Sustainable management of contaminated sites

Presentation 2.2

Phase 2 Site investigation plan

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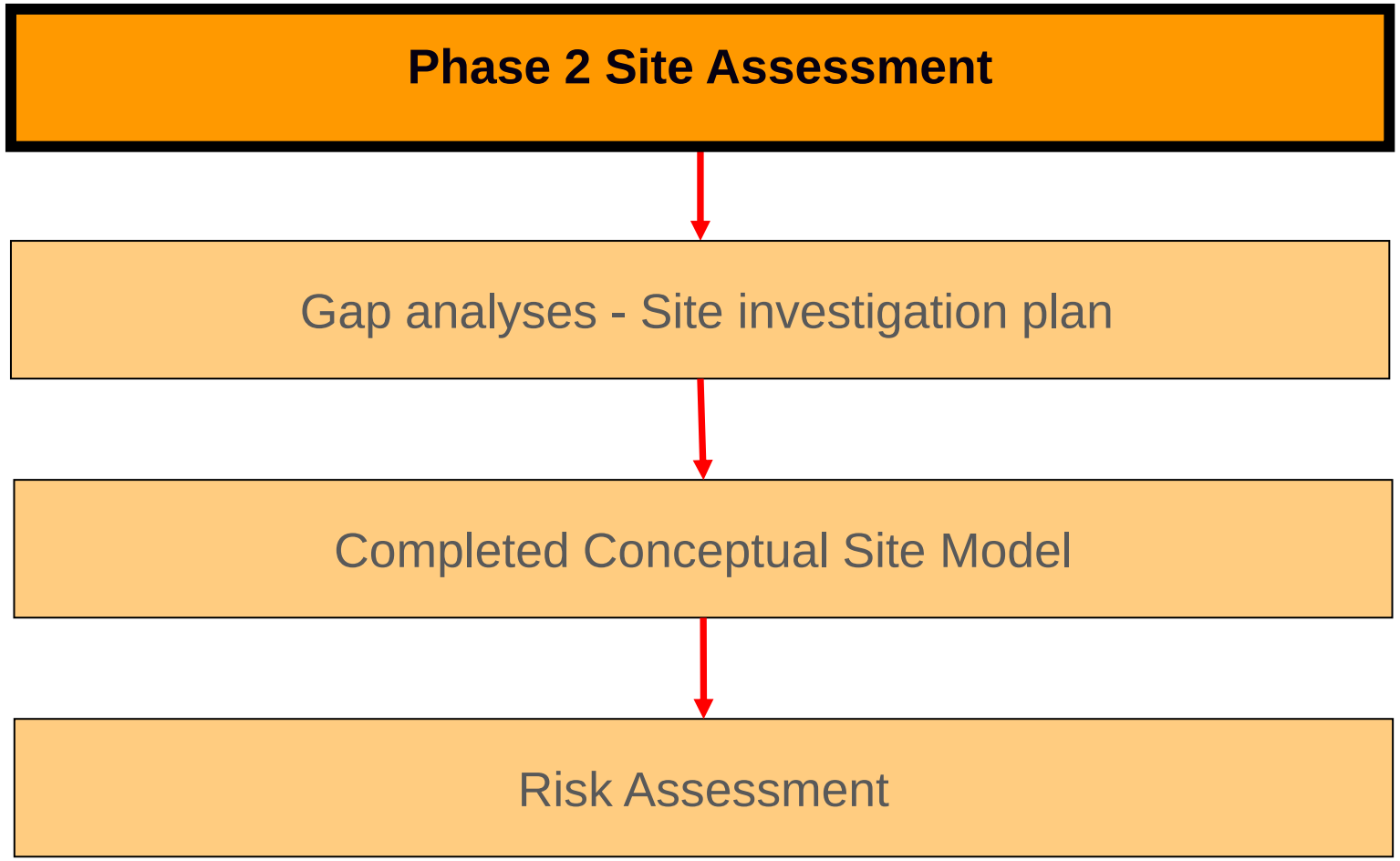
Phase 2 Deliverables



Phase 2 Objectives

Fill in the gaps of the Initial CSM by

- Establish if a site component is a source of contamination

And if so

- Establish quantitatively for each site component the contamination situation of
  - ✓ The Source of the contamination
  - ✓ The Receptor pathways
  - ✓ The Receptors
- Establish quantitatively for each site component the associated environmental risks
  - ✓ Human health risks
  - ✓ Risk for the ecosystem
  - ✓ Risk for migration risks

Site investigation plan

- **Stocks with hazardous waste**
  - ✓ Inventory plan - Inventory of the hazardous waste stocks / PCB containing equipment
- **Contaminated building(s)**
  - ✓ Building assessment plan - Assess the contaminated (parts of) building(s)
- **Buried hazardous waste**
  - ✓ Pit survey plan - Survey the horizontal and vertical extent of the buried hazardous waste
- **Contaminated soil and ground water including the source area(s)**
  - ✓ Soil and groundwater survey plan including a sampling and analyses plan
    - Assess the horizontal and vertical extent of the source area(s)
    - Assess the horizontal and vertical extent of the soil and groundwater contamination(s)

Hazardous waste
Inventory plan

Main objectives of the inventory are:

- To identify the:
  - ✓ Different types of hazardous waste
  - ✓ Quantify the amount of hazardous waste
  - ✓ Status of the hazardous waste (packed or not, in or outside the building etc.)
- To assess the environmental risks
- To design risk reduction measures / remove, repack and dispose the waste

