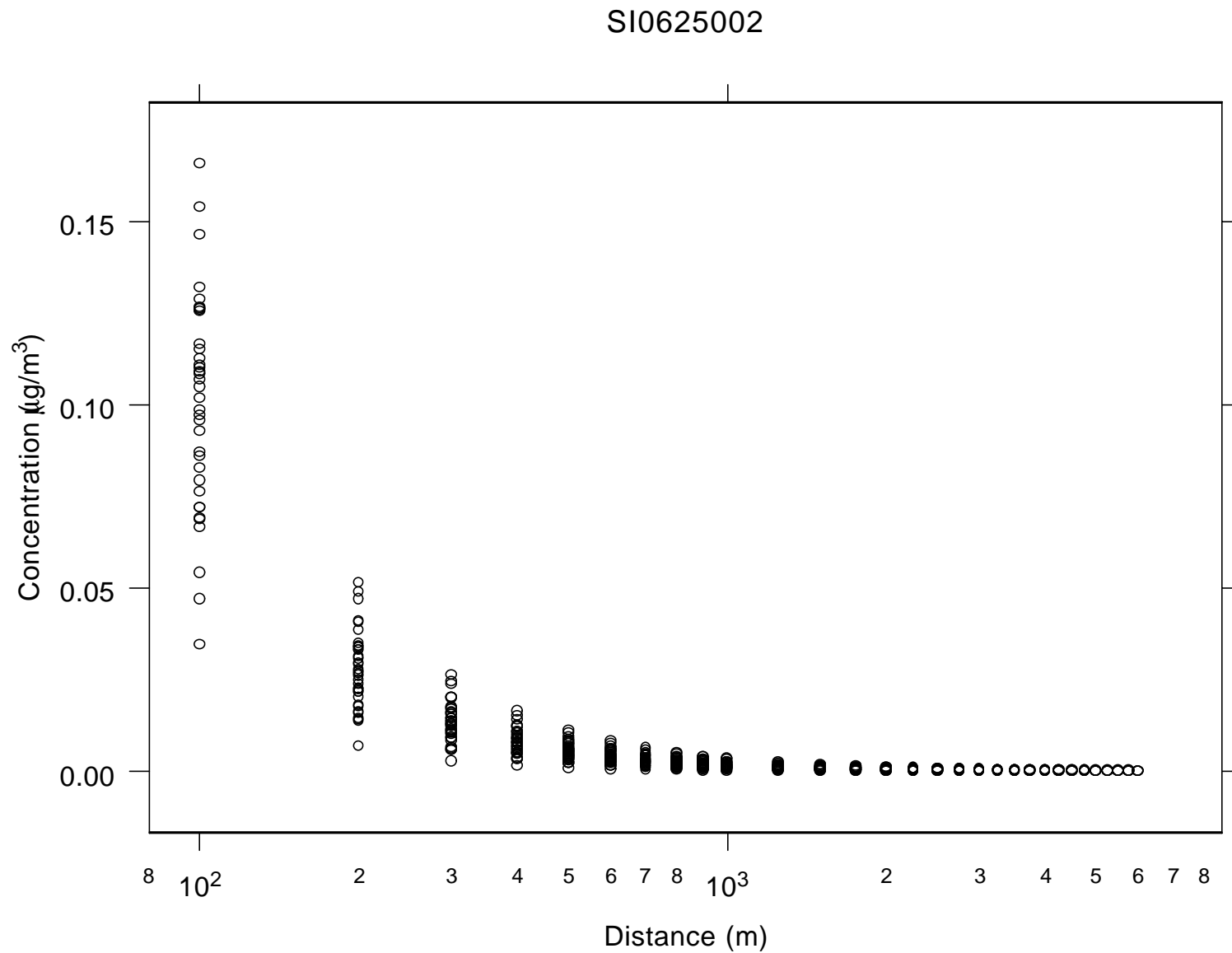


Figure 11. Annual average concentration at all receptors as a function of distance for the landfill at site 0625002.



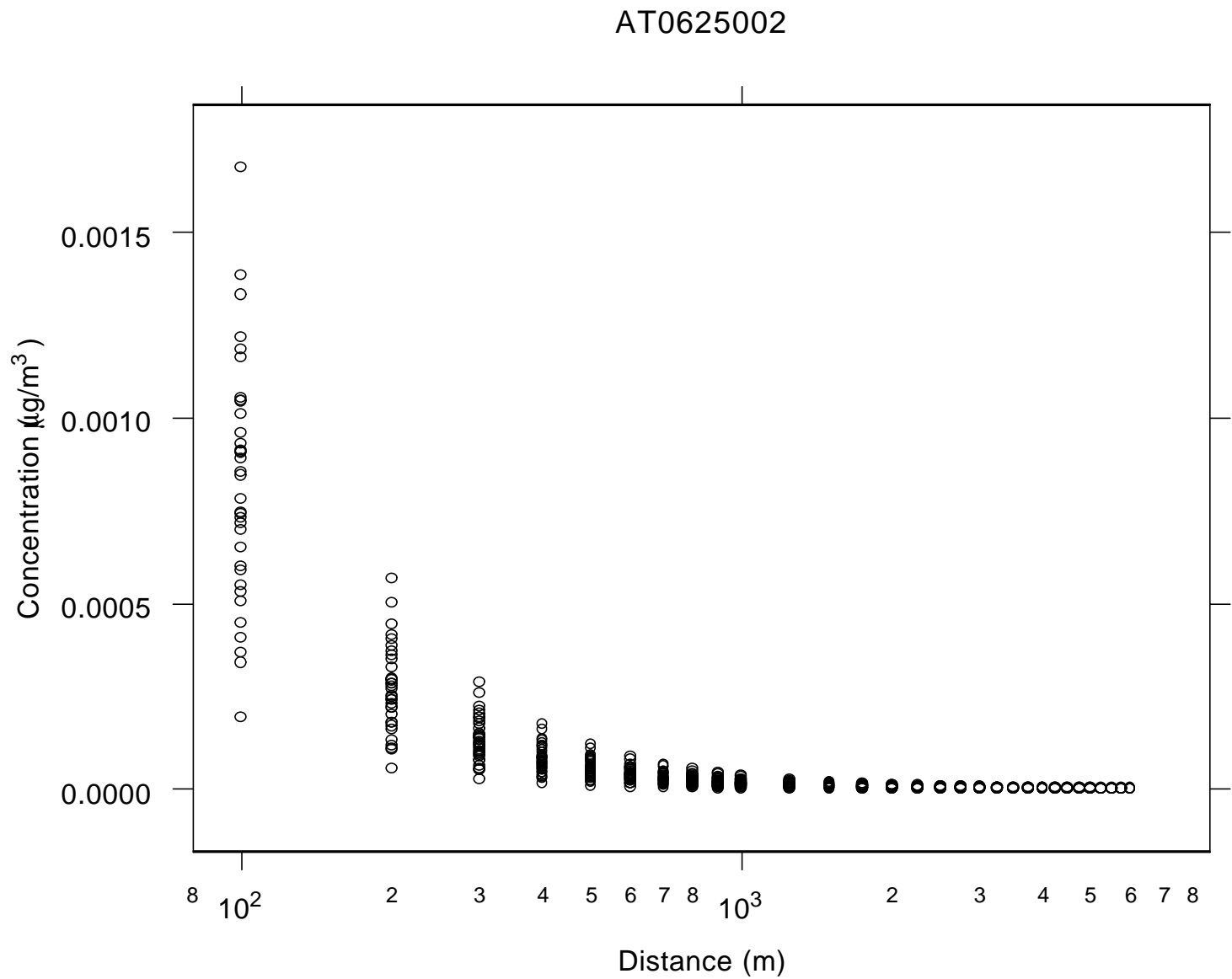


Figure 13. Annual average concentration at all receptors as a function of distance for the aerated tank at site 0625002.

