FINAL

FORMER NAVAL AIR STATION MOFFETT FIELD
RESTORATION ADVISORY BOARD
BUILDING 943, EAGLE ROOM
MOFFETT FIELD, CALIFORNIA

NOTE: A glossary is provided on the last page of these minutes.

Subject: RAB MEETING MINUTES

The Restoration Advisory Board (RAB) meeting for former Naval Air Station (NAS) Moffett Field was held on Thursday, 15 May 2008, at Building 943, Eagle Room, Moffett Field, California. Mr. Bob Moss, RAB community co-chair, and Mr. Darren Newton, U.S. Navy Base Realignment and Closure (BRAC) Environmental Coordinator (BEC) and RAB co-chair, opened the meeting at 7:10 p.m.

WELCOME

Mr. Newton and Mr. Moss welcomed everyone in attendance. Mr. Moss asked for self-introductions of those present and provided a brief agenda overview. He said tonight's presentation on polychlorinated biphenyls (PCBs) will be given by Dr. Patrick Wilson of the U.S. Environmental Protection Agency (EPA), not by Mr. Newton as indicated on the meeting agenda that was mailed to the RAB members and interested parties. Additionally, the regulatory agencies will not be providing an update at tonight's meeting to allow more time for tonight's presentations. Mr. Newton said the Navy and regulatory agencies meet regularly.

The Moffett Field RAB meeting was attended by:

RAB Members	Regulators	Navy	Consultants & Navy Support	NASA	Public & Other
10	2	3	3	4	21

ANNOUNCEMENTS

- Mr. Moss said the next RAB meeting is scheduled for 10 July 2008; however, EPA representatives will not be able to attend because of a scheduling conflict with EPA's National Association of Remedial Project Managers annual training conference. The EPA RAB representatives have requested that the RAB meeting be rescheduled to 17 July 2008. Mr. Moss asked for a formal vote of the RAB. The RAB voted in favor of rescheduling the RAB meeting to Thursday, 17 July 2008.
- Mr. Moss said that Mr. Scott Gromko, U.S. Navy remedial project manager is no longer with the Navy. Mr. Moss recommended the RAB send Mr. Gromko a certificate of appreciation for his work on Moffett Field. Mr. Moss asked for a formal vote of the RAB. The RAB voted in favor of a certificate of appreciation.
- Mr. Newton introduced Mr. Mark Walden, Navy lead remedial project manager for Moffett Field. Mr. Walden is a geologist who began working with the Navy about five years ago. He has recently been transferred to the Moffett Field project from the Hunters Point project and will be the project manager for Hangar 1. Mr. Walden's general role as lead remedial project manager will be to execute the environmental restoration program at Moffett Field and ensure consistency between projects and documents.
- Mr. Newton reviewed Moffett Field points-of-contact information, including the information repository and administrative record locations, and reviewed the 2008 RAB meeting schedule. A handout listing Moffett Field points-of-contact information was made available at the sign-in table. Mr. Newton said that phone numbers for some of the NASA representatives were not included in this handout. The handout will be updated to include this information for the next RAB meeting.

- Mr. Newton reminded RAB members to call him or Mr. Moss for an excused absence if they are unable to attend a RAB meeting. RAB member Mr. Arthur Schwartz is unable to attend tonight's RAB meeting and has received an excused absence.
- Mr. Newton said Mr. Jack Gale has resigned from the RAB. Mr. Gale, present at tonight's meeting, commended the RAB. Mr. Newton thanked Mr. Gale for his service.

APPROVAL OF MEETING MINUTES

Mr. Moss asked for corrections to the 13 March 2008 meeting minutes. RAB member Mr. Gabriel Diaconescu asked to replace the word "includes" with the word "describes" in the following sentence on Page 9 of the meeting minutes:

> RAB member Mr. Gabriel Diaconescu asked whether it is possible to build a comprehensive geographic system of the area that <u>includes</u> environmental information.

The sentence was corrected as follows:

> RAB member Mr. Gabriel Diaconescu asked whether it is possible to build a comprehensive geographic system of the area that <u>describes</u> environmental information.

The 13 March 2008 meeting minutes were approved as corrected. Meeting minutes are posted to the Moffett Field project Web site at http://www.bracpmo.navy.mil/bracbases/california/moffett/.

DOCUMENTS FOR REVIEW

Documents are available in CD-ROM format. Sign-up sheets for the documents listed below were circulated during the meeting.

#	DOCUMENT	APPROXIMATE SUBMITTAL DATE
1.	Draft Site 27 Remedial Action Report	February 2008
2.	Draft Site 26 Alternative Remediation Technical Memorandum	April 2008
3.	2007 Annual Groundwater Report	June 2008
4.	Site 29 (Hangar 1) EE/CA	TBA
5.	Site 29 (Hangar 1) Action Memorandum	TBA

RAB COMMUNITY CO-CHAIR ELECTION

Mr. Newton said the RAB community co-chair serves a one-year term and is nominated and elected by the RAB. Mr. Moss was elected as the RAB community co-chair in May 2007; thus his term has expired and it is time to nominate and elect a RAB member for the community co-chair position. Mr. Newton asked for nominations for the position of community co-chair. Mr. Bob Moss was nominated; no other nominations were received. RAB member Mr. Lenny Siegel moved to accept Mr. Moss by acclamation. The RAB accepted Mr. Moss as RAB community co-chair. The next RAB community co-chair election will be held in May 2009.

