Comments on WTC Signature Study and Peer Review from Greg Meeker, Paul Lioy and Mort Lippmann, November 3, 2005

The peer review of the Final Report on the World Trade Center (WTC) Dust Screening Method Study appears to be a thorough review of the materials provided to the peer reviewers by EPA. There are some excellent comments that should be considered before any final decision is made on whether or not to use a WTC collapse dust signature (indicator) as part of the analytical protocols for the sampling and analysis of residual dust in buildings in Lower Manhattan and nearby downwind areas of Brooklyn.

There are, however, sections of the peer review report that delve into discussions that are either beyond the scope of the charge, or that dealt with issues that arose due to EPA's failure to provide relevant information. There were also some reviewers' misconceptions that were not properly vetted during the review process. Prior to finalizing the charge questions to the reviewers the Panel was asked for comment, and Greg Meeker provided two pages of comments that were not passed along to the reviewers. In his comments, Mr. Meeker provided additional technical information on some of the issues that the reviewers found troubling, and provided a framework that might have aided them in their evaluation and the development of their recommendations (comments attached).

The review of the method and the signature concept in general should have been considered in the context of the Phase I study as proposed by EPA. It has been clear for months that the Phase I study would not only include analysis for the signature component(s) but a selected list of the COPCs as well. Analysis of the Phase I data set, including information about building type, age, use, distance from the WTC site, elevation, wind direction on 9/11, and other factors would have provided the final verdict on the signature concept and its applicability to each of the greater issues of interest. This is a point that was discussed by the WTC Expert Technical Panel as late as July, 2005. It is not at all clear that the signature study was reviewed in that context, nor is it clear that all EPA representatives who formulated the charge questions either understood or clearly articulated that concept. The problem of addressing residual WTC contamination four years after the event is extremely complex and difficult. There is no "off the shelf" method that can address the problem by providing yes or no answers, and no approach to the problem can be totally satisfactory with respect to all of the issues that have been the subject of extensive deliberation by the WTC Expert Technical Panel. The signature concept, as proposed and demonstrated through the signature study, is clearly the best and most appropriate course of action available at this time for determining whether or not elevated concentrations of COPC's actually were derived from the deposited WTC dust. It is only through additional data collection and analysis, along with further refinement of the method, that the process can be truly evaluated. The signature study was only for the purpose of demonstrating that the process could be started. To the extent that the review actually delayed the implementation of the Phase I study in Lower Manhattan and nearby Brooklyn, some of the time spent was warranted to ensure that interpretable results could be obtained for triggering a clean up. However, the

process went on too long, and the peer review process was flawed for three reasons: 1. the lack of specific information on the deliberations of the WTC expert technical panel, 2. there were no significant adjustments to the charge questions based upon Mr. Meeker's concerns and 3. there was no contact with members of the WTC Expert Technical Panel to address specific technical issues.

Summary addressing primary difficulties identified by peer reviewers.

Scatter of data and exclusion of data from three laboratories.
The peer reviewers of the Final Signature Study Report generally agreed that the scatter in the data and exclusion of three laboratories was a serious problem and required further study to explain the results. Several suggestions were made as to the cause of the scatter in the data. The reviewers focused primarily on possible problems with sample preparation, specifically the drop mount and one minute settling. The WTC Expert Technical Panel's signature sub-group agrees that the data show more scatter than desirable. However, given the nature of the material analyzed, and the time available for method development, we believe that scatter in the data is certainly within acceptable limits for the intended purpose of the Phase I survey, as described below in the discussion. Even the data from the laboratories that were not used by EPA in the final analysis show the same trends as the other laboratories, suggesting that there was a problem with inconsistent sample preparation between laboratories. This is a point that could have been addressed in the selection criteria for the laboratories to analyze the Phase I samples. Further, the peer review group almost entirely overlooked two other possible causes for the scatter in the data; 1) the possibility that the "standard" samples sent to the laboratories were not entirely homogeneous from jar to jar; and 2) the possibility that the "standards" may not have been removed from the jars in a way to insure homogeneity between aliquots. Finally, we believe that there may have been significant problems with the 4 Albany spiking material. In retrospect, it probably should not have been used as a pure spiking material for this study. The data derived from the 4 Albany spiked samples should not be considered in the final analysis unless the material used for spiking is clearly demonstrated to represent pure, undiluted WTC dust.

