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January 9, 2018

Mr. James R. Carroll
Program Administrator
Land Restoration Program
Land Management Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 625
Baltimore, Maryland 21230

Subject: **Block I Building A and Building A Basement Investigation Report—Summer 2017, Middle River Complex, Middle River, Maryland**

Dear Mr. Carroll:

This report summarizes activities completed this summer as part of ongoing indoor air studies in Building A and the Building A basement at the Middle River Complex (MRC), in Middle River, Maryland (Figure 1). This report focuses on four of these activities: (1) installation of new air-purifying units in the Building A basement; (2) conducting a closed-circuit television (CCTV) camera survey to investigate infrastructure beneath the basement and between the basement and the main floor; (3) conducting a vapor-extraction pilot test from a sump in the basement to the existing sub-slab-depressurization system (SSDS); and (4) surveying indoor air around the floor vents on the main floor of Building A using a FROG 4000™ field instrument. These activities were completed to address the results of several recent investigations summarized below.

Several investigations earlier in 2017 at the Lockheed Martin Corporation (Lockheed Martin) MRC in the Building A basement focused on trichloroethene (TCE) detected in sub-slab soil vapor, indoor air, and water. These investigations identified possible migration pathways for vapor and water in the Building A infrastructure (e.g., formerly used air handlers, ducts, drain lines, and sumps). Data suggest that impacted water and vapor, likely emanating from contaminated soil under the former plating shop, is infiltrating into basement sumps associated with the former heating system and into sumps installed to mitigate water infiltration into pits that historically housed heavy equipment. This contaminated soil, water, and soil vapor are likely continuing sources of TCE to indoor air in the Building A basement.

In March and April 2017, TCE concentrations in indoor air were continuously monitored at select floor features and breathing zones in the southern portion of the Building A basement. Water samples were also collected from select floor features (i.e., sumps, storm drains) and analyzed for TCE. This investigation also researched all available historical records to document subsurface infrastructures beneath the Building A main floor, beneath the Building A basement floor, and behind the eastern wall of the Building A basement. Of particular interest was the infrastructure (i.e., air handlers, air ducts, air vents, and sumps) associated with the historical heating units in the basement that may be contributing to vapor migration into the basement.

Tetra Tech, Inc. (Tetra Tech) identified building infrastructure, elevations and utilities, possible sources of contamination, and connections to nearby buildings in historical drawings that show as-built details of the air-duct network that runs under the main floor of Building A. As presented on Figure 2, this ductwork originates at former heater room locations of the historical Building A heating system. A subset of information relevant to this investigation, which is also included in the *Block I Historical Information and Conceptual Site Model Report* (Tetra Tech, 2017), follows:

- Several former and existing (but nonfunctioning) heater rooms are in the Building A basement. Twelve heating rooms originally existed, but some were removed once heat was added to the main floor. Building A is 600 feet long, thus each of the 12 heater rooms supplied air to approximately two structural-column widths (an approximately 50-foot span) in Building A. Each heater room included a large air handler that forced hot air through a tunnel network beneath the main floor. The air handlers are no longer in operation, but their sumps remain; these sumps may connect to pipes that carry water to other parts of the building (see Appendix A, “Underground Piping, A Building, Plant No. 1, January 11, 1945”).

- Some of the historical air-duct network was filled with concrete during foundation and construction work, including recently, when MRA Systems, Inc. (MRAS) installed a freezer unit in the southern portion of Building A. However, no documentation verifying which areas have been filled by concrete (or other materials) has been found.

- Five heater rooms are currently intact (surrounded by walls), including heater room A-1 (between columns D4 and D5), heater room A-3 (between columns D8 and D9), heater room A-5 (between columns D16 and D17), heater room A-6 (between columns D19 and D20), and heater room A-11 (between columns D29 and D30). Each heater room contains a large air handler with a sump underneath; the sumps control groundwater infiltration into the basement and prevented fouling of the air handlers (Figure 2).

- Two former heater rooms (A-9, between columns D26 and D27, and A-12, between column D31 and the southern basement wall) no longer have walls or an air handler, but the large rectangular sump associated with each remains in the basement floor (Figure 2).

- Duct networks (associated with the previous air-handler operation) extending up to the main floor of Building A intersect the individual sumps. The ducts connect to vents adjacent to several columns and might be associated with the historical air-return system.

- Most of the existing sumps are outfitted with pumps plumbed to lift station #5. Several of these pumps might be inoperable or broken. Water from lift station #5 is pumped to the sanitary sewer. Historical drawings indicate that several floor drains and drain tiles under the basement floor were once connected to the storm-drain system.

Ancillary information from site operations personnel, obtained during previous construction projects, indicates that a large eight-by-nine-foot "chamber" is behind the eastern wall of the basement, extending up to underneath the slab-on-grade main floor of Building A. This chamber is behind the basement sidewall and connects to a four-by-four-foot air duct running easterly under the main floor of Building A. From this main duct, offshoot ducts run in a north/south direction along the columns. Air vents associated with these air ducts are at the foot of many columns. These vents were used historically to provide heat to the main floor of Building A. Tetra Tech attempted to confirm this information during the closed-circuit television (CCTV) survey detailed later in this report.

As stated earlier, some of the historical air-duct network has been filled with concrete, but other portions of the ductwork have been filled with wood and other debris. No documentation specifically verifying which areas have been filled with concrete or other materials was found. Most importantly, no assessment of the integrity of these plugs has been made, so the effectiveness of these seals has not been determined.

Two cylindrical sumps, north of column D24 and not associated with the heater rooms, were used historically to control water infiltration into an adjacent pit housing a large piece of equipment. These sumps (SP1 and SP1A) are presumed to be connected underground, and any water that accumulates within the sumps is controlled by a sump pump (SP1), which connects to the discharge line that runs to lift station #5 (Figure 2). Three other sumps (HRS1, HRS2, and the Boiler Room sump) north of lift station #5 have pipes running underground that, reportedly (via on-site personnel), converge before discharging into lift station #5.

These connections were not evident upon visual inspection; however, discussions with EMCOR (the on-site maintenance contractor) indicate that the pipes converge and discharge below grade into the side of the sump, which is below the typical water level. Seven sumps (HRS7, HRS6, HRS5, SP1, SP1A, HRS4, and HRS3) south of the lift station appear to discharge into lift station #5 from three separate lines. Sumps HRS7, HRS6, HRS5, SP1, and SP1A appear connected and to converge into one pipe that discharges underground into the side of the lift station sump, whereas the two sumps closest to lift station #5 (HRS3 and HRS4) appear to discharge into the lift station separately via their own pipes (Figure 2).

Evidence suggests that the water accumulating in each basement sump is pumped back to lift station #5 through a network of steel and polyvinyl chloride (PVC) piping connected to the sump pumps at each location. Water levels in operating sumps (HRS3, HRS5, HRS6, and HRS7) in the central and southern portions of the basement were monitored over a two-month period (from February 24, 2017 to April 21, 2017). Water levels varied among individual sumps during this monitoring, but remained consistent within each sump, and do not appear to be affected by precipitation or other factors. For example, HRS5 and HRS7 consistently contained only a few inches of water, while the water level in HRS6 was consistently high (within 10 inches of the basement floor, possibly indicating a broken pump), indicating a state of equilibrium.

During this two-month observation period, HRS4 was the only pump that consistently operated in the central and southern portions (the targeted zone) of the basement; TCE was detected in HRS4 sump water at a concentration of 1.1 micrograms per liter (µg/L). The HRS4 pump operates when water from a seal-lubrication system associated with the firewater line collects in the sump; blow-off water is routed to the sump via a connected pipe when the line is tested. At no time during the two-month period did the sump pumps in HRS5, HRS6, or HRS7 operate; these pumps might be broken, or the float level for these pumps might be set too high, and/or the volume of water infiltrating into these sumps might be low.

Fifteen floor features were sampled for volatile organic compounds (VOCs), including 10 sumps (HRS1 through HRS7, SP1, SP1A, and BRS), three storm-drain samples (SD1 through SD3), one lift-station sample (LS5), and one elevator-shaft sample (ELS). TCE is the VOC detected most frequently (eight of 15 samples), with the highest concentration (5,100 µg/L) detected at heater room sump HRS5. Other sampling locations that exhibited elevated TCE include SP1A (440 µg/L) and SP1 (160 µg/L). These floor features are consistent with areas that have historically exhibited the highest TCE levels (air, water, and portable gas chromatograph/photoionization detector [GC/PID] sampling), predominantly in the areas around column D24 (SP1 and SP1A) and column D26 (HRS5). TCE was detected at lower levels in the southern portion of the basement (14 µg/L at HRS6, and 41 µg/L at HRS7). TCE was not detected in samples collected in the northern portion of the basement, including water samples in heater room sumps (HRS1, HRS2, and HRS3), the boiler room sump (BRS), and the elevator shaft (ELS).