HANGAR 1 PROGRESS REVIEW

Mr. Newton said that at the March 2008 RAB meeting, Mr. Gromko provided a progress update on the Hangar 1 structural analysis. The Navy has recently received a draft of the structural analysis report and is reviewing it. Mr. Newton said the Hangar 1 Information Update No. 4 describes the purpose of conducting the structural analysis and provides examples of questions about the hangar's structural integrity that will be answered by the structural analysis. Mr. Newton said there are three alternatives that would add weight to the structure if implemented. Preliminary indications for these three alternatives seem to indicate that the structure would require retrofitting and bracing to be able to withstand any additional weight. Other preliminary evaluations of the structural analysis seem to indicate that the Hangar 1 structure would remain standing without the siding. Mr. Newton said the structural analysis is not applicable to Alternative 11, which is to demolish and remove the hangar. Findings of the structural analysis will be included in the Hangar 1 Engineering Evaluation/Cost Analysis (EE/CA). The Navy will summarize the structural analysis results in the revised EE/CA.

- Community member Mr. Steve Williams asked Mr. Newton to list the three alternatives that would add weight to the structure. Mr. Newton said they are Alternative 2, cover with rubberized material; Alternative 4, coat with acrylic coating; and Alternative 6, cover with new visually similar siding.
    - Mr. Williams asked if any of these alternatives would constitute removing the siding, and if it did, would the new visually similar siding weigh more than the current siding. Mr. Newton said the alternatives were reviewed in detail at the January 2008 RAB meeting and he does not have the information at-hand.
- RAB member Mr. Richard Eckert asked for an update on the sister hangar in Akron, Ohio, which is also contaminated with PCBs. Ms. Sandy Olliges of the National Aeronautics and Space Administration (NASA) said it has been about four years since NASA personnel visited the Akron hangar. At that time, the Akron team could not seal in the PCBs, especially in the interior of the hangar. She believes this to still be the situation. Mr. Peter Strauss, Technical Assistance Grant consultant to the Center for Public Environmental Oversight, said he spoke with a EPA representative a couple of years ago who said the exterior of the Akron hangar was being rubberized and the interior of the hangar had to be cleaned about every six months. The plan was to use the hangar for a weather-related activity. Mr. Strauss said it was not his impression that there were problems with containing the PCBs in Akron.
- A community member asked whether the Akron, Ohio, hangar is the only hangar similar to Hangar 1 and whether the hangars in Tustin and El Toro are similar. Mr. Newton said the Tustin hangars are constructed of wood and are similar to Hangars 2 and 3 at Moffett Field and that the El Toro hangars are much smaller and constructed of metal. Mr. Don Chuck of NASA said he believes there is another hangar similar to Hangar 1 in the Carolinas/Georgia area.
- A community member asked about the possibility of covering the structure with the fiberglass fabric technology discussed at previous RAB meetings. Mr. Newton said that as part of the environmental restoration program, the Navy is addressing the contamination. The EE/CA includes a historic mitigation consideration for a siding material. Mr. Newton said that while this was reviewed at a previous RAB meeting, he thinks that a fabric technology siding material would be captured as part of the historic mitigation considerations as are other siding materials. The community member said that for Alternative 10, remove siding and coat exposed surfaces, it would appear that the siding would be removed before application of the fabric technology. The community member said he does not see any mention of the fabric technology. Mr. Newton said a fabric technology (along with any siding material) would be part of historic mitigation consideration, not part of addressing the contamination. The EE/CA will include historic mitigation considerations.

PCBs: DISCUSSION AND PROPERTIES

Mr. Newton introduced the PCBs discussion and said PCBs are a man-made chlorinated organic material manufactured from 1929 to 1977. PCB materials were used for electrical as well as thermal applications because of their non-flammable and insulating properties. There were a wide range of uses for PCB materials including transformers and capacitors, oil used in motors and hydraulics, glues and adhesives, oil-based paint and lacquers, degreasers, and refrigerators and air conditioners.

Mr. Newton introduced Dr. Patrick Wilson of the EPA to present general background information on PCBs including the EPA's position on PCBs. Dr. Wilson is a senior regional toxicologist and supports EPA's Resource Conservation and Recovery Act (RCRA) program, which is a sister division of Superfund. The presentation slides are included as an appendix at the end of these meeting minutes.

PCBs are a mixture of compounds containing a biphenyl molecular structure with varying numbers and arrangements of chlorine atoms attached. The number of chlorine atoms determines the stability of the PCB chemical: the more chlorine atoms present, the more stable the chemical becomes in the environment. Additionally, the number of chlorine atoms determines how the human body treats the chemical. Aroclor is one of nine commercial PCB mixtures, with varying levels of chlorination, formerly produced in the United States. PCBs present the following physical properties: colorless, odorless, low vapor pressure, viscous liquid or solid, and low electrical conductivity. PCBs present the following chemical properties: flame retardant, lipophilic (mixes easily with oil or fat), and very stable (i.e., does not breakdown easily in the environment). Dr. Wilson discussed each of these properties.

PCBs were banned in the United States because they are persistent in the environment, have bioaccumulation and bioconcentration effects, and are found in virtually all human fat tissue. Toxicities of concern to humans include cancer as well as non-cancer toxicities to the kidney, liver, skin, immune system, nervous system, and developmental and reproductive systems. Acute health effects of PCBs include chloracne and irritation of the eyes, face and skin. "Acute" effects occur when there is a large amount of exposure over a short amount of time. In the United States, acute effects are not as common as chronic effects. Chronic health effects of PCBs include liver disorders, potential reproductive effects (reproductive effects have been demonstrated in animals) and cancer. "Chronic" effects occur when there is exposure to low levels of PCBs over a long period of time.

The EPA risk assessment guidelines for carcinogens are categorized into five groups. PCBs are classified into Group B - probable human carcinogen. Dr. Wilson reviewed evidence leading to EPA's classification of PCBs into this category, including a comparison of PCBs to other known carcinogens, and animal and human studies. To help determine the toxicity of a chemical, the chemical's structure is compared with other chemicals whose effects are known.

Dr. Wilson also discussed the potential for human exposure to PCBs, displayed a map of U.S. Superfund sites containing PCB contamination, discussed the bioaccumulation and biomagnification properties of PCBs, and presented various data charts.

