

Use of a Large Diameter Auger (LDA) for Partial Mass Removal from a Source Zone

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NORDROCS 2008 Meeting



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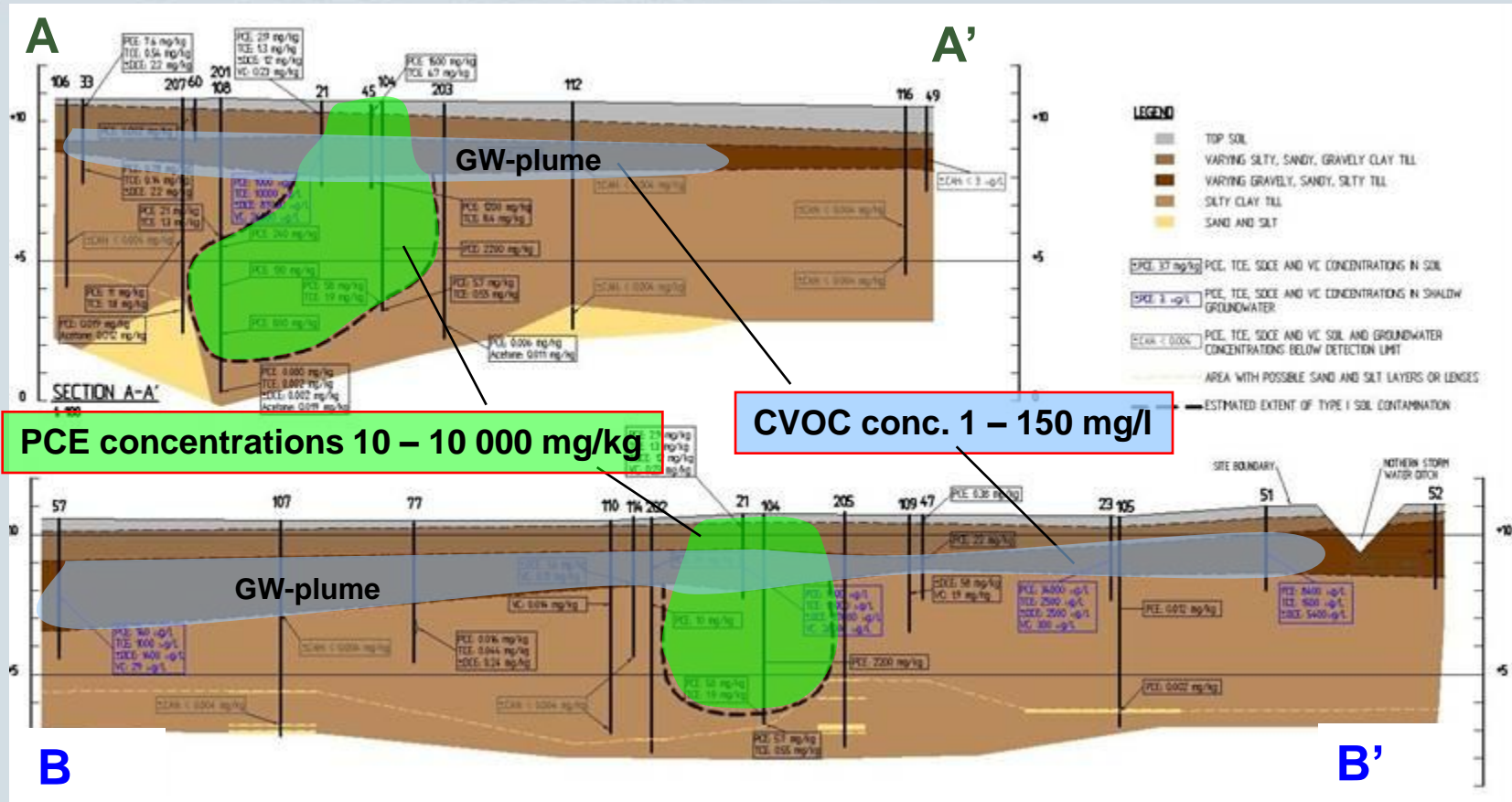
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- Source zone removal with LDA
- Advantages and disadvantages of the LDA

