MEMORANDUM

- TO: Lenny Siegel
- **FROM:** Peter Strauss
- DATE: September, 2016
- SUBJ: Site 28: Review of Draft Air Sampling and Vapor Intrusion Plan Tier Response Evaluation Report and Draft Vapor Intrusion Air Monitoring Work Plan

Summary

In July, the Navy released a draft *Vapor Intrusion Air Monitoring Work Plan for Site 28* at Moffett Field. This was followed in August by the draft *Site 28 Air Sampling and Vapor Intrusion Plan Tier Response Evaluation Report.* Site 28 is the West-Side Aquifer area. This latter report is an evaluation and classification according to the Tiering System that was part of the 2010 Record of Decision (ROD) Amendment. It based on previous sampling events. Because the two cover the same area (Site 28), both documents are covered in this memo. See Figure 1 and Figure 2 at the end of this memo for maps of the Vapor Intrusion Study Area and the Navy's Area of Responsibility (i.e., Site 28).

In my opinion, the *Site 28 Air Sampling and Vapor Intrusion Plan Tier Response Evaluation Report* is most important, as it categorizes the 23 buildings within Site 28 according to the response action required to meet the requirements of the ROD Amendment. Twenty-three buildings are classified. Four require mitigation (i.e., prevention of vapor intrusion through the use of engineering controls). Nineteen require long-term monitoring. It also recommends some of the potential mitigation possibilities. The *Vapor Intrusion Air Monitoring Work Plan for Site 28* lays out a plan to conduct indoor air monitoring during winter 2017. It also suggests some mitigation possibilities.

During my review, I discovered that there were inconsistencies between the two reports. These are largely because the *Vapor Intrusion Air Monitoring Work Plan for Site 28* used an older version of the Tiering Evaluation. I have spoken with Environmental Protection Agency (EPA) about these inconsistencies, and although Alana Lee (EPA project manager) had not read the reports, she agreed to make sure that the buildings were properly classified in each report. Also of consequence was a mischaracterization of Building 10 in the *Site 28 Air Sampling and Vapor Intrusion Plan Tier Response Evaluation Report*. Building 10 has an interim remedial action that includes an engineering control. At one time there were extremely high levels of trichloroethene (TCE) in the indoor air and the steam tunnel that connects this building to Hangar 1. Both the tunnel and Building 10 have a temporary engineered fix, so they should be classified as a Tier 1.

Background

In August 2010, the EPA amended the 1989 ROD to select a remedy for the vapor intrusion pathway. The Vapor Intrusion Study Area was defined as the area where TCE concentrations in shallow groundwater are greater than 5 micrograms per liter (μ g/L). The ROD Amendment provides a system to determine the appropriate response action for each building/property. This is called the tiering system. For existing buildings, the tiering system is based on indoor air sampling with or without engineering controls (ECs) in place and other lines of evidence. Below is a brief description of the tiers.

- Tier 1: The indoor air concentrations exceed both the outdoor air concentrations and the indoor air cleanup levels. Tier 1 buildings require an appropriate EC to meet indoor air cleanup levels. Governmental, proprietary, and informational institutional controls (ICs) will be implemented as needed.
- Tier 2: Indoor air concentrations are below indoor air cleanup levels with an EC in place or in operation. For Tier 2, operation and maintenance (O&M) of active ventilation systems will be continued, or other selected engineered remedies will be implemented to meet remedial action objectives. Long-term monitoring and governmental, proprietary, and informational ICs will be implemented.
- Tiers 3A and B: For a building without an effective EC in place or in operation, if the indoor air concentrations **exceed** the outdoor air concentrations (for any of the contaminants of concern or COCs)¹, but are below the indoor air cleanup levels, then the building is classified as Tier 3A. If the indoor air concentrations are at or **below** the outdoor air concentrations, then the building is Tier 3B. *Tiers 3A and 3B buildings do not need an engineered remedy*. Long-term monitoring is required for Tier 3A, but not for Tier 3B. Governmental ICs will be implemented for both Tiers 3A and 3B.
- Tier 4: When converging lines of evidence demonstrate that there is no longer the potential for COCs resulting from vapor intrusion to exceed the indoor air cleanup levels, this tier is applied. No action is required for these buildings once the EPA approves documentation that no action is necessary.