The following questions were asked during or after the presentation.

- A community member asked whether the PCBs are man-made. Dr. Wilson said yes and added that there are no naturally occurring PCBs.
- During Dr. Wilson's discussion of dioxins, Mr. Williams asked whether dioxins were man-made for commercial use like PCBs were. Dr. Wilson said dioxins were made for a different application and are produced as a result of combustion of certain elements. The incomplete combustion of PCBs can produce dioxins.
- A community member asked about the timeframe of "weathering" in PCBs. (Weathering is a term used to describe the physical, chemical or biological processes that can alter the chlorination pattern of a PCB molecule, and thereby change the composition of environmental mixtures of PCBs.) Dr. Wilson said the

timeframe varies. Weathering changes are based on how the PCB compound mixes in the environment or where in the environment the PCB is present, such as in soil, water or sediment. The timeframe can range from two to 10 years.

- Mr. Williams asked whether weathering is a natural chemical change or a change produced by an environmental influence. Dr. Wilson said weathering is mediated by the environment. PCBs, by themselves, are very stable.
- A community member asked whether a "natural" or "environmental" breakdown of PCBs is faster. Dr. Wilson said PCBs do not breakdown naturally. The breakdown of PCBs is caused by an environmental factor.
- Mr. Moss asked whether the process of weathering always removes the same chlorine atom. Dr. Wilson said weathering can remove different chlorine atoms, thus producing different effects. This is dependent on the microorganism affecting the PCB molecule.
- In response to a case study example of liver tumors correlated to PCB contamination in Japan and Taiwan, a community member asked whether genetics is taken into account in these types of studies. Dr. Wilson said genetics is not taken into account.
- As a follow up to Dr. Wilson's discussion of PCB contamination in food and the discussion of fish advisories in the United States, Mr. Strauss asked whether PCB contamination differs in saltwater versus freshwater fish. Dr. Wilson said if PCBs are in the water and the fish eat in the area contaminated with PCBs, then the fish have been found to have high levels of PCB concentrations.
    - Mr. Williams asked why there are large number differences between fish advisories in various states. Dr. Wilson said he did not know, but it is not a result of different state regulations.
- Mr. Strauss said Aroclor 1268 is a toxin found in Hangar 1, while Aroclor 1254 is found throughout the base in addition to the hangar. Mr. Strauss asked whether there is a different toxicity between the two aroclors. Dr. Wilson said 1254 and 1260 have the highest toxicities. Aroclor 1268 has a lower proportion of dioxin-like components; however, once released into the environment, microorganisms can affect the chemical makeup, which affects the toxicity level.
    - Mr. Strauss asked whether there is any evidence that Aroclor 1254 changes to Aroclor 1268 or vice versa. Dr. Wilson said changes to the chemical would be site specific (i.e., this cannot be generalized).
- Mr. Strauss asked about the accuracy of aroclor tests in identifying 1268 versus 1254. Dr. Wilson said the numbers represent the percentage of chlorine in the PCB molecule. The EPA has started moving away from aroclor analyses because the tests do not provide as much information for mixtures as do congener analyses. (PCBs are mixtures.) A congener analysis would determine precisely the PCB molecule as well as the location and number of chlorine atoms. This analysis provides information as to whether the molecule is a dioxin-like component and would also determine more precisely the level of toxicity. Dr. Wilson said the EPA has begun adding congener analyses to aroclor analyses to find more specific information and detect PCB levels at lower concentrations, but these analyses are expensive.
    - Mr. Strauss asked the NASA representatives if a congener analysis had been done at the site. Ms. Olliges said NASA is not doing congener analyses. She said that Hangar 1 also contains Aroclor 1260, not only 1268, but 1268 was found in higher concentrations.
- RAB member Ms. Libby Lucas asked Dr. Wilson whether he reviewed and submitted comments on the South Bay Salt Pond Restoration Project's recreation document that was made available for public review and asked whether Dr. Wilson had any reservations about the residual toxicity at Site 25 in terms of using areas near the site for recreation. Mr. Newton said this is out of Dr. Wilson's scope as he does not work on the Moffett Field project. Ms. Olliges said that when the site-wide ecological assessment and human health

risk assessment was done for Site 25, the Navy looked at the recreational scenario and found that recreation was not an issue. Ms. Olliges said the contaminants are at a lower level than EPA's minimum for a recreational scenario.

- Ms. Lucas asked whether the recreational trail will be closed during remediation of Site 25. Ms. Olliges said the Navy would determine this, and Mr. Newton said Ms. Lucas' concern would be considered at that time.

Dr. Wilson concluded the presentation.

SITES 26/28 GROUNDWATER PROGRAM UPDATE

Ms. Julie Crosby, Navy remedial project manager, presented an overview of the Moffett Field groundwater program for Sites 26 and 28. The presentation discussed basewide groundwater monitoring; coordination with the regulatory agencies, Middlefield-Ellis-Whisman (MEW) Companies and NASA; and discussed the path forward for each site.

There are four aquifers at Moffett Field. The upper portion of the A aquifer is from 0 to 35 feet below ground surface (BGS); the lower portion of the A aquifer is from 33 to 55 feet BGS; the B aquifer is from 55 to 160 feet BGS; the C aquifer is from 160 to 240 feet BGS; and the Deep aquifer is greater than 240 feet BGS.

Basewide Groundwater Program

The basewide groundwater program includes groundwater elevation measurements and groundwater sampling. Groundwater elevation measurements and groundwater sampling is a joint effort between the Navy, MEW Companies and NASA. Groundwater elevation measurements and sampling is taken from the upper and lower A aquifer wells and B aquifer wells. There is no contamination in the C or Deep aquifers.