Operation of the continuous air-monitoring system indicates variable concentrations of TCE in indoor air at five breathing zone locations, and above some drains and sumps in the southern area of the Building A basement. The findings from the continuous air-monitoring and the sump sampling prompted additional investigations to better understand site infrastructure, with a primary focus on the duct system. Additional tasks completed include the following:

- installation of three additional air-purifying units in Building A basement, as a precaution
- a closed-circuit-television (CCTV) camera survey of select floor features in Building A basement, including the sumps in existing and former heating rooms, the air-duct network that runs behind the eastern basement wall, the storm-drain line that runs north/south under the basement floor, and the smaller floor drains, to determine their condition, identify possible breaches, and to better understand their direction and design
- a pilot test to evaluate the feasibility of extracting vapors from within the duct system in the Building A basement (former heater room A-9/sump HRS5), using the existing sub-slab-depressurization system
- a FROG 4000™ (GC/PID) survey on the main floor of Building A to assess whether detectable levels of TCE are present in and above air vents on the main floor

TECHNICAL SECTION

Additional indoor-air purifying units—as a precaution, three additional air-purifying units (for a total of six) were installed in the basement between columns D24 and D28 on May 11, 2017, around targeted floor features that exhibited the highest TCE levels in previous air, water, and portable GC/PID sampling. These units will supplement the existing air-purifying units until a more permanent solution is implemented. One unit was placed adjacent to floor sumps SP1 and SP1A, approximately 10 feet north of column D24; one unit was placed adjacent to floor sump HRS5 at column D26; and one unit was placed adjacent to column D28. The air-purifying units are electric and plugged into a standard wall outlet. These units contain carbon filters that purify the air by stripping out contaminants (e.g., TCE). The carbon filters will be replaced quarterly (every three months).

CCTV camera survey—A CCTV camera survey was conducted in the Building A basement to determine the connection between the large sumps formerly associated with air handlers and the air-duct network underneath the main floor of Building A. The main survey objectives were to determine the condition of the storm-drain line that runs north/south under the basement floor; to determine the condition (i.e., open, blocked, abandoned) of several floor drains; and to determine the connections and/or breaches that might be in the subsurface utility lines. Mobile Dredging and Video Pipe, Inc., overseen by Tetra Tech, conducted the CCTV camera survey on June 28, 2017. Two camera types were used during the survey: a robotic crawler camera to survey the large air ducts associated with the air-handler sumps and the storm-drain line in the Building A basement, and a snake-type camera for smaller floor features with smaller diameter pipes (e.g., floor-drain lines).

Before conducting the robotic crawler camera survey, Tetra Tech assessed any blockages associated with the heater room sumps. These blockages were reportedly placed when the air handler infrastructure was removed, and consisted of either wood, concrete, or miscellaneous construction debris. Sumps HRS2 (heater room A-3) and HRS3 (heater room A-5) had low static water-levels, and were not blocked, so they could be accessed, and the camera could inspect the chute leading up to the main floor of Building A. Other sumps were investigated with the camera, despite the presence of blockages, to capture video documentation of their condition. A summary of the heater-room sump survey in the Building A basement is in Table 1.

Sumps surveyed using the robotic crawler camera included HRS2 (heater room A-3), HRS3 (heater room A-5), HRS4 (heater room A-6), HRS5 (heater room A-9), and HRS7 (heater room A-12). A video camera attached to the robotic crawler recorded video (along with a narrative from the field technician) of the sump and the associated water conveyance system. The survey continued in each sump until the robotic crawler could proceed no farther. Blockages, debris, and high static-water levels (see Table 1) limited the CCTV survey in most sumps. Upon reaching its limit in the air duct, the camera was rotated 360 degrees to capture full video documentation of the obstruction.

A storm drain (accessed via the manhole [SD] near column D18) was also surveyed using the robotic crawler camera. The historical drawing (Appendix A) indicates a large-diameter storm-drain line running north/south under the Building A basement, but a visual inspection and the CCTV survey did not confirm its presence. The manhole (SD) near column D18 and manhole (SD1) near column D26 do not contain large-diameter storm-drain pipes running north/south, but rather contain smaller diameter pipes (i.e., possible floor drains) that intersect the manhole sumps through the sidewalls. Through interviews with on-site personnel, these floor drains are suspected to have been plugged up and abandoned. The manhole (SD) near column D18 did contain a larger diameter (estimated to be 24–28 inches) pipe that intersected the manhole sump in the northwest corner; it appears to be connected to the storm-drain line running north/south located west of the Building A dock (outside). The historical drawing in Appendix A indicates a smaller six-inch storm-drain line that runs north/south just east of the manholes; this line appears to be the main storm-drain under the basement floor line, and is connected to the subsurface floor drain network. Video documentation from the robotic camera survey is on the compact disc (CD) included as Appendix B.

A second survey was conducted with a snake-type plumbers' camera that was able to traverse smaller diameter pipes. This camera provided real-time video of floor drains, small sumps, and pipe conduits. A summary of the snake camera findings is below. Floor features are labeled in Figure 2 for reference.

- SP1 sump total depth is about six feet 11 inches, with no pipe connections visible.
- SP1A is about five feet deep, and has a dripping three-inch pipe on its eastern side.
- FD1 floor drain near column D24 is clogged by sediment at a depth of about eight inches.
- The floor drain in the pit (PFD) between columns D24 and D25 turns downward less than one foot from its top; this drain might be connected to sumps SP1 and SP1A (which are suspected to be connected to each other underground).
- Water and sediment in floor drain FD2 is one foot below ground surface; this drain is possibly connected underground to storm-drain manhole SD1.

- A square concrete form/berm with a perforated circular lid inside is south of HRS5 (BD); it is about four feet deep and contains about two feet of water.
- The depth of SD (assumed storm drain) at column D18 is two feet, 10 inches.
  - An approximately 24- to 28-inch pipe connected at its base in the northwestern corner appears to be leading west outside of the building, and might intersect the storm drain that runs north/south just west of Building A. The water level in the pipe is about 40%, and debris was found about four feet inside the pipe. The pipe has multiple fractures, is in poor condition, and turns west (left).
  - An approximately two- to three-inch-diameter pipe connects to the drain's western wall.
  - An approximately 10-inch pipe is attached into its southern side.
- SD1 (assumed storm drain) is at column D26.
  - An approximately three-inch pipe/hole is on the northern side (SD1N); sediment and water in the pipe are at an approximate depth of seven feet.
  - A four-inch pipe exits its northeastern side and appears to head toward (and might be connected to) floor drain FD2; this pipe continues for 14 feet, turns right after four more feet, and then continues downward.
  - A three-inch pipe turns 90 degrees on the western wall.
  - An estimated four-inch hole is about eight feet in on the southern wall (SD1S).
  - A four-inch hole is on the southeastern wall.

Full surveys into the sidewalls of assumed storm drains SD and SD1 could not be completed, because water and sediment were in the smaller drains and pipes of these features. Site interviews indicate that many of these floor drains have been abandoned, however water and sediment prevented verification of a formal abandonment (sealed with concrete). The CCTV survey indicates that the underground network of floor drains, pipes, and manholes/sumps are interconnected. Floor drains that might have mitigated water infiltration in and near pits associated with former equipment that operated in Building A appear to be connected to nearby sumps and storm drains. Other floor drains appear to have been abandoned, which is supported by information received while conducting historical interviews of on-site personnel. The information obtained during the CCTV survey will be compiled and used to further assess proper mitigation and remediation strategies for addressing elevated TCE concentrations in air and water in the Building A basement.

***Vapor-extraction pilot test*—**A pilot test in the Building A basement on July 6, 2017 sought to determine the feasibility of connecting some of the larger basement sumps to the current Building A sub-slab-depressurization system, to remove and treat TCE-contaminated vapor. A polyvinyl chloride (PVC) header line, extending from the current SSDS system to the pilot-test location (sump HRS5 near column D26), was installed before the test began. On July 5, 2017, the concrete around sump HRS5 was cleaned with water and Simple Green® in preparation for the extraction pilot-test. The sump was then sealed with plywood overlain by 40-millimeter polyethylene sheeting, StegoTack® double-sided tape, pea gravel, and Great Stuff™ foam sealer.