Oil Sampling

Hazardous waste
Inventory plan

Content

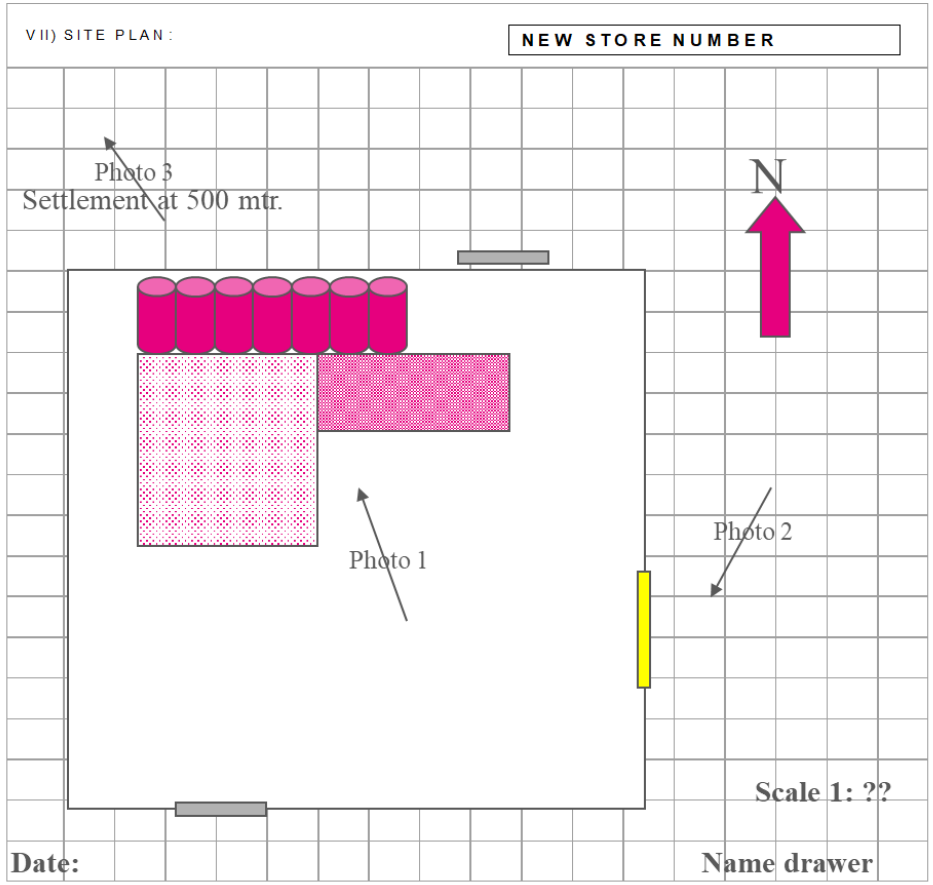
- The basic site information
  - ✓Address
  - ✓Contact details and person
  - ✓Accessibility
- The needed
  - ✓PPE
  - ✓Manpower and their qualifications
  - ✓Sampling materials
  - ✓Equipment
- Detailed planning
- A scaled map with
  - ✓An arrow indicating the North
  - ✓Location of the hazardous waste stock(s) to be inventoried
- The necessary field forms
  - ✓Logbook
  - ✓Inventory field forms
  - ✓Sample transport form if samples will be submitted for analyses

Knowledge gaps	Recommendation hazardous inventory plan	Human resources	Equipment and collaborating agencies
• Former warehouse use • Current warehouse use	• Interview owner building / caretaker • Consult site administration • Consult management • Reveal cadaster information	• At least 1 experienced persons	• Site layout map • Drawings building with utilities in building • Collaborate with ✓ Owner /caretaker building ✓ Stakeholders
• Amounts & types of hazardous wastes used to be stored	• Consult ✓ Sit owner ✓ site administration ✓ Site management	• At least 1 experienced persons	• Site layout map • Collaborate with ✓ Owner /caretaker building ✓ Stakeholders
• Amounts & types of hazardous wastes still present	• Conduct inventory • Types • Amounts • Condition • Sample • Analyze-screen waste samples on-site • Analyze re[presentative samples	• At least 2 experienced persons inside • At least 1 experienced persons as watch outside	• Phase 1 report • Site layout map • Stationery • PPE • Photo camera • Field form ✓ Inventory forms / field PC ✓ Sample transport form ✓ Log book • Collaborate with ✓ Owner /care taker site

Hazardous waste
Inventory tasks

Make a scaled store layout plan

- North arrow
- Simple grid plan
- Legend
- Position of hazardous waste, containers, waste etc.
- Direction to nearest major road and settlements
- Location of nearest water (standpipe, stream etc.)
- Direction of photos made



Hazardous waste
Inventory tasks

Categories of stored (hazardous) waste

- **PCB / POP must be disposed as they are**
  - ✓ POPs listed in SC
  - ✓ Banned otherwise
- **PCB / POP are not only the pure product but also**
  - ✓ Visibly deteriorated or contaminated
  - ✓ Expire date has past (pesticides)
  - ✓ Not labelled
  - ✓ Empty packaging
- **Equipment containing PCB**
  - ✓ Open application
  - ✓ Closed application