Site Background

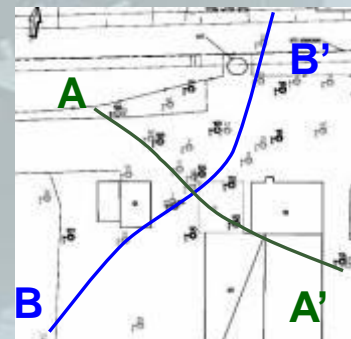
- Manufacturing site in rural area of south Sweden
- Historical discharge of PCE and Acetone to subsurface from a waste collection storage
- Golder performed investigations, risk assessment, feasibility study and source zone remediation
- Groundwater monitoring program on-going



Source zone and GW-plume



- Silty clay till soil with imbedded sand and silt layers
- PCE source zone depth approx. 9 mbgs., horizontal extent approx 80 sqm.
- Shallow groundwater plume approx 2000 m²
- Depth to bedrock and primary aquifer 25 - 30 meters



Selected remediation strategy

Following screening process, selected remediation strategy included two phases:

Phase I

Source zone removal (>50 mg/kg PCE).

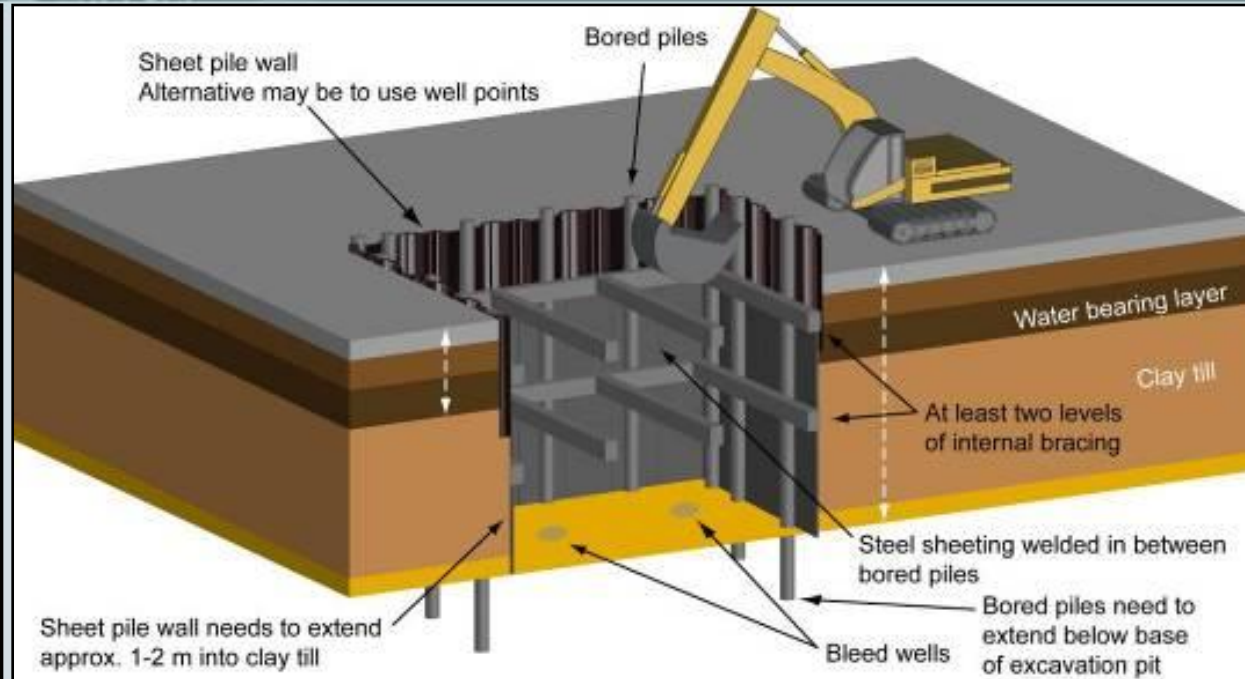
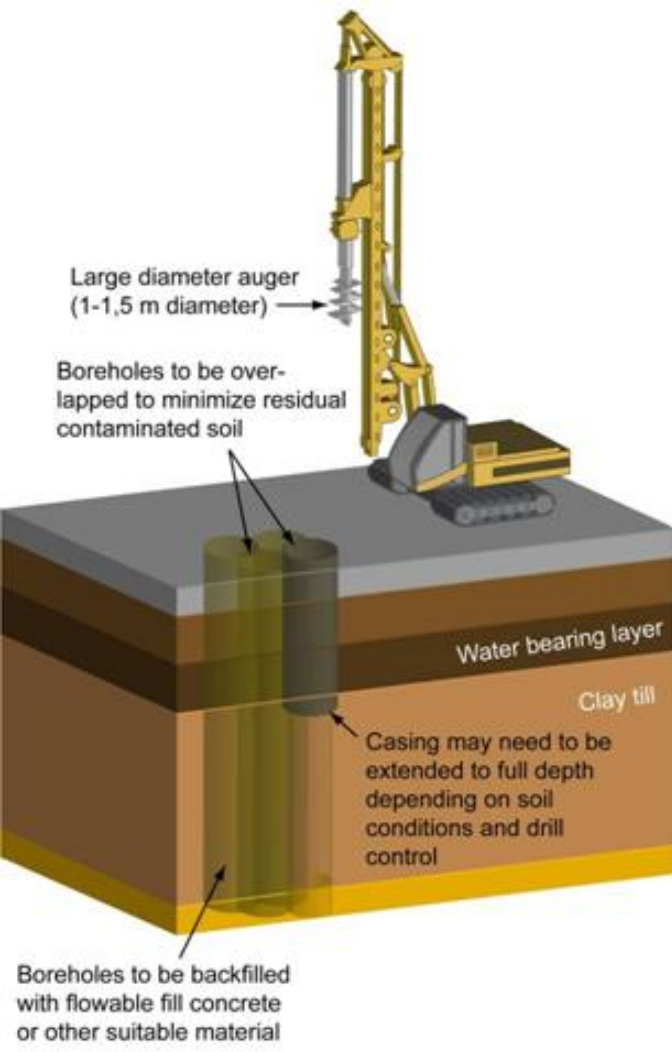
Objective to remove potentially mobile DNAPL and residual non-mobile DNAPL that can feed the shallow groundwater plume.