A four-inch bulkhead and four-inch-diameter hose fittings were then installed into the seal (see Appendix C). A four-inch-diameter, clear, flexible hose was run from the newly installed four-inch-diameter PVC header pipe to the southern area of the basement. A ball valve for throttling was installed in the clear flexible hose at the connection to the PVC header pipe. A pressure gauge and measuring point for flow rates were also installed. Air extraction rates, applied vacuum, and volatile organic compound (VOC) concentrations were measured during testing.

Flow rates of 25 cubic feet per minute (cfm) and 50 cfm were used during testing. Vapor samples were collected immediately after starting the extraction pilot-test on July 6, 2017; start and end samples were collected at a flow rate of 25 cfm (designed BSMT-25) and 50 cfm (designed BSMT-50). The 25-cfm test started at 10:50 a.m.; the BSMT-25 START sample was taken at 10:55 a.m. and the BSMT-25 END sample was taken at 12:00 p.m. The 50-cfm test was started immediately after the 25-cfm test ended; the BSMT-50 START sample was taken at 12:10 p.m. and the BSMT-50 END sample was taken at 1:00 p.m. Flow rates and applied vacuums are shown in Table 2; results of the laboratory analysis are shown in Table 3.

The testing indicated that the sump was sealed effectively and that vapor could be extracted from the sump. The flow rates and applied vacuums exhibited at sump HRS5 are similar to those associated with sub-slab vapor-extraction points, indicating that the vapor flow-rate from the sump is constrained. VOC results indicate that the extracted vapor is a significant VOC source area to indoor air. VOC levels declined significantly during the two-hour test based on laboratory analytical results[1], but were still at relatively high levels at the end of the test. This trend is similar

[1] Grab samples collected using one-liter Summa® canisters and shipped to TestAmerica, Inc. in Knoxville, Tennessee for VOC analysis by United States Environmental Protection Agency (USEPA) Method TO 15.

to what has been shown at other sub-slab vapor-extraction points. After the pilot test was complete, flow was adjusted to 25 cfm, and the flow from the sump was incorporated into the airflow associated with continuous SSDS operation.

FROG 4000™ survey—Tetra Tech used a commercially available GC/PID hand-held unit (FROG 4000™) to provide an alternative means of real-time VOC analysis in indoor air. The FROG 4000™ portable GC is a commercial field instrument that is sufficiently sensitive and selective for use in vapor-intrusion applications. On July 21 and 22, 2017, Tetra Tech conducted a TCE survey in two areas in Building A and the Building A basement at the MRC using the FROG 4000™ unit. The analysis was limited to detecting TCE; the instrument was calibrated to identify an ion specifically characteristic of TCE, thus removing any interference from other VOCs. Each sample was collected over approximately 10 minutes. The two areas surveyed were:

- in Building A basement near column D26, near former heater room sump HRS5
- in the northern portion of the main floor of Building A, in and above air-vent grates near building columns (rows B and C), as shown on Figure 3

Heater room sump HRS5 has exhibited elevated TCE concentrations and had been covered and sealed for the pilot test before conducting the FROG 4000™ survey. Samples were collected above this sump to evaluate the integrity of the cover and the effectiveness of the vapor extraction. No TCE was detected in the three samples collected one foot above and along the length of sump HRS5.

The FROG 4000™ survey also included an analysis of the air vents on the main floor of Building A. The survey objective was to determine whether elevated TCE detected in basement sumps is venting up through the air ducts connected to the sumps. A site walk to assess the location of available air vents was conducted before the survey began. Many of the vents had been covered during previous construction, however, 29 air vents were found in the northern section of Building A along the B and C column rows, and running from columns B6 through B18, C2 through C14, and C17 through C19. Air vents at C13 and C14 are in a temperature-controlled room, and air vents C17 through C19 are in the new MRAS construction area just north of the former plating shop. Air vents at columns C15 and C16 are covered or have been removed. Figure 3 shows the locations of the available air vents.

Many large industrial fans were operating on the main floor of Building A throughout the two-day testing period. TCE results for the FROG 4000™survey conducted on the Building A main floor are in Table 4 below. TCE detections were recorded in samples collected inside the vents and in indoor air above the vents, and range from 6.1 to 19.3 parts per billion (ppb). Figure 3 shows the highest TCE detections observed next to the associated building columns. Air samples collected above the vents range from one foot to approximately five feet high; the latter height specifically targets the breathing zone (BZ).

TCE was detected at three locations (B18, C8 and C11) during the first day of screening, but not during the following day. TCE concentrations detected inside air vents at C14 and C18 are very similar to the TCE concentrations detected above the air vents in the breathing zone. The latter phenomenon could indicate residual TCE left in the instrument system from sample to sample. The FROG 4000™ unit may be affected by environmental factors, such as humidity and temperature. Despite these limitations, the presence of TCE in and above the air vents on the Building A main floor was confirmed.

Employee desks and workstations are near air vents on the Building A main floor. Since TCE was detected in and above these air vents, and because these vents might be connected to air ducts that lead to sumps in the Building A basement (where elevated TCE has been detected in both air and sump water), these air vents are being sealed using a vapor barrier and bolt-down steel plate. This mitigation effort will seal off this pathway. Subsequent to sealing the vents, additional field screening will be conducted to verify the covers' effectiveness.

Each of these activities completed this summer are a component of the ongoing mitigation effort to address TCE impacts at Building A and the Building A basement. We will continue to inform you as we propose and complete additional tasks related to this effort. If you have any questions regarding this report, please feel free to contact me at (301) 548-2209.

Sincerely,

Lynnette M. Drake

Project Lead, Environmental Remediation
Lockheed Martin Corporation

Enclosures:
Figures
Tables
Appendices A, B (CD only), and C

cc: (via e-mail without enclosure)
Gary Schold, MDE
Mark Mank, MDE
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Christine Kline, Lockheed Martin
Norm Varney, Lockheed Martin
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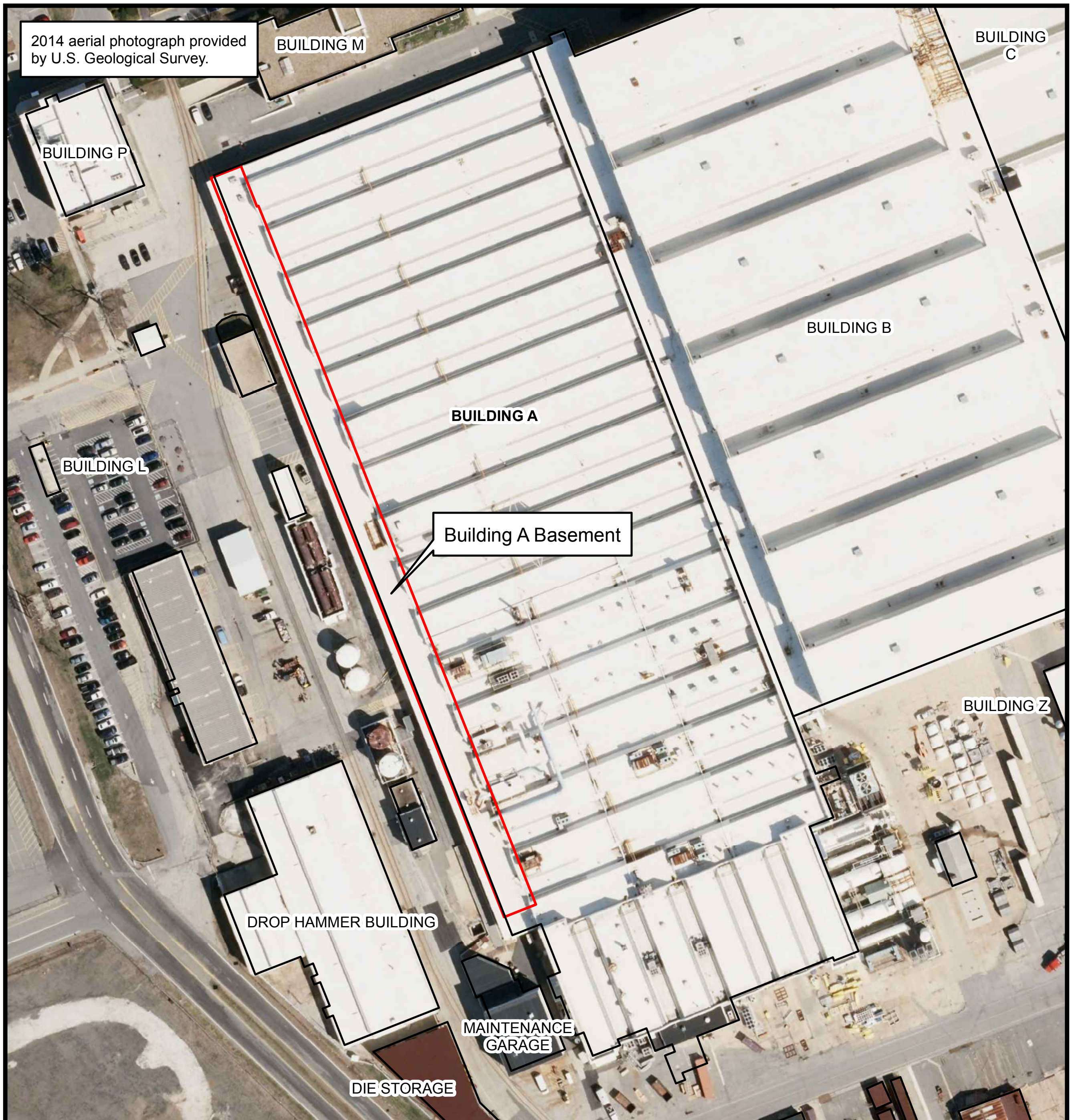
FIGURES