Failure of the study to consider other analytical methods
Since September of 2001, extensive analytical work has been done on WTC dust by numerous laboratories using a wide variety of analytical techniques. There is a wealth of data in the literature on trace element chemistry, major element chemistry, organic chemistry, optical properties, unique and/or unusual components and more. In addition, several of the panel members have been personally involved in numerous studies involving a wide variety of analytical techniques and methods including XRD, XRF, ICP-MS, infrared spectroscopy, etc. All of these results were considered in the deliberations of the WTC Expert Technical Panel regarding possible signature components and methods to analyze the components. This information was not effectively used by the peer reviewers, nor were any of the members of the signature subgroup contacted to provide informational clarifications during the peer review panel's conference calls. This was a deficiency in the peer review process. Why bother to have

knowledgable experts on the WTC Expert Technical Panel if you do not use their technical expertise effectively in the evaluation of the nature of this complex mixture?

Concerns regarding false positives

It has always been recognized that implementation of this method will result in some number of false positives. This is clearly outlined in the method, the referenced literature, and in the WTC Expert Technical Panel discussions. The question is, given a realistic background level, is the number of false positives that are likely to occur acceptable? Based on the signature study, we believe the answer will be yes, In addition, since these will be false positives, and if the selected COPC's go above the recommended Phase I guidelines, the units could be considered for clean up. The final answer to this question, however, cannot be determined until additional data are collected and analyzed during the Phase I study.

Failure of the study to thoroughly analyze the chemistry (Fe content) of slag wool and rely only on published values.

This criticism comes from an apparent misconception, by most of the reviewers, that the chemical composition of the WTC slag wool was determined by simply using values in the TIMA literature. This statement is totally incorrect. The WTC slag wool composition was determined by considerable analytical work by quantitative electron probe microanalysis of polished samples at the USGS. Only after the composition of WTC MMVF was accurately determined was TIMA and other industry literature consulted to determine the appropriate glass fiber industry name for each chemical fiber type found in WTC dust. We think that both the peer reviewers and the members of the WTC Expert Technical Panel were done a dis-service by the lack of meaningful discussion between members of the two groups prior to completing the peer review group's report.

Concerns regarding persistence of slag wool.

We believe this is a valid concern and should be evaluated, although we believe that, in indoor environments, the amount of slag wool would not be significantly reduced unless the material sat in water for an extended period of time. Tests to address this question could be conducted quickly for minimal expense.

Use of outdoor dust in the USGS spiking material.

It would have been preferable to use all indoor dust in the USGS spiking material. However, the amount of material needed simply was not available and is not available.. The USGS spiking material did contain a substantial amount of indoor dust (i.e. unaffected by rain), and this should have been elucidated in EPA's final report. Furthermore, the relative abundances of slag wool in indoor and outdoor dust was not that different, and was primarily do the higher gypsum abundance in the indoor samples. It is important to recognize that the relative proportion of MMVF types was consistent between outdoor and indoor dust.

Extrapolation to fibers per gram.
Extrapolation to fibers per gram was done in order to report consistent units between laboratories. The units could have, and probably should have, been fibers per milligram. The use of fibers per gram was not intended to give a false impression of better counting statistics. It was, however, pointed out by the WTC Expert Technical Panel to EPA, prior to the peer review, that actual fiber numbers should be reported with the data to demonstrate actual counting statistics. It should also be pointed out that in most peer reviewed methods for dust and particle analysis actual fiber numbers are adjusted to common units such as fibers per cm^2 and, in doing so, the fiber numbers are significantly elevated over the number actually counted.