Phase II

Monitored natural attenuation of groundwater for 2-year period following removal of source zone.

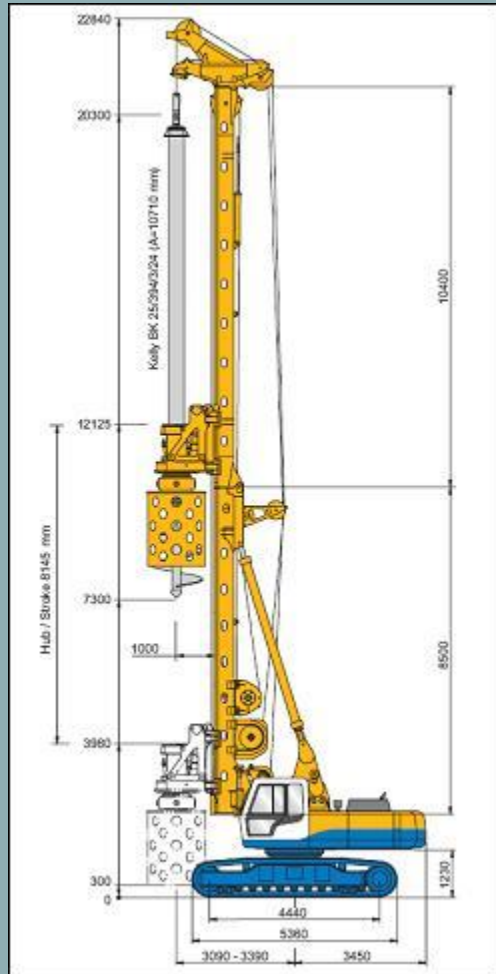
Possible in-situ addition of chemical reduction or biological degradation amendments may be added at a later date contingent upon groundwater contaminant trends.

Source zone removal options



- Two options considered
- Cost estimates for both options approx equivalent
- LDA selected due to flexibility and safety

Large Diameter Auger (LDA)



