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LOCKHEED MARTIN

May 3, 2017

Mr. Jim Carroll
Voluntary Cleanup Program
Maryland Department of the Environment
1800 Washington Boulevard, Suite 625
Baltimore, Maryland 21230

Subject: **Building A Sub-Slab Depressurization-System Assessment and Indoor Air Quality Monitoring, Building A, Middle River Complex, Middle River, Maryland**

Dear Mr. Carroll:

Tetra Tech, Inc. (Tetra Tech) is submitting this memorandum to document the activities conducted while the Building A sub-slab depressurization system (SSDS) was not operational for the 15-day period of October 19–November 3, 2016. A detailed account of the system failure, along with a summary of the associated indoor air monitoring in Building A, the Building A basement, and Building B, follows.

Sub-slab depressurization-system (SSDS) failure—The Building A SSDS was found non-operational during a routine system check on October 21, 2016. Through the time-counter display on the control panel, Tetra Tech estimates that the system had shut down around 12:00 p.m. on October 19, 2016. Electrical measurements obtained from inside the blower's control panel revealed that two of three fuses had blown; new fuses were subsequently ordered. Initial diagnosis with Gasho, the manufacturer's representative and vendor, through teleconference indicated possible blower failure. During the site visit the autodialer batteries were found to be corroded and no longer working. This was most likely related to the blower power problem and was the cause for the delay in realizing the SSDS had shut down.

On October 24, 2016, Tetra Tech made additional assessments before installing the new blower fuses, including manually rotating the blower fan blades to confirm that the blower had not seized, and inspecting the condition of the wires inside the blower electrical box. The blower fan blades moved freely; the wires in the blower electrical box showed signs of heat stress (e.g., blackened by heat), but were not obviously damaged otherwise, so a system restart was attempted. New fuses were installed and the system was restarted. Upon restart, the same two blower fuses immediately blew, allowing only the heat exchanger to run. The heat exchanger remained in operation for less than a minute and then shut down, as designed, due to a low-vacuum alarm.

On October 25, 2016, S&S Technologies, the SSDS installation contractor, inspected the system to confirm blower failure. The fuses were replaced again during that inspection, and the system was restarted with the carbon units offline and the dilution valve fully open (to confirm that the issue was not back pressure). Upon restart, the same two fuses immediately blew. Electrical measurements from inside the control panel showed that the system was pulling the proper amps/voltage. S&S Technologies was able to confirm blower failure based on this information. Gasho was subsequently contacted to begin return of the blower to the manufacturer (Ametek) for repair.

On October 30, 2016, S&S Technologies removed the blower from the system and shipped it to the manufacturer via Federal Express freight. To expedite installation, S&S Technologies transferred a rental blower (DR858AY72W) from Gasho in Pennsylvania to the site on November 2, 2016. To accommodate the smaller rental blower, the influent and effluent piping connecting to the blower were reduced from four-inch to 2.5-inch-diameter. The system was restarted with the rental blower on November 3 around 1:00 p.m. The following day, the flow at each vapor-extraction point was adjusted to optimize vacuum influence and a system check was conducted.

Reason for blower failure and purchase of back-up blower—Gasho reported that an electrical issue within the failed blower motor had caused it to operate as a single-phase motor instead of the necessary three-phase motor. The blower was repaired under the manufacturer’s warranty. The original blower, repaired by Ametek and returned to Tetra Tech, was installed on December 1, 2016. Tetra Tech and Lockheed Martin decided to purchase the rental blower and store it in Building C as a back-up blower.

Photo-ionization detector survey during downtime—While the Building A SSDS was not operational, Tetra Tech conducted an interim indoor air quality screening survey using a photo-ionization detector (PID) to take readings in strategic locations, including:

- near the MRAS equipment excavation in the Building A floor (shown in Figure 1)
- at locations in Building A and the Building A basement that historically have shown elevated trichloroethene (TCE) concentrations in air
- at the area surrounding sampling location SV-136-A, where new vertical extraction points were added during the recent SSDS expansion to remove sub-slab vapors from this area of Building A

The PID survey was conducted on October 28–31, 2016 to screen the indoor air conditions until Summa® canisters could be prepared and used for accurate quantitation of concentrations.