Air Sampling and Tier Response Evaluation Report

The Navy is responsible for implementing the ROD Amendment within the Navy Area of Responsibility (AOR). The Navy's AOR coincides with Site 28, where the Navy operates the West-Side Aquifer Treatment System (WATS) to remediate groundwater affected by possible Navy sources. This site includes 23 buildings (2, 3, 10, 12, 13, 14, 15, 16, 29, 45, 67, 76, 107, 126, N210, N239, N239A, N243, N243A, 510, 555, 566, and 567) that are occupied and partially occupied. None of these buildings are residential.

Air Sampling

In January 2016, a third series of indoor and outdoor air samples was collected since the ROD Amendment was signed. Two hundred air samples, including 172 indoors, were

¹ The COCs are tetrachloroethene (PCE), TCE, cis- and trans-1,2-dichloroethene (cis- and trans-1,2-DCE), 1,1-DCE, 1,1-dichloroethane (1,1-DCA), and vinyl chloride. These COCs are dissolved in shallow groundwater and their vapors have been detected in some buildings overlying the shallow groundwater.

collected from 93 locations. Both the number of samples and sampling locations were selected based on the results of the building surveys, the 2012 and 2014 indoor air sampling locations, and sampling results. Samples were collected from the basement and in the breathing zone of first-floor work areas (office areas, meeting rooms, and high-traffic areas such as hallways) and at potential vapor intrusion pathways (foundation cracks, expansion joints, crawl spaces, drains, and pipe inlets). In buildings with heating, ventilation, and air conditioning (HVAC) systems, indoor air samples were collected during normal work hours with the HVAC system operating and at the end of a three-day holiday weekend after the HVAC system had been shut down for 36 to 48 hours.

The 2012 indoor air sampling event was conducted in late spring (May/June 2012). The 2014 sampling event was conducted in winter (February 2014). The 2016 sampling event also occurred in winter (January 2016). Due to the drought (low precipitation favors low vapor intrusion), the results for the February 2014 and January 2016 sampling events may not be typical of an average winter. EPA considers winter months the crucial time to collect samples.

Tier Response Evaluation

Sampling events along with consideration of the results of a soil gas and shallow groundwater investigation conducted in 2013 are used to designate the response action tier classification for each building. Classifications may change, depending on the latest monitoring results. All were classified as either Tiers 1 or 3A. Both tiers require long-term monitoring. It should be noted that sealing of cracks is not considered an engineering control (EC).

Tier 1

Of the 23 buildings sampled, only four buildings (Buildings 45, 126, 567, and N239A) had one or more work area sampling result with concentrations exceeding the commercial indoor air cleanup levels in the ROD Amendment (EPA 2010). These are described below. None have mitigation measures installed, but potential mitigation measures are discussed.

- **Building 45** has a concrete slab floor with visible cracks and seams. Electrical conduits and a utility corridor trench are present below Room 101 where elevated samples were collected. The corridor trench traverses the building at an unknown depth. In 2016, TCE and PCE were detected slightly above the indoor air cleanup levels at two work area locations. In another location PCE was detected above outdoor levels.. Numerous potential indoor sources were documented during the pre-sampling building inspection, including paint and adhesive cans. Given that TCE and PCE were previously below their indoor air cleanup levels, uncertainties exist about the source of increased levels. While Building 45 is classified as Tier 1 based on 2016 sampling, follow-up indoor source evaluation and sampling will confirm whether the increase in TCE and PCE levels is from an indoor source. If there are no indoor sources, potential long-term mitigation options include installing a floor sealant and sealing floor utility conduits.
- **Building 126** is a one-story structure that is occupied by the Moffett Historical Society Museum. The building has a concrete slab floor and carpeting, with

