Development of the Inventory of 9/11 Agents

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I. Introduction

The World Trade Center (WTC) Health Program (Program) has developed an **Inventory of 9/11 Agents** (Inventory) that the Program will use for administrative purposes.

The **Inventory** categorizes hazards as: chemical hazards; physical hazards; biological hazards; and other hazards, which includes experiences that might cause psychological harm. The Inventory lists agents and experiences to which responders, recovery workers, and survivors were possibly exposed but does not provide information on the magnitude of exposure. Furthermore, not all responders, recovery workers, and survivors would have been exposed to all of the agents on this Inventory. Individual Program members' potential for exposures and magnitude of exposures are determined through an exposure assessment process, and these exposure assessment findings are used in the individual certification decisions for a member's health conditions.

The **Inventory** is based on the following definition of 9/11 agents:

> *Chemical, physical, biological, or other hazards reported in a published, peer-reviewed exposure assessment study of responders, recovery workers, or survivors who were present in the New York City disaster area, or at the Pentagon site, or the Shanksville, Pennsylvania site, as those locations are defined in 42 C.F.R. § 88.1, as well as those hazards not identified in a published, peer-reviewed exposure assessment study, but which are reasonably assumed to have been present at any of the three sites.*

The WTC Health Program had previously defined 9/11 agents as:

> *Chemical, physical, biological, or other hazards reported in a published, peer-reviewed exposure assessment study of responders or survivors who were present in the New York City disaster area, or at the Pentagon site, or the Shanksville, Pennsylvania site, as those locations are defined in 42 C.F.R. § 88.1.*

After using the previous definition of 9/11 agents for some time, the Program has determined that it is too limited in scope. Therefore, the Program revises the definition to clarify that "other hazards" may include experiences that might cause psychological harm. The definition is also expanded to include those hazards not addressed in published, peer-reviewed exposure assessment studies of the 9/11-exposed population, but which, based on the professional judgment of the Program's Science Team, are reasonably assumed to have been present at any of the three sites.[1] Such hazards reasonably assumed to have been present may include, for example, environmental risk factors such as solar radiation, heat, and cold.

The Program defines an exposure assessment study as one that provides a *de novo* identification of at least one primary potential hazard (*e.g.*, chemical agent, physical agent, biological agent, or experiences that might cause psychological harm) that meets both of the following criteria: (1) was present[2] at one of the 9/11 disaster areas[3] during the attack, response, or recovery; and (2) can reasonably be determined to have been present in an exposure pathway[4] of a responder, recovery worker, or survivor. Studies that only cite hazards identified in other studies do not qualify as exposure assessment studies.

The Program recognizes that the **Inventory** may not include every hazard to which responders, recovery workers, and survivors may have been exposed during the September 11, 2001, terrorist attacks or in their aftermath. Some hazards may not have been identified or measured at one of the 9/11 disaster areas. Additionally, not all responders, recovery workers, and survivors would have been exposed to all of the agents on this Inventory.

The **Inventory** may be used to support several Program activities, including the assessment of the validity of petitions to add a health condition to the List of WTC-Related Health Conditions,[5] and, under certain conditions, the scientific evaluation conducted before proposing to add a health condition to the List of WTC-Related Health Conditions. Specifically, when evaluating the scientific basis for adding a condition under the *Policy and Procedures for Adding Non-Cancer Health Conditions*, if the available evidence is determined by the Administrator to demonstrate a high, but not substantial, likelihood that the health condition is causally associated with 9/11 exposures, then the Administrator may direct the

[1] The Science Team's application of "professional judgment" includes knowledge gained through education and experience including, but not limited to, professional practice, field experience (including at the 9/11 disaster sites), and scientific research. The Science Team may augment their professional judgment with additional information as necessary.
[2] Presence is determined by sampling conducted at a site or response to questions asked of responders, recovery workers, or survivors at one or more of the sites.
[3] Includes the New York City disaster area, Pentagon site, and Shanksville, Pennsylvania site as defined in §42 CFR 88.1.
[4] The WTC Health Program uses the ATSDR [2016] definition of Exposure Pathway: The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway. *See* https://www.atsdr.cdc.gov/glossary.html#G-D-.
[5] *See* Policy and Procedures for Handling Submissions and Petitions to Add a Health Condition to the List of WTC-Related Health Conditions, available at: https://www.cdc.gov/wtc/policies.html.

Science Team to review scientific sources published by the U.S. government that address health outcomes associated with 9/11 agents as identified in this Inventory.[6]

The revised definition of "9/11 agents" is now used to develop the Inventory. The agents identified in the First Periodic Review of Cancers[7] were reviewed based on the revised definition and included when they met the revised definitional criteria.[8] To develop the Inventory, the Program hired a contractor to identify 9/11 agents based on the original definition of "9/11 agent." The contractor identified 9/11 agents from studies in a catalog of studies provided by the Program that were considered to meet the initial definition be published, peer-reviewed, exposure assessment studies, and also developed and used a literature search strategy to find additional studies identifying 9/11 agents; the contractor's report is available upon request. The contractor applied the definition previously used by the Program. The Program reviewed the methods and results provided by the contractor and harmonized and corrected discrepancies in both the contractor's catalog of studies and the resulting draft inventory of 9/11 agents. The 9/11 agents reasonably assumed to have been present were then identified by the Program and added to the Inventory.

The tables below comprise the Inventory which is based on the updated definition of "9/11 agents." The agents included in the Inventory are those identified to date. The WTC Health Program reserves the right to update the Inventory of 9/11 Agents as additional information about hazards is obtained.

II. Chemical Hazards

A. Identified in the Peer-Review Literature

Chemicals were identified in studies that collected air, settled dust, surface, and biological samples. The chemicals identified as 9/11 agents from exposure assessment studies are included in Table 1.

1. Air and Settled Dust Studies

a. Methods

Additional criteria for determining whether chemicals identified in air or settled dust sample are 9/11 agents includes detection in personal or area air samples or settled

[6] *See* Policy and Procedures for Adding Non-Cancer Health Conditions to the List of WTC-Related Health Conditions, Feb 2017, available at: https://www.cdc.gov/wtc/pdfs/WTCHP_PP_Adding_NonCancers_14_February_2017.pdf.

[7] *First Periodic Review of Scientific and Medical Evidence Related to Cancer for the World Trade Center Health Program*, available at https://wwwn.cdc.gov/ResearchGateway/Publications/prc1.

[8] Some chemicals identified in the First Periodic Review of Cancers are not included on the Inventory of 9/11 Agents because they were identified as chemicals of potential concern, but were not detected at concentrations above the limit of quantitation. One chemical, vinyl chloride, was used as a basis for adding a type of cancer (liver and bile duct) to the List of WTC-Related Health Conditions but is not included in this Inventory of 9/11 Agents. *See* 77 Fed. Reg. 35574, at 35589 and Table A (June 13, 2012), available at https://www.gpo.gov/fdsys/pkg/FR-2012-06-13/pdf/2012-14203.pdf. However, other chemicals (arsenic and inorganic arsenic compounds, polychlorinated biphenyls, and trichloroethylene) were also provided as basis for adding liver and bile duct cancers to the List of WTC-Related Health Conditions, and those chemicals are included on this Inventory of 9/11 Agents.

dust or wipe samples. Also, the samples must have been collected at one of the 9/11 disaster areas during the attack, response, or recovery periods, and the concentration or amount identified on the sample must have been greater than the lower limit of detection (LOD) of the sampling and analytical method.

For chemicals identified on wipe samples from window surfaces and for settled dust samples, the Program recognizes that some of them may have settled onto surfaces prior to the attack, response, or recovery periods. However, the Program has determined that it will assume that the chemicals were present in the dust during the attack, response, or recovery periods.

For chemicals added to the Inventory, Chemical Abstracts Service (CAS) numbers and synonyms were obtained from the study, when provided, or from the PubChem Open Chemistry Database at the National Center for Biotechnology Information, a part of the National Library of Medicine at the National Institutes of Health (NIH),[9] when available.

In the Inventory of chemical 9/11 agents provided in Table 1, some of the chemicals are grouped based on similarity of properties, such as asbestos and silica. In these cases the group name is provided followed by a ":" and then the specific chemical identity is listed. For large groups with a variety of chemical species, the group is identified and highlighted in blue, and the identified members of the group are listed below it.

b. Exclusions

Several government-authored studies were excluded from consideration because they either were not independently peer-reviewed or they reported on chemicals identified in other studies.[10] Additionally, one paper addressed water runoff from Ground Zero [Litten *et al*. 2003]. It is unclear what the concentrations in water runoff mean; the water collection locations were outside the 9/11 disaster area and may have resulted in non-9/11 related chemicals also being present. If the chemicals in the water were leached from the settled dust or washed out from the air by rain, then the results of analyses of the settled dust or air samples should represent the potential exposures. Thus the relevant information from water runoff regarding the chemicals to which the responders, recovery workers, and survivors were exposed should be captured. It is unclear if all of the components of the runoff came from the WTC site and if responders, recovery workers, and survivors were exposed to these chemicals. For these reasons the chemicals identified in Litten *et al*. [2003] are not included in the Inventory.

[9] *See* PubChem Open Chemistry Database, available at: https://pubchem.ncbi.nlm.nih.gov/.