Concentrations ranging from zero ppm to 3.2 parts per million (ppm) were detected in areas surrounding SV-136-A. The highest PID reading detected during the two surveys was in an open walkway west of SV-136-A. This concentration was greater than the PID results (0.3 ppm and 0.4 ppm) detected immediately adjacent to SV-136-A. The PID measured no detectable readings (0 ppm) at the MRAS excavation area north of the former plating shop. Indoor air sampling locations and rationales are in Table 1. Sampling locations and PID survey results are shown on Figure 1.

Summa® canister sampling during downtime—Following the PID surveys, Summa® canisters were used to collect nine samples on November 1, 2016, as follows:

Indoor air quality (eight-hour samples):

- two samples (EXC-1 and EXC-2) adjacent to the MRAS excavation area north of the former plating shop
- one near SV-018-A, in the fire-pump room in Building A basement
- one near SV-015-A, in former plating shop (current newly expanded bond layup room)
- one near SV-136-A, near a new vertical extraction-point added during the SSDS network expansion
- one near SV-079-A, near the autoclaves on eastern side of the Building A main floor

Sub-slab soil vapor (one-hour samples):

- one at SV-015-A, to target the active employee area in the former plating shop (newly expanded bond layup room)
- one at SV-136-A, to target the active employee area in new rout and trim area
- one at SV-079-A, to target the active employee area near autoclaves

All Summa® canisters and associated regulators functioned properly during sampling. Starting pressures ranged from -29 to -30 inches of mercury (Hg), and ending pressures ranged from zero to -5 inches Hg. All canisters collected an adequate volume of air for sampling. Outdoor temperatures during the sampling period ranged from 45 to 59 degrees Fahrenheit, with overcast skies and winds ranging from calm to nine miles per hour. Barometric pressure averaged 30.34 during the sampling period.

Table 2 compares TCE results from the Summa® canister sampling to PID survey results at each sampling location. Summa® canister sampling locations and results are shown on Figure 2. No exceedances of the indoor air screening level (8.8 $\mu g/m^3$) were observed. One TCE exceedance (640 $\mu g/m^3$) of the sub-slab screening level (293 $\mu g/m^3$) was detected at location SV-136-A. This sub-slab exceedance does not affect human exposure.

In comparing the Summa® canister sampling results from the November 1, 2016 sampling to the two most recent biannual sampling events (August 2016 and February 2016), the TCE levels detected during the November 1, 2016 event while the SSDS was shutdown were slightly elevated as compared to the TCE levels detected during the August and February 2016 biannual sampling events. Table 3 presents a comparison of the TCE concentrations detected in indoor air for the three sampling events at locations 015-A, 018-A, 079-A, and 136-A.

Conclusions—No exceedances of the TCE indoor air screening level were detected in the laboratory analytical results. The PID survey and Summa® canister sampling results suggest that the shutdown of the SSDS caused insignificant sub-slab-vapor or indoor-air-quality issues within the buildings.

Sincerely,

Lynnette M. Drake

Lynnette M. Drake
Remediation Project Lead, Environmental Remediation
Lockheed Martin Corporation