Measurement of fiber dimensions.
Measurement of fiber dimensions was made during the study in order to determine mass of slag wool in each sample. However, it was determined that fiber number (fibers/gram) provided better data. The majority of fibers in the dust are in the 1-10 μm diameter range. A single long 20 μm diameter fiber can significantly affect the calculated mass determination, particularly with low total fiber numbers.

Use of PLM to identify slag wool
PLM was employed at the beginning of the study for fiber counting. If a liason had been arranged between the two panels, this point could have been easily clarified to the peer reviewers. These data should have been presented in the report. The analyses showed that the PLM results were no better than results obtained using SEM, and the analysis did not require substantially less time. It is true that determining the precise refractive index for slag wool in order to distinguish it from rock wool was not done. However, the amount of rock wool in WTC dust is minimal (1-3% total MMVF), and the inability to distinguish it from slag wool by not using the exact refractive index would not have made a significant difference in the results. The more abundant soda-lime glass is easily distinguishable from slag wool using a single index oil of 1.605 or 1.550. Other fiber types were also observed in background samples, and those fiber types required x-ray microanalysis for identification.

Discussion
The WTC Expert Technical Panel has, over the last 15 months, generally endorsed the concept of working toward developing a signature for identification of residual WTC dust contamination in indoor and possibly some outdoor spaces. Through the efforts of numerous individuals within the US Environmental Protection Agency, the United States Geological Survey, the Environmental & Occupational Health Sciences Institute of UMDNJ/Rutgers University, New York University Nelson Institute of Environmental Medicine, University of North Carolina, the City of New York, and other agencies and organizations, a proposal was formulated to use slag wool, along with other dust components, possibly gypsum and concrete particles, as signature or screening components to help identify residual contamination from the dust generated during the collapse of the WTC. A point that was missed by the Peer Review Panel was that it was always thought by the WTC Expert Technical Panel that the method would be used in conjunction with standard methods for the analysis of other selected COPCs, including

asbestos, lead, and PAHs on the same samples. The signature concept was formulated concurrently with a much-revised Phase I sampling and analysis plan developed by EPA. During this process several alternatives for a signature were seriously considered and eventually rejected for a variety of reasons. Records of the discussions regarding these alternatives as primary signature components are in the Panel Meeting summaries and other available documents. Alternative signature components that were discussed include combinations of trace elements (e.g. antimony and chlorine), asbestos, PAHs, iron spheres, and others. Even a proposal to use the behavior of microorganisms exposed to WTC dust was brought to the attention of the WTC Expert Technical Panel.

The proposal to use slag wool as the primary signature component was judged by many on the WTC Expert Technical Panel and others to be sound for several reasons. The reasons include the following: 1) slag wool was found as a major component (10-60 %) of *all* pure bulk WTC dust samples collected shortly after September 11, 2001 and these analyses were completed by numerous groups; 2) slag wool is durable and likely to be persistent in undisturbed spaces for years; and 3) slag wool is easily identifiable by available analytical techniques at low concentrations.

It was also recognized, from the beginning, that slag wool is a common building material and is likely to be present at relatively high concentrations in some areas of interest, thereby potentially generating false positives. It was also recognized that the relative abundance of slag wool in residual WTC dust could be affected by parameters such as distance from the source, elevation, and ability to penetrate into indoor spaces through small openings. All of these issues were discussed extensively by the WTC Expert Technical Panel on numerous occasions.
Note: The actual robustness of this approach would have already been on the road to testing, if the EPA Phase I plan had been implemented after the July, 2005 meeting; concurrent with the Signature Peer Review. It is now November, and we are no closer to implementing a Phase I plan for Southern Manhattan and nearby Brooklyn.