LEGEND

STRUCTURE

BASEMENT LEVEL

0 75 150 Feet

N

FIGURE 1

SITE LOCATION MAP
BUILDING A AND BUILDING A BASEMENT

Lockheed Martin Middle River Complex
Middle River, Maryland

DATE MODIFIED: 09/12/17

CREATED BY: JEE

TETRA TECH

Map Document: (P:\GIS\Middle_River\MapDocs\MXD\bldg_a_site_layout.mxd)
09/12/17 -- JEE

PGH P:\GIS\MIDDLE_RIVER\MAPDOCS\MXD\BLDG_A_BASEMENT_UTILITIES.MXD 09/27/17 JEE

FIGURE 2

BUILDING A BASEMENT INFRASTRUCTURE AND UTILITY PLAN

LEGEND

- BASEMENT INTERIOR LAYOUT
- BUILDINGS A, B AND C GROUND FLOOR LAYOUT
- VMPs THROUGH BUILDING A FLOOR
- VMPs THROUGH BUILDING A BASEMENT WALL
- EXISTING IAQ SAMPLE LOCATION
- BASEMENT COLUMN
- CITY WATER MAIN
- DRAIN TILE
- STORM SEWER
- SUMP DISCHARGE PIPING
- SUMP DISCHARGE PIPING, ESTIMATED (UNDERGROUND)
- HEATER ROOM FOOTPRINTS

Background drawing is an historic utilities drawing provided by Lockheed Martin Corporation.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 12.5 25 Feet

N

DATE MODIFIED: 09/27/17

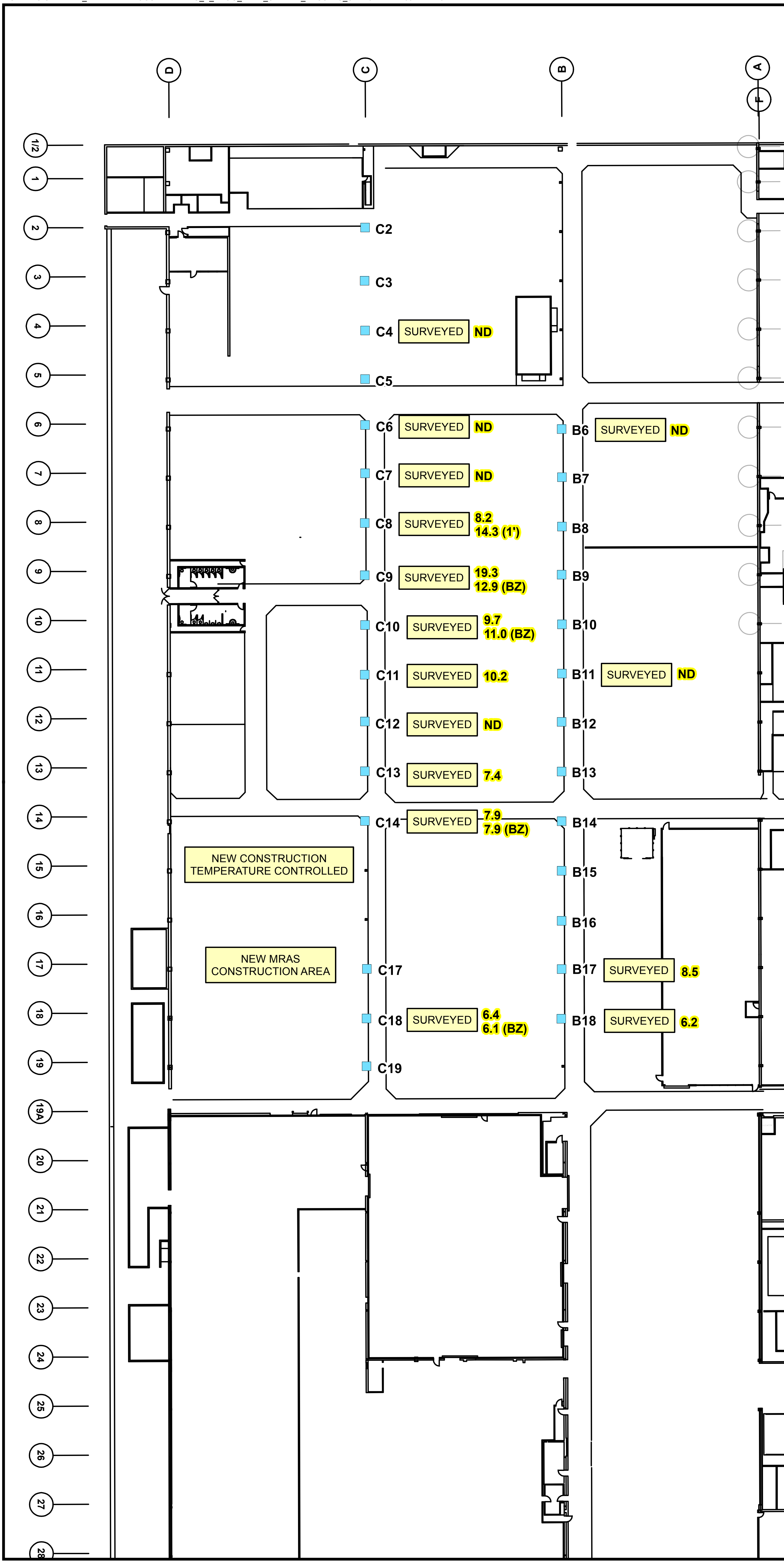
CREATED BY: JEE

TETRA TECH

PGH P:\GIS\MIDDLE_RIVER\MAPDOCS\MXD\BLDG_A_FROG_VENT_SAMPLE_RESULTS_SEP2017.MXD 09/27/17 JEE

FIGURE 3

FROG SURVEY OF AIR VENTS, BUILDING A MAIN FLOOR



Legend

- Air Vent Location
- Building A Interior Layout
- BZ Breathing Zone (five feet above vent)
- ND TCE Not Detected During Survey

All sample results in ppb (parts per billion).