Measuring groundwater elevation is a one-day event that occurs in March and November of every year. More than 1,000 water level measurements are taken by Navy, MEW Companies and NASA crews. Of these, more than 400 measurements are collected by the Navy.

Basewide groundwater sampling is conducted in November/December of every year. More than 600 wells are sampled north of Highway 101. Of these, Navy crews sample approximately 125 wells. The groundwater is sampled for volatile organic compounds (VOCs). Also, every five years, the groundwater is sampled for dissolved metals and total petroleum hydrocarbons.

The results of the groundwater elevation measurements and sampling are compiled and evaluated in annual groundwater reports. The 2006 Annual Groundwater Report concludes that groundwater consistently flows to the north at Sites 26 and 28. At Site 26, the VOC plume is stable; there is no movement or change to the plume shape. At Site 28, the report concludes that dissolved VOCs continue to flow onto Moffett Field. The 2007 Annual Groundwater Report will be available for public review in June 2008.

Site 28

Site 28 is located west of the runways and includes the West-Side Aquifers Treatment System (WATS). The groundwater contamination at the site is from Navy sources as well as the regional plume. At the site, there are six upper A aquifer extraction wells and three lower-A aquifer extraction wells. WATS, which began operating in 1998, is a pump-and-treat system that treats groundwater through an advanced oxidation process and granular activated carbon. The treated water is discharged to the Eastern Diked Marsh and Stormwater Retention Pond. All discharged water is compliant with National Pollutant Discharge Elimination System requirements.

In 2007, WATS was operational 98.9 percent of the time; it was occasionally offline for maintenance such as filter changes. Also in 2007, WATS treated 34,532,488 gallons of extracted groundwater and removed 378 pounds of VOCs. Over its lifetime, WATS has treated 304,302,868 gallons of extracted groundwater and has removed 3,997 pounds of VOCs.

Currently, the Navy is partnering with MEW Companies to prepare the site-wide Focused Feasibility Study (FFS) and Technical Impracticability (TI) Evaluation. The FFS and TI evaluate the effectiveness of the current remedy, and evaluate and compare alternatives for site-wide groundwater remediation. Volume I (Sections 1 through 5) was submitted to the EPA on 14 April 2008. The Navy is working with MEW Companies to finalize the FFS.

Site 26

Site 26 is located east of the runways and includes the East-Side Aquifer Treatment System (EATS). The groundwater contamination at the site is from Navy sources; Site 26 is not part of the regional plume. EATS operated from January 1999 through July 2003 and consists of five Upper-A aquifer extraction wells. It treats groundwater using an air stripper and granular activated carbon. During its operation, EATS removed 67 million gallons of groundwater and approximately 23.6 pounds of VOCs. In 2003, EATS was taken offline to evaluate plume stability, chemical of concern rebound, natural attenuation, and application of Hydrogen Release Compound® (HRC).

Ms. Crosby provided an overview of the Site 26 Draft Technical Memorandum, which includes an analysis of the site hydrogeology, an in-depth evaluation of the contamination, and an evaluation of the remedial alternatives. The in-depth evaluation of the contamination found that the residual contamination is present at low concentrations and found in the fine-grain soils. In addition, the report found that the plume contracts with depth.

The Draft Technical Memorandum evaluated 11 remedial alternatives, which were evaluated for implementability, effectiveness and cost. Ms. Crosby reviewed the list of alternatives, and the following three met both implementability and effectiveness, but were screened out because of cost: Micro-Scale Zero Valent Iron ($40 million), Nanoscale Zero Valent Iron ($46 million), and Combination of Biotic and Abiotic Treatment ($13 to $14 million). During the cost analysis, the Navy considered the following factors: natural attenuation of the plume, absence of ecological receptors, and plume stability. The Site 26 Draft Technical Memorandum concludes that no remedial alternative can be implemented without inordinate costs, due to the complex site hydrogeology. Ms. Crosby said the residual contamination is present in fine-grain soils and it is extremely difficult to remove contamination from this type of substance. The Navy recommends evaluating a TI Waiver and is working with the regulatory agencies to develop a path forward.

The following questions were asked during or after the presentation.

- In relation to EATS, Mr. Siegel explained further to the RAB what happens during a pump-and-treat system. He drew a figure of an exponential curve and explained that pump-and-treat systems eventually reach an asymptote, where the system is not removing any more contaminants. He said studies show that pump-and-treat systems rarely reach the Maximum Contaminant Level (MCL). When the system reaches the asymptote, optimization of the pump-and-treat system needs to be considered. Mr. Siegel said that although the pump-and-treat system did not achieve the MCL and the optimization efforts made progress but still did not reach the MCL, the question becomes whether other technologies could be used to reach the MCL goal. Mr. Siegel said it needs to be shown that a second or third technology is not successful before resorting to natural attenuation. Mr. Newton said EATS has removed about 67 million gallons of groundwater and about 23.6 pounds of VOCs, which has cost about $5 million. There are about 4.5 pounds of VOCs remaining. The Navy tried HRC, but it was not successful. Mr. Newton said the Navy evaluated 11 alternatives in the Site 26 Technical Memorandum and the additional cost of $13 million to $46 million for implementation of one of the alternatives is to remove the last 4.5 pounds of VOCs. Mr. Siegel said an important question is whether it is worth exploring or implementing a new technology to remove the remaining VOCs.
- Mr. Chuck said that although he has not read the Draft Technical Memorandum, he believes the Navy did not demonstrate that the pump-and-treat system reached an asymptote. He said it is important that the asymptote be reached first.