LA0625501

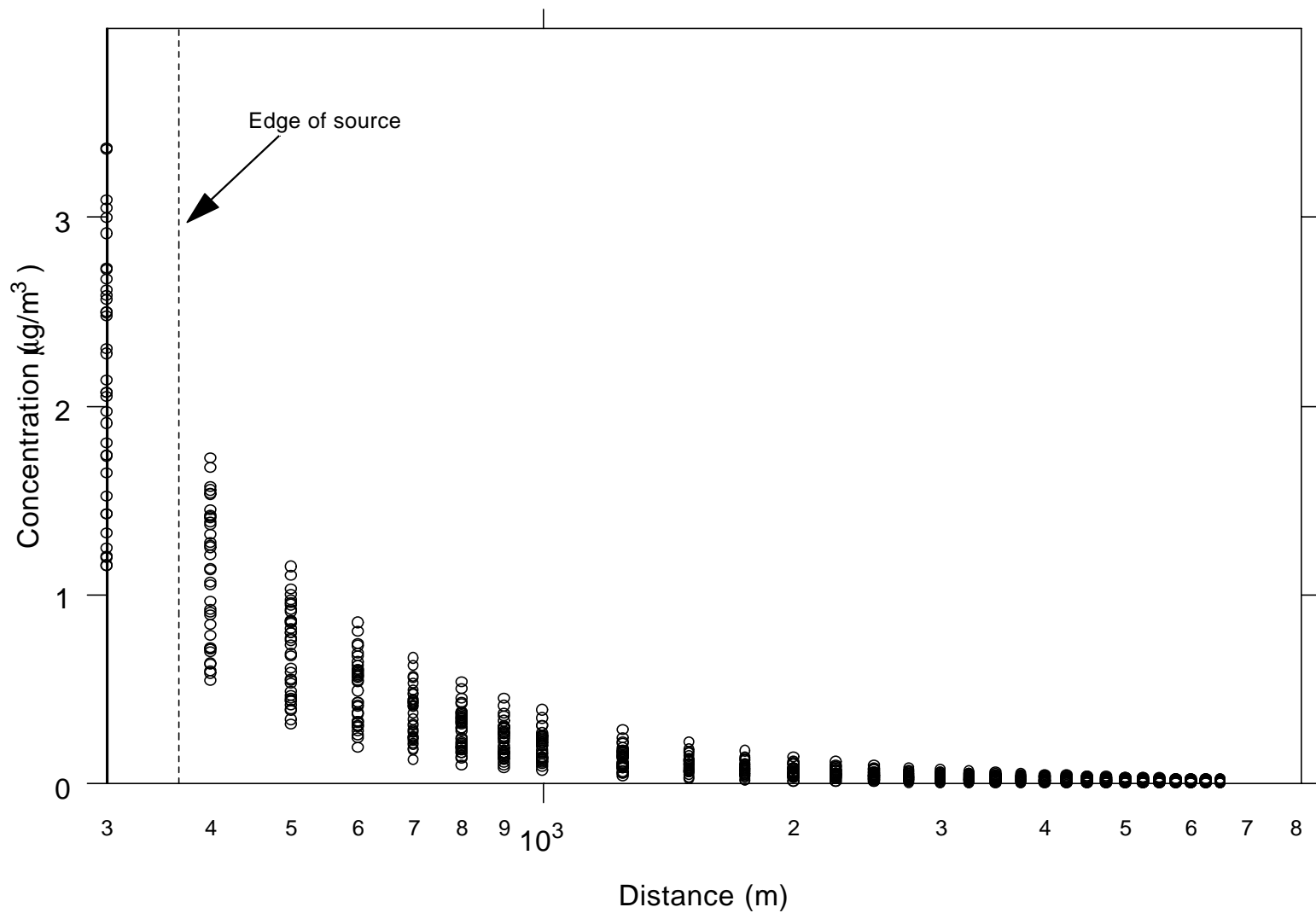


Figure 14. Annual average concentration at all receptors as a function of distance for the land application unit at site 0625501.

WP0720506

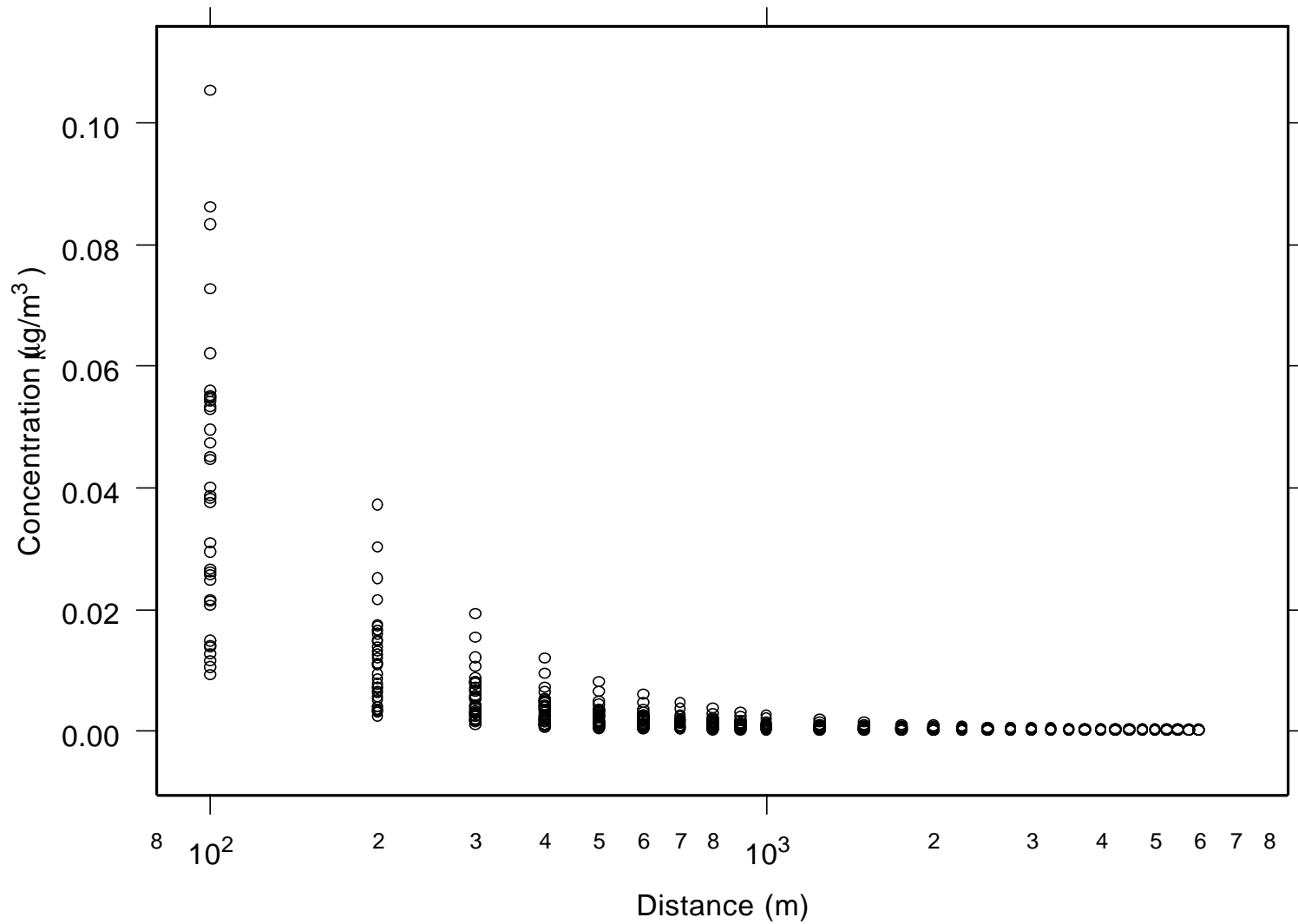


Figure 15. Annual average concentration at all receptors as a function of distance for the waste pile at site 0720506.