N

0 25 50 Feet

Lockheed Martin Middle River Complex
Middle River, Maryland

DATE MODIFIED:	CREATED BY:
09/27/17	JEE

TETRA TECH

TABLES

Table 1
Camera Survey Results for Building A Basement Heater-Room Sumps

Heater room sump	Water level	Blockage	Camera survey
Heater Room A-1/ sump HRS1	Static water-level in sump high	No blockage—visual inspection only	Sump not surveyed due to high water level in sump; possible broken sump pump; chute open leading up to main floor, visible above ground behind wall
Heater Room A-3/ sump HRS2	Static water-level in sump low	No blockage	Chute clear and open behind eastern wall leading up to main floor; 12-inch pipe connected to sump below ground in sidewall
Heater Room A-5/ sump HRS3	Static water-level in sump low	Wood blockage in top shaft of sump	Concrete rubble in bottom of sump; open behind eastern wall but formed wood blockage in chute leading up to main floor
Heater Room A-6/ sump HRS4	Static water-level in sump low; sump pump turns on often	Concrete and rebar blockage in top shaft of sump	Slightly deeper sump with additional one-foot-square depression in sump; most active sump due to fire-line-water lubrication system that empties into sump, causing sump pump to turn on; 12-inch pipe connected to sump below ground in sidewall
Former Heater Room A-9/sump HRS5	Static water-level in sump low	Concrete wall covered with weathered wood planks (engineered blockage)	Unable to view past engineered blockage under eastern wall; fire-line bleed-off valve connected to pipe that discharges into sump during tests of fire-line system
Heater Room A-11/ sump HRS6	Static water-level in sump high	Appears open—no blockage	Used snake-type camera due to high water level; limited view due to water; chute behind wall appears to be open; possible broken sump pump
Former Heater Room A-12/sump HRS7	Static water-level in sump low	Concrete rubble blockage under wall	Unable to view past blockage with camera; concrete rubble pieces appear to have been placed in sump from behind wall

Table 2
Vacuum and Air-Flow Rates During
Basement Sump HRS-5 Vapor-Extraction Pilot Test, July 6, 2017

Time	Vacuum (in. H_2O)	Velocity (ft/min)	Flow rate (cfm)
Initial	1.13	315	27.5
11:00	1.12	350	30.6
11:10	1.11	338	29.5
11:20	1.16	338	29.5
11:30	1.13	315	27.5
11:40	1.12	295	25.8
11:50	1.14	298	26.0
12:00	1.16	302	26.4
12:10	3.60	591	51.6
12:20	3.62	594	51.9
12:30	3.63	589	51.4
12:40	3.65	610	53.3
12:50	3.63	582	50.8
13:00	3.65	580	50.6
Post	1.16	306	26.7

cfm—cubic feet per minute
ft/min—feet per minute
in. H_2O—inches of water column

Table 3
Summary of Analytical Detections in
Extraction-Vapor Samples from Basement Sump HRS-5, July 6, 2017

Constituent	Concentration (µg/m^3)			
	BSMT-25 START (10:55 a.m.)	BSMT-25 END (12:00 p.m.)	BSMT-50 START (12:10 p.m.)	BSMT-50 END (1:00 p.m.)
Chlorodifluoromethane	ND	ND	ND	8.9
cis-1,2-Dichloroethene	970	140	120	73
1,1-Dichloroethane	180	32	24	13
1,1-Dichloroethene	5,500	530	400	200
trans-1,2-Dichloroethene	ND	28	22	12
1,1,1-Trichlorethane	ND	ND	ND	7.9
Trichloroethene	52,000	7,300	6,500	4,900
Total VOCs	58,650	8,030	7,066	5,215

Grab samples collected using one-liter Summa® canisters and shipped to TestAmerica, Inc. in Knoxville, Tennessee for VOC analysis by United States Environmental Protection Agency (USEPA) Method TO 15.

All concentrations are in micrograms per cubic meter air (µg/m^3)

BSMT-25 and BSMT-50—vapor samples collected at 25 and 50 cubic feet per minute, respectively

µg/m^3—microgram(s) per cubic meter

ND—not detected

VOCs—volatile organic compounds

Table 4
Building A Main Floor FROG 4000™ Field-Screening Results

Location by column	TCE (ppb) 7/21/17	TCE (ppb) 7/22/17
C4	NS	Not detected
C6	NS	Not detected
C7	NS	Not detected
C8 (vent)	8.2	Not detected
C8 (one foot above vent)	14.3	Not detected
C9 (vent)	19.3	NS
C9 (breathing zone above vent)	12.9	NS
C10 (vent)	9.7	NS
C10 (breathing zone above vent)	11.0	NS
C11	10.2	Not detected
C12	Not detected	NS
C13	NS	7.4
C14 (vent)	NS	7.9
C14 (breathing zone above vent)	NS	7.9
C18 (vent)	NS	6.4
C18 (breathing zone above vent)	NS	6.1
B6	NS	Not detected
B11	NS	Not detected
B17	8.5	NS
B18	6.2	Not detected

ppb—parts per billion
TCE—trichloroethene
NS—not sampled

APPENDICES

APPENDIX A—UNDERGROUND PIPING, A BUILDING, PLANT NO. 1, JANUARY 11, 1945 (FIGURE)

UNDERGROUND PIPING "A" BLDG.
PLANT No. 1

REVISIONS		
DATE	BY	PO. NO.

