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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ATMOSPHERIC RESEARCH AND EXPOSURE ASSESSMENT LABORATORY
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27711

March 22, 1994

Subject: Wind-Tunnel Modeling Study of WTI Incinerator at East Liverpool

From: William H. Snyder, MD-81
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To: Pamela Blakley, Ohio Permitting Section
Waste Management Division, EPA Region 5

Shortly after the submission of our proposal on the subject study (Feb. 25, 1994), you asked me if, in the final report, we would explain why we did not conduct a good-engineering-practice (GEP) stack-height study. I believe it is more appropriate to provide such explanation separately and prior to the conduct of the study we have proposed. Indeed, you may wish to pass this explanation through OAQPS channels to be sure that I have not misinterpreted their regulations and procedures. Even further, you may wish to delay the start of our wind-tunnel study until OAQPS has had a chance to review it.

The specific recommendations for GEP stack-height determination are set forth in two OAQPS documents (EPA, 1981; 1985), and an example wind-tunnel demonstration study was provided by Snyder and Lawson (1985).

As you are aware, a formula is available for calculating the GEP stack height when the stack is located in the vicinity of buildings or structures, but no such formula exists for the case where downwash is caused by nearby terrain features. "The GEP creditable stack height, based on nearby terrain, must be determined through the use of appropriate field or fluid modeling studies" (EPA 1981). The GEP stack height is that needed to prevent excessive pollutant concentrations in the vicinity of the source. OAQPS has defined "excessive concentrations" through a comparison of maximum ground-level concentrations (glc's) observed in the presence and in the absence of "nearby" terrain. In other words, the maximum glc measured in a model that includes nearby terrain obstacles is termed "excessive" when it is 40% or more above the maximum glc measured in a model that does not include downwash, wake or eddy effects produced by nearby terrain. "Nearby" is defined as that within 0.8 km (0.5 mi) of the stack. The procedure specified by EPA (1985) for existing sources is that the nearby and distance limitations would apply with respect to the terrain feature(s) inserted and removed during the conduct of a wind-tunnel study. Further, the lesser of $10H_T$ or 2 miles is specified as the upwind extent of the nearby terrain feature(s) (to be inserted and removed during the wind-tunnel study) as long as such feature(s) achieves a height H_T, at or within 0.8 km (0.5 mi) from the stack, that is greater

than or equal to 40% of the GEP stack height (H_G) determined through application of the above-mentioned formula when the stack is located in the vicinity of a building. of the above guidance to the WTI site is discussed below.

From the preliminary information provided to me, I understood that the GEP stack height (as calculated by J. Scire of Sigma Research) was H_G = 80.8 m. I now understand from you that the calculation was in error and that you are in the process of recalculating the GEP stack height. Unless the new value of the GEP stack height were substantially different from the 80.8 m value, I don't think my arguments would change. I will thus use the 80.8 m value.

The terrain cross sections at the WTI site are displayed in Figure 1. Note that the vertical scale is exaggerated by a factor of 4. These were derived from USGS maps along a line through the stack and oriented in the direction of approximately 125° - 305° -- the wind directions where we expect to observe maximum terrain-downwash effects (see Figure 2). The predominant feature is, of course, the river valley.

Applying the above guidance, we should first define H_T, the maximum height of the terrain at or within 0.8 km (0.5 mi or 2640 ft) from the stack that is greater than or equal to 40% of H_G (40% of 80.8 m = 32.3 m or 106 ft). In fact, the highest terrain within the ½-mile radius has elevation of 1080 ft and the stack-base elevation is 705 ft, so that H_T = 375 ft. The upwind extent of the terrain that may be removed and replaced with faired terrain is thus $10H_T$ or 3750 ft, which is less than 2 miles.

An example of the way the terrain might be faired is shown as the dotted line on Figure 1. It is our opinion from having done previous wind-tunnel studies of dispersion in complex terrain that the effect of such fairing (or any other reasonable fairing) would not be substantial, since the modifications to the terrain would be rather small. This may be explained in rather simplified terms as follows. Looking at Figure 3, on the northwest side, the difference between the real terrain and the faired terrain is a hill of height 140 ft -- note that this figure is the same as Figure 1 except that I've shaded in this "perturbation hill". The peak of this hill is about 3000 ft (more than 20 hill heights) upwind of the source. From previous work by Lawson *et al* (1989), we do not expect to observe excess ground-level concentrations (more than 40%) when the source is beyond 10 hill heights downwind of the hill. The "perturbation hill" in the southeast direction is about the same distance away, but even smaller in height. This is not to suggest that terrain effects are negligible, or even small; rather, it suggests that by following the strict and conservative OAQPS guidelines, we do not expect to be able to justify a significantly taller GEP stack height. On the contrary, from our previous experience with flow and dispersion in valleys (Snyder *et al*, 1991), we expect to see rather large terrain effects, particularly with winds from the southeast, and therefore we propose to make comparisons with data from a similar source in flat terrain.