WP0722107

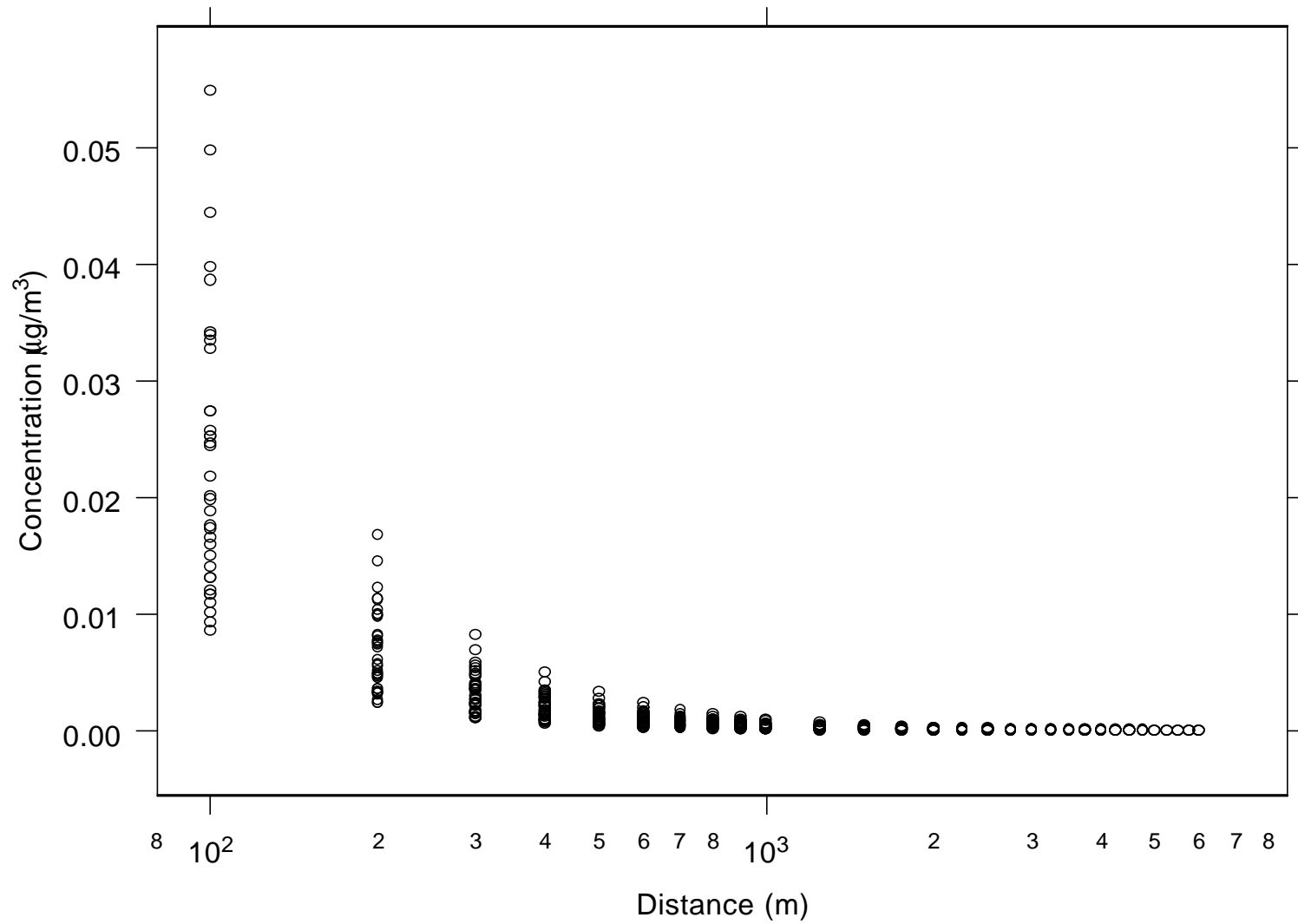


Figure 16. Annual average concentration at all receptors as a function of distance for the waste pile at site 0722107.

LF0730914

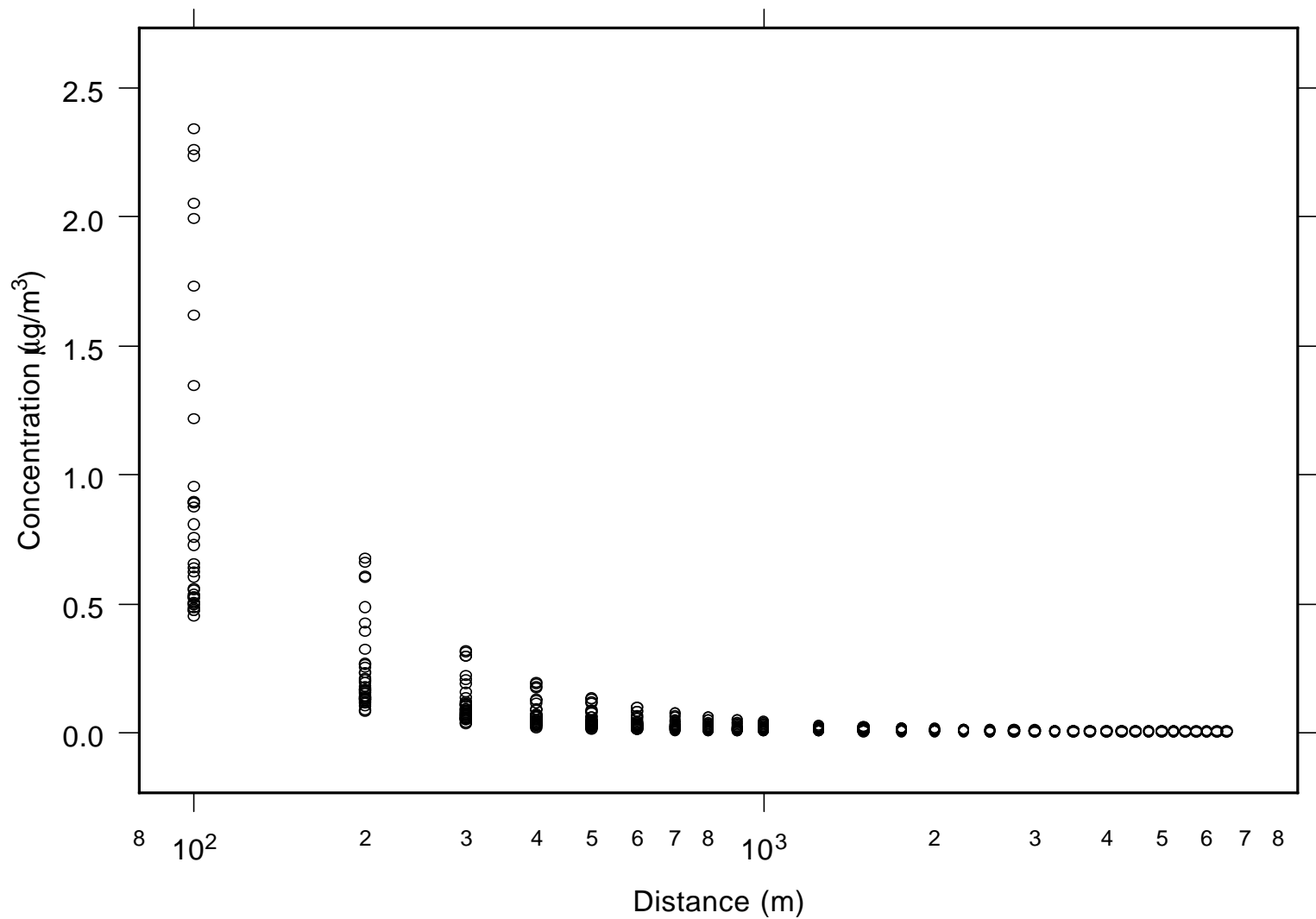


Figure 17. Annual average concentration at all receptors as a function of distance for the landfill at site 0730914.