[10] This includes: The First Periodic Report of Cancer [NIOSH 2011]; Summary of Cancer Classifications of COPC [Middendorf and McCleery 2012]; Evidence for Establishing Recovery Dates [McCleery 2012]; Lowers and Meeker [2005]; Lowers *et al*. [2005]; and Meeker *et al.* [2005].

c. Uncertainties

When a chemical that has a metal component is identified, such as calcium sulfate, then the chemical is identified and is reported on the Inventory. However, metals that are reported are often identified by a destructive analytical method (*e.g.*, inductively coupled plasma atomic emission spectrometry or atomic absorption spectrometry) so that only the metal component is identified. In this situation it is not clear whether the chemical present at the 9/11 site is the elemental metal or a compound of that metal. This also occurs for anions such as chlorine and bromine. Thus, for these entities the exact makeup or variety of the chemical, whether elemental metal or a compound of the metal, is unclear. The toxicity of chemicals containing a metal can vary greatly depending on the specific chemical species. In addition, chlorine and bromine are often identified in fires as part of hydrogen chloride and hydrogen bromide, not as chlorine or bromine gases. However, because only the element is identified, the Program considers the element to be the 9/11 agent unless more specific information is available.

2. Biological Monitoring Studies

a. Methods

To be considered "identified" from a study using biological samples, the study must report on a group of persons exposed during the attack, response, or recovery periods and compare the group to an appropriate non-exposed group.[11] The biomarker level in the exposed group must be significantly greater ($p<0.05$) than in the non-exposed group. To the extent possible, the half-life of the chemical in the biological sample will be considered when establishing whether exposure may have occurred during the attack, response, or recovery.

b. Exclusions

Biological monitoring studies that did not sufficiently document that a chemical was present at the site during the attack, response, or recovery were excluded from consideration. In biomonitoring studies the study participant is the sample collector, and this person may not have been stationary at the site. Likewise, the half-life of a chemical in a biological medium may be long. Therefore, mere presence of a chemical in a biological sample does not establish where or when the exposure occurred. One example of an excluded study is Rom *et al*. [2002] which was a case study of one WTC responder where bronchoalveolar lavage (BAL) was used to recover chemicals deposited in the lung. Amosite, one type of asbestos, was found in the BAL, but there is no way to tell when or where the person was exposed to

[11] When feasible, the non-exposed group should consist of persons that were not present during the attack, response, or recovery periods, but that are otherwise comparable to the exposed group in terms of age, gender, race, ethnicity, and occupation.

amosite, which has a half-life in the lungs of several decades. Further, amosite was not identified in any air or bulk sample analyses.

B. Reasonably Assumed to Have Been Present

Based on the best available evidence and the professional judgment of the Program's science team, chemical hazards reasonably assumed to have been present at the 9/11 disaster sites during the attack, response, or recovery include chemical hazards that are typically found at implosion and demolition sites, related to fires, found in rescue operations, and at DMAT stations.[12] Chemicals reasonably assumed to have been present at the 9/11 disaster sites are listed in Table 1 and the source is identified as such.

III. Physical Hazards

A. Identified in the Peer-Review Literature

The literature searches did not produce any exposure assessment studies which identified physical hazards (e.g., slipping hazards, tripping hazards, and noise) that meet the criteria for inclusion on the Inventory.

B. Reasonably Assumed to Have Been Present

Based on the best available evidence and the professional judgment of the Program's science team, physical hazards reasonably assumed to have been present at the 9/11 disaster sites during the attack, response, or recovery include solar radiation, heat stress conditions, and cold stress conditions as well as hazards that are typically found at implosion and demolition sites and related to fires.[13] These are listed in Table 2, and the source is identified as such.

[12] Chemical hazards reasonably assumed to have been present were added to the Inventory based on the professional judgment of the Program's science team; that judgment was augmented as appropriate by information available on similar exposure scenarios. For example, the Science Team reviewed information about common gases and vapors in fires identified by NIST and described at: http://www.doctorfire.com/toxicity.html.

[13] Physical hazards reasonably assumed to have been present were added to the Inventory based on the professional judgment of the Program's science team; that judgment was augmented as appropriate by information available on similar exposure scenarios. For example, the Science Team reviewed information in several reports including: Fardhosseini MS, Esmaeili B, Wood R [2015], Safety Guidelines for Post-disaster recovery and reconstruction operations, available at: https://sarmad.unl.edu/documents/research/Recovery%20Manual_0.pdf (date accessed May 18, 2018); Safe Work Australia [2016] Demolition work Code of Practice, available at: https://www.safework.sa.gov.au/uploaded_files/CoPDemolitionWork.pdf (date accessed May 18, 2018); and Klitzman, S, Goldberg M, and Olmstead E [1994], Health Hazards to Construction Workers During the Demolition of Two Tenement Buildings, publication date: Jan. 1, 1994).

IV. Biological Hazards

A. Identified in the Peer-Review Literature

The literature searches did not produce any exposure assessment studies which identified biological hazards that meet the criteria for inclusion on the Inventory.

B. Reasonably Assumed to Have Been Present

Based on the best available evidence and the professional judgment of the Program's science team, biological hazards reasonably assumed to have been present at the 9/11 disaster sites during the attack, response, or recovery include bloodborne pathogens. Biological hazards reasonably assumed to have been present at the 9/11 disaster sites are listed in Table 3, and the source is identified as such.

V. Other Hazards

A. Identified in the Peer-Review Literature

For other hazards the literature searches produced only exposure assessment studies addressing experiences that might cause psychological harm. Experiences that might cause psychological harm were identified in studies that assessed exposure to trauma or stress and are included in Table 4.

1. Methods

Experiences that might cause psychological harm are traumatic or stressful exposures. An additional criteria for determining whether a traumatic or stressful exposure is a 9/11 agent is that it was significantly associated ($p<0.05$) with an increased risk for a health outcome after adjustment for other mental health exposures and compared to an appropriate control group.

2. Exclusions

Studies were excluded from consideration if all adjusted analyses involving experiences that might cause psychological harm failed to achieve statistical significance. Studies that reported only crude, unadjusted analyses were excluded.[14] Additionally, meta-analyses and reviews that included only exposures reported in other published papers were excluded.[15] Finally, studies and findings that did not differentiate between individuals who were unexposed to the September 11, 2001, terrorist attacks or their aftermath and responders,

[14] Studies excluded on this basis include Reibman *et al*. [2005]; DiMaggio *et al*. [2009]; DiMaggio *et al*. [2010].
[15] Studies excluded on this basis include Liu *et al*. [2014]; Perlman *et al*. [2011]; Lowell *et al*. [2017].

recovery workers, and/or survivors were excluded[16] because the effect on the 9/11-exposed populations could not be assessed separately from the non-9/11 population.

3. *Uncertainties*

Certain social support factors (e.g., lack of family, social, or co-worker support) may have existed during the attack, response, or recovery periods, and/or may have been present before 9/11. These social support factors may have modified an individual's experience of the September 11, 2001, terrorist attacks. However, these factors are not considered to be part of the psychologically harmful experience itself. Because it is unclear whether such social support factors meet the 9/11 agent criteria, they have not been included on the Inventory of 9/11 Agents.

B. Reasonably Assumed to Have Been Present

Based on the best available evidence and the professional judgment of the Program's science team, at present no other hazards have been identified as reasonably assumed to have been present at the 9/11 disaster sites during the attack, response, or recovery. If such hazards are identified in the future, they will be included in Table 4.

[16] Studies excluded on this basis include Hasin *et al*. [2007]; some findings in Ahern *et al*. [2002].

Table 1. Chemical Hazards

#	Chemical	CAS	Source[17]	Synonyms
1	(E)-2-(6-Nonexnoxy)-tetrahydropyran	55305-36-7	Lioy et al. [2002]	
2	1,1,1-Trichloroethane	71-55-6	COPC [2003]	Methylchloroform; Trichloroethane; Methyl chloroform; Chlorothene; Inhibisol
3	1,1,2,2-Tetrachloroethane	79-34-5	COPC [2003]	S-Tetrachloroethane; Acetylene tetrachloride; Bonoform;
4	1,1,2-Trichloroethane	79-00-5	COPC [2003]	Vinyltrichloride; Ethane, 1,1,2-trichloro-; Beta-Trichloroethane; Vinyl trichloride
5	1,1-Dichloroethane	75-34-3	COPC [2003]	Ethylidene chloride; Ethylidene dichloride; Ethane, 1,1-dichloro-; Dichloroethane
6	1,1-Dichloroethylene	75-35-4	COPC [2003]	1,1-Dichloroethene; 1,1-DCE; Vinylidene chloride
7	1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	Yiin et al. [2004]	Dibenzofuran, 1,2,3,7,8-pentachloro-;1,2,3,7,8-Pentachlorodibenzo[b,d]furan
8	1,2,3-Triphenyl-3-vinyl-cyclopropene	---	Lioy et al. [2002]	
9	1,2,4-Trichlorobenzene	120-82-1	COPC [2003]	Benzene, 1,2,4-trichloro-; Unsym-Trichlorobenzene; Hostetex L-pec;
10	1,2,4-Trimethylbenzene	95-63-6	Geyh et al. [2005]; COPC [2003]	Pseudocumol; Psi-cumene
11	1,2-Benzphenanthrene	218-01-9	Offenberg et al. [2004]	Chrysene; Benzo[a]phenanthrene; 1,2-Benzophenanthrene; 1,2-Benzphenanthrene
12	1,2-Dichlorobenzene	95-50-1	COPC [2003]	O-Dichlorobenzene; Chloroben; O-Dichlorbenzol
13	1,2-Dichloroethane	107-06-2	COPC [2003]	1,2-dichloroethane; Ethylene dichloride; Ethylene chloride; Ethane, 1,2-dichloro
14	1,2-Dichloroethylene, trans-	540-59-0	COPC [2003]	Trans-1,2-Dichloroethene; (E)-1,2-Dichloroethylene; (E)-1,2-Dichloroethene; Trans-Dichloroethylene
15	1,2-Dichloropropane	78-87-5	COPC [2003]	Propylene dichloride; Propane, 1,2-dichloro-; Propylene chloride;

[17] Peer review literature sources are identified as the basis for adding the chemical to the Inventory of 9/11 Agents when available. Biomarker studies are identified by an "*" after the citation, whereas air and settled dust studies are not further delineated. Latex and common gases or vapors in fires identified by NIST as described at: http://www.doctorfire.com/toxicity.html are listed because they are "reasonably assumed to have been present at any of the three sites."