Hazardous waste
Inventory tasks

Make the inventory of the stock using Standard field forms

- Large quantities in tonnes and /or m^3
- Small quantities in kg and /or litres
- Record solid or liquid or gas
- Record product information from labels
- Type size and condition of packaging
- Record if waste is mixed
- Record type and number of empty containers in m^3
- Type of closed application and number and size
- Quantities of spilled waste on the storage floor
- **Use own collected field data, not old records**

Hazardous waste

Inventory tasks

Chemical analyses required for

- Unidentified products of larger quantities*
- Old products past their shelf-life of larger quantities
- Chemical analyses on PCB of oil from closed applications

Remarks

- We are not going to sample and analyze all waste
- This will be done as part of the preparation for the repackaging and disposal

***see also Phase 1 reconnaissance survey**

Hazardous waste

Inventory tasks

Site photo report with photos of the surrounding, the waste and the labels

Hazardous waste
Inventory tasks

Report (including photo report)

- **Open and closed electrical applications**
  - ✓ Type and number
  - ✓ Quantity of oil containing PCB
  - ✓ Other material containing PCB
- **Proximity to neighboring**
  - ✓ Population
  - ✓ Water courses
  - ✓ Food stocks
  - ✓ Stables
- **Position of utilities**
  - ✓ Water wells
  - ✓ Power lines
  - ✓ Open water
- **Hazardous waste**
  - ✓ Composition / substance
  - ✓ Quantities
  - ✓ Conditions
  - ✓ Packaging
  - ✓ Analytical results
  - ✓ Location on map storage / warehouse
- **Type & condition storage**
  - ✓ Open
  - ✓ Half open
  - ✓ Closed and locked
- **Type & condition of storage floor**
  - ✓ Unpaved
  - ✓ Open pavement
  - ✓ Concrete

Contaminated building

Assessment plan

Main objectives building assessment

- Identify contaminated part(s) of the building
- Quantify the contaminated part(s) of building
- Determine type and degree of contaminated part(s) building
- Gather data to implement for risk reduction measures / clean the building