Bauer BG25

Weight = 70 tons

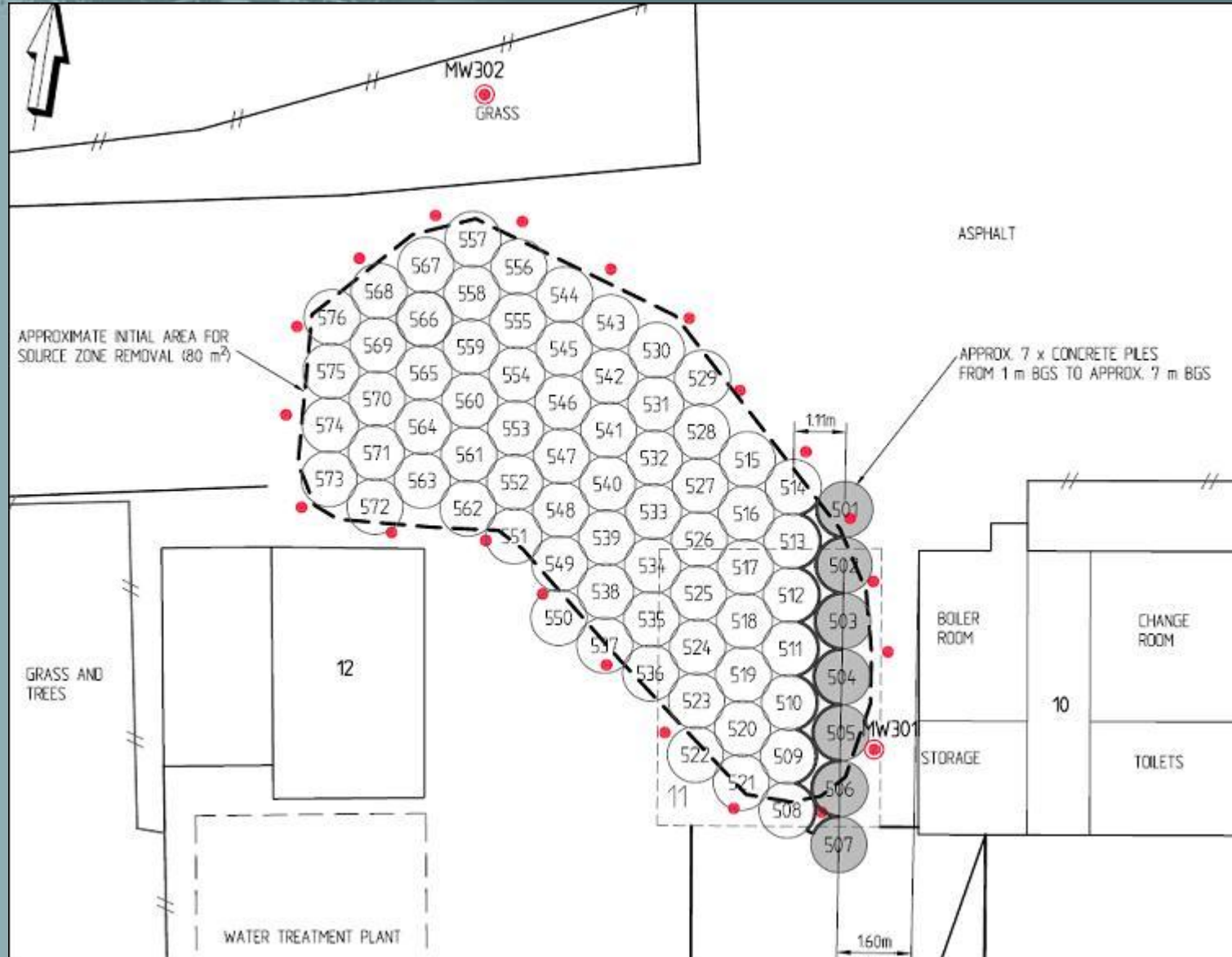
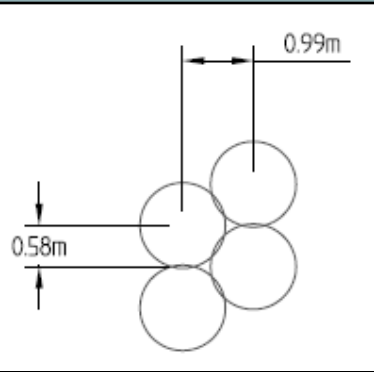
Torque = 245 kNm

Height = 23 m



- Solid flight auger diameter typically 1 – 1.5 meters
- Auger length approximately 1.5 to 2 meters
- Commonly used for ground engineering (eg. pile excavation and soil stabilization)
- Can be used with or without casing
- Casing sections screw together

Source zone removal



Borehole pattern = theoretical soil removal of 96%

Initial borehole plan included 76 boreholes.