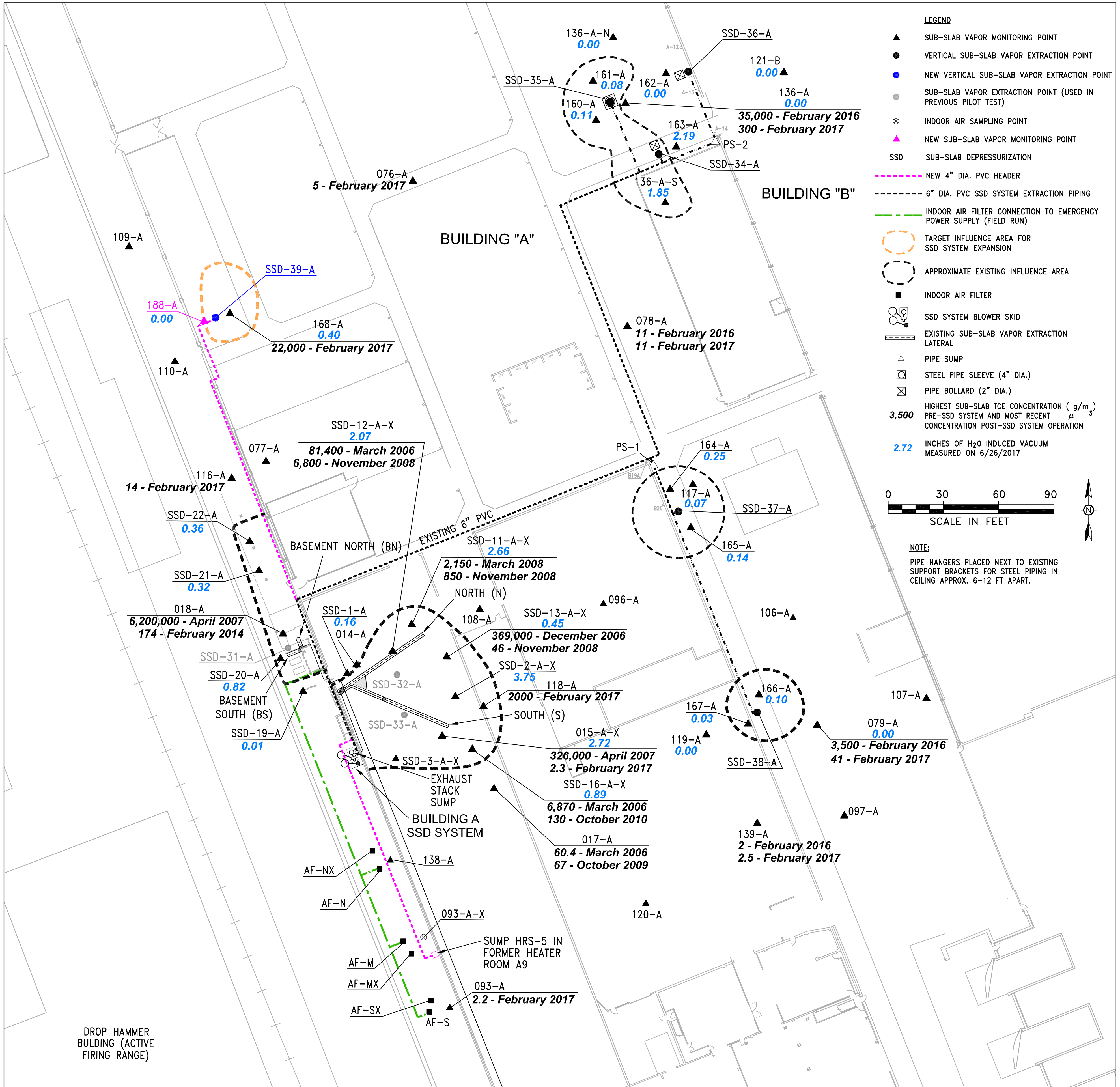
BUILDING & FIELD ENGR DEPT.
THE GLENN L. MARTIN CO.
BALTIMORE, MARYLAND

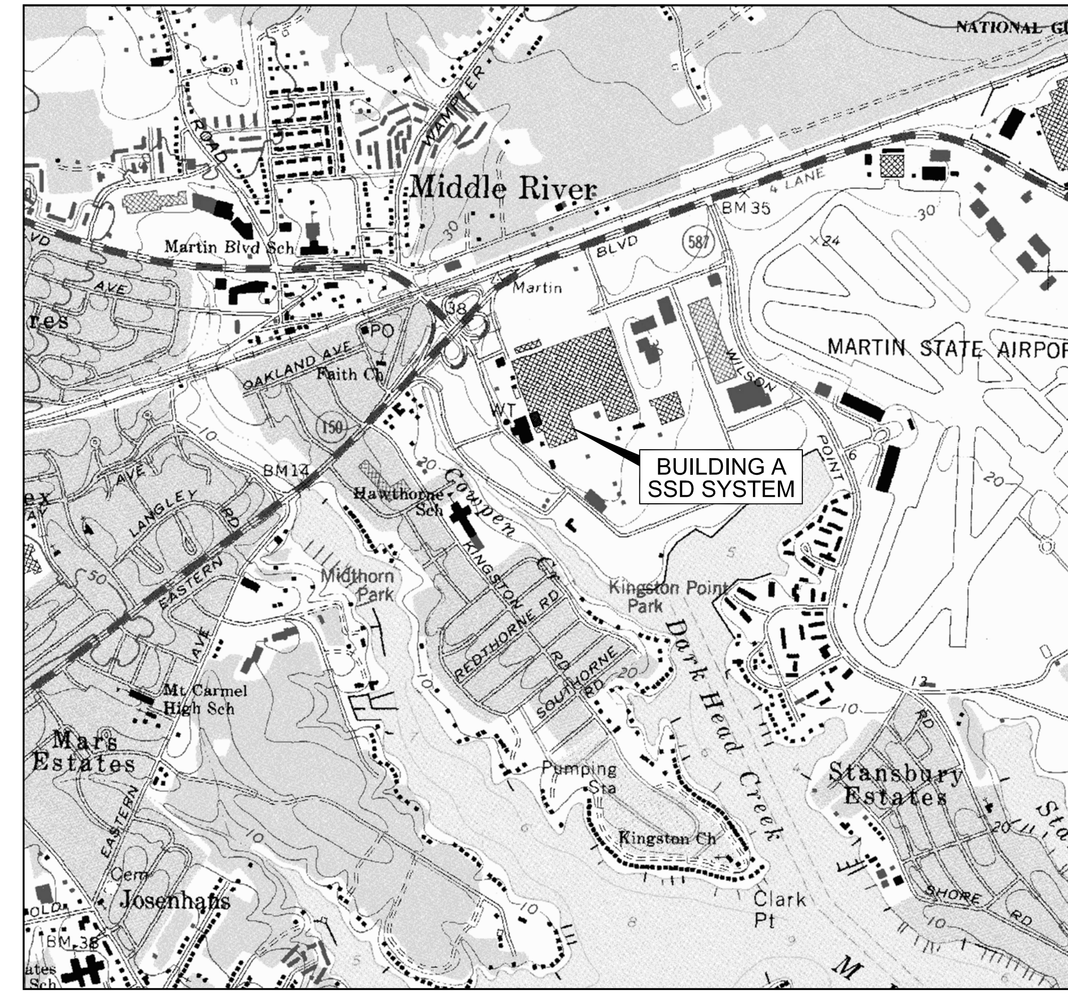
G.L.M. No.
ED-960

FINAL REVISION AS BUILT

APPENDIX B—CCTV CAMERA SURVEY (CD)

APPENDIX C—VAPOR-EXTRACTION PILOT-TEST FIGURES





SITE LOCATION MAP

0 1000 2000 3000
SCALE IN FEET

APPROVED BY:	DATE	REVISION	APRVD.

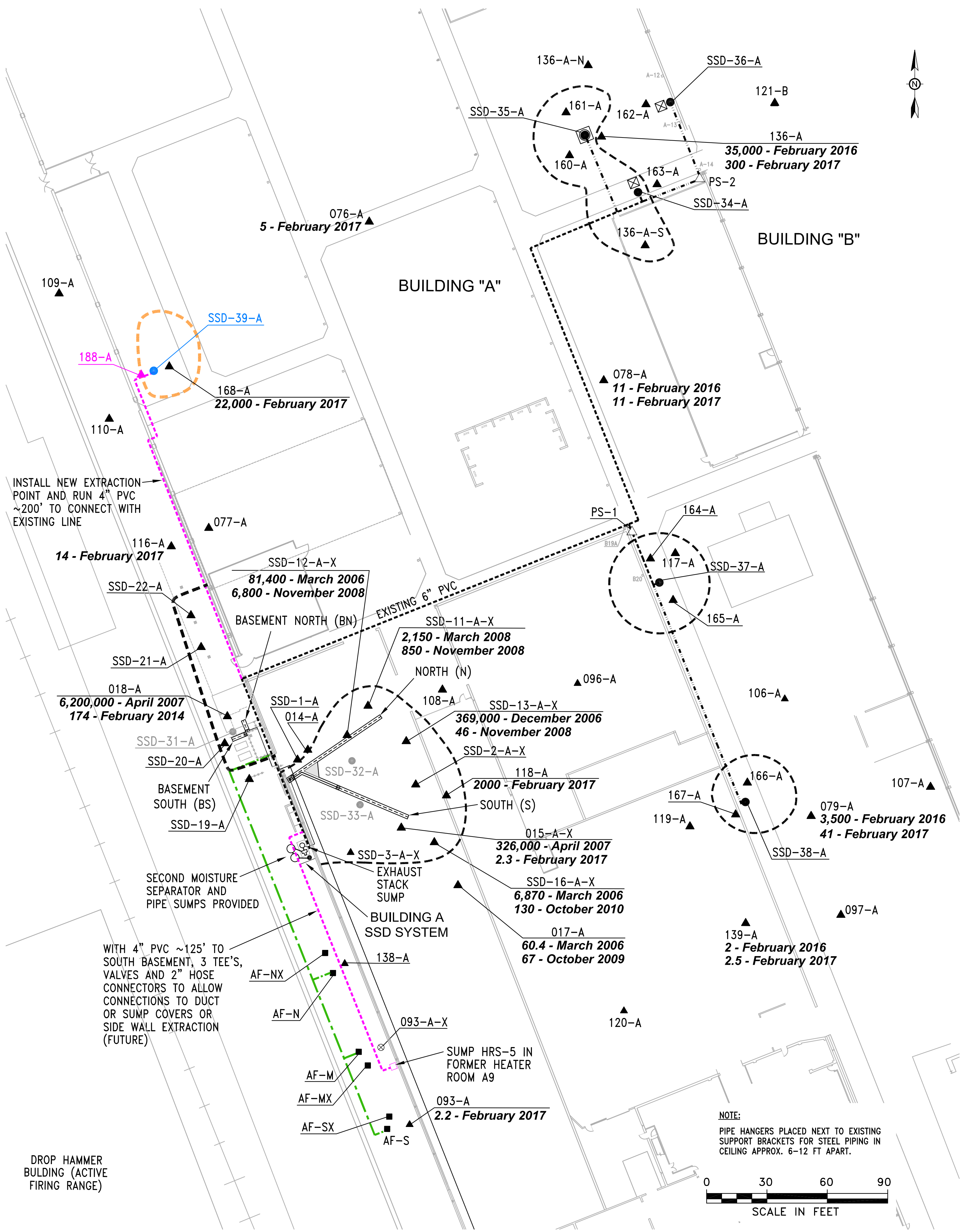
TITLE:
AS-BUILT
PLAN OVERVIEW
SSD SYSTEM THIRD-PHASE EXPANSION - BUILDING A

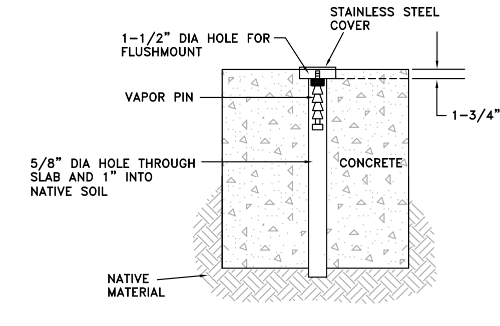
LOCATION:
LMC Middle River Complex
Middle River, Maryland