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FIGURES

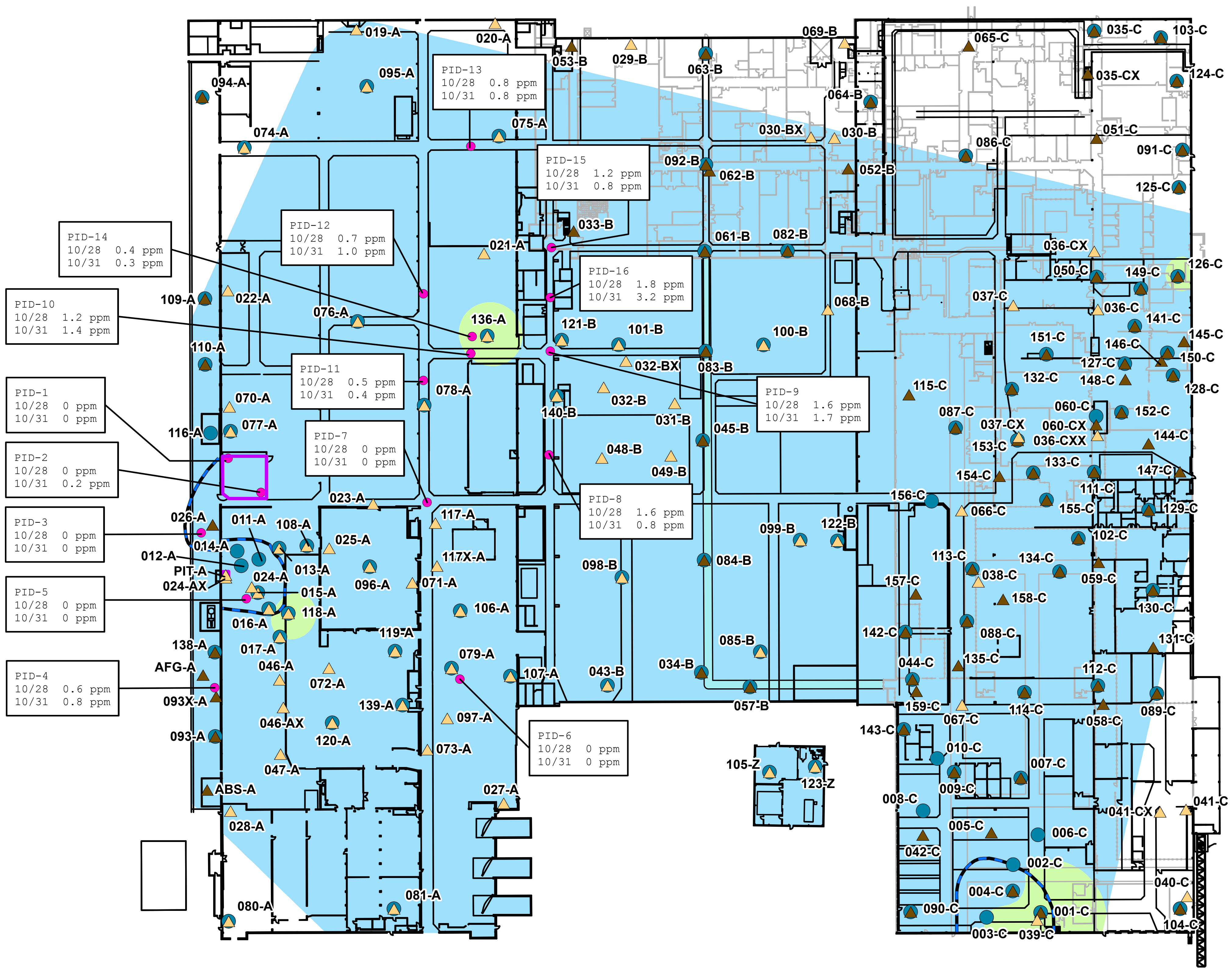

FIGURE 1

PID SURVEY, OCTOBER 2016
BUILDINGS A AND B

Legend

- PID Sampling Location
- IAQ, 1st Floor
- IAQ, Basement
- SV
- Excavation Area
- Tunnel
- SSD Treatment Unit
- SSD Radius of Influence
- Buildings A, B and C
- Building B and C Basement