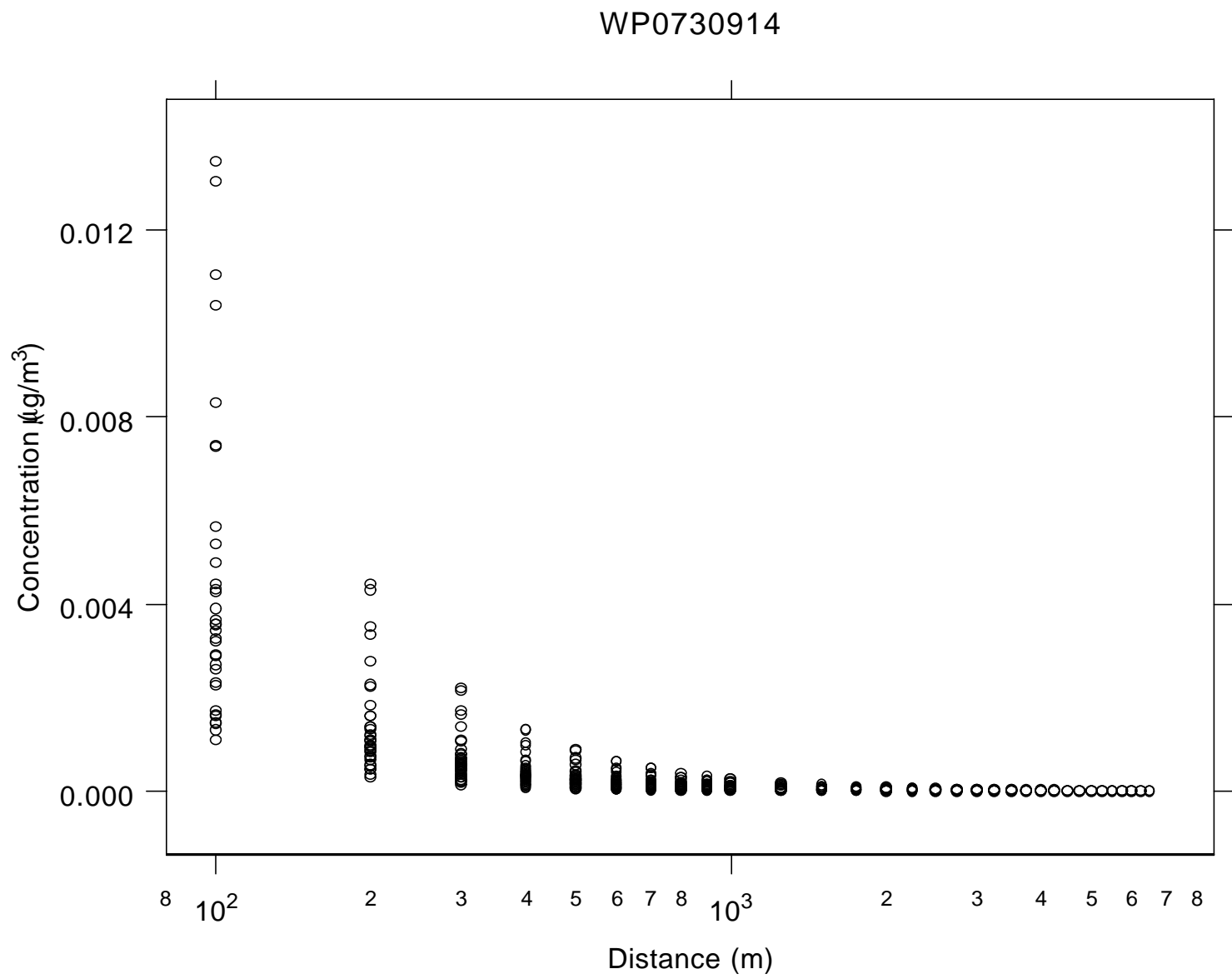


Figure 18. Annual average concentration at all receptors as a function of distance for the waste pile at site 0730914.





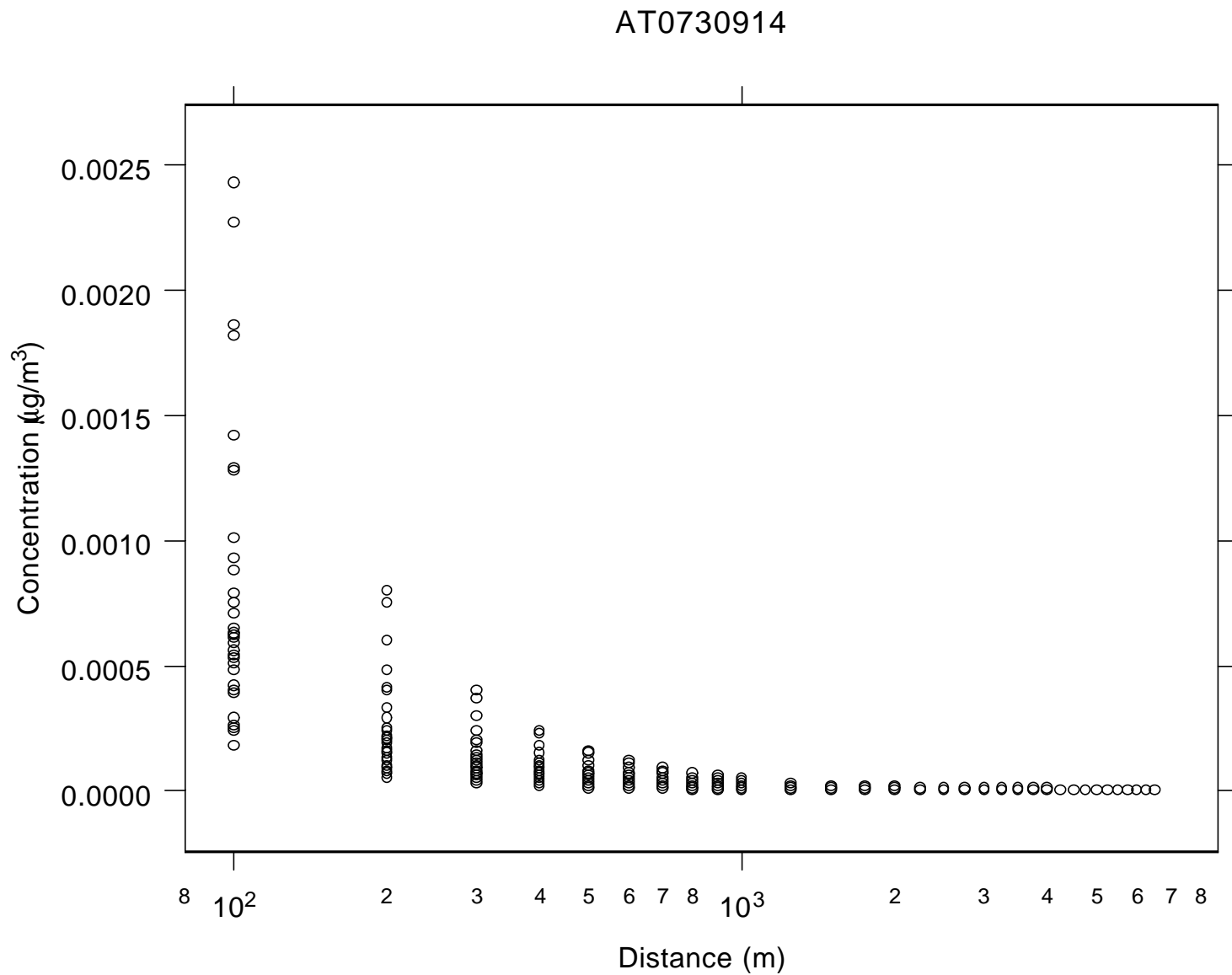


Figure 20. Annual average concentration at all receptors as a function of distance for the aerated tank at site 0730914.