visible seams on the floor slab. In 2012, a new HVAC system was installed. All sampling events detected PCE and TCE at concentrations exceeding the indoor air cleanup level in work area samples with the HVAC system in operation and the HVAC off. Additionally, vinyl chloride was detected in one work area sample at a concentration of 2.3 μ g/m³ (micrograms per cubic meter), exceeding the indoor air cleanup level with the HVAC off. The Navy conducted an investigation to further characterize the extent of PCE contamination in groundwater in the area of Building 126. The groundwater investigation and additional groundwater monitoring are being used to develop an in-situ groundwater treatment to remedy the VOC contamination. Installation of a floor sealant is an option for an interim mitigation measure.

Building 567 is a one-story structure. The building is used as a warehouse. The building has concrete slab floors with visible cracks and seams in the slab. Holes from former bollards (posts that prevent vehicle movement) exist near the bay doors and extend to a depth of approximately 2.5 feet. The building does not have an HVAC system. In 2016, TCE was detected at a concentration ($5.3 \mu g/m^3$).

) in one work area sample. Similar to Building 45 above, potential indoor sources were documented during the pre-sampling building inspection in September 2015. Given that TCE was previously reported below the indoor air cleanup level, and that four monthshad elapsed between the building inspection and sampling, the source of the TCE elevation is uncertain. A follow-up indoor source evaluation will be performed as part of the next indoor air sampling round to confirm that the sudden increase in TCE level is not from an indoor source. If there is no indoor source, potential interim mitigation measures that can be implemented in Building 567 include sealing utility floor conduits, cracks, holes and seams and installing an HVAC system to provide positive pressure to the building.

• **Building N239A** is a two-story structure with a basement. The building is currently used for offices and centrifuge operations. Cracks and seams are visible on the slab floor. Two offices on the second floor operate Monday through Friday. Centrifuge testing areas are not regularly used. The building has a basement used for storage and other activities, including possible weekend use. The basement floor and walls are constructed of concrete. There are electrical conduits present. Unknown conduits penetrate the wall below grade.

TCE was detected at concentrations exceeding the indoor air cleanup level in all three sampling events. At one point TCE in a utility room was measured at 40 μ g/m³. The source of the elevated TCE may be conduits that penetrate the foundation of the building. The utility room is not a regular work area and is rarely occupied. Potential interim and final mitigation measures for the utility room include sealing floor utility conduits, installing air filters into the HVAC floor conduits, sealing floor cracks and seams, installing vent fans in the western exterior wall, and modifying the operation of the HVAC system to maintain positive pressure. Potential long-term mitigation options for the office space also include reconfiguration of the HVAC system and installation of a floor sealant.

Tier 3A

All other buildings were classified as Tier 3A. Some of these buildings have had some mitigation measures, described below. Also note that that Buildings 3, 12, 14, and N210 each had sampling results from at least one non-work area location that exceeded the commercial indoor air cleanup level for TCE. These samples were pathway samples, which include crawl spaces, a utility tunnel, hallways, utility rooms, and conduit floor penetrations. However, COCs were detected below the EPA's indoor air cleanup level in all the work area samples. EPA agrees that exceedence of pathway samples does not require the Building to be elevated to a higher Tier

Building 10 is a one-story structure that formerly housed the boiler plant for the steam lines at NASA Ames. The boiler was taken out of service by February 2014 and removed. With removal of the boiler, the building is only intermittently occupied during the day. It has one floor with a maintenance shop, the former boiler room, two offices, and a break room. There is a utility corridor tunnel that runs from Building 10 to Hangar 1 that contained the helium supply lines for the dirigibles in Hangar 1 and steam lines for heating. The steam lines ran through floor trenches into the tunnel and distributed steam to the other buildings at NASA Ames. Building 10 has a concrete slab floor with some visible cracks and seams. Due to high concentrations of VOCs in the 2012 samples, the Navy installed a cutoff wall and a blower in the tunnel 170 feet from the Building to remove vapors from the tunnel and control COC concentrations in Building 10. Ouarterly indoor air monitoring was implemented at Building 10, including in the tunnel access area, to monitor the effectiveness of the interim measure. During the fourth quarter of 2012, TCE concentrations increased to levels above the indoor air cleanup goals. The increase was verified during the first quarter 2013 monitoring period. Due to these results, modifications to the mitigation system were made. These included installation of a wall at the Building 10 entrance to the tunnel and installation of an additional blower inside the Building 10 floor trench. Since modifications were made in May 2013, TCE levels measured in work-area guarterly sampling have decreased and remained below indoor air cleanup goals.