- Mr. Moss said he has reviewed the report that indicates that the bioremediation was effective, however its effectiveness was limited. Ms. Crosby added that it worked well in high concentration areas, not in areas of low concentration. Mr. Moss said the fact that the bioremediation was effective only in high concentration areas does not justify not using the technology. He said that EATS has been offline for five years, so it is premature to say that it has reached an asymptote. Mr. Moss said that perhaps the contamination could decrease with continued pump-and-treat in addition to bioremediation or another technology.
- Mr. Moss said the report estimates that it would take 50 years to remove all of the VOCs; however, a time estimate cannot be given because the system has been offline for five years.
- Mr. Moss said the cost estimates for the alternatives do not strike him as a lot of money and it is premature to "walk away from" the system. Ms. Crosby said a TI Waiver does not mean the Navy will walk away from the system. She said the remaining VOCs are at a low concentration, located in the fine grain material, and have been naturally attenuating. In addition, the plume is stable.
- Mr. Newton said the Draft Technical Memorandum was released on 22 April 2008. There is a 60-day public review and comment period through 22 June 2008.
- To provide background context to the RAB, Mr. Strauss said the Navy came to the RAB years ago about removing VOCs at the site and said it could not remove VOCs in a reasonable amount of time. Mr. Strauss said the Navy and community came together and the solution was to install the air stripper. Mr. Strauss said he does not know why EATS was turned off, especially since it only operated for four years. He said the amount of money spent is a lot for providing only four years of service. Mr. Strauss said a removal timeline of 50 years is not sufficient to request a TI Waiver.
- Mr. Strauss asked to whom comments on the Draft Technical Memorandum should be submitted. Ms. Lee said comments should be submitted to the Navy, with a copy to the regulatory agencies.
- Mr. Strauss said that cost, even in EPA guidance, is generally not a factor. This is stated in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Ms. Crosby added that this is also stated in the TI Waiver.
- Mr. Williams asked how the absence of ecological receptors affects the Navy's recommendation for Site 26. Ms. Crosby said the groundwater does not come to the surface and thus there are no ecological receptors above surface that are exposed to the groundwater. She said the Navy's goal is to protect human health and the environment.
    - Mr. Williams asked if it is too late at this point to be considering future uses of the site and asked whether the Navy or MEW Companies would have to address the site again if ecological receptors were introduced to the site as a result of new land use. Ms. Crosby deferred the question to Mr. Chuck. Mr. Chuck said there is a Memorandum of Agreement (MOA) between the Navy and NASA and said he was unsure about the exact terms of the MOA. Mr. Williams said it is important to know how the site may be affected in the future and what party would be responsible for additional remediation and costs. Mr. Newton said he would look into this point. Mr. Newton said that generally, when property is transferred under the BRAC program, if there is a change in historical or current use of a site, the Navy is typically not responsible for costs associated with the change of use, but Mr. Newton said he does not know the specific agreements regarding this site.
- Mr. Siegel said the driver for cleanup of the east side aquifers is California state law, which treats all aquifers as potential drinking water sources. To provide background context, Mr. Siegel explained that when the groundwater remediation issue first came up with the Navy several years ago, the east side aquifer was sectioned into northern and southern portions. The Navy made the case not to treat the northern section due to saltwater intrusion, stating that if this groundwater were to be used for drinking water, it would have to be treated anyway because of the saltwater. It was agreed that the no further action was required in the

northern section of the plume due to a no beneficial use designation for groundwater, but would remediate portions of the aquifers that do not have saltwater intrusion.
Mr. Siegel said that if the Navy formally requests a TI Waiver, it would be requesting a waiver of the nondegradation objective of the California law that protects aquifers, essentially waiving the requirement to remediate the groundwater at the site. Mr. Siegel said the site had never been evaluated for potential vapor intrusion pathways into the atmosphere.

- Mr. Strauss said there are vapor intrusion problems area-wide and there should be some vapor intrusion from this plume into the atmosphere. Ms. Crosby said there is potential vapor intrusion, but it would be diluted in the atmosphere, and dilution is not an issue. Furthermore, there are no buildings over the EATS plume, so there is not a concern for vapor intrusion.
- A community member asked for an example of where a TI Waiver has been granted or not granted. The community member said a TI Waiver is a potential "get out jail free card," and asked whether this would create a precedent for other sites. Ms. Lee said that under Superfund there is a process to follow for a TI Waiver. Several factors are considered, such as practicality from an engineering standpoint. It is important to note that a TI Waiver does not waive the protection of human health and the environment. The TI waives the ability to meet the MCL, not all else. Ms. Lee said the EPA can present information on TI Waivers at a subsequent RAB meeting.

Ms. Crosby concluded the presentation.

RAB BUSINESS

Future RAB Topics

Mr. Newton asked for topic suggestions for future RAB meetings. The following topics were identified as potential agenda items:

- EPA presentation on TI Waivers
- Properties of trichloroethylene (TCE)

RAB Schedule

At tonight's meeting, the RAB approved rescheduling the next meeting to Thursday, 17 July 2008. The next meeting will be held from 7 to 9:30 p.m. at Building 943, Moffett Field, California. The RAB meeting schedule for 2008 is as follows:

- 17 July 2008
- 11 September 2008
- 13 November 2008

Adjourn

The meeting was adjourned at 9:40 p.m., and Mr. Newton thanked everyone for attending. Mr. Newton can be contacted with any comments or questions:

- Mr. Darren Newton
  BRAC Environmental Coordinator, Former NAS Moffett Field, BRAC Program Management Office West; 1455 Frazee Road, Suite 900; San Diego, CA 92108; Phone: 619-532-0963; Fax: 619-532-0940; E-mail: darren.newton@navy.mil

GLOSSARY OF TERMS USED IN THESE MINUTES

BEC – Base Realignment and Closure Environmental Coordinator
BRAC – Base Realignment and Closure
EATS – East-Side Aquifer Treatment System
EE/CA – Engineering Evaluation/Cost Analysis
FFS – Focused Feasibility Study
HRC – Hydrogen Release Compound®
MCL – Maximum Contaminant Level
MEW – Middlefield-Ellis-Whisman
MOA – Memorandum of Agreement
NAS – Naval Air Station
NASA – National Aeronautics and Space Administration
NCP – National Oil and Hazardous Substances Pollution Contingency Plan
PCB – Polychlorinated biphenyl
RAB – Restoration Advisory Board
RCRA – Resource Conservation and Recovery Act
TBA – To Be Announced
TCE – trichloroethylene
TI – Technical Impracticality
EPA – U.S. Environmental Protection Agency
VOC – Volatile organic compound
WATS – West-Side Aquifers Treatment System

RAB meeting minutes are posted on the Navy's environmental Web page at:
http://www.bracpmo.navy.mil/bracbases/california/moffett/.