REFERENCES:

EPA 1981 Guideline for Use of Fluid Modeling to Determine Good Engineering Practice Stack Height. Rpt. No. EPA-450/4-81-003, Envir. Prot. Agcy., Res. Tri. Pk., NC, 47p.

EPA 1985 Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations). Rpt. No. EPA-450/4-80-023R (Revised June 1985), Envir. Prot. Agcy., Res. Tri. Pk., NC, 102p.

Lawson, R.E. Jr., Snyder, W.H. & Thompson, R.S. 1989 Estimation of Maximum Surface Concentrations from Sources Near Complex Terrain in Neutral Flow. *Atmos. Envir.*, **23**, 321-31.

Snyder, W.H., Khurshudyan, L.H., Nekrasov, I.V., Lawson, R.E. Jr. & Thompson, R.S. 1991 Flow and Dispersion of Pollutants within Two-Dimensional Valleys. *Atmos. Envir.*, **25A**, 1347-75.

Snyder, W.H. & Lawson, R.E. Jr. 1985 Fluid Modeling Demonstration of Good-Engineering-Practice Stack Height in Complex Terrain. Rpt. No. EPA-600/3-85/022, Envir. Prot. Agcy., Res. Tri. Pk., NC, 89p.

cc: D.A. Vallero
W.B. Petersen
D.B. Schwede

— WTI-TER.002 (1,2) WTI Terrain Silhouette through stack from 305 deg. to 125 deg.
03-18-94 col1 = dist from stack (ft), col2 = elev. (ft)

-- RVAL8L.001 (1,2) IDEAL SHAPE OF RUSSIAN VALLEY 8. DIMENSIONS IN MM.
COL 1, X; COL 2, Z
X = Xraw/0.25 Y = (Yraw + 458)/0.4875

-- RVAL8R.001 (1,2) IDEAL SHAPE OF RUSSIAN VALLEY 8. DIMENSIONS IN MM.
COL 1, X; COL 2, Z
X = Xraw/0.25 Y = (Yraw + 303)/0.2659

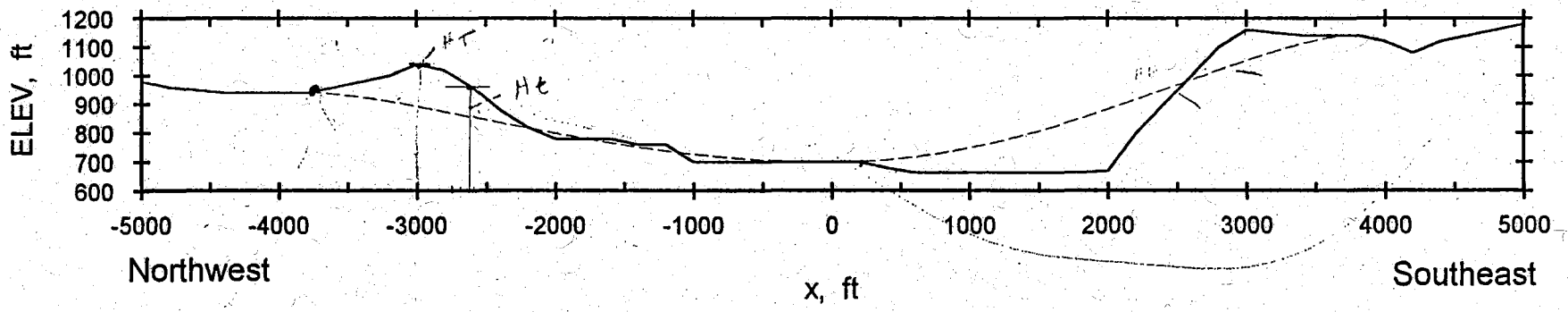

Figure 1. Cross-sectional view of terrain surrounding WTI incinerator in 305° - 125° direction. Solid line: actual terrain; dotted line: faired terrain.