The Navy is maintaining the interim measure until a final remedy is implemented for Building 10 and will monitor indoor air at Building 10 as long as the current interim measure is in place. A final remedial mitigation approach is being evaluated for future implementation (see *Vapor Intrusion Air Monitoring Work Plan for Site 28* below).

Building 10 is classified as Tier 3A because indoor air concentrations of COCs exceed the outdoor air concentration ranges. In 2014, this building was classified as Tier 2. Based on conversations with EPA in August, the EPA project manager (Alana Lee) thought that this building should be classified in Tier 1 until the final remedy is implemented.

• **Building 12** is a two-story structure that is used as a military commissary and warehouse. It is open 24 hours per day. Interim mitigation measures implemented at Building 12 consisted of sealing conduits that penetrated the floor slab above the crawl space and allowing passive venting of the crawl space. Follow-up

confirmation air samples in work-space samples with the HVAC system both on and off were below indoor air cleanup levels. However, all work-space samples had concentrations of TCE that exceeded the outdoor air concentration and pathway samples collected in the crawl space in 2012, 2014, and 2016 exceeded the indoor air cleanup level.

- **Building 15** is a one-story structure that is used by NASA security. One room is staffed 24 hours per day, 7 days per week. NASA adjusted the HVAC system in 2004 to increase the makeup air supplied into the building after indoor air sampling results ranged from 0.23 to 7.22 μ g/m³ for TCE.
- **Building 16** is a single-story building with a slab-on-grade foundation. The building consists of offices, a wood shop, and a machine shop. It is currently occupied by a maintenance contractor. NASA adjusted the HVAC system in 2004 to increase the makeup air supplied into the building to maintain positive pressure after indoor air sampling results for TCE ranged from 0.6 and 15.1 μ g/m³ in 2003 -2004. After adjusting the makeup air supply, TCE concentrations were reduced to less than 1.0 μ g/m³ by mid-May 2004.

In 2012 all sampling results were below indoor air cleanup levels with the HVAC system both on and off. In 2014, indoor air samples were below indoor air cleanup levels with the HVAC system both on and off, except for one sample (Room 103), where TCE was detected at a concentration of 6.6 μ g/m³ with the HVAC off. However, in January 2016, all sampling results were below indoor air cleanup levels.

Building N210 is a three-story structure that was formerly used as an aircraft hangar and later converted to office space. The building has a concrete slab floor and carpet, tile, and raised flooring over the slab. The original HVAC system supplied air through ducts in the subfloor with floor grates, which enhanced vapor migration into the building. TCE concentrations in indoor air ranged from 0.22 to 176 µg/m³. In 2005, the HVAC system was adjusted to supply air through a duct system through the ceiling and to run at a high-capacity flow rate to maintain positive pressure in the building. The air intake, which was originally at ground level, was relocated to the roof. The original subfloor system was modified under some rooms on the first floor to capture the vapors beneath the raised floor area with the system exhaust on the roof. The adjustments in operation of the HVAC system successfully lowered COC concentrations to below indoor air cleanup levels. However, the HVAC system has difficulty maintaining temperatures at the high-capacity flow rate. Also, the building occupants have noted odors inside the building when aircraft are taking off from the runway at Moffett Field.

Nevertheless, the HVAC system is operated as an interim measure EC to maintain good indoor air quality because of the vapor intrusion reported prior to 2005. In 2014, this building was classified as Tier 2.