Restoration Advisory Board Former
NAS Moffett Field

Polychlorinated Biphenyls (PCBs)

Patrick Wilson, Ph.D., M.P.H.
Senior Regional Toxicologist
U.S. EPA

THE DOSE MAKES THE POISON

All Substances are Poisons.

There is None Which is Not a Poison.

The Right Dose Differentiates a Poison and a Remedy

Paracelsus (1493-1541)

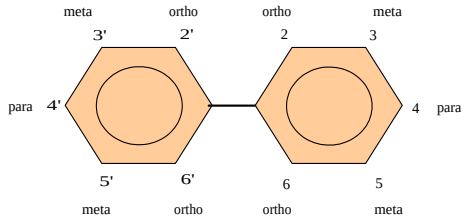
PCB PHYSICAL PROPERTIES

- **Colorless**
- **Odorless**
- **Low vapor pressure**
- **Viscous liquid or solid**
- **Low electrical conductivity**

PCBs CHEMICAL PROPERTIES

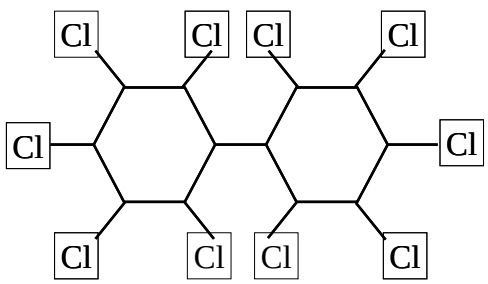
- **Flame Retardant**
- **Lipophilic (mix easily with oil or fat)**
- **Very Stable**

PCB Molecular Structure



Structure of Polychlorinated Biphenyl (PCB) Molecule

Fully-Chlorinated PCB Molecule



Key Concepts

- **Polychlorinated biphenyls (PCBs):** a mixture of compounds containing the biphenyl structure with varying numbers (i.e., one to ten) and arrangements of chlorine atoms attached.
- **Aroclor:** One of nine commercial PCB mixtures, with varying levels of chlorination, formerly produced in the United States. The percent of chlorine content varies across the different Aroclors, depending on their intended uses. Generally, samples of pure Aroclor exhibit a distinct pattern of congener concentrations, but transformations during routine use and/or weathering can alter these patterns.

Key Concepts

- **Congener:** One of the 209 possible PCB molecules, each distinguished by the number and arrangement of chlorine atoms. Commercially-produced PCB mixtures collectively include about 175 congeners, some at concentrations so low they are not detectable in environmental samples. One hundred and ten of the 209 congeners typically constitute 98 percent of PCB mass measured in samples.
- **Dioxin-Like Congener:** One of 12 PCB congeners that exhibits toxicity similar to that of dioxin as the result of structural similarity to 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). The 12 dioxin-like PCB congeners are: 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169 and 189.

Key Concepts

- **Dioxins and Furans:** Two families of chemicals related by their similar physical and biological characteristics. Several hundred different compounds exist among the chlorinated dibenzo-*p*-dioxins (CDDs) and the chlorinated dibenzofurans (CDFs). The term "dioxin" is often used to refer to the most toxic dioxin compound, 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). CDDs and CDFs are products of combustion created by anthropogenic activities and natural processes.
- **Weathering**: Physical, biological, or chemical processes that can alter the chlorination pattern of a PCB molecule, and thereby change the congener composition of environmental mixtures of PCBs.

Why Were PCBs Banned??

- **Persistent in the environment**
- **Bioaccumulation and bioconcentration effects**
- **Found in virtually all human fat tissue**
  - Humans 2300 ng/g (ppb)
  - Human Breast Milk 1200 ng/g (ppb)

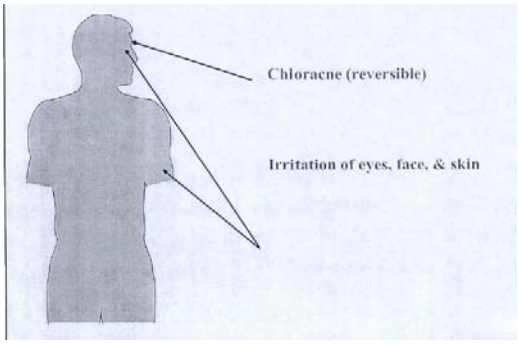
Toxicities of Concern

Cancer

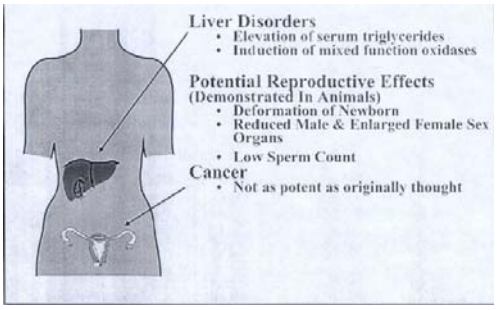
Non-cancer Toxicity

- Kidney
- Liver
- Skin
- Immune System
- Nervous System
- Developmental\Reproductive System

What Are the Acute Health Effects of PCBs?



What Are The Chronic Health Effects of PCBs?