TETRA TECH

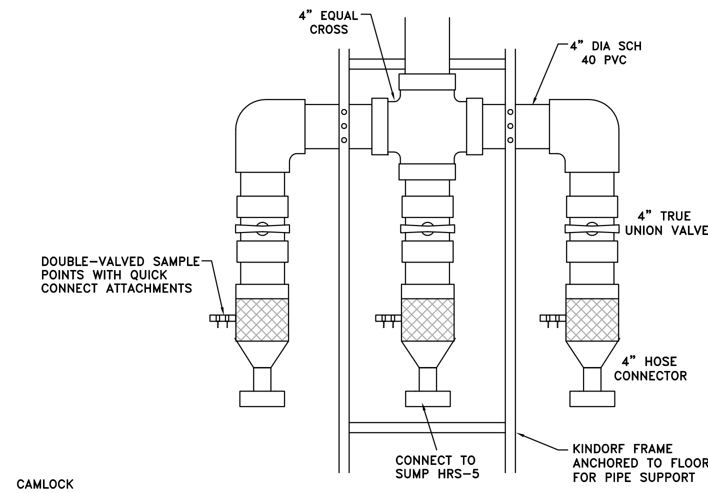
APPROVED	PAR
DRAFTED	CMP
PROJECT#	117-0512124
DATE	9-28-17

DRAWING: G1

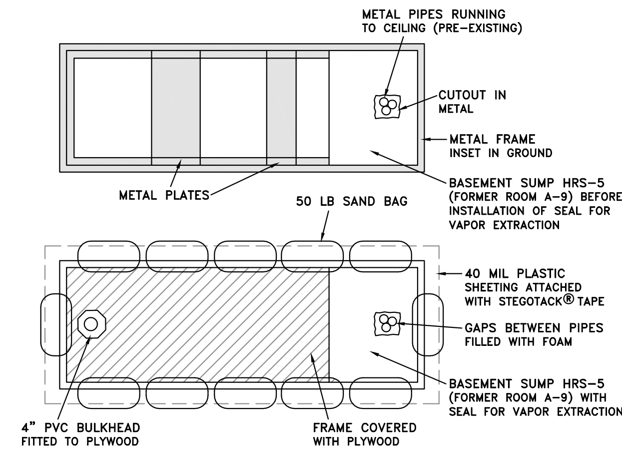




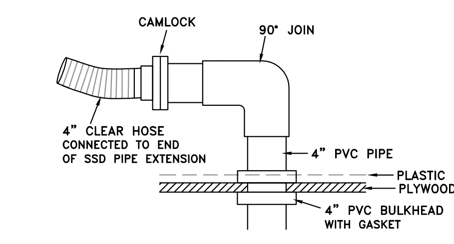
VAPOR MONITORING POINT DETAIL (188-A)
NOT TO SCALE



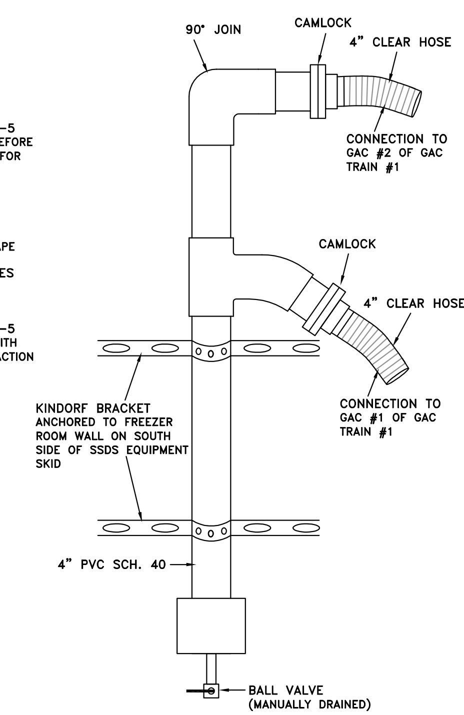
END OF SOUTH BASEMENT SSD SYSTEM PIPE EXTENSION
NOT TO SCALE



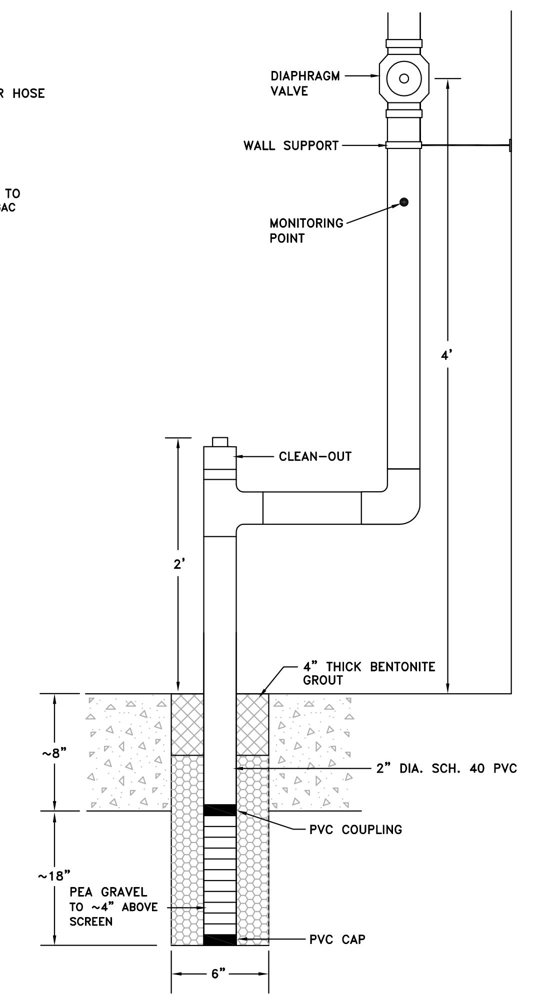
BASEMENT SUMP HRS-5 VACUUM SEAL - TOP VIEW
NOT TO SCALE



BASEMENT SUMP HRS-5 VACUUM SEAL BULKHEAD DETAIL
NOT TO SCALE



DRAIN STACK FOR USE IN WINTER
NOT TO SCALE



SSD-39-A DETAIL
NOT TO SCALE

LEGEND

- ▲ SUB-SLAB VAPOR MONITORING POINT
- ● VERTICAL SUB-SLAB SOIL VAPOR EXTRACTION POINT
- ● (blue) NEW VERTICAL SUB-SLAB VAPOR EXTRACTION POINT
- ● (grey) SUB-SLAB VAPOR EXTRACTION POINT (USED IN PREVIOUS PILOT TEST)
- ⊗ INDOOR AIR SAMPLING POINT
- ▲ (magenta) NEW SUB-SLAB VAPOR MONITORING POINT
- SSD SUB-SLAB DEPRESSURIZATION
- NEW 4" DIA. PVC HEADER
- 6" DIA. PVC SSD SYSTEM EXTRACTION PIPING
- INDOOR AIR FILTER CONNECTION TO EMERGENCY POWER SUPPLY (FIELD RUN)
- TARGET INFLUENCE AREA FOR SSD SYSTEM EXPANSION
- APPROXIMATE EXISTING INFLUENCE AREA
- ■ INDOOR AIR FILTER
- SSD SYSTEM BLOWER SKID
- EXISTING SUB-SLAB VAPOR EXTRACTION LATERAL
- △ PIPE SUMP
- STEEL PIPE SLEEVE (4" DIA.)
- ⊠ PIPE BOLLARD (2" DIA.)
- ***3,500*** HIGHEST SUB-SLAB TCE CONCENTRATION ($\mu g/m^3$) PRE-SSD SYSTEM AND MOST RECENT CONCENTRATION POST-SSD SYSTEM OPERATION

WASHED PEA GRAVEL GRADATION	
SIEVE SIZE	PERCENT PASSING
1/2"	100%
3/8"	85 TO 100%
#4 (4.75MM)	10 TO 30%
#8 (2.36MM)	< 5%
#20 (0.85MM)	< 2%

NOTES:

A. GRAVEL MATERIAL SHALL CONFORM TO ASTM C-33 SPECIFICATIONS FOR 3/8"AGGREGATE.

B. GRAVEL SHALL BE SEMI-ROUND AND FREE OF ORGANIC MATERIAL.

APPROVED BY:

DATE	REVISION	APRVD.