Contaminated building

Assessment plan

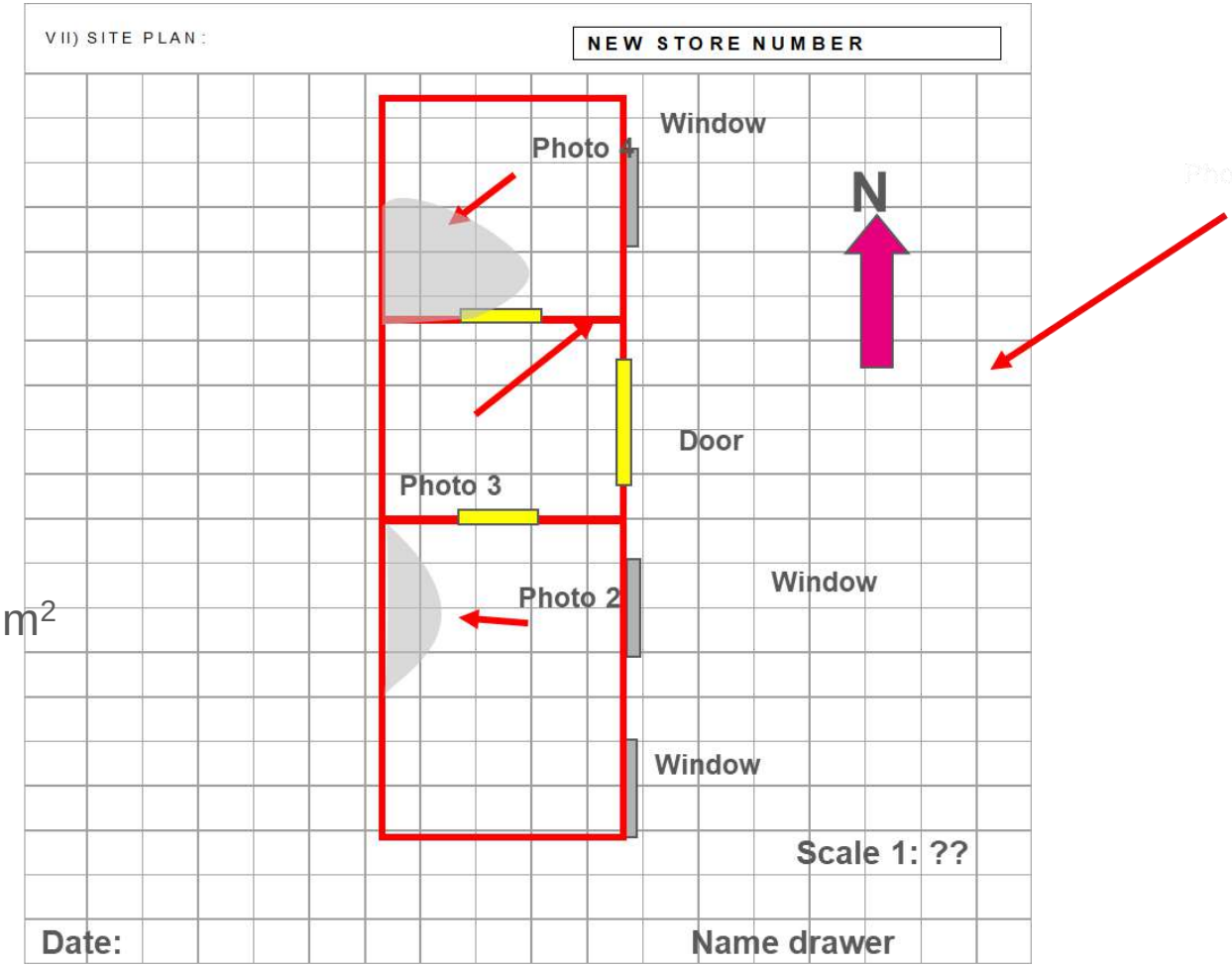
Content

- The basic information of the building
  - ✓ Address
  - ✓ Contact details
  - ✓ Accessibility
- The needed
  - ✓ PPE
  - ✓ Manpower and their qualifications
  - ✓ Sampling materials
  - ✓ Equipment
- Detailed planning
- A scaled map with
  - ✓ An arrow indicating the North
  - ✓ The location of the contaminated building(s)
- The necessary field forms
  - ✓ Logbook
  - ✓ Sample transport form if samples will be submitted for analysis

Knowledge gaps	Recommendation contaminated building assessment plan	Human resources	Equipment and collaborating agencies
• Former use of building • Current use of building	• Interview owner building / caretaker • Consult site administration • Consult management • Reveal cadaster information	• At least 1 experienced persons	• Site layout map • Drawings building with utilities in building • Collaborate with ✓ Owner / caretaker building ✓ Stakeholders
• Type contaminated parts (floors and walls of rooms/ warehouse) • Material(s) of contaminated parts(s) • Degree & extent of contaminated part(s) building	• Measure contaminated parts • Take samples from floors and walls • Analyze samples	• At least 2 experienced persons inside • At least 1 experienced persons as watch outside	• Site layout map • Drawings building with utilities in building • PPE • Photo camera • Stationeries • Field form ✓ Building assessment form ✓ Sample transport ✓ Logbook • Collaborate with ✓ Owner /caretaker building

Contaminated building
Assessment tasks

- **Make a scaled drawing of the building**
  - ✓ North arrow
  - ✓ Legend
  - ✓ Indicate the contaminated parts
  - ✓ Direction of photos made
- **Assess whether the building is contaminated**
  - ✓ Contaminated spot on the floors and walls in m^2
    - Type building material
    - Estimate infiltration depth
  - ✓ Remaining part contaminated in m^3
    - Doors and window panels and frame
    - Beams and rafters



Contaminated building
Assessment tasks

Building photo report with photographs of the contaminated part(s) of building(s)






Contaminated building
Assessment tasks

Report (including photo report)

- **Type & condition building from the outside**
  - ✓ Walls intact / broken
  - ✓ Roof intact / broken
  - ✓ Doors intact / locked / open / broken
  - ✓ Window intact / locked / open / broken
  - ✓ Signs of contamination
- **Type & condition building from the inside**
  - ✓ Storage room(s) door(s) intact / locked / open / broken
  - ✓ Window(s) intact / locked / open / broken
  - ✓ Roof intact / broken
  - ✓ Walls intact / broken
  - ✓ Signs of contamination
- **Type & condition of floor**
  - ✓ Unpaved
  - ✓ Open pavement intact / broken
  - ✓ Concrete intact / broken
  - ✓ Wood intact / broken
  - ✓ Signs of contamination
- **Observations**
  - ✓ Sampling point logs
  - ✓ Map building with sampling points
  - ✓ Samples taken and analyzed with analytical reports

Pit with hazardous waste

Pit survey plan

Main objectives pit survey

- Determine the exact location and extent (horizontal & vertically) of the pit / bunker
- Estimate the amount buried in the pit / bunker
- Determine type of chemicals buried in the pit / bunker
- Gather data to implement risk reduction measures / excavation, packaging and disposal