#	Chemical	CAS	Source[17]	Synonyms
16	1,3,5-Trimethylbenzene	108-67-8	COPC [2003]	Mesitylene, Symmetrical trimethylbenzene, sym-Trimethylbenzene
17	1,3-Butadiene	106-99-0	COPC [2003]	Buta-1,3-diene; Divinyl; Butadiene Vinylethylene
18	1,3-Dichlorobenzene	541-73-1	COPC [2003]	M-Dichlorobenzene; 541-73-1; M-Dichlorobenzol; M-Phenylene dichloride;
19	1,3-Dichloropropylene, trans-	542-75-6	COPC [2003]	1,3-Dichloropropene; Trans-1,3-Dichloropropene;
20	1,3-Diphenylpropane	1081-75-0	Swartz et al. [2003]	[1',1'-(1,3-propanediyl)bis-benzene]
21	1,4a-dimethyl-7-(methylethyl)-1,2,3,4,9,10,10a,4aoctahydrophenanthrene no. 1	13601-88-2	Swartz et al. [2003]	
22	1,4-Dichlorobenzene	106-46-7	Edelman et al. [2003]*; Geyh et al. [2005]; COPC [2003]	P-Dichlorobenzene; Para-Dichlorobenzene; Paradichlorobenzene;
23	1,4-Dioxane	123-91-1	COPC [2003]	P-Dioxane; Dioxane; ; Diethylene ether; 1,4-Diethylene dioxide
24	1,6-Dimethyl naphthlalene	575-43-9	Swartz et al. [2003	
25	12-Acetoxydaphnetoxin	---	Lioy et al. [2002]	
26	1-Azabicyclo[2.2.2]octan-3-one	3731-38-2	Lioy et al. [2002]	
27	1-Dodecanol, 2-methyl-, (S)-	57289-26-6	Lioy et al. [2002]	
28	1-Ethyl naphthalene	1127-76-0	Butt et al. [2004]; Swartz et al. [2003]	Naphthalene, 1-ethyl-; Naphthalene, ethyl-; Ethylnaphthalene
29	1H-1,2,4-Triazole, 1-ethyl	16778-70-4	Lioy et al. [2002]	
30	1-Hexadecanol, 2-methyl	2490-48-4	Lioy et al. [2002]	
31	1-Hexyl-2-nitrocyclohexane	---	Lioy et al. [2002]	
32	1H-Indene, 1-(phenylmethylene)-	---	Lioy et al. [2002]	
33	1H-Pyrrole-3-propanoic acid, 2,5-dihydro-4-methyl-2, 5-dioxo	487-65-0	Lioy et al. [2002]	
34	1-Hydroxyphenanthrene	2433-56-9	Edelman et al. [2003]*	
35	1-Hydroxypyrene	5315-79-7	Lioy et al. [2002]; Edelman et al. [2003]*	

#	Chemical	CAS	Source[17]	Synonyms
36	1-Methyl-9H-fluorene	1730-37-6	Lioy et al. [2002]; Swartz et al. [2003]	1-Methylfluorene; 9H-Fluorene, 1-methyl-; 1-Methyl-9H-fluorene; Fluorene, 1-methyl-;
37	1-Methylanthracene	610-48-0	Offenberg et al. [2004]	
38	1-Methylnaphthalene	90-12-0	Swartz et al. [2003]; Offenberg et al. [2004]; COPC [2003]	Alpha-Methylnaphthalene; Methylnaphthylene; Naphthalene, 1-methyl-;
39	1-Methylphenanthrene	832-69-9	Lioy et al. [2002]	
40	1-Pentacontanol	---	Lioy et al. [2002]	
41	1-Phenanthrenecarboxaldehyde	13601-88-2	Swartz et al. [2003]	1,2,3,4,4a,9,10,10a-octahydro-1,4a-dimethyl-7-(1-methylethyl)-, [1r-(1
42	2-(3'-Hydroxyphenylamino)-5-methyl-4-oxo-3,4-dihydrophyrimidine	57456-60-8	Lioy et al. [2002]	
43	2,2',4,4'-tetrabromodiphenyl ether	5436-43-1	Butt et al. [2004]	4,4'-Oxybis(1,3-dibromobenzene); 2,2',4,4'-Tetrabromodiphenyl ether; BDE-Butt et al. [2004]; PBDE Butt et al. [2004]
44	2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	Yiin et al. [2004]	
45	2,3,4-Trimethylhexane	921-47-1	Lioy et al. [2002]	
46	2,3,5-Trimethylnaphthalene	2245-38-7	Swartz et al. [2003]	1,6,7-Trimethylnaphthalene; ; Naphthalene, 1,6,7-trimethyl-;
47	2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	Yiin et al. [2004]	
48	2,3-Dihydrofluoranthene	30339-87-8	Lioy et al. [2002]	
49	2,3-Dimethyl-1-pentanol,	10143-23-4	Lioy et al. [2002]	
50	2,4-Dichlorodiphenyltrichloroethane	50-29-3	Lioy et al. [2002]; Butt et al. [2004]	DDT, Clofenotane; Chlorophenothane; P,p'-DDT; Dicophane; Dichlorodiphenyltrichloroethane
51	2,4-Dimethylheptane	2213-23-2	Lioy et al. [2002]	
52	2,4-Dimethylhexane	589-43-5	Lioy et al. [2002]	
53	2,4-Tolune Diisocyanate	584-84-9	Reasonably assumed to have been present	2,4-Diisocyanatotoluene; Tolylene-2,4-diisocyanate; 2,4-Toluene diisocyanate; 2,4-Diisocyanato-1-methylbenzene; Toluene-2,4-diisocyanate
54	2,6,10,14-tetramethyl-Pentadecane	1921-70-6	Swartz et al. [2003]	Pristane; 2,6,10,14-Tetramethylpentadecane; Norphytane; Bute hydrocarbon;

#	Chemical	CAS	Source[17]	Synonyms
55	2,6-Dimethyl naphthlalene	581-42-0	Swartz et al. [2003]; COPC [2003]	Naphthalene, 2,6-dimethyl-; Dimethylnaphthalene, mixture of isomers; 2,6-Dimethyl-naphthalene
56	2,6-Toluene Diisocyanate	91-08-7	Reasonably assumed to have been present	Toluene-2,6-diisocyanate; 2,6-Diisocyanatotoluene; 2-Methyl-m-phenylene diisocyanate
57	2-Benzylquinoline	1745-77-3	Lioy et al. [2002]	
58	2-Butanone	78-93-3	COPC [2003]	2-Butanone; Methyl ethyl ketone; Butan-2-one; Butanone; Ethyl methyl ketone
59	2-Ethyl naphthalene	939-27-5	Butt et al. [2004]; Swartz et al. [2003]	Beta-Ethylnaphthalene; .beta.-Ethylnaphthalene; 2-Ethyl-naphthalene
60	2-Hexanone	591-78-6	COPC [2003]	Hexan-2-one; ; Hexanone; 2-Oxohexane; Propylacetone
61	2-Hexyl-1-Decanol	2425-77-6	Lioy et al. [2002]; Yiin et al. [2004]	1-Decanol, 2-hexyl-; 2-Hexyldecan-1-ol; 2-Hexyldecyl Alcohol; 2-Hexyldecanol
62	2-Hydroxyphenanthrene	605-55-0	Edelman et al. [2003]*	
63	2-Methylanthracene	613-12-7	Lioy et al. [2002]; Offenberg et al. [2004]	Anthracene, 2-methyl-; Anthracene, methyl-; Methylanthracene
64	2-Methylnaphthalene	91-57-6	Lioy et al. [2002]; Swartz et al. [2003]; COPC [2003]	Beta-Methylnaphthalene; Naphthalene, 2-methyl-; .beta.-Methylnaphthalene
65	2-Methylphenanthrene	2531-84-2	Lioy et al. [2002]; Offenberg et al. [2004]	2-methyl-phenanthrene; 2-Methyl phenanthrene
66	3,3´-Dichlorobenzidine	91-94-1	Lioy et al. [2002]	
67	3,3-Dimethylhexane	563-16-6	Lioy et al. [2002]	
68	3,4-Dihydrocyclopenta(cd)pyrene	25732-74-5	Lioy et al. [2002]	Acepyrene
69	3,6-Dimethylphenanthrene	1576-67-6	Offenberg et al. [2004]	Phenanthrene, 3,6-dimethyl-
70	3-Chloropropylene	107-05-1	COPC [2003]	Allyl Chloride; 3-Chloro-1-propene; 1-Propene, 3-chloro-; 3-Chloropropylene
71	3-Hydroxyphenanthrene	605-87-8	Edelman et al. [2003]*	
72	3-Methoxycarbonyl-2-methyl-5-(2,3,5-tri-O-acetyl-beta-d-ribofuranosyl)	---	Lioy et al. [2002]	
73	3-Methylphenanthrene	832-71-3	Offenberg et al. [2004]	Phenanthrene, 3-methyl-; 3-methyl-phenanthrene
74	4,4'-Biphenyldicarbonitrile	1591-30-6	Lioy et al. [2002]	