EPA Risk Assessment Guidelines for Carcinogens

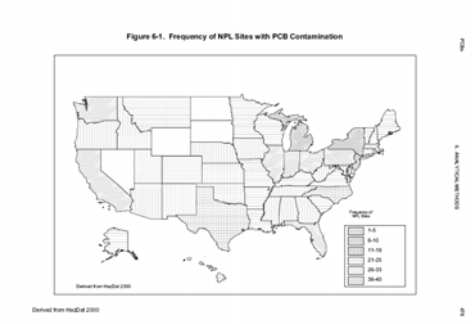
- Group A - Human Carcinogens
- Group B - Probable Human Carcinogen
- Group C - Possible Human Carcinogen
- Group D - Not Classifiable
- Group E - Negative Evidence

POTENTIAL FOR HUMAN EXPOSURE

Table 6-13. Polychlorinated Biphenyl Residues in Domestic Raw Foods for Fiscal Years 1969–1976

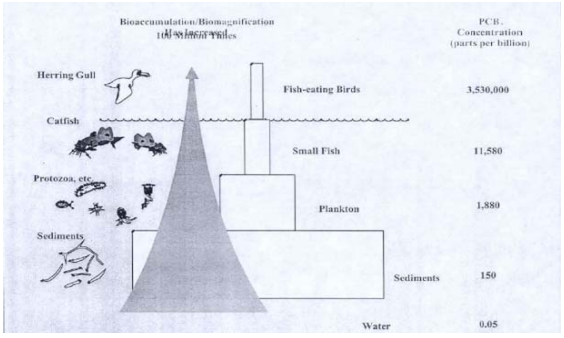
Commodity	Number of samples analyzed	Percent of sample with positive detections	Average concentration (ppm)[a]
Fish	2,901	46.0	0.892
Shellfish	291	18.2	0.056
Eggs	2,303	9.6	0.072
Red meat[b]	15,200	0.4	0.008
Poultry[b]	11,340	0.6	0.006
Fluid milk	4,638	4.1	0.067
Cheese	784	0.9	0.011

Superfund Sites With PCB Contamination



National PCB Fish Advisories

Bioaccumulation/Biomagnification



Mean Concentration of PCBs in Human Breast Milk

Location	Sample Size		PCB concentration (ng/g lipid)[a]	PCB concentration (ng/g milk)	Source
National Canadian Study	No data	1970		6	Mes and Davies 1979
	100	1975		12	Mes and Davies 1979
	210	1982		26	Mes et al. 1986
	412	1986		6.35	Mes et al. 1993
	497	1992	238	7.21	Newsome et al. 1995
National Sweden Study	135	1972	1,090		Lunden and Noren 1998
	153	1976	910		
	431	1980	780		
	102	1984–1985	600		
	120	1988–1989	650		
	60	1990	510		
	60	1991	410		
	40	1992	380		
Akwesasne Indian Reservation	19	1986–1989	602		Fitzgerald et al. 1998
	38	1990	352		
	40	1991–1992	254		
Warren and Schoharie County, New York (rural)	52	1986–1989	375		Fitzgerald et al. 1998
	57	1990	404		
	45	1991–1992	318		
Northern Germany (age 27–31, primiparae)	15	1986	1,300		Schade and Heinzow 1998
	68	1988	1,050		
	84	1990	1,000		
	43	1992	750		
	29	1994	650		
	14	1996	450		

Serum PCB Concentrations

Table 6-21. Serum Polychlorinated Biphenyl (PCB) Levels in Non-occupationally Exposed U.S. Populations That Do Not Consume Fish from PCB-Contaminated Waters (1973–1996)

Area and sampling method	Number of subjects	Year	PCB level ng/mL (ppb) Arithmetic mean	Geometric mean	Arithmetic standard deviation	95% Confidence interval	Range	Reference
Nonconsumers of Great Lakes sport fish	41	1996		1.2			0.46–2.9	Anderson et al. 1998
Infrequent male consumers of Great Lakes sport caught fish	57	1994–1995		1.5			0.5–9.7	Hanrahan et al. 1999
Infrequent female consumers of Great Lakes sport caught fish	42	1994–1995		0.9			0.5–3.3	Hanrahan et al. 1999
Females from Cornwall and Mississauga Ontario, Canada	35	1992		3.2[a]			1.3–12.0	Kearney et al. 1999
Males from Cornwall and Mississauga Ontario, Canada	45	1992		3.9[a]			1.1–12.0	Kearney et al. 1999
Los Angeles–Long Beach, California work force*	738	1982–1984	5	4[a]	4.37	–	<1–37	Sahl et al. 1985a, 1985b
Jefferson, Ohio, volunteers	59	1983	5.8	4.4	6.5	4–8	1–45	Welty 1983
Fairmont, West Virginia, volunteers	40	1983	6.7	5	5.3	5–8	1–23	Welty 1983
Norwood, Massachusetts, volunteers	990	1983	4.9	4.2	3.5	4–6	2–30	Condon 1983
Old Forge, Pennsylvania, volunteers	138	1981	3.6	–	–	–	<3–43	Reid and Fox 1982

Serum PCB Concentrations

Table 6-21. Serum Polychlorinated Biphenyl (PCB) Levels in Non-occupationally Exposed U.S. Populations That Do Not Consume Fish from PCB-Contaminated Waters (1973–1996) *(continued)*