Source zone removal

Sampling protocol

Soil column extracted with the auger

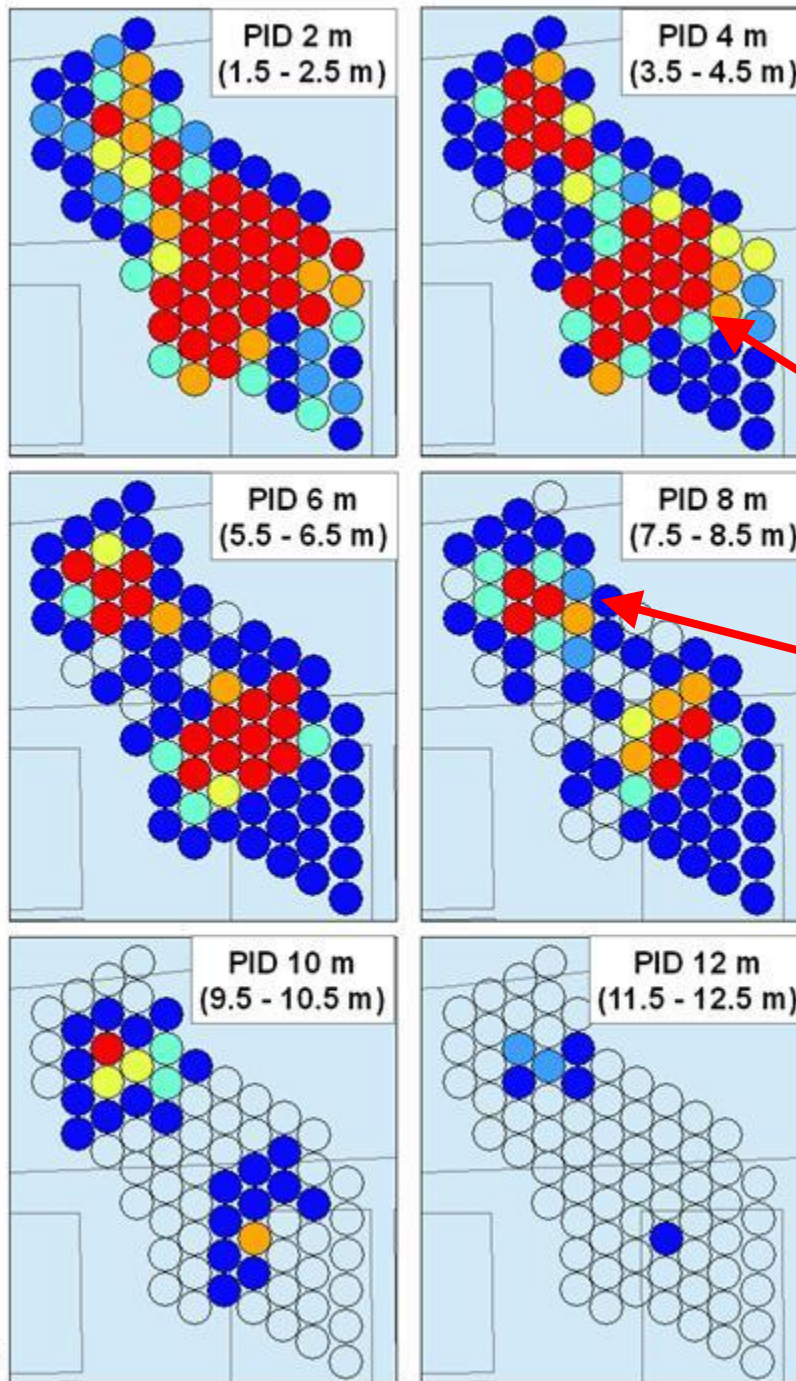


Approx 3 soil samples selected for PID screening from each lift

- Soil samples collected from each auger lift and screened with PID.
- Select samples were sent for laboratory analysis with 48 hour turnaround.
- Assessment of PID and analytical data was performed to guide depth for each borehole and to determine if additional boreholes were required.



