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MEMORANDUM

date: 03.21.2020

from: HMFH Architects, McPhail Associates, Bala Engineers

to: AHS Building Committee

re: Geothermal Wells

On Monday, February 24, 2020 the first geothermal test well was stopped when Naphthalene (NAPL) was discovered in bedrock approximately 160' below surface. (See Field Report for more detail.) In short, this is a known substance as it relates to the known contaminants from previous activities on the AHS site, BUT it is now found in a previously unknown location. Prior to this, the project/Town has been aware of contaminated soils, we are now aware of contaminated bedrock.

HMFH and its consultants were tasked by the SBC at its March 3, 2020 meeting to investigation alternative well locations and scenarios. And to identify the risks, impacts, and relative, approximate costs associated with the alternative scenarios. Below is a narrative of the different options investigated. We have indicated the level of risk using 1 through 5, with 5 having the highest level of risk. Risk refers to level of contamination and future unknown environmental impacts.

Included, attached herein are:
-site plan graphics with bulleted aspects of each option
-McPhail memo evaluating each option
-McPhail Field Report dated February 24, 2020

OPTIONS 1/1A:
Option 1 and 1A are at the original proposed location of Peirce Practice Field. This is the same location as the initial test well noted above. Option 1 is for (130) 500-foot deep wells. Option 1A is for approximately (70) 900-foot deep wells. A test well program is required, but this area is presumed to have the highest level of contaminants at bedrock because 1) it has been identified in the initial test well, and 2) it is closest to the original contaminant source to the west.

Because the contaminant is located ~160 feet below grade, the Design Team has no way of knowing what future environmental impact the drilling of wells could/would have.

Due to finding this known contaminant (NAPL) in a previously unknown location (bedrock), increased health and safety protocols will need to be observed if drilling in the location of Peirce Practice Field. Additional installation procedures will need to be followed to drill in the location of Peirce Practice Field. The estimated range of increase to the project budget due to the increased protocols and procedures is $1.85m to $3.5m.

We anticipate that the increased protocols and procedures would mean the well installation will take longer than originally anticipated. Each well may take between 3 and 5 days to drill and depending on whether there are 130 or 70 wells, and assuming two rigs working at a time, the approximate duration for installation ranges from five (5) to 16 months. The longer the well installation takes, the more likely there will be project schedule impacts.

We anticipate impacts to construction logistics and the school parking capacity, which will likely incur additional costs.

The building's mechanical design would remain as is currently designed in the 60% construction documents set.

RISK = 5
Options 1 and 1A are not recommended.

OPTION 2
Option 2 proposes to locate either (130) 500-foot deep wells or approximately (70) 900-foot deep wells at the northeast corner of the school site where the current softball field is located. A test well program is required, but due to its distance from the known source of contamination to the west, this area is presumed to have a mid-level risk of contaminants at bedrock.

Because contaminants may be located in the bedrock, the Design Team has no way of knowing what future environmental impact the drilling of wells could/would have.

Due to the potential for finding contaminant in bedrock, there is the potential to require increased health and safety protocols and additional installation procedures. The estimated potential range of increase to the project budget is $925k to $1.75m.

As noted in Option1/1A, the potential for increased protocols and procedures would mean the well installation will take longer than originally anticipated and the longer the well installation takes, the more likely there will be project schedule impacts.

A complexity of Option 2's well field location is there will need to be a much longer piping route from the wells to the Phase I mechanical room located at the west end

(in the Performing Arts wing). This route would require traversing over the Mill Brook culvert and up the embankment at the east side of the STEAM wing, which is already a very complicated and crowded (underground) area of the site. This piping route will likely incur increased costs, impacts to construction logistics, and potential project schedule impacts. And the longer pipe travel will increase geothermal pump energy use.

We anticipate impacts to the school parking capacity, which likely will incur additional costs.

The building's mechanical design would remain as is currently designed in the 60% construction documents set.

IF the test well program was to show similar contamination at this area of the site as at the Peirce Practice Field and therefore incur a similar level of increased costs and impact to the project schedule, the SBC may then decide to abandon the geothermal wells. IF this were to occur, for example in July, and a redesign of the building's mechanical system (with structural and architectural impacts) were to be required, this would have a significant impact on the project schedule, shifting all phased project completion dates. Please note: the structural design for Phase I is being priced and readied for early bidding in April.