Area and sampling method	Number of subjects	Year	PCB level ng/mL (ppb) Arithmetic mean	Geometric mean	Arithmetic standard deviation	95% Confidence interval	Range	Reference
Maternity patients from western Michigan control group of nonfisheaters	71	1982	4	–	–	–	–	Schwartz et al. 1983
Lake Michigan random nonfisheaters	418	1980	–	6.6[a]	–	–	<3–60	Humphrey 1983
Canton, Massachusetts, volunteers	10	1980	7.1	5.2	5.2	3–11	1–18	Condon 1983
Billings, Montana, random packinghouse workers	17	1979	7.5	5.8	6.8	4–11	2–30	Drotman 1981
Franklin, Idaho, volunteers	105	1979	–	–	–	–	<5	Drotman 1981
Random unexposed railroad workers at unspecified location	19	1979	12	–	–	–	10–27	Chase et al. 1982
Newton, Kansas, volunteers	7	1979	4.9	4.2	3.1	2–8	2–11	Vernon 1981
Michigan PBB cohort	1,631	1978–1979	7.7	6.4	–	–	<1–57	Kreiss et al. 1982
Bloomington, Indiana, volunteers and controls	110	1977	18.8	–	10.8	17–21	6–79	Baker et al. 1980
Lake Michigan random nonfisheaters	29	1973	17.3	15[b]	–	–	<5–41	Humphrey 1983

Source: Adapted from Kreiss 1985; Massachusetts Department of Public Health 1987; Sahl et al. 1985a, 1985b

[a]Pre-employment survey of utility company workers
[b]Median

PCB Half Lives

Table 3-9. Apparent Half-lives (Years) of PCB Congeners from Multiple Studies *(continued)*

Congener	Brown et al. 1989	Buhler et al. 1988	Chen et al. 1982[a,b]	Chen et al. 1982[a,c]	Luotamo et al. 1991[d]	Luotamo et al. 1991[e]	Ryan et al. 1993[f]	Wolff and Schecter 1991[g]	Wolff et al. 1992[h]	Yakushiji et al. 1984
153	12.4	0.93	47	26		∞	3.8		∞[h]	27.5
105	3.9		0.58	0.51					∞[h]	
138	6–7	0.88	32	20			3.4		16.7	16.3
163	>20									
183						0.13			7.9[i]	
128			5.2	5.4					7.9[i]	
171						0.08			24	
156			∞	∞			4.0			
180		0.34	∞	∞			4.3			9.9
169							10.4			
170			47	71			3.9			
n	39	1	17[a]	7[a]	12	12	1, 3	1–4	18–165	8
Data[j]	Geomean	nr	Median	Median	Mean	Mean	Median	Mean	Geomean	Mean

Source: Modified from Shirai and Kissel (1996)

[a]Recalculated using median concentration ratios
[b]First and second samples
[c]First and third samples
[d]Serum
[e]Adipose
[f]Half-life of congener 169 was not recalculated due to inadequate data.
[g]Does not include adjustment for growth
[h]Based on a 46-month interval
[i]Co-eluting 28/31
[j]Co-eluting 47/48/52
[k]Co-eluting 47/49/52
[l]Co-eluting 74/66/70
[m]Co-eluting 74/66
[n]Co-eluting 95/56/60
[o]Co-eluting 99/101
[p]Co-eluting 108/118
[q]Co-eluting 153/105
[r]Co-eluting 183–128
[s]For congener 105, the n's were 14 and 6
[t]Mean = arithmetic mean; geomean = geometric mean; nr - not reported

PCBs
3. HEALTH EFFECTS Toxicokinetics
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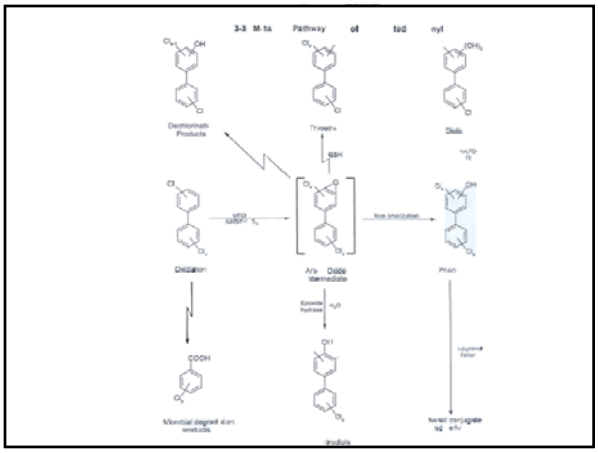
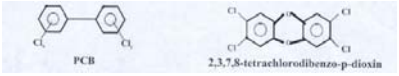


How Are PCBs and Dioxins Related?



- Chemical structural similarity
  - Dioxin-like PCBs pr Coplanar PCBs (CPCBs) are similar dioxins
  - Preliminary test data indicate correlation between chemical structure and toxicity
- Products of Incomplete Combustion (PICs) of PCBs
  - Dioxins
  - Dioxin-like chlorinated polycyclic aromatic hydrocarbons (PAHs)
- Presence of dioxins or dioxin-like chlorinated PAHs results in risk regardless of route of formation

PCB Congeners Toxicity

Exhibit A-2
TOXIC EQUIVALENCY FACTORS (TEFs) FOR THE DIOXIN-LIKE PCBS

Congener	Humans/ Mammals[1]	Fish[2]	Birds[2]
77	0.0001	0.0001	0.05
81	0.0003	0.0005	0.1
105	0.00003	<0.000005	0.0001
114	0.00003	<0.000005	0.0001
118	0.00003	<0.000005	0.00001
123	0.00003	<0.000005	0.00001
126	0.1	0.005	0.1
156	0.00003	<0.000005	0.0001
157	0.00003	<0.000005	0.0001
167	0.00003	<0.000005	0.00001
169	0.03	0.00005	0.001
189	0.00003	<0.000005	0.00001

[1] WHO TEFs for humans and mammals were updated in 2005 (Van den Berg, et al., 2006).
[2] WHO TEFs for fish and birds were published most recently in Van den Berg, et al. (1998).

Intelligence is about making decisions based upon imperfect knowledge and among partially good choices.

Douglas R. Hofstadter
Pulitzer Prize Winner