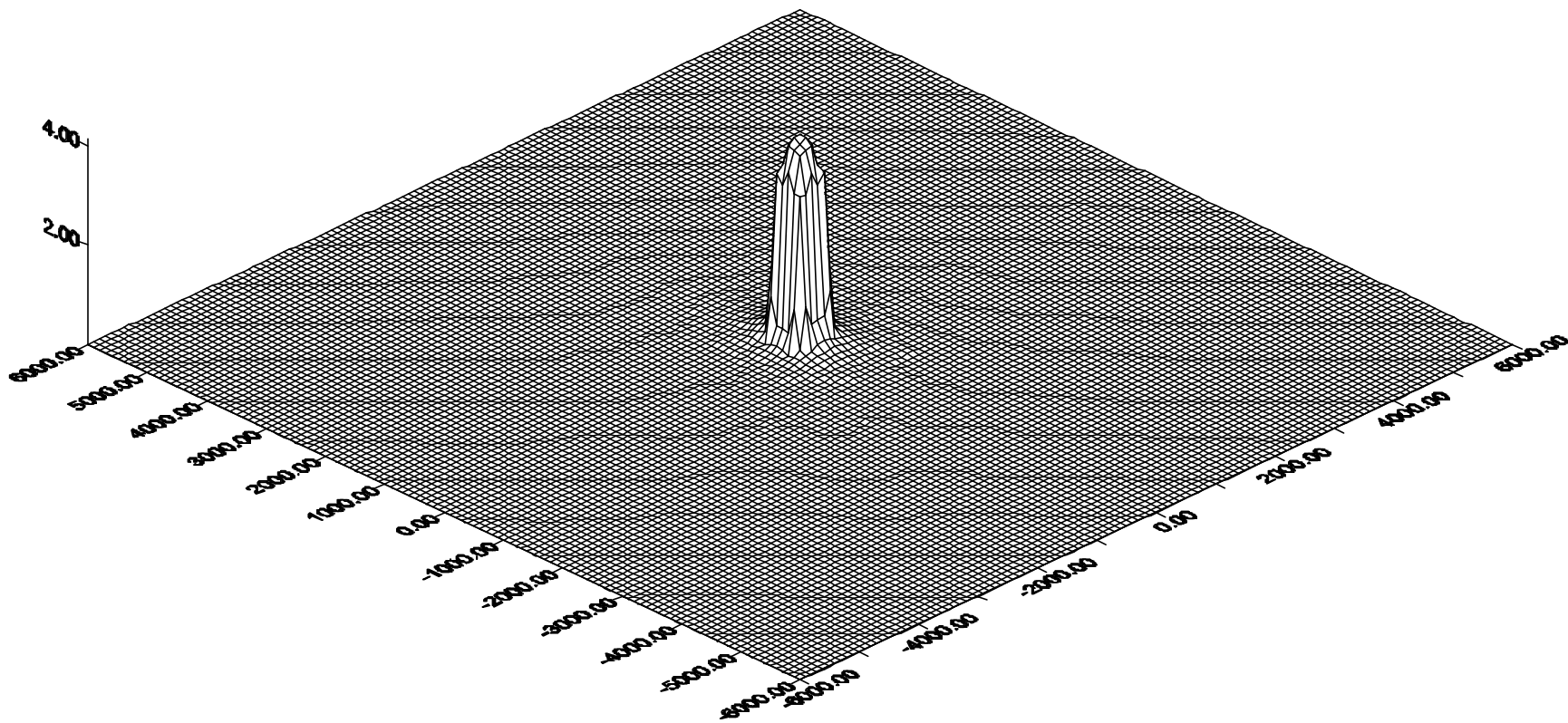
LA0136703  
Dry Deposition

Figure 21. Spline surface of annual dry deposition for the land application unit at site 0136703.

LF0531702  
Dry Deposition

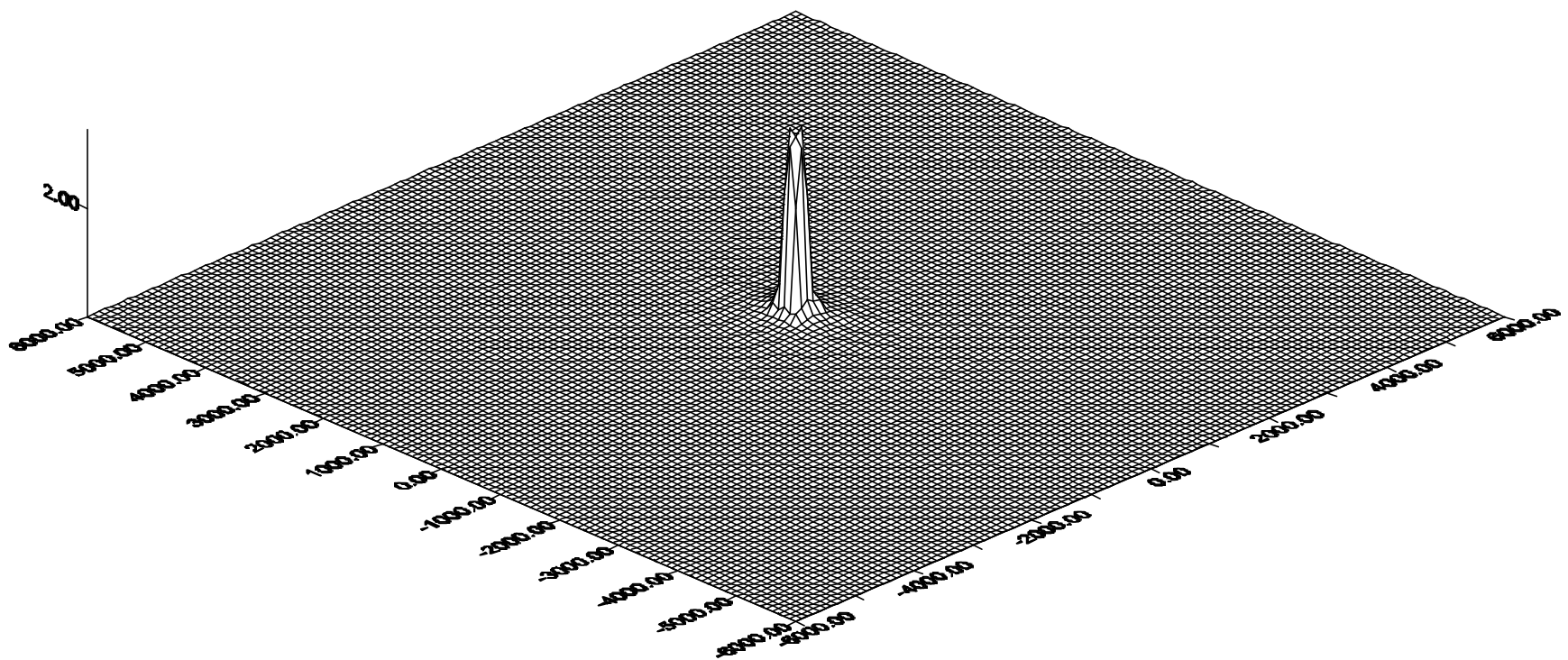


Figure 22. Spline surface of annual dry deposition for the landfill at site 0531702.