Vapor Intrusion Air Monitoring Work Plan for Site 28

This work plan covers proposed sampling for 23 selected buildings within Site 28 for the January/February 2017 air sampling event. The work plan also discusses proposed plans

for mitigation and O&M system inspection and review at buildings with active or passive vapor intrusion mitigation measures after these measures are put in place. Note that the classification used in this report predates those used in the later *Air Sampling and Tier Response Evaluation Report*, described above. For instance, in this report Building 10 and Building 126 are described as Tier 1. In the latter report there are four buildings categorized as Tier 1, and Building 10 is categorized as Tier 3A. I have discussed these discrepancies with EPA, and it is going to make sure that the categories are consistent.

Air Monitoring

Monitoring is scheduled for January/February 2017. It coincides with quarterly air monitoring at Building 10. Depending on use and occupancy, the Navy will collect 8, 10, or 24 hour air samples from buildings without an HVAC system. Buildings with an HVAC system that supplies outdoor air to the building will be sampled twice: once during work hours with the HVAC system operating and once 36 to 48 hours after the building ventilation system has been shut down (or converted to internal air circulation). The sampling duration will be 8 or 10 hours. However, for buildings that are occupied or may be occupied 24 hours per day, sampling duration will be 24 hours.

Of the 23 industrial/commercial buildings evaluated during a 2012 study, only two buildings (Buildings 10 and 126) were classified as Tier 1, which mandates that an appropriate EC be implemented as a remedy to meet indoor air cleanup levels. Three of the buildings (Buildings 67, 76, and 566) were classified as Tier 3B; they do not require ECs or long term monitoring. Building N210 was classified as Tier 2, as it has a required EC. The other buildings are classified as Tier 3A (Buildings 2, 3, 13, 14, 15, 16, 29, 45, 107, N239, N239A, N243, N243A, 510, 555, and 567) because indoor air concentrations meet indoor air cleanup levels in work areas with no EC in place or operating.

For Building 10, air monitoring and inspection are to confirm changes in building occupancy, modifications to HVAC, and may include screening tools such as a photoionization detector (PID), or a portable gas chromatograph, such as an electron capture detector or equivalent instrumentation.

Mitigation Measures

The Navy is in the process of preparing a Work Plan for design and implementation of vapor intrusion mitigation systems for Buildings 10, 16, 126, N210, N239 and N239A at the site. The mitigation Work Plan is currently anticipated to be completed in 2017.

The Work Plan will be submitted to regulatory agencies for review and approval prior to implementation. The vapor intrusion mitigation remedies for each building include sealing vapor pathway conduits (utilities and flooring), installing/modifying ventilation systems, or other measures. Note that EPA does not consider sealing pathway conduits as an engineering control (EC), but adjustments to the HVAC system is an EC.

The following are the anticipated mitigation measures for each building:

• **Building 16**: Sealing of utility floor conduits and operating the HVAC system to maintain positive pressure (already done). Additional measures may include installation of a passive soil gas venting system.

- **Building N210**: In addition to the interim measure that provides positive pressure to the building, other measures may include reconfiguration of the HVAC system, installation of floor sealant, and sealing floor utility conduits.
- **Building N239**: Mitigation measures include sealing of utility floor conduits and modification to the operation of the HVAC system to maintain positive pressure in the work areas. Additional measures may include installation of a passive venting system.
- **Building N239A**: Potential mitigation measures for the utility rooms include sealing of floor utility conduits, installing vent fans in the western exterior wall, and modifying the operation of the HVAC system to maintain positive pressure in between two utility rooms.
- **Building 10**: The anticipated remedial design includes filling the trenches and tunnel underneath the building with flowable cement. In the event that indoor air levels are not reduced to below the cleanup goal levels after the installation of flowable cement, a contingency measure, such as applying floor sealant may be necessary.



Figure 1: Vapor Intrusion Study Area



Figure 2: Navy Area of Responsibility Covered In This Report