In addition to the above, another issue raised and discussed later in the process of signature development by WTC Expert Technical Panel members and others involved in its deliberations was how a signature was to be used. There are many aspects to this question, however, with respect to the proposed Phase I sampling and analysis plan it became clear to the scientists involved that any proposed WTC signature would require continuous and extensive evaluation *during* the Phase I study. The usefulness of a signature would need to be iteratively evaluated for a variety of applications and factors including, but not limited to, identification of specific impacted units and buildings, the geographical extent of contamination, proximity to new construction, and types of areas to which the signature might be applied, e.g. apartments, offices, ages of structures, etc. The peer reviewed signature validation study, as designed, should have been used to answer one primary question; to what extent could a set of qualified laboratories identify and differentiate samples of background dust from samples of that same background dust spiked with pure WTC collapse dust. In addition, the implementation of the Phase I study would have also helped define an initial average background level of slag wool for the impacted areas, and would have provided information about levels of quantification

that could be expected. All other scientific questions relating to the application of the signature to issues being addressed by the WTC Expert Technical Panel and EPA would properly be addressed by analysis of data acquired during the Phase I study.

The peer reviewers were given 9 charge questions. Question 1 deals with the design of the study design. All of the peer reviewers agreed that the study was properly designed and, for the most part, properly executed. However, as noted above, we believe the EPA signature study was not evaluated in the proper context.

Question 2 asked if the reviewers believed that the study demonstrated that slag wool could be used as the signature component. The reported consensus opinion of the peer review committee stated "the proposed method has not demonstrated the utility of slag wool as a successful signature constituent." It was also stated in the review that "the information was insufficient to reject slag wool as a signature." These consensus opinions were derived with four of the reviewers answering YES to question 2, 1 reviewer answering NO, and 1 reviewer answering MIGHT BE. With the four YES votes came several questions and reservations. The other reviewers cited additional problems with the study. Many of those reservations were addressed above.

We, as members of the WTC Expert Technical Panel signature sub-group believe that many of the problems with question 2 that were cited by the peer reviewers can be effectively addressed by EPA. For example, if the data for the analyses are examined, as in Figure 1 below, it is clear that nearly the same trend was observed by all laboratories even though absolute values varied considerably. The data generally show low background levels, with the exception of one high value (C1-RTP), and proportionally higher values for the USGS spiked samples. This suggests variations in the preparation of samples by individual laboratories, but general consistency within laboratories. The 4 Albany samples should not be considered as samples spiked with pure WTC dust. For whatever reason, the spiking material appears to have been diluted by a factor of 5 to 10 prior to preparation of the spiked test samples. Therefore, these samples appear to have undergone a double dilution whereby the actual concentrations of WTC dust would have been 1 %, 0.5%, and 0.1%, rather than the expected 10, 5 and 1 %.