Pit with hazardous waste

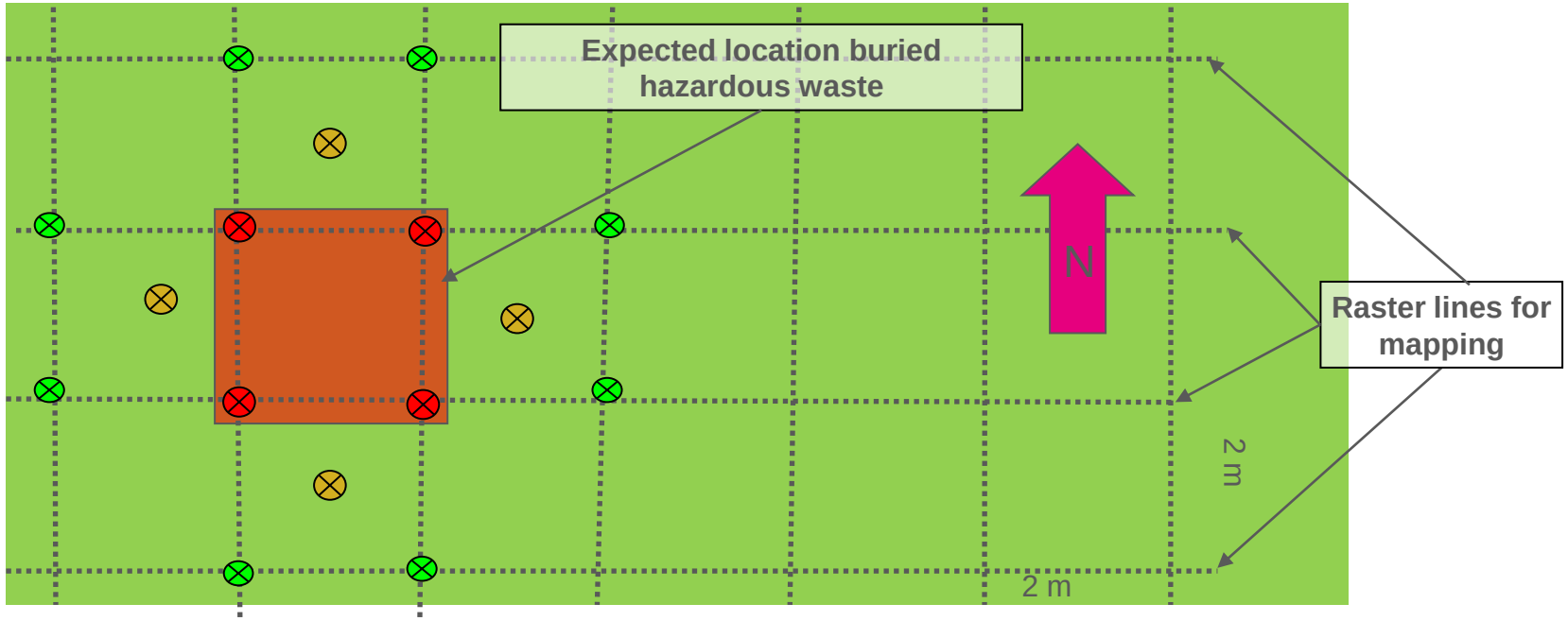
Pit survey plan

Content

- The basic information of the pit or bunker
  - ✓ Address
  - ✓ Contact details
  - ✓ Accessibility
- The needed
  - ✓ PPE
  - ✓ Manpower and their qualifications
  - ✓ Sampling materials
  - ✓ Equipment
- Detailed planning
- A scaled map with
  - ✓ North arrow
  - ✓ legend
  - ✓ Expected location of the pit / bunker
  - ✓ Proposed sample locations
- The necessary field forms
  - ✓ Logbook
  - ✓ Bore logs
  - ✓ Sample transport form if samples will be submitted for analysis
- Analysis
  - ✓ Number of samples buried waste

Pit with hazardous waste

Pit survey plan



- Borehole for mapping in horizontal direction
- Borehole for detailed mapping in horizontal direction
- Borehole for mapping in horizontal and vertical direction

Knowledge gaps	Recommendation pit survey plan	Human resources	Equipment and collaborating agencies
• Former site use • Current site use	• Visit site • Interviews	• At least 1 experienced persons	• Site layout map • Site layout map with underground utilities • Collaborate with ✓ Site owner / site caretaker ✓ Stakeholders
• Dimension of the pit / bunker • Construction of pit / bunker • Types of waste dumped • Concentration waste • Amount of waste • Situation leakage / infiltration	• Measure dimensions of visible signs on the surface • Installing boreholes outside the pit / bunker to confirm hor. extent • Install at least 1 borehole in pit / bunker to establish depth / vert. extent • Install wells upstream and downstream • Take samples and analyze samples • Describe soil profile and wells on bore logs • Take samples & mark on site location map • Analyze samples. • Field work order is from clean to contaminated ✓ Surrounding ✓ Mapping ✓ Inside	• Trained fieldwork team of at least 3 persons	• PPE • Photo camera • Stationery • Map surrounding • Site location map • Map underground utilities • Drilling & sampling equipment • Monitoring well materials • Sampling containers & labels • Land surveying equipment Collaborate with • Site owner / site caretaker