Screening Levels

Indoor Air	Soil Vapor
8.8 μg/m^3	293 μg/m^3

August 2016 Sub-Slab Vapor TCE Concentration

- 10000 ug/m3
- 1000 ug/m3
- 293 ug/m3
- 0.1 ug/m3

Lockheed Martin Middle River Complex
Middle River, Maryland

0 62.5 125 Feet

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DATE MODIFIED: 11/16/16

CREATED BY: JEE

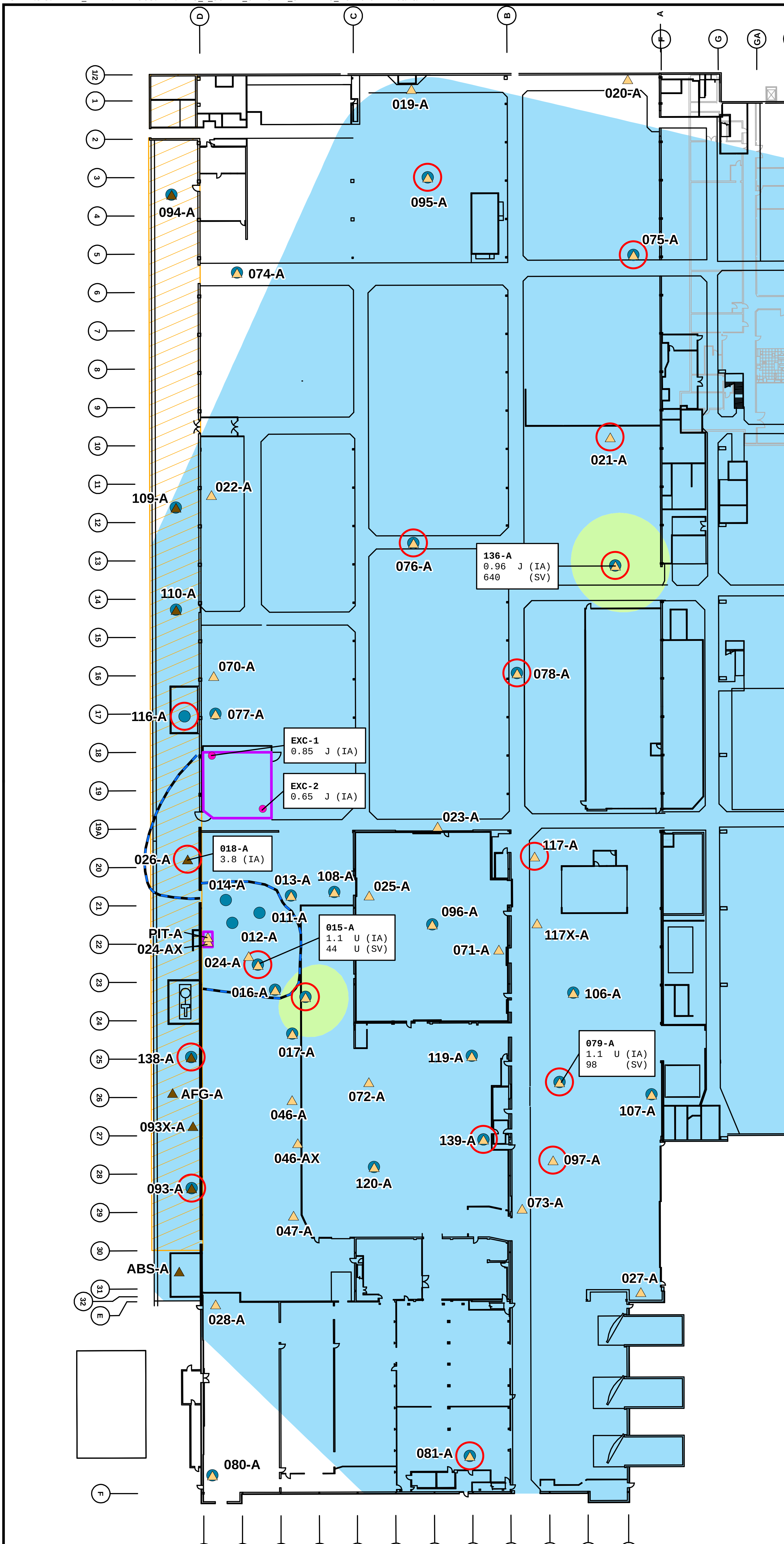
TETRA TECH

Map Document: (P:\GIS\Middle_River\MapDocs\MXD\bldg_abc_pid_sampling_oct2016.mxd)
11/16/16 -- JEE

PGH P:\GIS\MIDDLE_RIVER\MAPDOCS\MXD\BLDG_A_SUMMA_CANISTER_SAMPLING_NOV2016.MXD 03/13/17 JEE

FIGURE 2

SUMMA CANISTER SAMPLING, NOVEMBER 2016 BUILDING A



Legend

- IAQ, 1st Floor
- IAQ, Basement
- SV
- Round 21 Sampling Locations
- SSD Radius of Influence
- Buildings A, B and C
- Bulding A Basement
- Building B and C Basement
- Excavation Area
- SSD Treatment Unit

All results in microgram(s) per cubic meter ($\mu g/m^3$).

X - moved from original location once.

Screening Levels

Indoor Air	Soil Vapor
8.8 $\mu g/m^3$	293 $\mu g/m^3$

IAQ - Indoor Air Quality
SSD - Sub-slab Depressurization
SV - Soil Vapor
TCE - Trichloroethene

August 2016 Sub-Slab Vapor TCE Concentration

- 10000 ug/m3
- 1000 ug/m3
- 293 ug/m3
- 0.1 ug/m3

N

0 32 64 Feet

Lockheed Martin Middle River Complex
Middle River, Maryland

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TABLES

Table 1

PID Survey Sample Locations and Rational, Buildings A and B
Lockheed Martin Middle River Complex, Middle River, Maryland