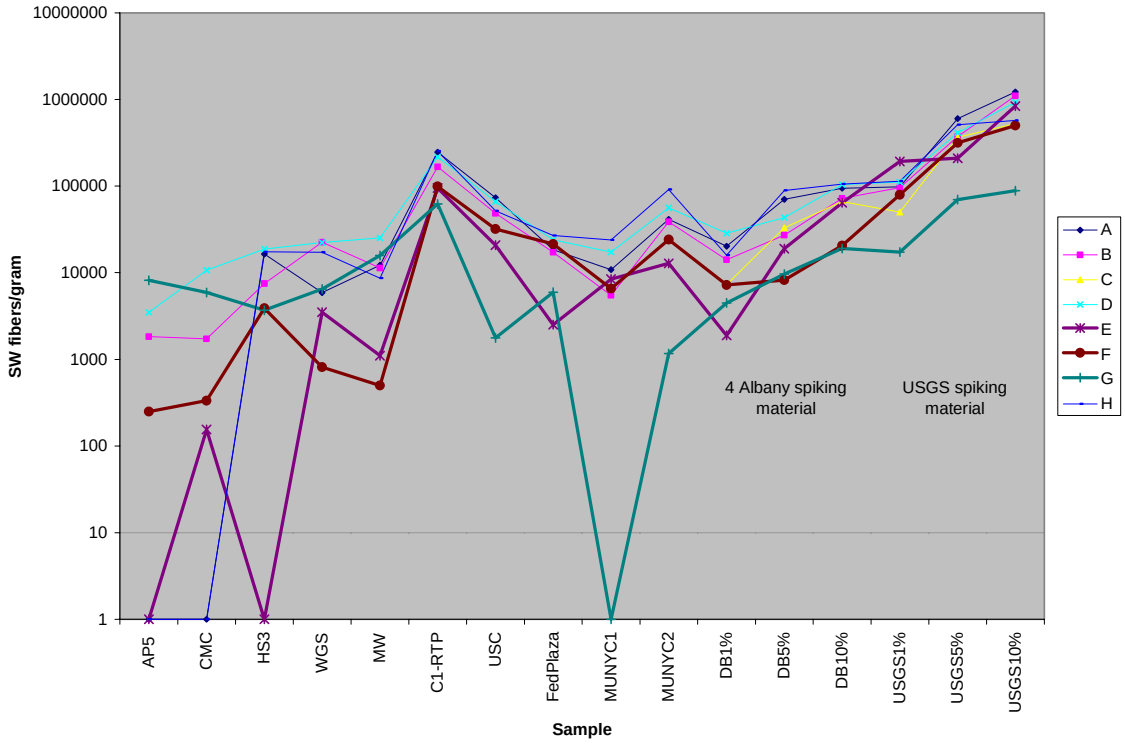


Figure 1.

Regarding question 5, it should be noted that the full details of how the "standards" were prepared were not provided to the reviewers. The data in Figures 1 and 2 of the Final Report on the World Trade Center (WTC) Dust Screening Method Study were obtained on aliquots taken from the blended samples prior to those samples being sent to EPA to be split into aliquots that were then sent to the 8 laboratories involved in the study. The details of how and where these primary blended samples were split were never provided in the final report. The USGS has extensive experience in preparation of homogeneous reference materials. It is extremely difficult to blend such materials particularly when the materials are relatively coarse grained and contain dissimilar particle types such as fine granular dust and fibers. It is equally difficult to split a large amount of blended sample into many uniform individual containers ensuring that each container contains precisely the same material. Normally when a reference material is produced random containers of the material are tested for homogeneity between and within containers prior to distribution. We wonder if some of the scatter observed in the data may be a result of the "standards" that were sent to the laboratories not being identical or the laboratories not sampling from the bottle in a way to insure identical aliquots.

In summary, we believe that many of the objections to the EPA signature validation study outlined by the peer reviewers come as a result of a failure to provide the reviewers with information regarding how the method was to be used in the Phase I sampling plan. We also believe that some assumptions that were made by the reviewers should have been verified through questions provided to the EPA scientists or through them to the WTC

Expert Technical Panel. Finally, we have some concerns as to how the EPA signature validation study was conducted with respect to splitting of spiked samples and also to the use of the 4 Albany spiking material. Despite these specific concerns, we believe that the EPA signature validation study has sufficiently demonstrated that laboratories can distinguish between properly spiked background and unspiked background with an acceptable false positive rate. We therefore urge EPA to continue with plans to use the WTC signature as outlined in the Phase I study for Lower Manhattan and nearby Brooklyn.

Sent to EPA July 28, 2005

Comments on Draft Charge Questions from Greg Meeker.

Purpose of the signature study

The study only addresses to what extent laboratories can identify spiked samples in a series of "background" samples using a pre-selected set of collapse dust components, i.e. proposed signature components. The study also provides preliminary levels for background for the proposed components. If validated, this method will be used to address two questions. These two questions are not adequately discussed in the Draft Charge Questions. These questions are:

1. What is the geographical extent of dust contamination from the collapse and later transport of materials? A primary goal of this process is to use a WTC dust signature to help evaluate the geographical extent of collapse dust contamination. It should be recognized that after four years this task can only be done as an iterative process whereby newly collected samples from Phase 1 (in general proceeding outward from the WTC site) are analyzed, the data are continually evaluated, and necessary adjustments are made to the methods and final data objectives. The purpose of the signature evaluation study was to evaluate the analytical capabilities of the laboratories in detecting the components using the methods developed. The study did not address how the dust components were distributed during and after the collapse. It should also be recognized that there **may** be conditions such as distance from the WTC site or elevation that will limit the extent to which the method can provide an estimate for the extent of contamination, but that the method may work very well within a specifically defined area that has yet to be totally determined. The area sampled by USGS (see attached map) provides an area of "high confidence" for application of the signature because these samples all contained similar concentrations of slag wool (approximately 10 to 50% with an average value of about 30%). The data from Governors Island presented by EPA at the July 12 Panel meeting strongly suggests that the slag wool signature will be valid to a much greater distance. Given the above background information and caveats, are the results of the study robust enough so that contract laboratories, possibly with assistance of government laboratories, can proceed to use the method to collect data for EPA to begin the iterative process of evaluating the extent of contamination using samples collected during Phase 1?
2. Given that a sampling "unit" is within an area **demonstrated to have been impacted by the collapse dust**, and that "unit" shows elevated COPCs, can any of the proposed signature components be used to demonstrate that the "unit" has or, more likely, **has not** been impacted by WTC dust? It is a given that there will be some number of false positives (acceptable number or percent yet to be determined, the number of false positives will increase as the number selected for a lower cutoff decreases) but there should not be a significant number of false negatives.

These two questions are different and the samples required to answer them may not necessarily be entirely the same. There may be sampling opportunities that could help address question 1 that will not fit the proposed statistical sampling plan designed largely for question 2. If these sampling opportunities arise they should be taken advantage of and not overlooked because they do not fit a predetermined sampling plan.

Additional comments

- It must be made clear that the pure DB spiking material contained only about 2% slag wool. This number is significantly less than what was found in the 37 USGS samples and other bulk samples collected by Lioy and other groups (~30 % slag wool). The reason for this is not known at this time. The analysis data of the two spiking materials should be included with the data. The DB spiking material is suspect as a "pure" WTC dust in that the major component ratios do not agree with **ANY** of the other known and well characterized bulk samples. However, the data from the samples spiked with the DB material still appears to demonstrate that the analysis method can be

extended to levels well below what appears to be the average background determined in this study. The USGS spiking material was a composite of several of the bulk WTC dust samples shown on the attached map. This information should be provided for the peer review.

- The measured number of fibers, not the calculated fibers per gram, determines the **maximum** accuracy these measurements can have. These numbers must be included with the data.

- The full details of sample collection and preparation including production of reference spiking material, background dust and spiked samples must be included for the peer review. Analytical results on these materials along with laboratory calibration data on the supplied reference material must also be included. This information is a critical part of the overall study.

- Details on all of the methods actually used for analysis of the various components by each of the different laboratories should be included. (e.g. software or method actually used to calculate gypsum and concrete)

- Exactly what background documents will be included in the package sent to the reviewers?

- Will there be a mechanism for the peer reviewers to ask for and obtain additional information if they feel the information provided is inadequate to properly evaluate the study?

- Q1) c) should read "They are *sufficiently* homogeneous in WTC dust." None of the WTC dust samples are truly homogeneous.

- Where are the references for the documents mentioned in the Charge Questions? It is not clear which documents are being referred to.

- The term "elements of concrete" should be replaced by "phases compatible with concrete." How did each laboratory interpret "Ca-rich particle" for the concrete analysis.