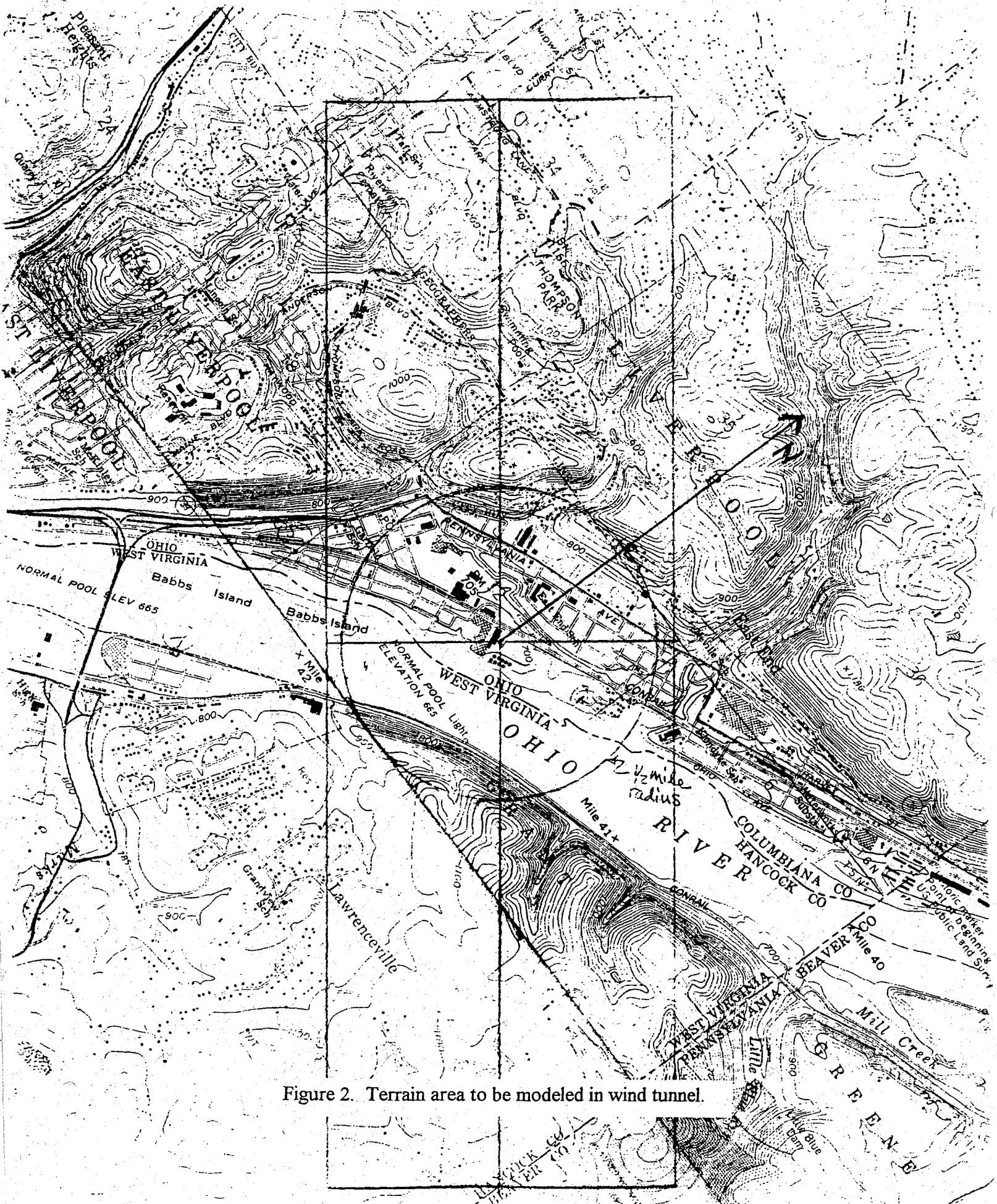

Figure 2. Terrain area to be modeled in wind tunnel.

— WTI-TER.002 (1,2) WTI Terrain Silhouette through stack from 305 deg. to 125 deg.
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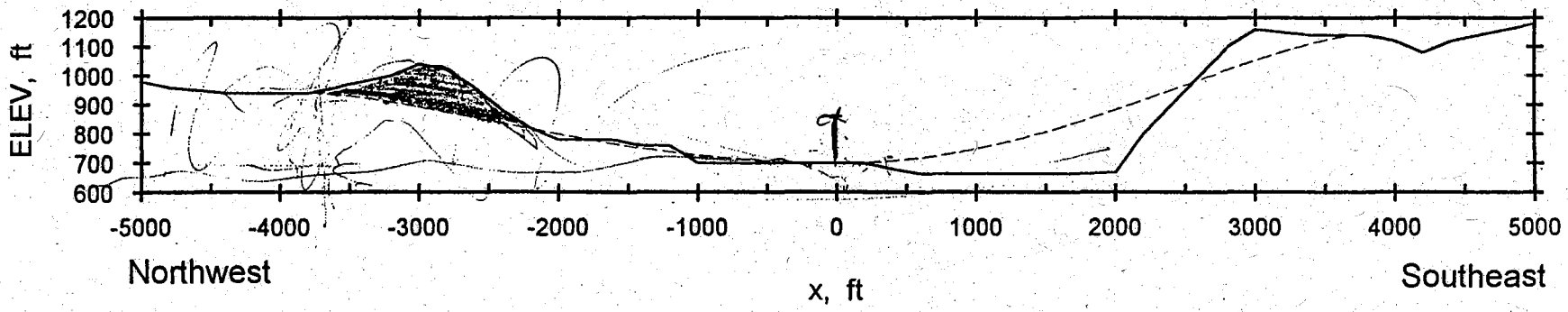

Figure 3. Same as Figure 1 except that "perturbation hill" is shaded.