Sample ID	Sample Locations and Rationale
PID-1	Along western wall of Building A main floor monitoring within the immediate area of the Middle River Aircraft System (MRAS) excavation.
PID-2	Along the eastern side of the MRAS excavation area monitoring the area just outside of the plastic sheeting inside the building.
PID-3	In Building A near sub-slab monitoring point SV-018-A to monitor breathing zone in the basement area.
PID-4	In Building A basement monitoring large rectangular sump that has shown elevated trichloroethene (TCE) concentrations during previous monitoring events
PID-5	In the former plating shop (current expanded Bond Layup Room) to monitor the location of the sub-slab depressurization system (SSDS) trench and monitoring points on the main floor of Building A
PID-6	On the eastern side of the Building A main floor near the autoclaves monitoring the area of SV-079-A that has shown elevated sub-slab concentrations of TCE
PID-7	At the major intersection in the central portion of Building A, on the main floor monitoring area, halfway between former plating shop and new rout and trim area (SV-136-A) that has shown elevated sub-slab TCE concentrations.
PID-8	In western portion of Building B just across the Building A/B divide monitoring outside Aero Tooling workshop south of the SV-136-A area
PID-9	At intersection of open walkways at the Building A/B divide monitoring area immediately southeast of SV-136-A
PID-10	Located in open walkway just behind sanding booths in new rout and trim area monitoring area south of the SV-136-A.
PID-11	In central portion of Building A in open walkway heading toward and monitoring area southwest of SV-136-A.
PID-12	In north-central portion of Building A in open walkway monitoring area west of SV-136-A
PID-13	In northeastern portion of Building A, in open walkway monitoring area north of SV-136-A
PID-14	Adjacent to the SV-136-A area monitoring, in an area of elevated sub-slab TCE concentrations, and where new vertical extraction points were recently added to the SSDS
PID-15	In open walkway at the Building A/B divide monitoring area, just northwest of SV-136-A
PID-16	In open walkway at the Building A/B divide monitoring area, just northwest of SV-136-A

Abbreviations:

MRAS - Middle River Aircraft Systems
PID - photoionization detector
ppm - parts per million
SSDS - sub-slab depressurization system
TCE - trichloroethene

Table 2
Comparison of Indoor Air Quality (Summma® Canister) and Sub-Slab Soil Vapor TCE Concentrations to PID Survey Results
Lockheed Martin Middle River Complex, Middle River, Maryland

Sample ID	IA (1,3)	SV (1,2)	PID (10/28/16)	PID (10/31/16)
EXC1-A-110116	0.85*J*	NS	0 ppm	0 ppm
EXC2-A-110116	0.65*J*	NS	0 ppm	0.2 ppm
015-A-110116	1.1*U*	44*U*	0 ppm	0 ppm
018-A-110116	3.8	NS	0 ppm	0 ppm
136-A-110116	0.96*J*	640	0.4 ppm	0.3 ppm
079-A-110116	1.1*U*	98	0 ppm	0 ppm

IA— indoor air
J— estimated
NS— not sampled
PID— photoionization detector
ppm— parts per million
TCE— trichloroethene (also known as trichloroethylene)
U— nondetect
USEPA— United States Environmental Protection Agency

(1) TCE concentrations are in microgram(s) per cubic meter ($\mu g/m^3$).

(2) Screening values are derived in accordance with *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (November 2002). Screening values are equal to USEPA industrial-air screening values divided by an attenuation factor of 0.03, and correspond to a target cancer-risk level of 1×10^{-5}.

(3) Industrial-air screening levels are from *USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites* (May 2016).

Table 3
Comparison of Indoor Air Quality (Summma® Canister) TCE Concentrations
Lockheed Martin Middle River Complex, Middle River, Maryland

Sample ID	IA TCE results (November 1, 2017 during SSDS shutdown)	IA TCE results (August 2016 biannual event)	IA TCE results (February 2016 biannual event)
015-A	1.1 $\mu g/m^3$	0.38*U* $\mu g/m^3$	0.38*U* µg/m3
018-A	3.8 $\mu g/m^3$	2.3 $\mu g/m^3$	3.3 µg/m3
136-A	0.96*J* $\mu g/m^3$	0.38*U* $\mu g/m^3$	0.38*U* µg/m3
079-A	1.1 $\mu g/m^3$	0.38*U* $\mu g/m^3$	0.72*J* µg/m3

IA— indoor air
J— estimated
$\mu g/m^3$— microgram(s) per cubic meter
ppm— indoor air
TCE— trichloroethene (also known as trichloroethylene)
U— nondetect