TITLE:

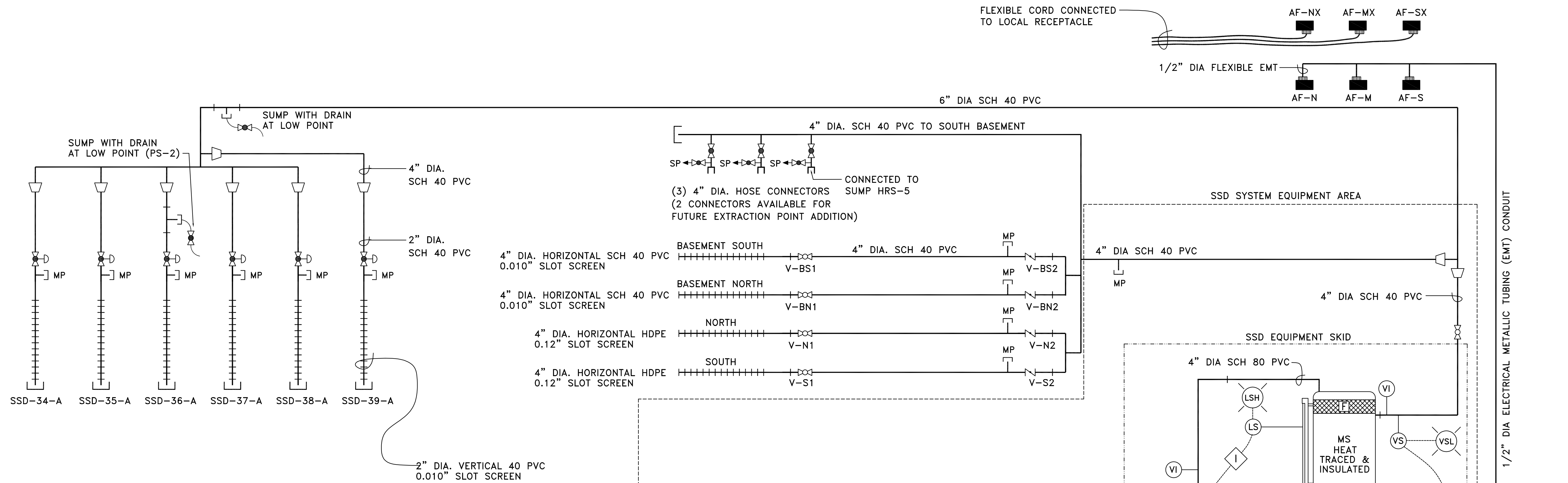
AS-BUILT
PIPING LAYOUT AND DETAILS
SSD SYSTEM THIRD-PHASE EXPANSION - BUILDING A

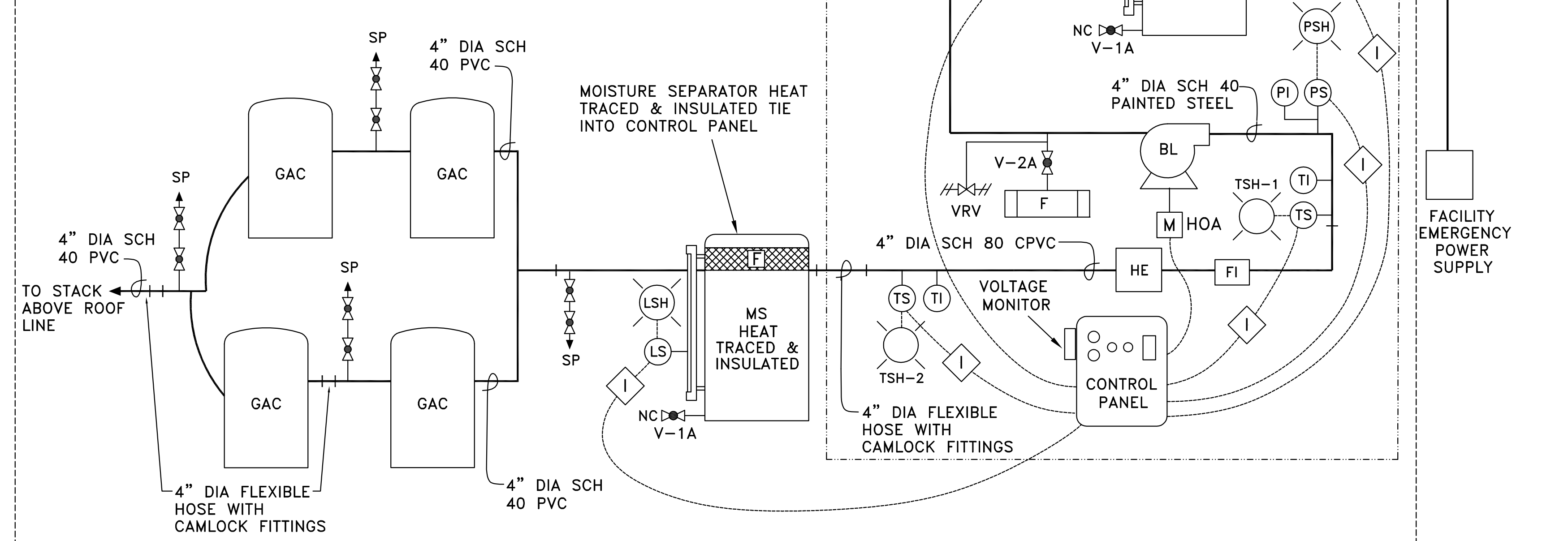
LOCATION: LMC Middle River Complex, Middle River, Maryland

TETRA TECH

APPROVED	PAR
DRAFTED	CMP
PROJECT#	117-0512124
DATE	9-28-17

DRAWING: G2





PROCESS AND INSTRUMENTATION DIAGRAM NOTES

AF-N, AF-M, AF-S	NORTH, MID, AND SOUTH INDOOR AIR FILTERS INSTALLED IN JANUARY 2016
AF-NX, AF-MX, AF-SX	NORTH, MID, AND SOUTH INDOOR AIR FILTERS INSTALLED IN MAY 2017
VI	VACUUM INDICATOR – 0–160" H_2O
MP	MEASURING POINT 1/4" MALE CONNECTOR WITH PLUG THREAD WITH TEFLON TAPE. FITTING MAY BE REMOVED FOR ANEMOMETER AND VACUUM READINGS PROVIDE 20" SOLID PIPE BOTH SIDES.
(symbol)	REDUCER
(symbol)	BUTTERFLY VALVE
(symbol)	BALL VALVE
(symbol)	BALL VALVE – NORMALLY CLOSED
(symbol)	DIAPHRAGM VALVE
FI	FLOW INDICATOR (DIRECT 90–450 SCFM READING)
F	INLET AIR FILTER
HE	HEAT EXCHANGER (XCHANGER AA-400)
MS	MOISTURE SEPARATOR (GASHO GX-100DL) WITH 40 GALLON CAPACITY, SLIGHT TUBE, REMOVABLE TOP, DRAIN VALVE
LS	LEVEL SWITCH
LSH	LEVEL SWITCH HIGH
VRV	VACUUM RELIEF VALVE – 2" (SET AT 81.6" WC)
SP	SAMPLE PORT 1/4" DIAMETER
BL	AMETEK®, ROTRON® 909BB72W 10 HP MOTOR, 300 SCFM @ 75" H_2O
PI	PRESSURE INDICATOR 0–160" H_2O
TS	TEMPERATURE SWITCH (ASHCROFT P/N T424-T05-030-XFS-150-260; TSH-1 SET AT 220° F AND TSH-2 SET AT 115° F)
GAC	GRANULAR ACTIVATED CARBON VAPOR TREATMENT (SIEMENS VENT SCRUB® VSC400, VOCARB® 48C)
(symbol)	INDOOR AIR FILTER (IQAir® GC™ VOC)
TI	TEMPERATURE INDICATOR 0–250° F
(symbol)	DISCONNECT SWITCH
PS	PRESSURE SWITCH (HIGH) (DWYER P/N 1950P-8-2F SET AT 80" WC)
VS	VACUUM SWITCH (LOW) (DWYER P/N 1950P-2-2F SET AT 3" WC)
V-N1	PROCESS VALVE LABELS
HOA	PANEL MOUNTED HAND/OFF/AUTO SWITCH FOR BLOWER
(symbol)	INTERLOCK BLOWER SHUTDOWN
(symbol)	LOCALLY MOUNTED INSTRUMENT
(symbol)	PANEL ALARM LIGHT
H	HIGH
L	LOW
SSD	SUB-SLAB DEPRESSUIZATION
M	MOTOR
EMT	ELECTRICAL METALLIC TUBING

APPROVED BY:	DATE	REVISION	APPRVD.

TITLE:
AS-BUILT
PROCESS AND INSTRUMENTATION DIAGRAM
SSD SYSTEM THIRD-PHASE EXPANSION - BUILDING A

LOCATION: **LMC Middle River Complex**
Middle River, Maryland

TETRA TECH

APPROVED	PAR	DRAWING:
DRAFTED	CMP	G3
PROJECT#	117-0512124	
DATE	9-28-17	