#	Chemical	CAS	Source[17]	Synonyms
75	4,4-Dichlorodiphenyldichloroethylene	72-55-9	Lioy et al. [2002]; Butt et al. [2004]	p,p'-DDE; Dichlorodiphenyldichloroethylene; DDT dehydrochloride; 4,4'-DDE; 2,2-Bis(4-chlorophenyl)-1,1-dichloroethylene
76	4,5-Methylenephenanthrene	203-64-5	Offenberg et al. [2004]	4H-Cyclopenta[def]phenanthrene; Methylenephenanthrene; 4H-Cyclopenta(def)phenanthrene
77	4-Bromophenoxybenzene	101-55-3	Butt et al. [2004]	1-Bromo-4-phenoxybenzene; 4-Bromodiphenyl ether; 4-Bromophenyl phenyl ether; 4-Bromophenoxybenzene
78	4-Ethyltoluene	622-96-8	COPC [2003]	4-Ethyltoluene; 1-Ethyl-4-methylbenzene; P-ethyltoluene; 4-Methylethylbenzene
79	4-Hydroxymandelic acid-TRITMS	---	Lioy et al. [2002]	
80	4-Methyl-2-propyl-1-pentanol	54004-41-0	Lioy et al. [2002]	
81	4-Methylphenanthrene	832-64-4	Lioy et al. [2002]	
82	7-Methyl-3,4,5(2H)-tetrahydroazepine	---	Lioy et al. [2002]	
83	9,10-Anthraquinone	84-65-1	Lioy et al. [2002]	
84	9,10-Dimethylanthracene	781-43-1	Offenberg et al. [2004]	Anthracene, 9,10-dimethyl-;
85	Acenaphthene	83-32-9	Butt et al. [2004]; Yiin et al. [2004]; Swartz et al. [2003]; Offenberg et al. [2004]; COPC [2003]; Wallingford et al. [2001]	1,2-Dihydroacenaphthylene; 1,8-Ethylenenaphthalene; Peri-Ethylenenaphthalene
86	Acenaphthylene	208-96-8	Butt et al. [2004]; Offenberg et al. [2004]; Wallingford et al. [2001]	Acenaphthalene; Cyclopenta[de]naphthalene; Cyclopenta(de)naphthalene
87	Acetaldehyde	75-07-0	Reasonably assumed to have been present	Ethanal; Acetic aldehyde; Ethyl aldehyde
88	Acetic acid	64-19-7	Reasonably assumed to have been present	Ethanoic acid
89	Acetone	67-64-1	COPC [2003]	Acetone; 2-propanone; Propanone; Dimethyl ketone; Methyl ketone
90	Acrolein	107-02-8	Reasonably assumed to have been present	Acrylaldehyde; 2-Propenal; Propenal; Acrylic aldehyde

#	Chemical	CAS	Source[17]	Synonyms
91	Acrylonitrile	107-13-1	Reasonably assumed to have been present	2-Propenenitrile; Vinyl cyanide; Prop-2-enenitrile; Propenenitrile
92	Alpha-Methylstyrene	98-83-9	COPC [2003]	Alpha-Methylstyrene; 2-Phenyl-1-propene; Isopropenylbenzene; 2-Phenylpropene;
93	Aluminum	7429-90-5	Lall et al. [2011]; Wallingford et al. [2001]; Plumlee [2006]	
94	Ammonia	7664-41-7	Reasonably assumed to have been present	
95	Anthracene	120-12-7	Butt et al. [2004]; Swartz et al. [2003]; Offenberg et al. [2004]; Wallingford et al. [2001]	Paranaphthalene; Anthracin; Green Oil
96	Antimony	7440-36-0	Edelman et al. [2003]*; COPC [2003]; Plumlee [2006]	Antimony powder; Stibium metallicum; Antimony, metallic; Antimony, elemental
97	Arsenic	7440-38-2	COPC [2003]; Wallingford et al. [2001]; Plumlee [2006]	
98	Asbestos	1332-21-4	Wallingford et al. [2001]; Jefferey et al. [2003]; COPC [2003]	Fibers (PCM)
99	Asbestos: Chrysotile	12001-29-5	Breysse et al. [2005]	
100	Asbestos: Libby Amphibole		Reasonably assumed to have been present	
101	Auraptenol	61235-25-4	Lioy et al. [2002]	
102	Barium	7440-39-3	Lall et al. [2011]; Plumlee [2006]	
103	Benz(a)acridine	225-11-6	Yiin et al. [2004]	1,2-Benzacridine
104	Benz(c)acridine	225-51-4	Lioy et al. [2002]; Yiin et al. [2004]	3,4-Benzacridine; B(c)AC; 7,8-Benzacridine; 3,4-Benzoacridine
105	Benz[a]acridine, 10-methyl-	3781-67-7	Lioy et al. [2002]	
106	Benz[a]anthracene	56-55-3	Lioy et al. [2002]; Pleil et al. [2004]; Swartz et al. [2003]; Wallingford et al. [2001];	Tetraphene; 1,2-Benzanthracene; Benzanthrene; Benzanthracene
107	Benzaldehyde	100-52-7	COPC [2003]	Benzoic aldehyde; Benzenecarbonal; Phenylmethanal; Artificial almond oil
108	Benzamide, N-acetyl-	1575-95-7	Lioy et al. [2002]	

#	Chemical	CAS	Source[17]	Synonyms
109	Benzene	71-43-2	Geyh et al. [2005]; COPC [2003]; Wallingford [2001]	Benzol; Benzole; Cyclohexatriene; Pyrobenzole; Benzine
110	Benzene, 1,1'-(1,3-butadiyne-1,4-diyl)bis-	886-66-8	Lioy et al. [2002]	
111	Benzimidazo [2,1-a] isoquinoline	239-44-1	Lioy et al. [2002]	
112	Benzo(a)pyrene	50-32-8	Pleil et al. [2004]; Swartz et al. [2003]; Wallingford et al. [2001]; Perera et al. [2005]*	Benzo[a]pyrene; 3,4-Benzopyrene; Benzo[pqr]tetraphene; 3,4-Benzpyrene
113	Benzo(b)fluoranthene	205-99-2	Lioy et al. [2002]; Pleil et al. [2004]; Wallingford et al. [2001]	Benz[e]acephenanthrylene; 3,4-Benzfluoranthene
114	Benzo(e)pyrene	192-97-2	Pleil et al. [2004]; Swartz et al. [2003]	Benzo[e]pyrene; 4,5-Benzopyrene; 1,2-Benzpyrene; 4,5-Benzpyrene; Benzo(l)pyrene
115	Benzo(g,h,i)perylene	191-24-2	Pleil et al. [2004]; Swartz et al. [2003]	1,12-Benzperylene; Benzo(ghi)pyrilene
116	Benzo(k)fluoranthene	207-08-9	Pleil et al. [2004]; Wallingford et al. [2001]	Benzo[k]fluoranthene; ;11,12-Benzofluoranthene; 8,9-Benzofluoranthene
117	Benzo[a]fluorene	238-84-6	Lioy et al. [2002]; Offenberg et al. [2004]	1,2-Benzofluorene; 11H-Benzo[a]fluorene; Chrysofluorene
118	Benzo[b]fluorene	243-17-4	Lioy et al. [2002]; Offenberg et al. [2004]	2,3-Benzofluorene; 11H-Benzo[b]fluorene; Benzo(b)fluorene; Benzo[b]fluorene; 11H-Benzo[b]fluorene
119	Benzo[b]naphtho[2,1-d]thiophene	239-35-0	Offenberg et al. [2004]	1,2-Benzo-9-thiafluorene; Benzo[a]dibenzothiophene; Naphtho[1,2-b]thianaphthene
120	Benzo[b]naphtho[2,3-d]furan	243-42-5	Lioy et al. [2002]	
121	Benzo[c]fluorene	205-12-9	Lioy et al. [2002]	
122	Benzo[c]phenanthrene	195-19-7	Lioy et al. [2002]	
123	Benzo[h]quinoline	230-27-3	Lioy et al. [2002]	
124	Benzo[jk]fluorene	206-44-0	Lioy et al. [2002]; Butt et al. [2004]; Swartz et al. [2003]; Offenberg et al. [2004]; Wallingford et al. [2001]; COPC [2003]	Fluoranthene; Idryl; 1,2-Benzacenaphthene; Benzo[jk]fluorene; Benzo(jk)fluorene
125	Benzyl butyl phthalate	85-68-7	Lioy et al. [2002]	