RISK = 2
Option 2 is not recommended.

OPTION 2A

Option 2A proposes to locate the well program in two locations. Approximately (35) 900-foot deep wells will be located at the Mill Brook parking lot and would serve the Humanities wing. And approximately (35) 900-foot deep wells will be located at the front green to the west of the new main entrance and would serve the STEAM wing. Two test well programs are required. Due to its distance from the known source of contamination to the west, the Mill Brook parking lot is presumed to have a low level of risk of contaminants. Due to the known PCE contamination at the front green, we anticipate a high level of potential risk for contamination at bedrock.

Because contaminants may be located in the bedrock, the Design Team has no way of knowing what future environmental impact the drilling of wells could/would have.

Due to the potential for finding contaminant in bedrock, there is the potential to require increased health and safety protocols and additional installation procedures. The estimated potential range of increase to the project budget is $925k to $1.75m.

As noted in Option1/1A, the potential for increased protocols and procedures would mean the well installation will take longer than originally anticipated and the longer the well installation takes, the more likely there will be project schedule impacts.

We anticipate impacts to construction logistics due to locating a well program on the already crowded and logistically challenging front green.

We anticipate impacts to the school parking capacity, which likely will incur additional costs.

The building's mechanical design would require revisions to incorporate the second mechanical room at the Humanities wing and changes to internal mechanical routes, and would incur increased costs, estimates up to $20k.

RISK = 4
Option 2A is not recommended.

OPTION 3
Option 3 proposes to locate a well program of approximately (35) 900-foot deep wells at the Mill Brook parking lot and would serve the Humanities wing only. A test well program is required. Due to its distance from the known source of contamination to the west, the Mill Brook parking lot is presumed to have a low level of risk of contaminants.

While seemingly a low risk, but because contaminants may be located in the bedrock, the Design Team has no way of knowing what future environmental impact the drilling of wells could/would have.

Due to the potential for finding contaminant in bedrock, there is the potential to require increased health and safety protocols and additional installation procedures. The estimated potential range of increase to the project budget is $460k to $875k. BUT since the number of geothermal wells to be drilled is decreased by half, we anticipate a decrease of project cost estimated at $2.5m.

As noted in Option1/1A, the potential for increased protocols and procedures would mean the well installation will take longer than originally anticipated, but since the proposed location of wells is to serve the Phase II building, the longer processes would likely be absorbed into the overall project schedule.

We anticipate impacts to the school parking capacity, which likely will incur additional costs.

The building's mechanical design would need to be redesigned to change the STEAM wing from geothermal sourced system. At minimum the redesign would be to a modified hydronic system or, more impactful to a VRF system. The redesign of

the mechanical (along with structural and architectural implications) would incur increased costs, estimated up to $60k. And an increase of the design schedule up to four (4) weeks, which will likely impact the overall project schedule.

RISK = 1
Option 3 is not recommended.

OPTION 4
Option 4 proposes elimination of all geothermal wells, therefore there is no risk of contaminants or of unknown future environmental impacts due to the drilling of the wells.

Due to the elimination of geothermal wells, we anticipate a decrease of project cost estimated at $5m.

The building's mechanical design would need to be redesigned to change from geothermal sourced system. At minimum the redesign would be to a modified hydronic system or, more impactful to a VRF system. The redesign of the mechanical (along with structural and architectural implications) would incur increased costs, estimated up to $110k. And an increase of the design schedule up to eight (8) weeks, which will impact the overall project schedule. For instance, it is possible that instead of moving into the Phase I building over December break (2021), the school might move in over February break (2022).

RISK = 0
Option 4 is recommended.

IN SUMMARY:
The Design Team recommends Option 4 with no geothermal wells because it poses the least risk to impacting/increasing the project budget, the least risk of any future environmental impacts, and the least risk of negatively impacting the project schedule.

While all the options pose a risk to the project schedule, only in Option 4 can we manage this risk. All other options are reliant on results of test well programs, potential need for further consideration of the SBC, and review and approvals by DEP (see McPhail's memo). All of which are out of the project's control at this time.

The concepts for the revised mechanical design have been initially discussed with Ryan Katofsky. An analysis of tradeoffs will be done to assist in making a final determination as to which system is best for AHS.

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