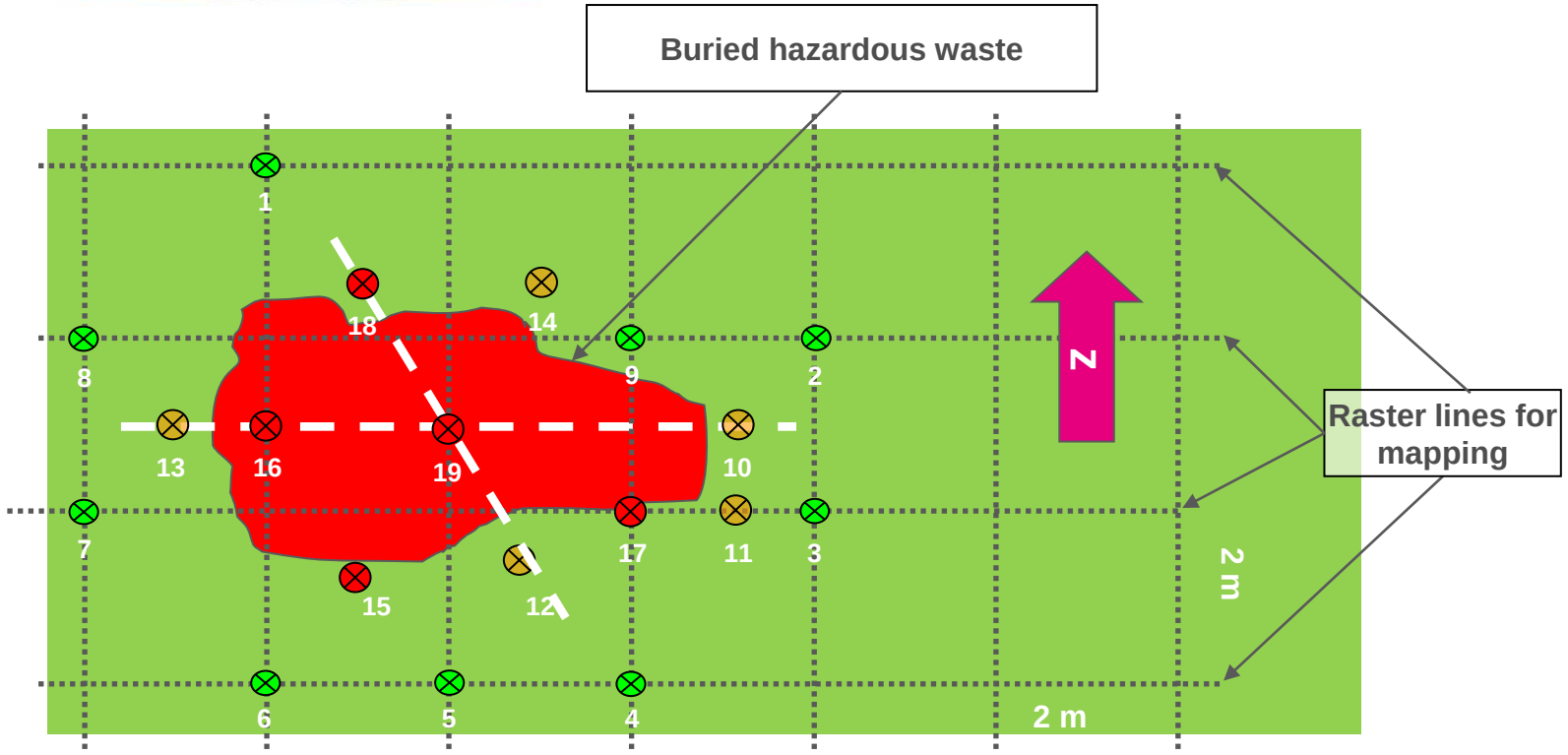
Pit with hazardous

Tasks pit survey

- Determine the pit location
  - Install boreholes in a grid of for instance 2 x 2 meters
  - Describe soil cuttings on bore logs max 0.5-meter intervals
  - Check for visual presence of pesticides and/or packaging material
- Make scaled site layout map with
  - North arrow
  - Legend
  - Installed boreholes
  - Contour of pit / bunker
- Take photos
  - Location with pit / bunker
  - Boreholes