#	Chemical	CAS	Source[17]	Synonyms
126	Benzyl Chloride	100-44-7	COPC [2003]	(Chloromethyl)benzene; Benzylchloride; Chloromethylbenzene; Alpha-Chlorotoluene
127	Beryllium	7440-41-7	COPC [2003]; Wallingford et al. [2001]; Plumlee [2006]	
128	Biphenyl	92-52-4	Butt et al. [2004]; Swartz et al. [2003]	1,1'-Biphenyl; Phenylbenzene
129	Bis(4-bromophenyl) ether	2050-47-7	Butt et al. [2004]	Bis(4-bromophenyl) ether; 4-Bromophenyl ether; 4,4'-Dibromodiphenyl ether; 4,4'-Oxybis(bromobenzene);
130	Bismuth	7440-69-9	Plumlee [2006]	
131	Bromine	7726-95-6	Lall et al. [2011]	
132	Bromoform	75-25-2	COPC [2003]	Tribromomethane; Methane, tribromo-; Tribrommethan; Methenyl tribromide
133	Bromomethane	74-83-9	COPC [2003]	Methyl bromide; Methane, bromo-; Embafume
134	Cadmium	7440-43-9	Wallingford et al. [2001]; COPC [2003]; Plumlee [2006]	
135	Caesium	7440-46-2	Plumlee [2006]	
136	Calcium	7440-70-2	Lall et al. [2011]; COPC [2003]; Wallingford et al. [2001]; Plumlee [2006]	
137	Calcium carbonate	13397-26-7	McGee et al. [2003]; Jefferey et al. [2003]; COPC [2003]	Calcite
138	Calcium hydroxide	1305-62-0	Jefferey et al. [2003]; COPC [2003]	Portlandite
139	Calcium sulfate	7778-18-9	McGee et al. [2003];Wallingford et al. [2001]; Jefferey et al. [2003]; COPC [2003]	Gypsum; Drierite; Sulfuric acid, calcium salt (1:1); Karstenite
140	Carbazole	86-74-8	Yiin et al. [2004]; Swartz et al. [2003]	9H-Carbazole; Dibenzopyrrole; Diphenylenimine; 9-Azafluorene
141	Carbonate carbon	---	Plumlee [2006]	
142	Carbon dioxide	124-38-9	Reasonably assumed to have been present	
143	Carbon monoxide	630-08-0	Wallingford et al. [2001]	

#	Chemical	CAS	Source[17]	Synonyms
144	Carbon, organic	7440-44-0	Olson et al. [2004]; Geyh et al. [2005]; Plumlee [2006]	
145	Carbon tetrachloride	56-23-5	Geyh et al. [2005]; COPC [2003]	Tetrachloromethane; Perchloromethane; Methane, tetrachloro-;
146	Carbonyl fluoride	353-50-4	Reasonably assumed to have been present	Carbonic difluoride; Fluorophosgene; Fluophosgene
147	Carbonyl sulfide	463-58-1	Reasonably assumed to have been present	Carbon oxysulfide; Carbon oxide sulfide; Carbonyl sulphide
148	Cellulose	9004-34-6	Wallingford et al. [2001]	
149	Cerium	7440-45-1	Plumlee [2006]	
150	Chlordane, cis-	5103-71-9	Butt et al. [2004]	Cis-Chlordene
151	Chlordane, trans-	5103-74-2	Butt et al. [2004]	Trans-Chlordene
152	Chlorine	7782-50-5	Lall et al. [2011]; Plumlee [2006]	
153	Chlorobenzene	108-90-7	COPC [2003]	Monochlorobenzene; Benzene chloride; Phenyl chloride; Benzene, chloro-
154	Chlorodifluoromethane	75-45-6	COPC [2003]	Difluorochloromethane; Methane, chlorodifluoro-; Chloro(difluoro)methane; Frigen;
155	Chloroethane	75-00-3	COPC [2003]	Ethyl chloride; Ethane, chloro-; Chlorene; Chlorethyl
156	Chloroform	67-66-3	Geyh et al. [2005]; COPC [2003]	
157	Chloromethane	74-87-3	COPC [2003]	
158	Chromium	7440-47-3	COPC [2003]; Wallingford et al. [2001]; Plumlee [2006]	
159	Chrysene	218-01-9	Butt et al. [2004]; Pleil et al. [2004]; Swartz et al. [2003]	Benzo[a]phenanthrene; 1,2-Benzophenanthrene; 1,2-Benzphenanthrene; 1,2,5,6-Dibenzonaphthalene
160	Cis-1,2-Dichloroethylene	156-59-2	COPC [2003]	Cis-1,2-Dichloroethene; Cis-Dichloroethylene; (Z)-1,2-Dichloroethylene; (Z)-1,2-Dichloroethene
161	Cis-1,3-Dichloropropylene	10061-01-5	COPC [2003]	Cis-1,3-Dichloro-1-propene; (Z)-1,3-Dichloropropene
162	Cobalt	7440-48-4	COPC [2003]; Wallingford et al. [2001]; Plumlee [2006]	

#	Chemical	CAS	Source[17]	Synonyms
163	Copper	7440-50-8	Lall et al. [2011]; COPC [2003]; Plumlee [2006]	
164	Cycloate	1134-23-2	Lioy et al. [2002]	
165	Cyclohexane	110-82-7	COPC [2003]	Hexamethylene; Hexanaphthene; Hexahydrobenzene;
166	Cyclohexanemethanol	100-49-2	Lioy et al. [2002]	
167	Cyclopenta[cd]pyrene	27208-37-3	Offenberg et al. [2004]	Acepyrene; Acepyrylene; Cyclopenta(cd)pyrene; Cyclopenteno(c,d)pyrene
168	Decabromodiphenyl ether	---	Butt et al. [2004]	[13C12]-Decabromodiphenyl ether
169	Dibenzo(a,h)anthracene	53-70-3	Pleil et al. [2004]; 50; Offenberg et al. [2004]; Swartz et al. [2003]; Wallingford et al. [2001]	Dibenz[a,h]anthracene; Benzo[k]tetraphene; 1,2:5,6-Dibenzanthracene; Dibenzo[a,h]anthracene; 1,2,5,6-Dibenzanthracene
170	Dibenzo[ac]anthracene	215-58-7	Swartz et al. [2003]; Offenberg et al. [2004]	Benzo[b]triphenylene; Benzo[f]tetraphene;Dibenz[a,c]anthracene; Benzotriphenylene; Dibenzo[a,c]anthracene
171	Dibenzofuran	132-64-9	Yiin et al. [2004]; Swartz et al. [2003]	Dibenzo[b,d]furan; Diphenylene oxide; 2,2'-Biphenylene oxide; 2,2'-Biphenylylene oxide
172	Dibenzothiophene	132-65-0	Butt et al. [2004]; Swartz et al. [2003]	Diphenylene sulfide; Dibenzo[b,d]thiophene; 9-Thiafluorene; Alpha-Thiafluorene
173	Dibenzyl	103-29-7	Swartz et al. [2003]	1,2-Diphenylethane; Bibenzyl; S-Diphenylethane; Dibenzil
174	Dibromochloromethane	124-48-1	COPC [2003]	Chlorodibromomethane; Methane, dibromochloro-; Monochlorodibromomethane
175	Dibutyl phthalate	84-74-2	Yiin et al. [2004]	Di-n-butyl phthalate; N-Butyl phthalate;Butyl phthalate
176	Dichlorodifluoromethane	75-71-8	COPC [2003]	Difluorodichloromethane; Genetron 12; Freon 12; Methane, dichlorodifluoro-; Refrigerant 12
177	Dichlorodiphenyldichloroethane	72-54-8	Butt et al. [2004]	P,p'-DDD; Rhothane; Dilene; Tetrachlorodiphenylethane
178	Dichloromethane	75-09-2	Geyh et al. [2005]; COPC [2003]	Methylene chloride; Methane, dichloro-; Methylene dichloride; Methylene bichloride
179	Dichlorotetrafluoroethane	76-14-2	COPC [2003]	1,2-Dichlorotetrafluoroethane; Dichlorotetrafluoroethane; Cryofluorane; Frigiderm