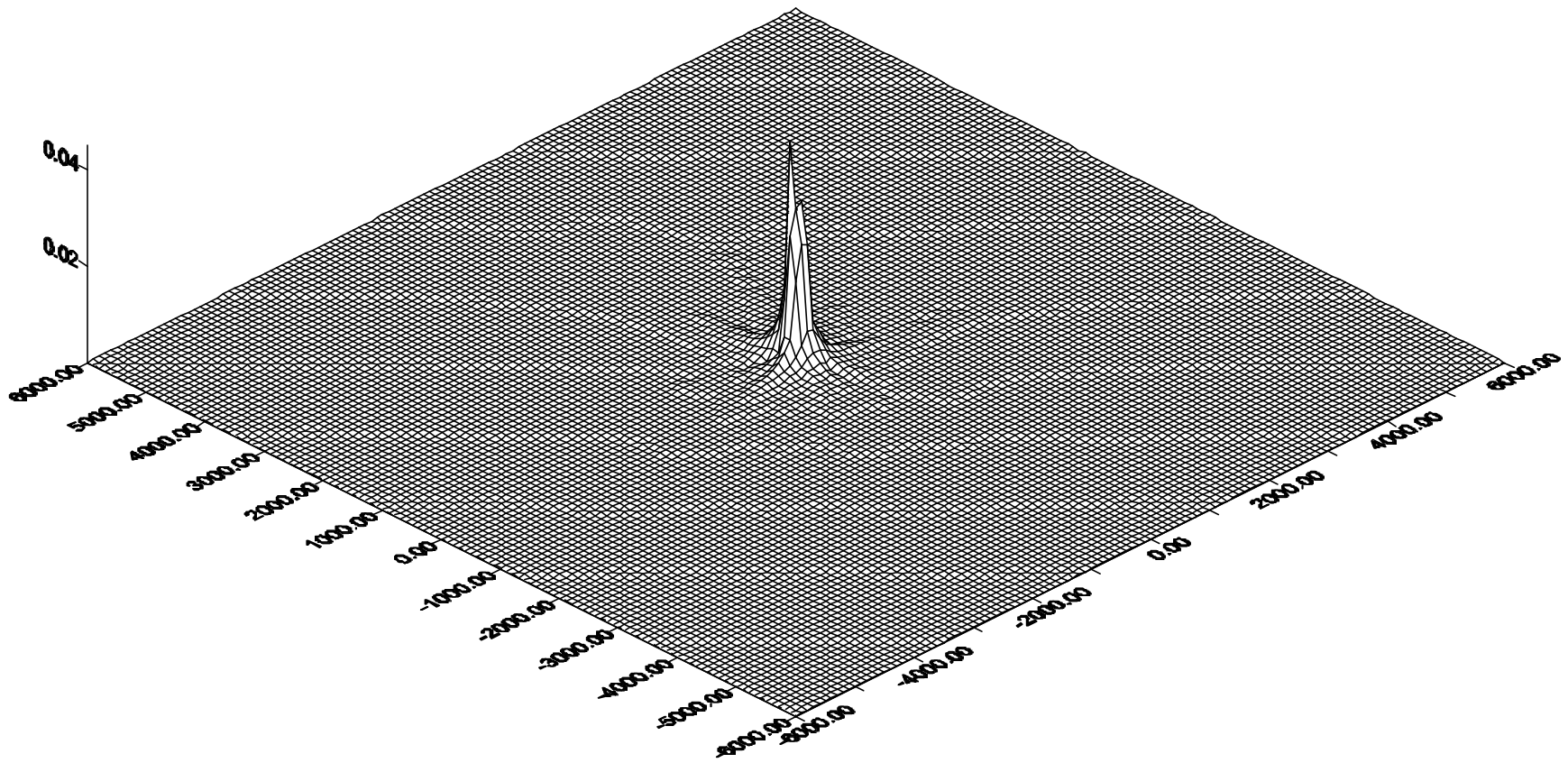
LF0625002  
Dry Deposition

Figure 23. Spline surface of annual dry deposition for the landfill at site 0625002.

LA0625501  
Dry Deposition

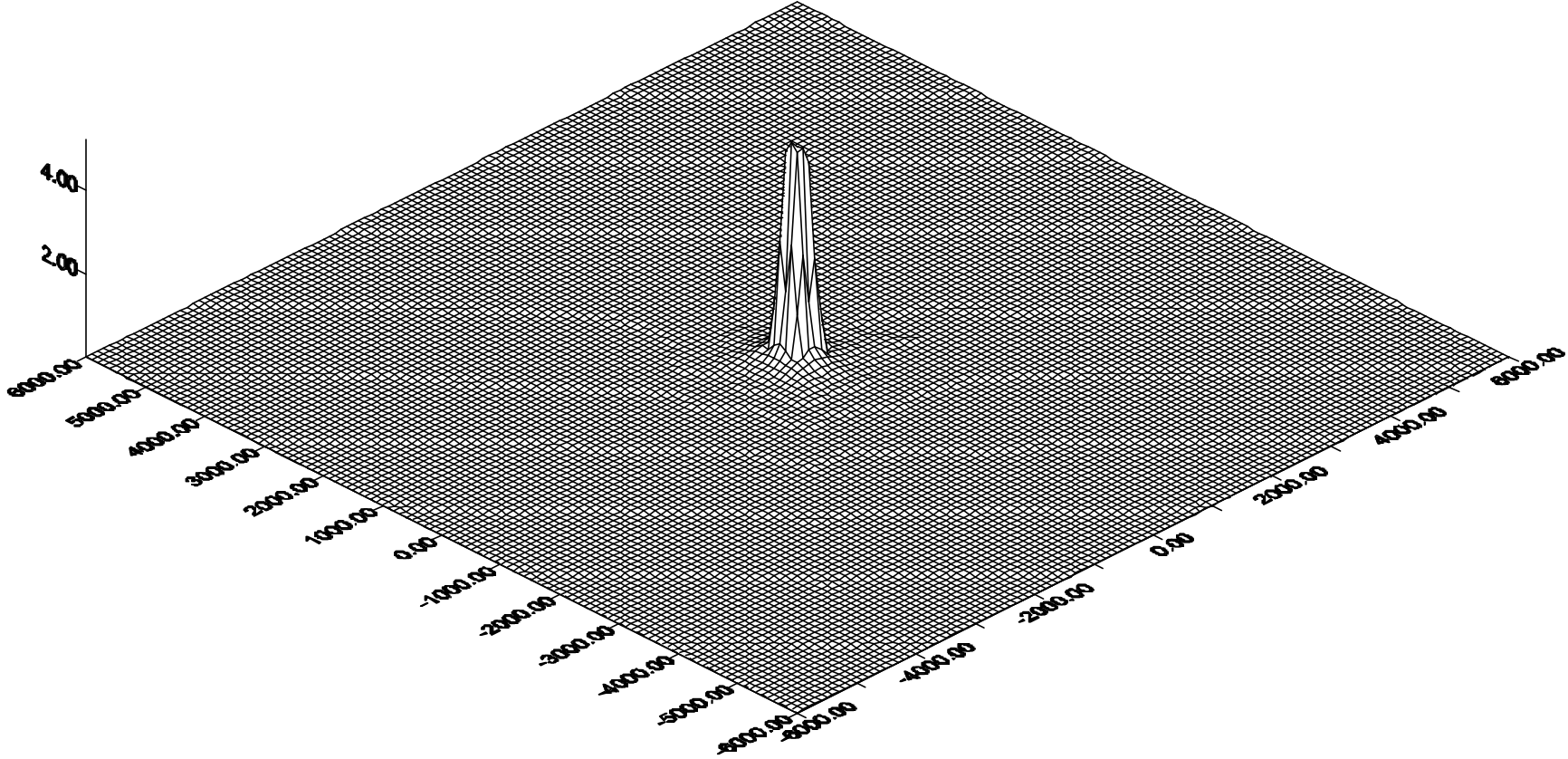


Figure 24. Spline surface of annual dry deposition for the land application unit at site 0625501.

WP0720506  
 Dry Deposition

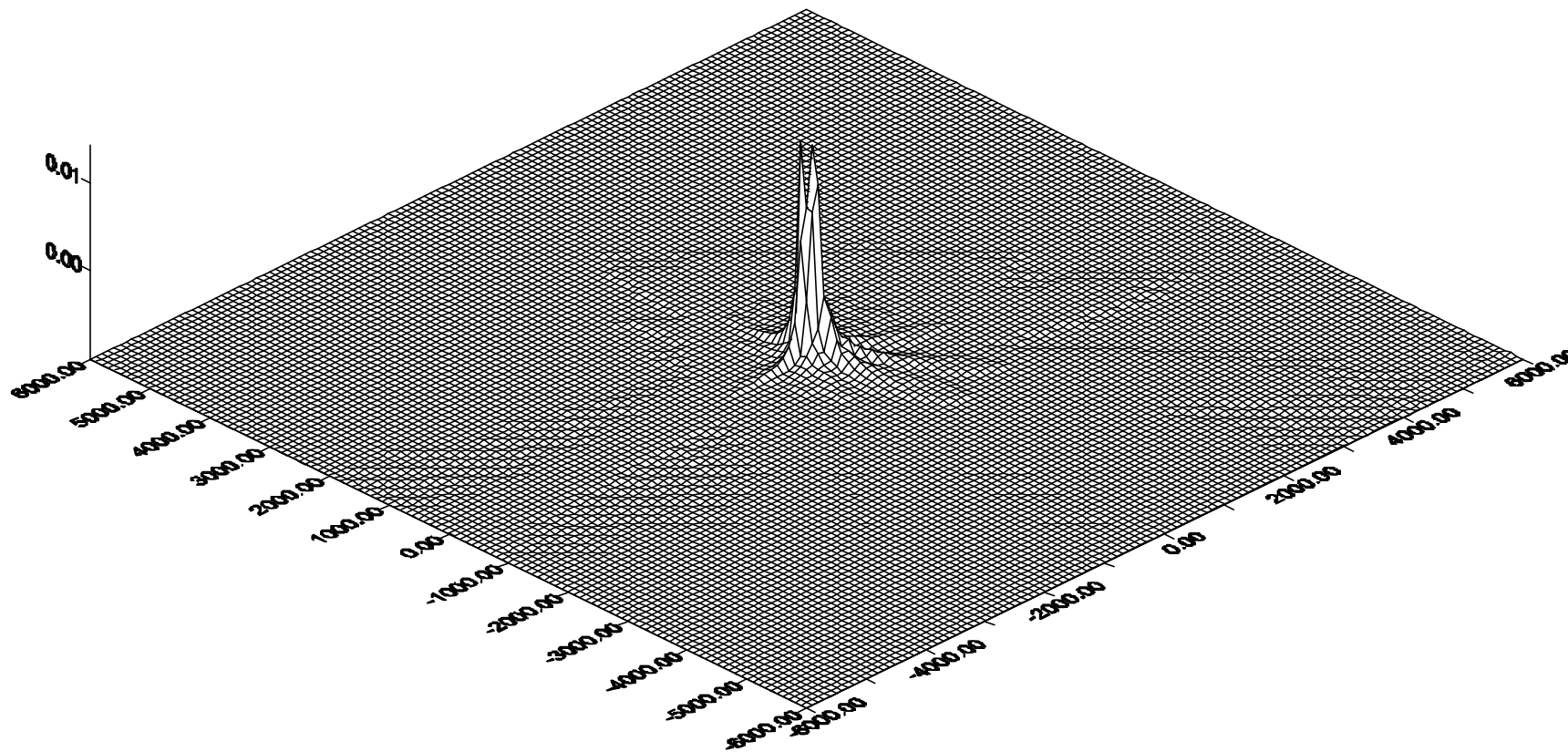


Figure 25. Spline surface of annual dry deposition for the waste pile at site 0720506.