Pit with hazardous

Tasks pit survey

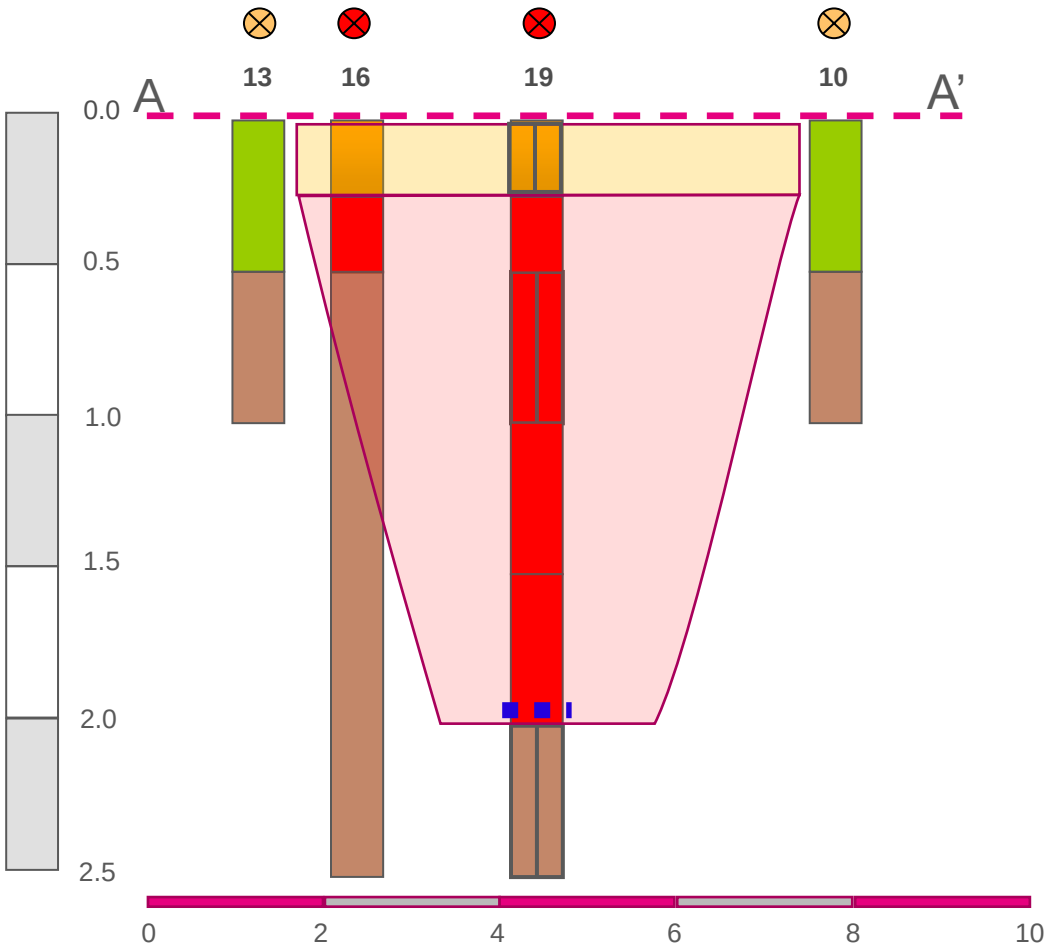


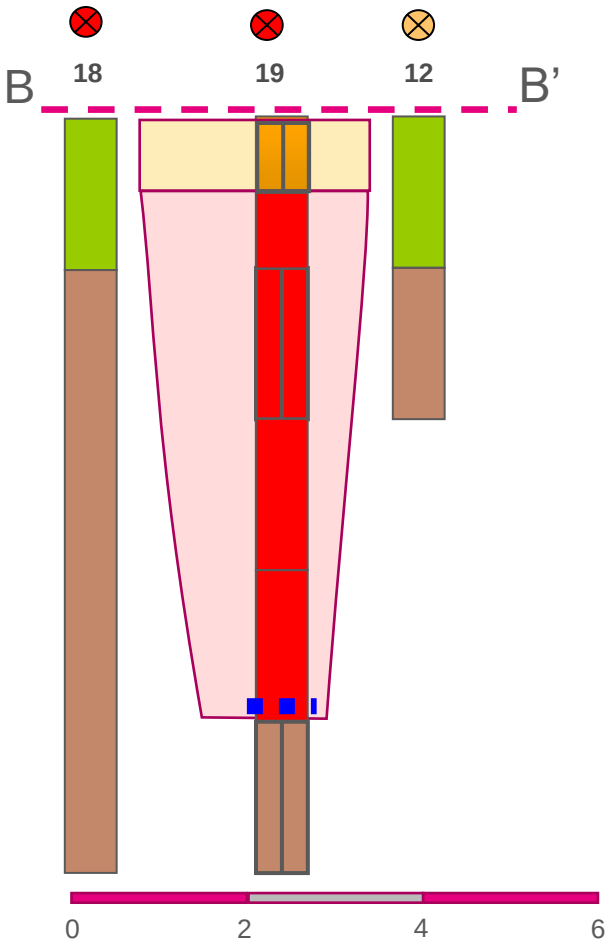
- Borehole for mapping in horizontal direction
- Borehole for detailed mapping in horizontal direction
- Borehole for mapping in horizontal and vertical direction

Pit with hazardous

Tasks pit survey

Bore logs installed boreholes





Undisturbed topsoil

Disturbed topsoil

Undisturbed subsoil

Pesticides and pesticides waste

Groundwater

Sample

Pit with hazardous

Tasks pit survey

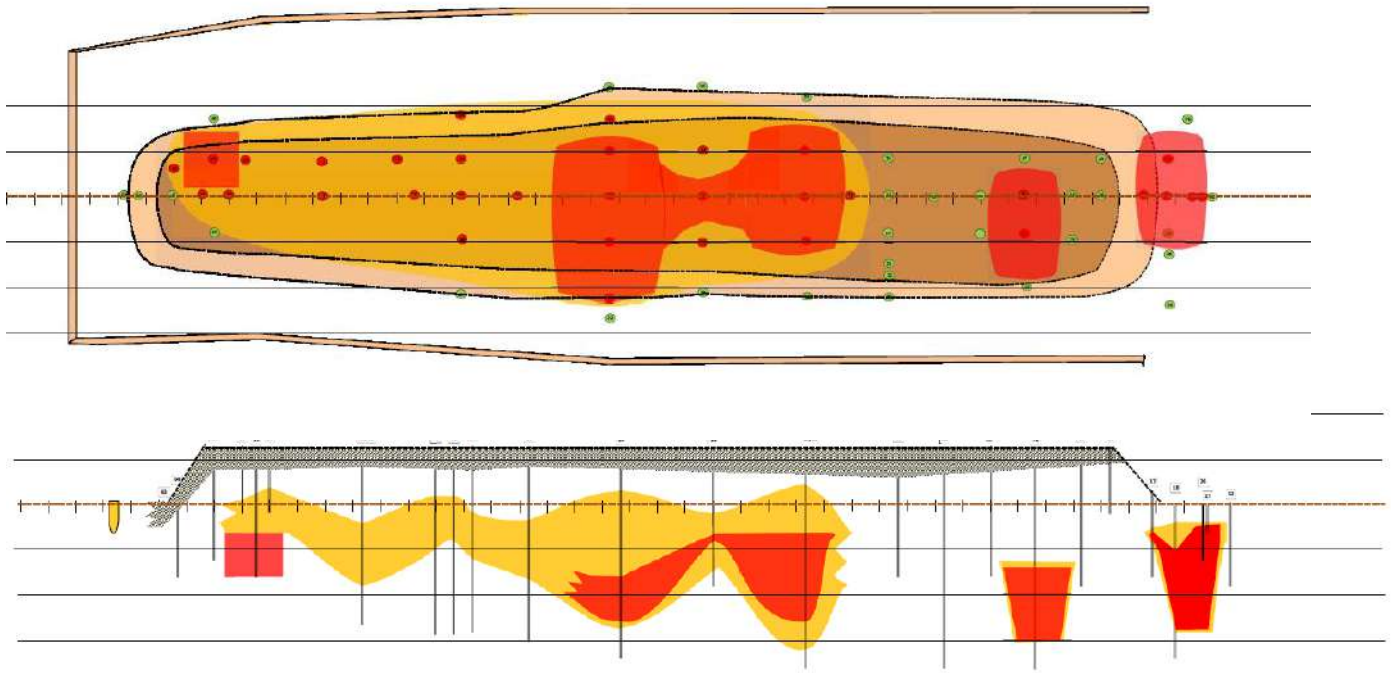
Photo report of the site with buried pesticides