#	Chemical	CAS	Source[17]	Synonyms
180	Dicyclohexyl phthalate	84-61-7	Lioy et al. [2002]	
181	Didodecyl phthalate	2432-90-8	Lioy et al. [2002]	
182	Dieldren	60-57-1	Butt et al. [2004]	Dieldrin; HEOD; UNII-I0246D2ZS0
183	Diesel exhaust	–-	Pliel [2004]; Wallingford et al. [2001]	
184	Diethyl phthalate	84-66-2	Yiin et al. [2004]	Ethyl phthalate; Phthalic acid diethyl ester; Anozol; Neantine
185	Diethyl phthalate	84-66-2	Lioy et al. [2002]	
186	Dihydrogeraniol	---	Lioy et al. [2002]	
187	Diisobutyl phthalate	84-69-5	Lioy et al. [2002]	
188	Dimethylcyanamide	1467-79-4	Lioy et al. [2002]	
189	Diphenyl ether	101-84-8	Swartz et al. [2003]	Diphenyl oxide; Phenoxybenzene; Phenyl ether
190	Droserone (2,8-dihydroxy-3-methyl-1, 4-naphthoquinone)	---	Lioy et al. [2002]	
191	Elemental carbon	7440-44-0	Lall et al. [2011]; Olson et al. [2004]; Geyh et al. [2005]	
192	Endosulfan	115-29-7	Butt et al. [2004]	Benzoepin; Thiodan; Thiosulfan; Thionex; Chlorthiepin
193	Ethanol	64-17-5	COPC [2003]	Ethyl alcohol; Alcohol; Methylcarbinol; Grain alcohol; Ethyl hydroxide
194	Ether, hexyl pentyl	32357-83-8	Lioy et al. [2002]	
195	Ethyl acetate	141-78-6	COPC [2003]	Ethyl ethanoate; Acetoxyethane; Vinegar naphtha; Ethyl acetic ester
196	Ethyl benzene	100-41-4	Edelman et al. [2003]*; Geyh et al. [2005]; COPC [2003]; Wallingford et al. [2001]	Phenylethane; Ethylbenzol; Benzene, ethyl-; Aethylbenzol
197	Fluorene	86-73-7	Lioy et al. [2002]; Butt et al. [2004]; Yiin et al. [2004]; Swartz et al. [2003]; Wallingford et al. [2001]	Diphenylenemethane; O-Biphenylenemethane; 2,3-Benzindene
198	Formaldehyde	50-00-0	Reasonably assumed to have been present	Formaldehyde; Formalin; Methanal; Paraformaldehyde; Methylene oxide

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199	Gallium	7440-55-3	Plumlee [2006]	Gallium(III) compounds
200	Germanium	7440-56-4	Plumlee [2006]	
201	Halite	7647-14-5	Jefferey et al. [2003]; COPC [2003]	sodium chloride
202	Heptachlor	76-44-8	Lioy et al. [2002]; Butt et al. [2004]	Heptachlor; Heptachlorane; Heptamul; 3-Chlorochlordene; Rhodiachlor
203	Heptachlor epoxide	1024-57-3	Butt et al. [2004]	Epoxyheptachlor;
204	Hexachlorobenzene	118-74-1	Lioy et al. [2002]	Perchlorobenzene
205	Hexachlorobutadiene	87-68-3	COPC [2003]	Hexachloro-1,3-butadiene; Hexachlorobutadiene; Perchlorobutadiene; HCBD
206	Hexachlorocyclohexane	58-89-9	Butt et al. [2004]; Lioy et al. [2002]	Lindane; Beta-HCH; Hexachlorane; Kwell; Gamma-HCH; Gamma-BHC
207	Hexyl N-butyrate	2639-63-6	Lioy et al. [2002]	
208	Hydrogen bromide	10035-10-6	Wallingford et al. [2001]	Hydrobromic Acid
209	Hydrogen chloride	7647-01-0	Wallingford et al. [2001]	Hydrochloric acid; Hydrogen chloride; Muriatic acid;
210	Hydrogen cyanide	74-90-8	COPC [2003]	Hydrocyanic acid; Formonitrile; Prussic acid;
211	Hydrogen fluoride	7664-39-3	Wallingford et al. [2001]	hydrofluoric acid
212	Hydrogen sulfide	7783-06-4	Wallingford et al. [2001]	Hydrosulfuric acid; Sulfane; Stink DAMP; Sulfur atom; Dihydrogen monosulfide
213	Indeno(1,2,3-cd)pyrene	193-39-5	Pleil et al. [2004]; Swartz et al. [2003]; Wallingford et al. [2001]; COPC [2003]	O-Phenylenepyrene;
214	Iron	7439-89-6	Lall et al. [2011]; COPC [2003]; Wallingford et al. [2001] ; Plumlee [2006]	
215	Isopentane	78-78-4	COPC [2003]	2-Methylbutane; Isopentane; Isoamylhydride; Butane, 2-methyl-;
216	Isopropyl alcohol	67-63-0	COPC [2003]	Isopropanol; 2-Propanol; Isopropyl alcohol; Propan-2-ol;
217	Lanthanum	7439-91-0	Plumlee [2006]	
218	Latex	---	Reasonably assumed to have been present	

#	Chemical	CAS	Source[17]	Synonyms
219	Lead	7439-92-1	Lall et al. [2011]; Edelman et al. [2003]*; Wallingford et al. [2001]; Plumlee [2006]	
220	Lithium	7439-93-2	Wallingford et al. [2001]; Plumlee [2006]	
221	Magnesium	7439-95-4	Lall et al. [2011]; COPC [2003]; Wallingford et al. [2001]; Plumlee [2006]	
222	Manganese	7439-96-5	Lall et al. [2011]; Wallingford et al. [2001]; Plumlee [2006]	
223	Mercury	7439-97-6	Wolff et al. [2005]*; Wallingford et al. [2001]; Plumlee [2006]	
224	Methyl alpha-ketopalmitate	---	Lioy et al. [2002]	
225	Methyl isobutyl ketone	108-10-1	COPC [2003]	4-Methyl-2-pentanone; 4-Methylpentan-2-one; Isopropylacetone;
226	Methyl tert butyl ether	1634-04-4	Edelman et al. [2003]*; Geyh et al. [2005]; COPC [2003]	Tert-Butyl methyl ether; Methyl tert-butyl ether; MTBE
227	Methylcyclopentane	96-37-7	COPC [2003]	Cyclopentane, methyl-; Methyl cyclopentane; Methylpentamethylene
228	Metribuzin	21087-64-9	Lioy et al. [2002]	
229	Mica	12001-26-2	Jefferey et al. [2003]; COPC [2003]	Mica-group minerals; Muscovite; Chacaltaite
230	Mirex	2385-85-5	Lioy et al. [2002]	Dechlorane; Paramex; Perchloropentacyclodecane; Bichlorendo; Perchlorodihomocubane
231	Molybdenum	7439-98-7	Wallingford et al. [2001]; COPC [2003]; Plumlee [2006]	
232	Monobutyl phthalate	131-70-4	Lioy et al. [2002]	
233	Naphthalene	91-20-3	Butt et al. [2004]; Swartz et al. [2003]; Offenberg et al. [2004]; Wallingford et al. [2001]	White tar, Camphor tar, Tar Camphor, Naphthalin, Naphthaline, Antimite, Albocarbon, Hexalene, Mothballs, Moth flakes
234	Naphthalene, 1-(methylthio)-	10075-72-6	Lioy et al. [2002]	
235	Naphthalene, 1,3-dimethylene	575-417	Lioy et al. [2002]	
236	n-Butane	106-97-8	COPC [2003]	Butane; Diethyl; Methylethylmethane

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237	Nefopam	13669-70-0	Lioy et al. [2002]	
238	n-Heptane	142-82-5	COPC [2003]	Heptane; Heptan; Heptyl hydride; Dipropylmethane
239	n-Hexane	110-54-3	COPC [2003]	Hexane
240	Nickel	7440-02-0	Lall et al. [2011]; Wallingford et al. [2001]; Plumlee [2006]	
241	Niobium	7440-03-1	Plumlee [2006]	
242	Nitric acid	7697-37-2	Wallingford et al. [2001]; COPC [2003]	Hydrogen nitrate; Aqua fortis
243	Nitric oxide	10102-43-9	COPC [2003]	Mononitrogen monoxide; INOmax; Nitrogen monooxide; Nitrosyl;
244	Nitrogen dioxide	10102-44-0	COPC [2003]	
245	n-Octane	111-65-9	Lioy et al. [2002]	
246	Nonachlor, cis-	5103-73-1	Butt et al. [2004]	Cis-nonachlor; C-Nonachlor;
247	Nonachlor, trans-	39765-80-5	Butt et al. [2004]	Trans-nonachlor; T-Nonachlor
248	n-Pentane	109-66-0	COPC [2003]	pentane
249	Octabromodiphenyl ether	85446-17-9	Butt et al. [2004]	1,1'-Oxybis(2,3,4,5-tetrabromobenzene
250	Octane	111-65-9	Lioy et al. [2002]	
251	Oxychlordane	26940-75-0	Butt et al. [2004]	Oxychlordan; Octachlor epoxide
252	Ozone	10028-15-6	COPC [2003]	Triatomic oxygen; Ozon
253	Pentanoic acid, 4, 4-dimethyl-3methylene-ethyl ester	36976-64-4	Lioy et al. [2002]	
254	Perfluorodecanoic acid	335-76-2	Trasande et al. [2017]*	
255	Perfluorohexanesulfonate acid	355-46-4	Tao et al. [2008]*; Trasande et al. [2017]*	
256	Perfluoroisobutylene	382-21-8	Reasonably assumed to have been present	Octafluoroisobutylene; PFIB; Octafluoro-sec-butene; Isobutene, octafluoro-;
257	Perfluoroundecanoic acid	2058-94-8	Trasande et al. [2017]*	
258	Perfluorooctanoic acid	335-67-1	Tao et al. [2008]*	
259	Perfluorononanoic acid	375-95-1	Tao et al. [2008]*	