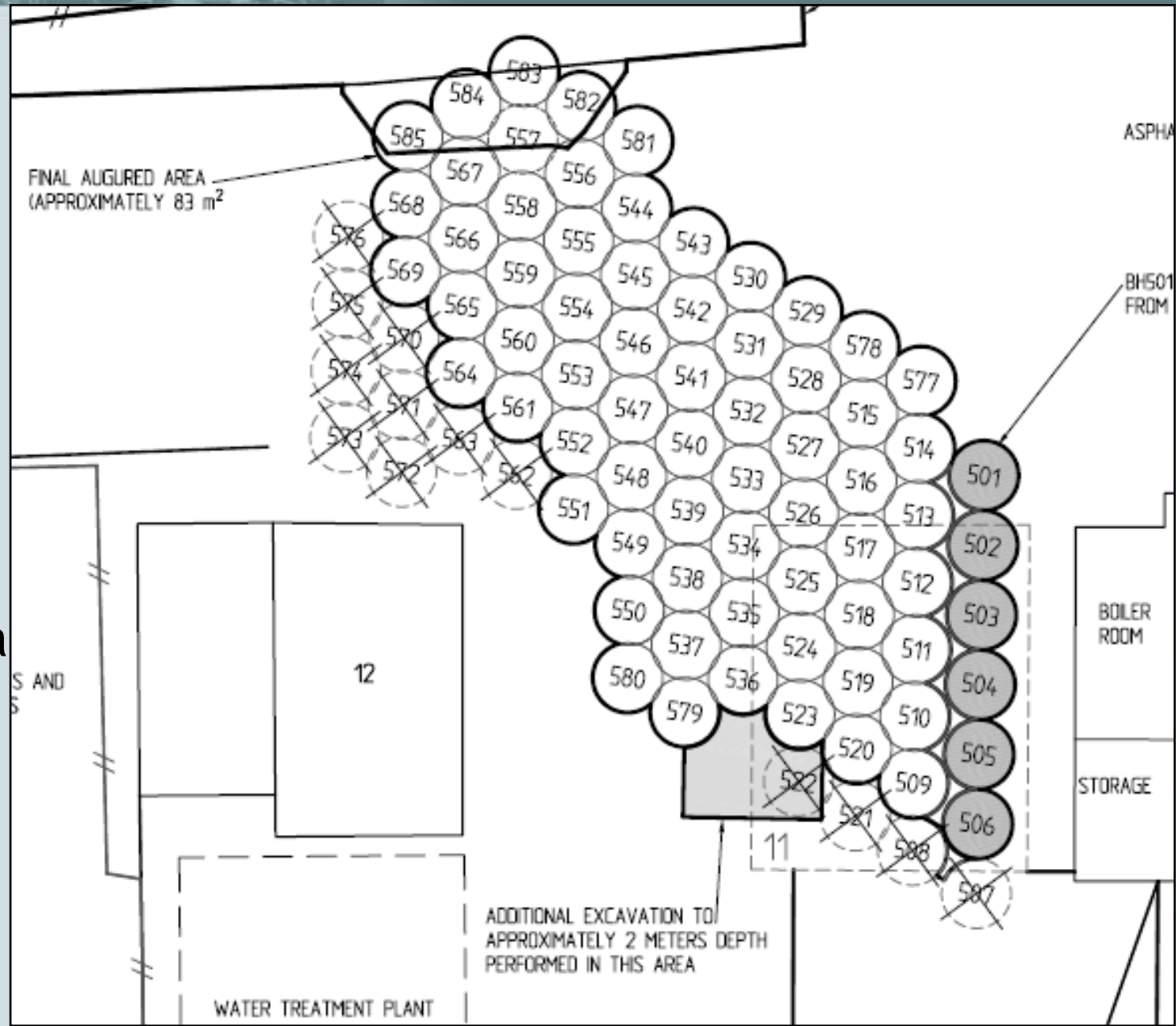
PID screening



- Two "hot spots" encountered.
- Hot spot near NW corner of Building 11
- Hot spot in northern area of initial source zone.
- Possibly linked to other historical waste storage location.

Final layout

- 85 boreholes installed.
- Total length of boreholes = 584 m
- Max depth = 12 m
- Average depth = 8 m
- Final augured area = 83 m²



Backfilling

- Boreholes backfilled in stages with crushed rock
- Compaction of backfill in boreholes achieved through reverse rotation of the casing and pressure from the auger.



LDA Advantages



- [Flexibility](#) (contamination can be followed both laterally and to depth based on sampling)
- [Speed](#) (approx 20-40 meters augering and backfilling per day depending upon soil conditions etc)
- [Safety](#) (no large open pits, no need for working in the pit, no need for welding)

LDA Disadvantages



- Cost
 - Mobilization to Sweden estimated at around 20-30,000 Euro
 - Approx 3-4,000 Euro per day of augering
- Need for overlap to ensure high % source zone removal. This results in some backfilled material being re-excavated.
- Boulders can be problematic
- Availability of drill rigs
- Accessibility to the site needs to be considered.



Thank you!

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