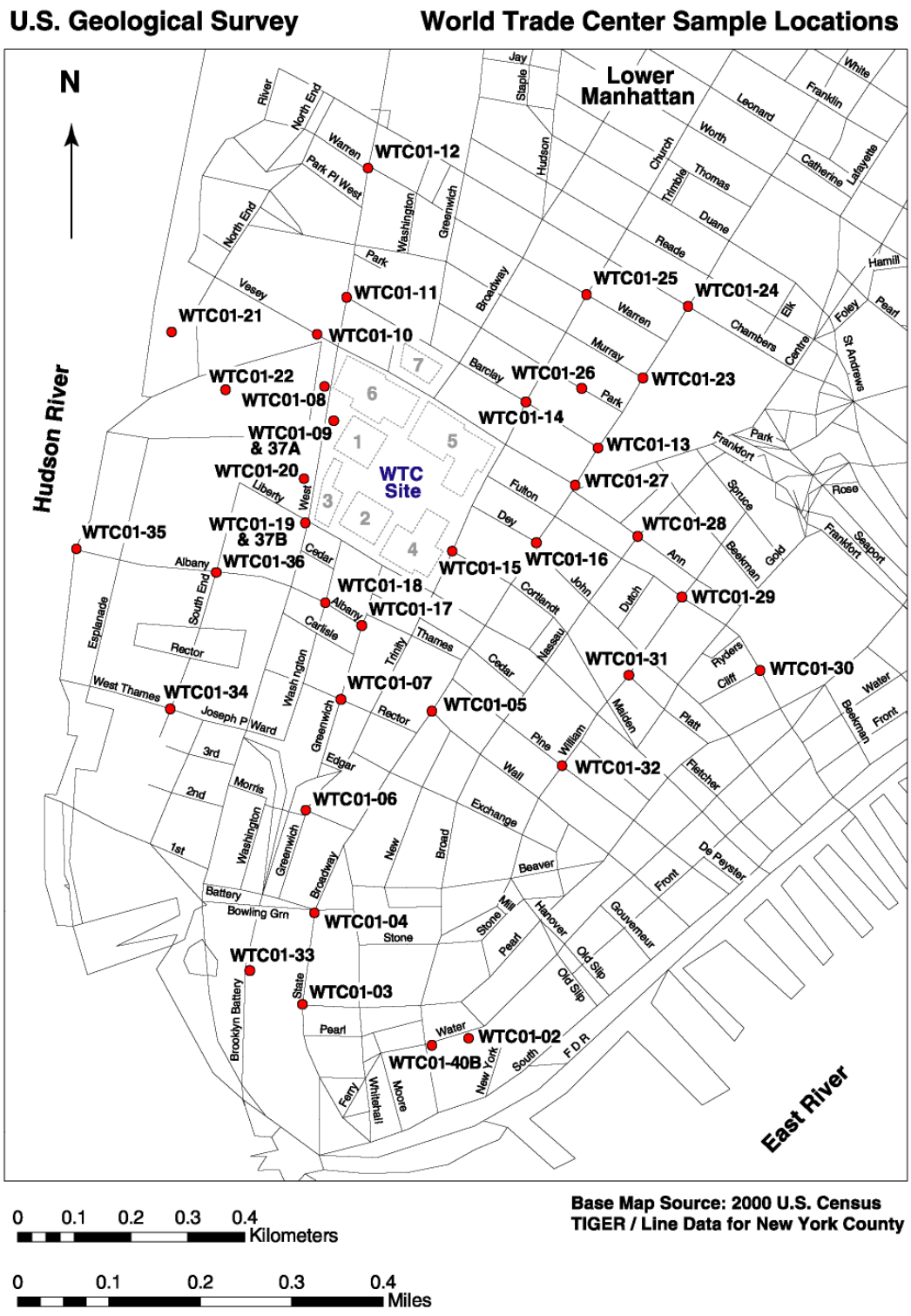
- Will plots of the data be provided to the reviewers as presented at the July 12 Panel meeting?

- The idea that some level of false positives is acceptable should be clearly stated.

- Relative levels of major, minor and trace components of bulk WTC dust are known. This data should be provided so that the reviewers can judge the range of levels of components, including COPCs, that will be present at the dilutions discussed in the signature study.

- Why did only one laboratory analyze the "28 different" background samples and how will these analyses be confirmed?

- In the data tables, do the Calcium-rich values include gypsum or has the gypsum been subtracted?



Samples collected and analyzed by USGS after 9/11. From Clark,et al, 2001. USGS Open-File Report 2001-0429, http://pubs.usgs.gov/of/2001/ofr-01-0429/