#	Chemical	CAS	Source[17]	Synonyms
260	Perylene	198-55-0	Swartz et al. [2003]; Offenberg et al. [2004]	peri-Dinaphthalene; Perilene; Dibenz[de,kl] anthracene
261	Phenanthrene	85-01-8	Lioy et al. [2002]; Butt et al. [2004]; Yiin et al. [2004]; Swartz et al. [2003]; Wallingford et al. [2001]; COPC [2003]	Phenanthren; Phenanthrin; Phenanthracene
262	Phosgene	75-44-5	Reasonably assumed to have been present	Carbonyl dichloride; Carbonic dichloride; Carbonyl chloride; Phosgen; Chloroformyl chloride
263	Phosphoric acid	7664-38-2	Wallingford et al. [2001]; COPC [2003]	Orthophosphoric acid
264	Phosphorus	7803-51-2	Wallingford et al. [2001]; Plumlee [2006]	
265	Phthalic acid, 2-hexyl ester	---	Lioy et al. [2002]	
266	p-Hydroxybenzoic acid hydrazide	5351-23-5	Butt et al. [2004]	4-hydroxybenzhydrazide; 4-Hydroxybenzohydrazide
267	Phytane	638-36-8	Swartz et al. [2003]	2,6,10,14-Tetramethylhexadecane; Phytan
268	Platinum	7440-06-4	Wallingford et al. [2001]	
	Polybrominated Diphenyl Ethers (PBDEs) See the following listings (#269-277) for specific PBDEs			
269	*BDE-47*	5436-43-1	Lioy et al. [2002]; Butt et al. [2004]; Herbstman et al. [2010]*	4,4'-Oxybis(1,3-dibromobenzene); 2,2',4,4'-Tetrabromodiphenyl ether; 4,4'-Oxybis(1,3-dibromobenzene); 2,2',4,4'-Tetrabromodiphenyl ether
270	*BDE 85*	182346-21-0	Herbstman et al. [2010]	1,2,3-tribromo-4-(2,4-dibromophenoxy)benzene
271	*BDE-99*	60348-60-9	Lioy et al. [2002]; Butt et al. [2004]; Herbstman et al. [2010]*	2,2',4,4',5-Pentabromodiphenyl ether
272	*BDE-100*	189084-64-8	Lioy et al. [2002]; Butt et al. [2004]; Herbstman et al. [2010]*	1,3,5-Tribromo-2-(2,4-dibromophenoxy)benzene
273	*BDE-153*	68631-49-2	Lioy et al. [2002]; Herbstman et al. [2010]*	2,2',4,4',5,5'-Hexabromodiphenyl ether
274	*BDE-154*	207122-15-4	Lioy et al. [2002]; Herbstman et al. [2010]*	2,2',4,4',5,6'-Hexabromodiphenyl ether
275	*BDE-183*	207122-16-5	Herbstman et al. [2010]	2,2',3,4,4',5',6-heptabromodiphenyl ether
276	*BDE-207*	437701-79-6	Lioy et al. [2002]; Butt et al. [2004]	2,2',3,3',4,4',5,6,6'-Nonabromodiphenyl ether

#	Chemical	CAS	Source[17]	Synonyms
277	*BDE-209*	1163-19-5	Lioy et al. [2002]; Butt et al. [2004]	Decabromodiphenyl oxide; Decabromodiphenyl ether; Pentabromophenyl ether
	Polychlorinated Biphenyls (PCBs) See the following listings (#278-282)for specific PCBs			
278	*PCB-110*	38380-03-9	Butt et al. [2004]	2,3,3',4',6- Pentachlorobiphenyl
279	*PCB-126*	57465-28-8	Butt et al. [2004]	3,3',4,4',5-Pentachlorobiphenyl
280	*PCB-138*	35065-28-2	Butt et al. [2004]	2,2',3,4,4',5'- Hexachlorobiphenyl
281	*PCB-153*	35065-27-1	Butt et al. [2004]	2,2',4,4',5,5'-Hexachlorobiphenyl
282	*PCB-180*	35065-29-3	Butt et al. [2004]	2,2',3,4,4',5,5'- Heptachlorobiphenyl
	Polychlorinated Naphthalenes (PCNs)[18] See the following listings (#283-288)for specific PCNs			
283	*PCN-35*		Butt et al. [2004]	
284	*PCN-59*		Butt et al. [2004]	
287	*PCN-66*	103426-96-6	Butt et al. [2004]	1,2,3,4,6,7-Hexachloronaphthalene
288	*PCN-67*	103426-97-7	Butt et al. [2004]	1,2,3,5,6,7-Hexachloronaphthalene
	Polychlorodibenzodioxins (PCDDs) See the following listings (#289-290)for specific PCDDs			
289	*2,3,7,8-Tetrachlorodibenzodioxin*	1746-01-6	Lioy et al. [2002]; Rayne et al. [2005]	Dioxin; TCDD; Tetradioxin; Tetrachlorodibenzodioxin; Dioxine
290	*1,2,3,7,8-Pentachlorodibenzodioxin*	40321-76-4	Lioy et al. [2002]; Rayne et al. [2005]	1,2,3,7,8-PeCDD
291	*1,2,3,4,7,8-Hexachlorodibenzodioxin*	39227-28-6	Lioy et al. [2002]; Rayne et al. [2005]	
292	*1,2,3,6,7,8-Hexachlorodibenzodioxin*	57653-85-7	Lioy et al. [2002]; Rayne et al. [2005]	1,2,3,6,7,8-HXCDD
293	*1,2,3,7,8,9-Hexachlorodibenzodioxin*	19408-74-3	Lioy et al. [2002]; Rayne et al. [2005]	
294	*1,2,3,4,6,7,8-Heptachlorodibenzodioxin*	35822-46-9	Wolff et al. [2005]; Edelman et al. [2003]*; Wolf et al. [2005]; Edelman et al. [2003]*; Rayne et al. [2005]	
290	*1,2,3,4,6,7,8,9-Octachlorodibenzodioxin*	3268-87-9	Lioy et al. [2002	
	Polychlorodibenzofurans (PCDFs) See the following listings (#291-300) for specific PCDFs			

[18] Horii et al. [2010]* identified PCNs as a group but did not identify specific PCNs.

#	Chemical	CAS	Source[17]	Synonyms
291	*2,3,7,8-Tetrachlorodibenzofuran*	51207-31-9	Lioy et al. [2002]; Rayne et al. [2005]	2,3,7,8-TCDF; Dibenzofuran, 2,3,7,8-tetrachloro-
292	*1,2,3,7,8-Pentachlorodibenzofuran*	57117-41-6	Lioy et al. [2002]; Rayne et al. [2005]	1,2,3,7,8-PeCDF
293	*2,3,4,7,8-Pentachlorodibenzofuran*	57117-31-4	Lioy et al. [2002]; Rayne et al. [2005]	4-PeCDF
294	*1,2,3,4,7,8-Hexachlorodibenzofuran*	70648-26-9	Lioy et al. [2002]; Rayne et al. [2005]	
295	*1,2,3,6,7,8-Hexachlorodibenzofuran*	57117-44-9	Lioy et al. [2002]; Rayne et al. [2005]	
296	*1,2,3,7,8,9-Hexachlorodibenzofuran*	72918-21-9	Lioy et al. [2002]; Rayne et al. [2005]	
297	*2,3,4,6,7,8-Hexachlorodibenzofuran*	60851-34-5	Lioy et al. [2002]; Rayne et al. [2005]	
298	*1,2,3,4,6,7,8-Heptachlorodibenzofuran*	67562-39-4	Lioy et al. [2002]; Rayne et al. [2005]	
299	*1,2,3,4,7,8,9-Heptachlorodibenzofuran*	55673-89-7	Lioy et al. [2002]; Rayne et al. [2005]	
300	*1,2,3,4,6,7,8,9-Octachlorodibenzofuran*	39001-02-0	Lioy et al. [2002]	Perchlorodibenzofuran
309	Potassium	7440-09-7	Plumlee [2006]	
310	Rubidium	7440-17-7	Plumlee [2006]	
311	Scandium	7440-20-2	Plumlee [2006]	
312	Selenium	7782-49-2	COPC [2003]	
313	Silica: Quartz	7631-86-9	COPC [2003]; Plumlee [2006]	Silicon dioxide
314	Silicon		Plumlee [2006]	
315	Silver	7440-22-4	COPC [2003]; Wallingford et al. [2001]; Plumlee [2006]	
316	Sodium	7440-23-5	COPC [2003]; Wallingford et al. [2001]; Plumlee [2006]	
317	Soot	---	Pleil et al. [2004]	
318	Strontium	7440-24-6	Plumlee [2006]	
319	Styrene	100-42-5	Geyh et al. [2005]; COPC [2003]; Wallingford et al. [2001]	Ethenylbenzene; Phenylethylene; Vinylbenzene
320	Sulfur	7704-34-9	Lall et al. [2011]; Plumlee [2006]	
321	Sulfur dioxide	7446-09-5	COPC [2003]	Sulphur dioxide; Sulfurous anhydride
322	Sulfuric Acid	7664-93-9	Wallingford et al. [2001]; COPC [2003]	Sulphuric acid; Oil of vitriol; Dihydrogen sulfate;