WP0722107  
 Dry Deposition

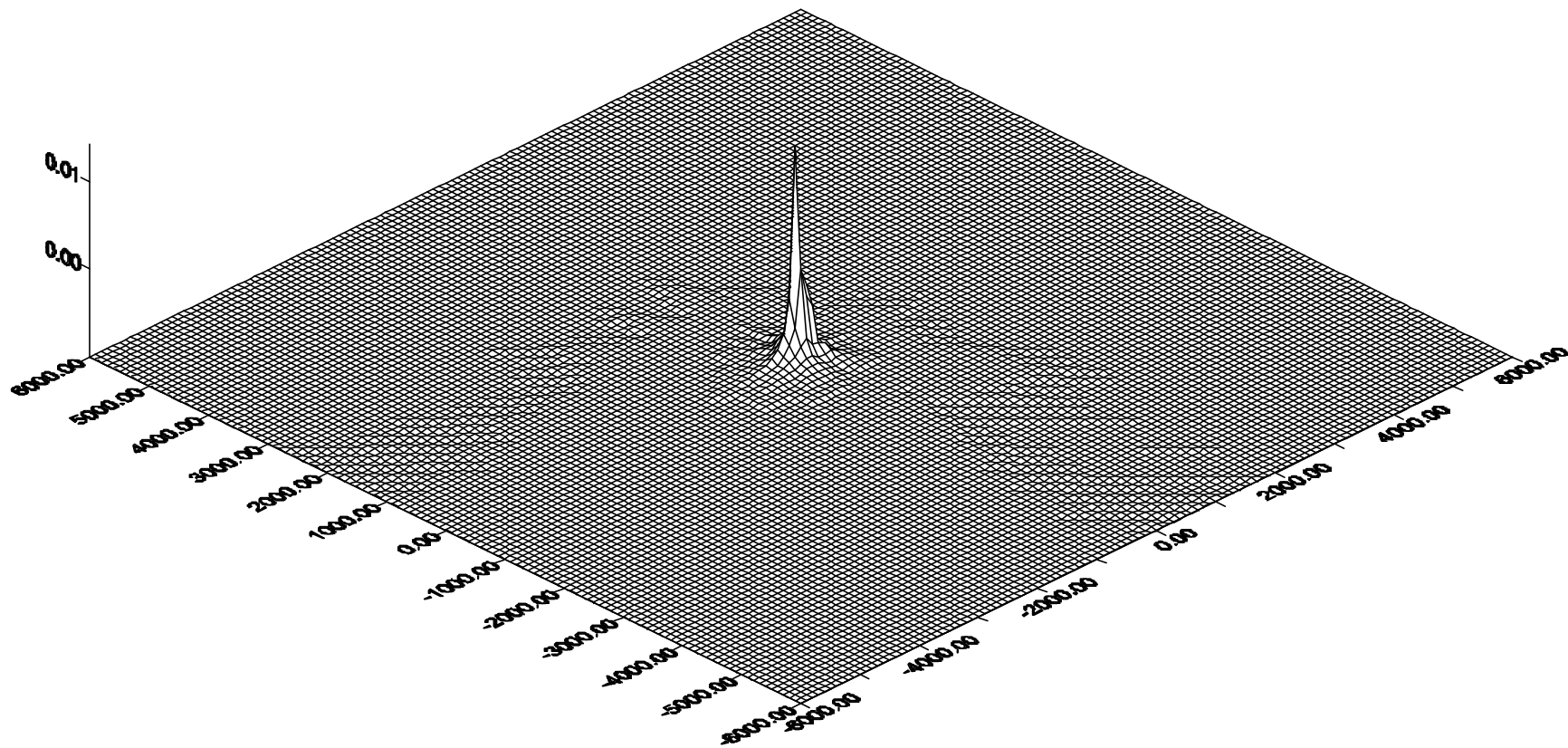


Figure 26. Spline surface of annual dry deposition for the waste pile at site 0722107.



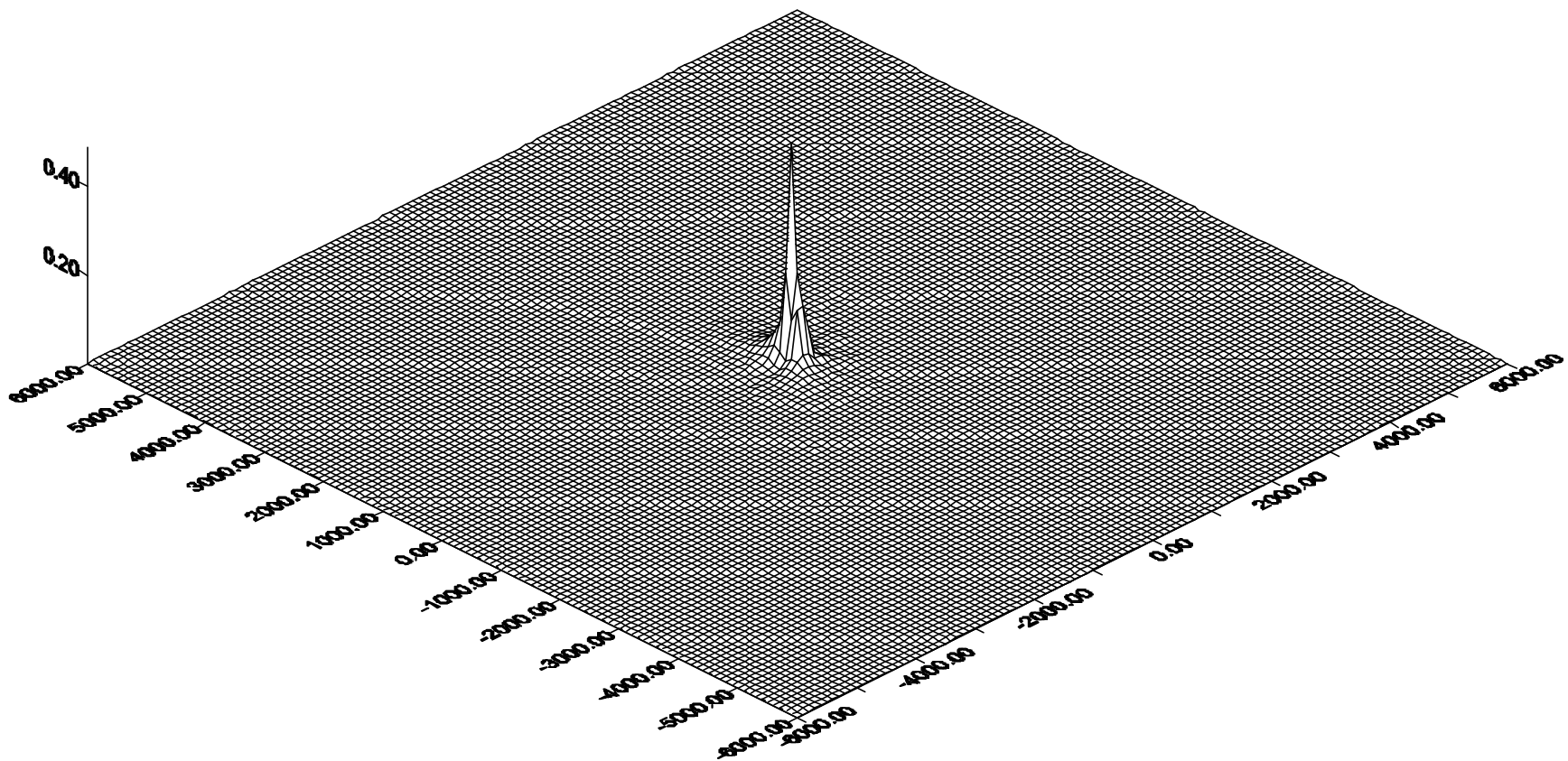
LF0730914  
Dry Deposition

Figure 27. Spline surface of annual dry deposition for the landfill at site 0730914.

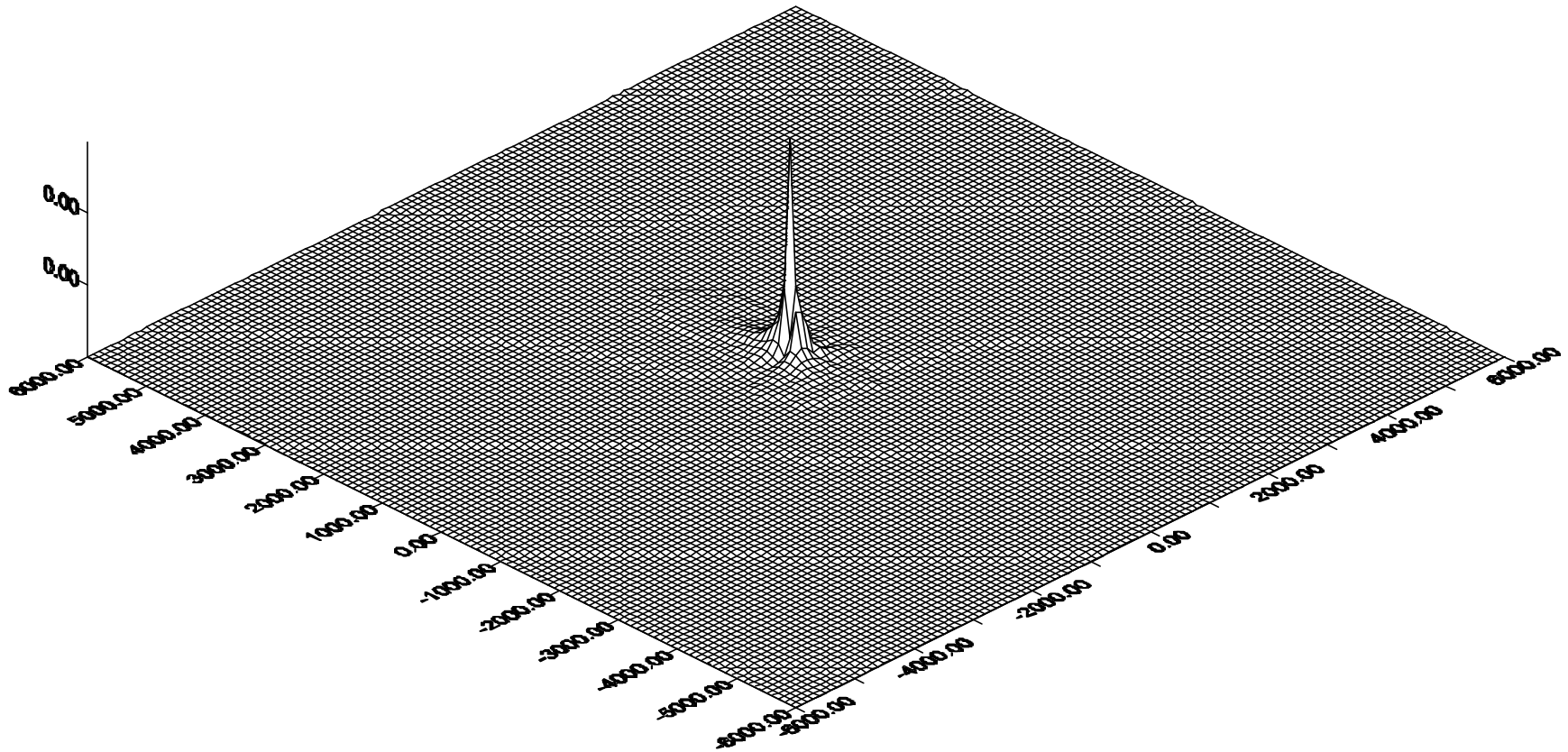
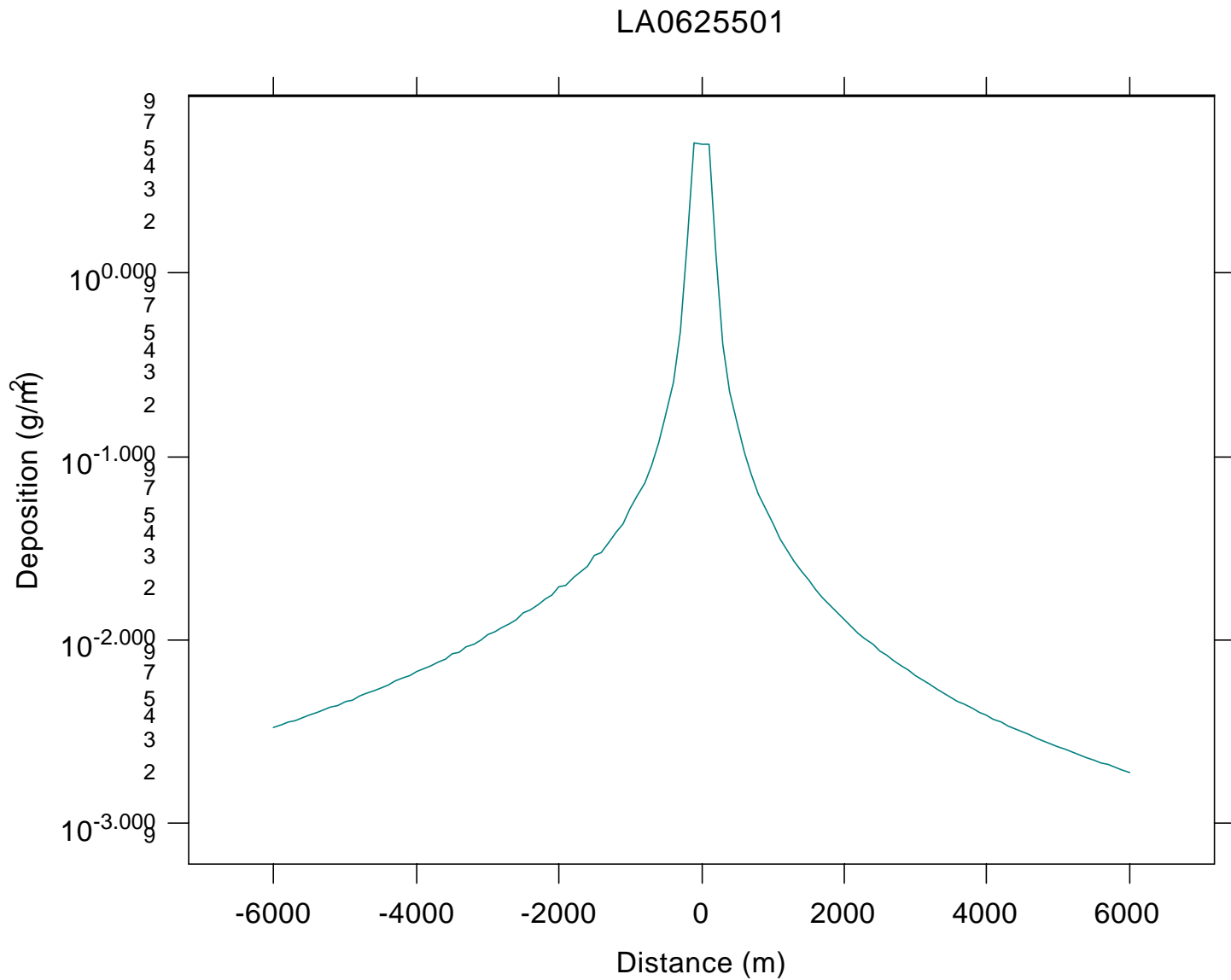
WP0730914  
Dry Deposition

Figure 28. Spline surface of annual dry deposition for the waste pile at site 0730914.



**Figure 29.** Cross-section through the center of the source for the deposition surface (Figure 24) land application unit at site 0625501.