#	Chemical	CAS	Source[17]	Synonyms
323	SVF: Synthetic vitreous fibers	65997-17-3	McGee et al. [2003]; Wallingford et al. [2001]; Jefferey et al. [2003]	MMVF; MMMF; Man-made vitreous fibers; Rock wool, Slag wool; Mineral wool fiber; fibrous glass; fiberglass
324	Tellurium	13494-80-9	Wallingford et al. [2001]	
325	Tetrachloroethylene	127-18-4	Edelman et al. [2003]*; Geyh et al. [2005]	Tetrachloroethene; Perchloroethylene
326	Tetrahydrofuran	109-99-9	COPC [2003]	Oxolane; Butylene oxide; Furan, tetrahydro-;
327	Thallium	7440-28-0	COPC [2003]; Plumlee [2006]	
328	Thorium	7440-29-1	Wallingford et al. [2001]; Plumlee [2006]	
329	Titanium	7440-32-6	Wallingford et al. [2001]; Plumlee [2006]	
330	Toluene	108-88-3	Geyh et al. [2005]; COPC [2003]; Wallingford et al. [2001]	Methylbenzene; Toluol; Phenylmethane;
331	Tribromodiphenyl ether	49690-94-0	Butt et al. [2004]	2,3',4'-Tribromodiphenyl ether
332	Trichloroethylene	79-01-6	Geyh et al. [2005]; COPC [2003]	Trichloroethene
333	Trichlorofluoromethane	75-69-4	COPC [2003]	Fluorotrichloromethane; Trichloro(fluoro)methane; Trichloromonofluoromethane;
334	Trichlorotrifluoroethane	354-58-5	COPC [2003]	1,1,1-Trichlorotrifluoroethane; Trichlorotrifluoroethane
335	Triphenylene	217-59-4	Butt et al. [2004]	9,10-Benzophenanthrene; Isochrysene; 9,10-Benzphenanthrene; Benzo(l)phenanthrene
336	Tungsten	7440-33-7	Plumlee [2006]	
337	Uranium	7440-61-1	Plumlee [2006]	
338	Vanadium	7440-62-2	Lall et al. [2011]; COPC [2003]; Wallingford et al. [2001]; Plumlee [2006]	
339	Vernolate (vernam)	1929-77-7	Lioy et al. [2002]	
340	Vinyl acetate	108-05-4	COPC [2003]	Ethenyl acetate
341	WTC Dust: Glass shards	–-	Lioy et al. [2002]	
342	WTC Dust: PM_{10}	–-	Geyh et al. [2005]	

#	Chemical	CAS	Source[17]	Synonyms
343	WTC Dust:$PM_{2.5}$	---	Lall et al. [2011]; Geyh et al. [2005]	
344	WTC Dust: Particles >2µm	---	Fireman et al. [2004]*	
345	WTC Dust: Particles >5µm	---	Fireman et al. [2004]*	
346	Xanthene	92-83-1	Lioy et al. [2002]	
347	Xylene, o-	95-47-6	COPC [2003]	1,2-Dimethylbenzene; 1,2-Xylene; Ortho-Xylene; O-Xylol
348	Xylene, p-	106-42-3	Breysse et al. [2005]; Edelman et al. [2003]*; Geyh et al. [2005]; COPC [2003]	1,4-Dimethylbenzene; Para-Xylene; 1,4-Xylene; P-Methyltoluene; P-Dimethylbenzene
349	Xylene,m-	108-38-3	Edelman et al. [2003]*; COPC [2003]	1,3-Dimethylbenzene; 1,3-Xylene; M-Xylol; M-Dimethylbenzene
350	Yttrium	7440-65-5	Wallingford et al. [2001]; Plumlee [2006]	
351	Zinc	7440-66-6	Lall et al. [2011]; COPC [2003]; Wallingford et al. [2001]; Plumlee [2006]	
352	Zirconium	7440-67-7	Wallingford et al. [2001]; Plumlee [2006]	

Table 2. Physical Hazards

#	Agent	Source
1	Cold Stress	Reasonably assumed to have been present
2	Heat Stress	Reasonably assumed to have been present
3	Solar radiation	Reasonably assumed to have been present
4	Noise	Reasonably assumed to have been present
5	Vibration	Reasonably assumed to have been present
6	Fire and Hot surfaces	Reasonably assumed to have been present
7	Explosion	Reasonably assumed to have been present
8	Slip	Reasonably assumed to have been present
9	Trip	Reasonably assumed to have been present
10	Fall (including fall from height)	Reasonably assumed to have been present
11	Struck by	Reasonably assumed to have been present
12	Caught in	Reasonably assumed to have been present
13	Needlestick	Reasonably assumed to have been present
14	Radio Frequency	Reasonably assumed to have been present

Table 3. Biological Hazards

#	Agent	Source
1	Bloodborne Pathogens	Reasonably assumed to have been present

Table 4. Other Hazards

#	Experience	Source[19]
1	Sustained injury on 9/11	DiGrande et al. [2008]; DiGrande et al. [2011]; Brackbill et al. [2009]; Gargano et al. [2016]; Perrin et al. [2007]; Hoven et al. [2005]; Cone et al. [2015]; Pietrzak et al. [2014]
2	Present in a WTC building on 9/11	DiGrande et al. [2008]; Brackbill et al. [2006]
3	Caught in dust cloud on 9/11	DiGrande et al. [2008]; Brackbill et al. [2009]; Pietrzak et al. [2012]; Wisnivesky et al. [2011]; Perrin et al. [2007]; Hoven et al. [2005]; Pietrzak et al. [2014]
4	Time of evacuation from WTC building on 9/11	DiGrande et al. [2011]
5	Firefighter who worked on 9/11 at WTC	Berniger et al. [2010a]; Berniger et al. [2010b]
6	Involved in search and rescue in Sept/Oct 2001	DiGrande et al. [2008]; Ahern et al. [2002]; Brackbill et al. [2009]; Pietrzak et al. [2012]; Perrin et al. [2007]; Galea et al. [2003]; Pietrzak et al. [2014]; Stellman et al. [2008]
7	Increased duration of work in search/rescue/recovery/clean-up	Brackbill et al. [2009]; Berniger et al. [2010a]; Berniger et al. [2010b]; Stellman et al. [2008]; Wisnivesky et al. [2011]; Perrin et al. [2007]; Pietrzak et al. [2014]
8	Firefighter with supervisor responsibilities at WTC site	Berniger et al. [2010a]; Berniger et al. [2010b]
9	Worked on the 9/11 pile	Wisnivesky et al. [2011]; Pietrzak et al. [2014]
10	Performed work tasks at WTC not common to profession	Perrin et al. [2007]
11	Displacement from home	Galea et al. [2002]; DiGrande et al. [2008]
12	Lived below Canal Street on 9/11	Ahern et al. [2002]; DiGrande et al. [2008]; Galea et al. [2003]
13	Damage to home or workplace	Brackbill et al. [2009]

[19] Peer review literature sources are identified as the basis for adding the hazard to the Inventory of 9/11 Agents; no "other hazards" were found that are "*not identified in a published, peer-reviewed exposure assessment study but are reasonably assumed to have been present at any of the three sites.*"

#	Experience	Source[19]
14	Saw a plane hit the WTC	DiGrande et al. [2008]; DiGrande et al. [2011]; Neria et al. [2013]
15	Saw the WTC collapse	DiGrande et al. [2008]; DiGrande et al. [2011]; Neria et al. [2013]
16	Saw people running from a cloud of dust and debris on 9/11	DiGrande et al. [2008]; DiGrande et al. [2011]; Neria et al. [2013]; Brackbill et al. [2009]; Pietrzak et al. [2012]
17	Saw people who were killed/seeing human remains	DiGrande et al. [2008]; DiGrande et al. [2011]; Pietrzak et al. [2012]
18	Saw people who were seriously injured	DiGrande et al. [2008]; DiGrande et al. [2011]
19	Saw people jump or fall from the Towers	DiGrande et al. [2011]
20	Directly witnessed 9/11 events (unspecified)	Galea et al. [2002]; Galea et al. [2003]; Ahern et al. [2002]; Brackbill et al. [2009]; Gargano et al. [2016]; Perrin et al. [2007]; Hoven et al. [2005]; Bowler et al. [2012]
21	Learning that a close family member or close friend was seriously injured on 9/11	Pietrzak et al. [2012]; Pietrzak et al. [2014]; Ghafoori et al. [2009]; Katz et al. [2009]
22	Learning that a close family member or close friend had died	Galea et al. [2002]; Galea et al. [2003]; Ahern et al. [2002]; Brackbill et al. [2009]; Neria et al. [2013]; Pietrzak et al. [2012]; Pietrzak et al. [2014]; Ghafoori et al. [2009]; Katz et al. [2009]; Pfeffer et al. [2007]; Pfeffer et al. [2009]
23	Worked for an employer that sustained fatalities	DiGrande et al. [2011]; Gargano et al. [2016]
24	Worked in firehouse that had fatalities	Berniger et al. [2010a]; Berniger et al. [2010b]
25	Loss of job	Galea et al. [2002]; Galea et al. [2003]; Ahern et al. [2002]; Brackbill et al. [2009]; Gargano et al. [2016]; Bowler et al. [2012]
26	Loss of possessions	Galea et al. [2002]

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