Pit with hazardous

Tasks pit survey

Report (including photo report)

- **Location and dimension pit**
  - ✓ Description of location in the landscape
  - ✓ Length, width and depth
  - ✓ Type and quantity waste
- **Type & condition pit**
  - ✓ Lined or not and if walls intact / broken
  - ✓ Capped or not and intact / broken
  - ✓ Floored or not and intact / broken
- **Observations**
  - ✓ Bore logs
  - ✓ Site location map with boreholes
  - ✓ Samples taken and analyzed with analytical reports



Contaminated soil and groundwater

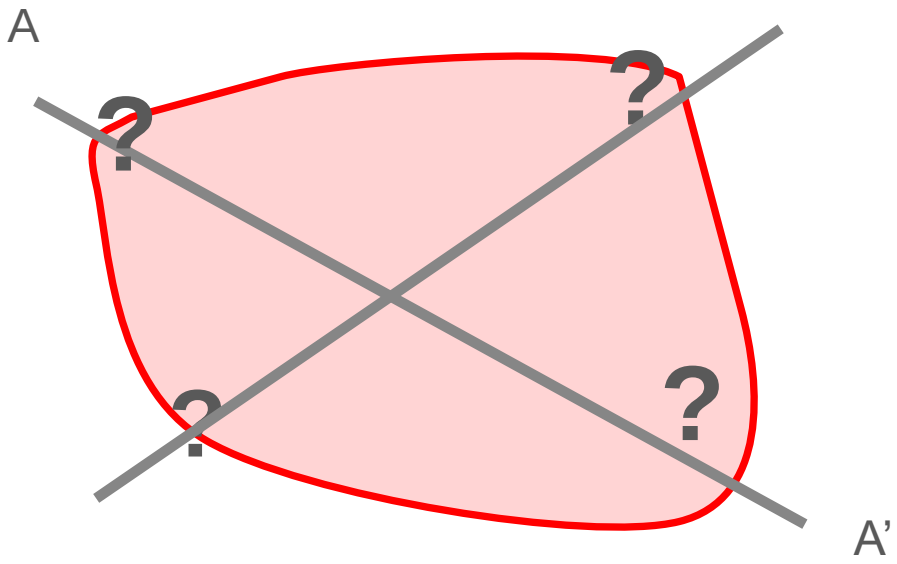
Sampling & analyses plan

Main objectives soil and groundwater survey

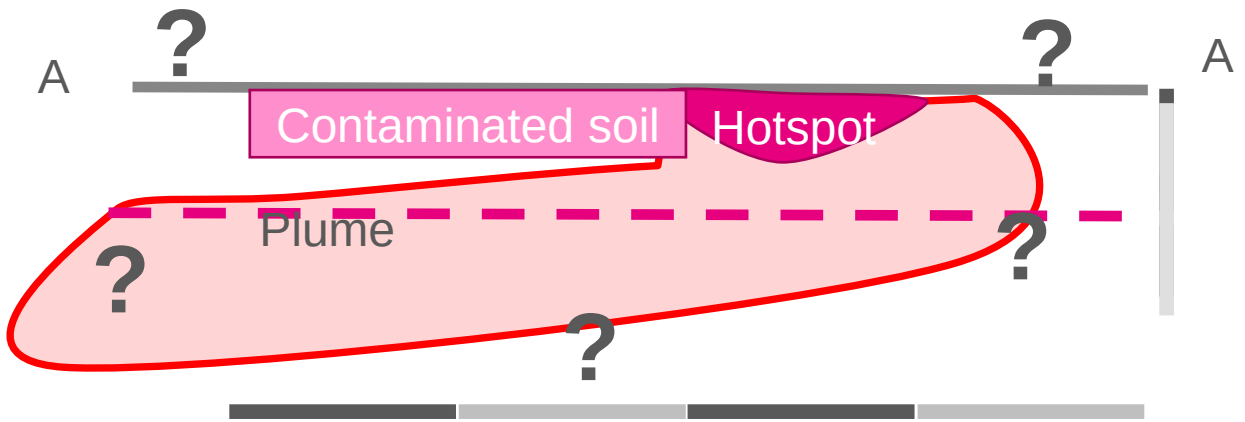
- Determine the exact location and extent (horizontal & vertically) of the contaminated soil and groundwater
- Estimate the amount contaminated soil and groundwater
- Determine type and degree of contaminated soil and groundwater
- Gather data to implement risk reduction measures / soil and groundwater remediation

Contaminated soil and groundwater

Sampling & analyses plan



What is the difference in the survey plan if the expected width of the contaminated soil is 500 meter instead of 50 meters?



What is the difference in the survey plan if the groundwater is 20 meters deep instead of 2 meters?

The scale of the soil and groundwater survey must to be established first!

Contaminated soil and groundwater

Sampling & analyses plan

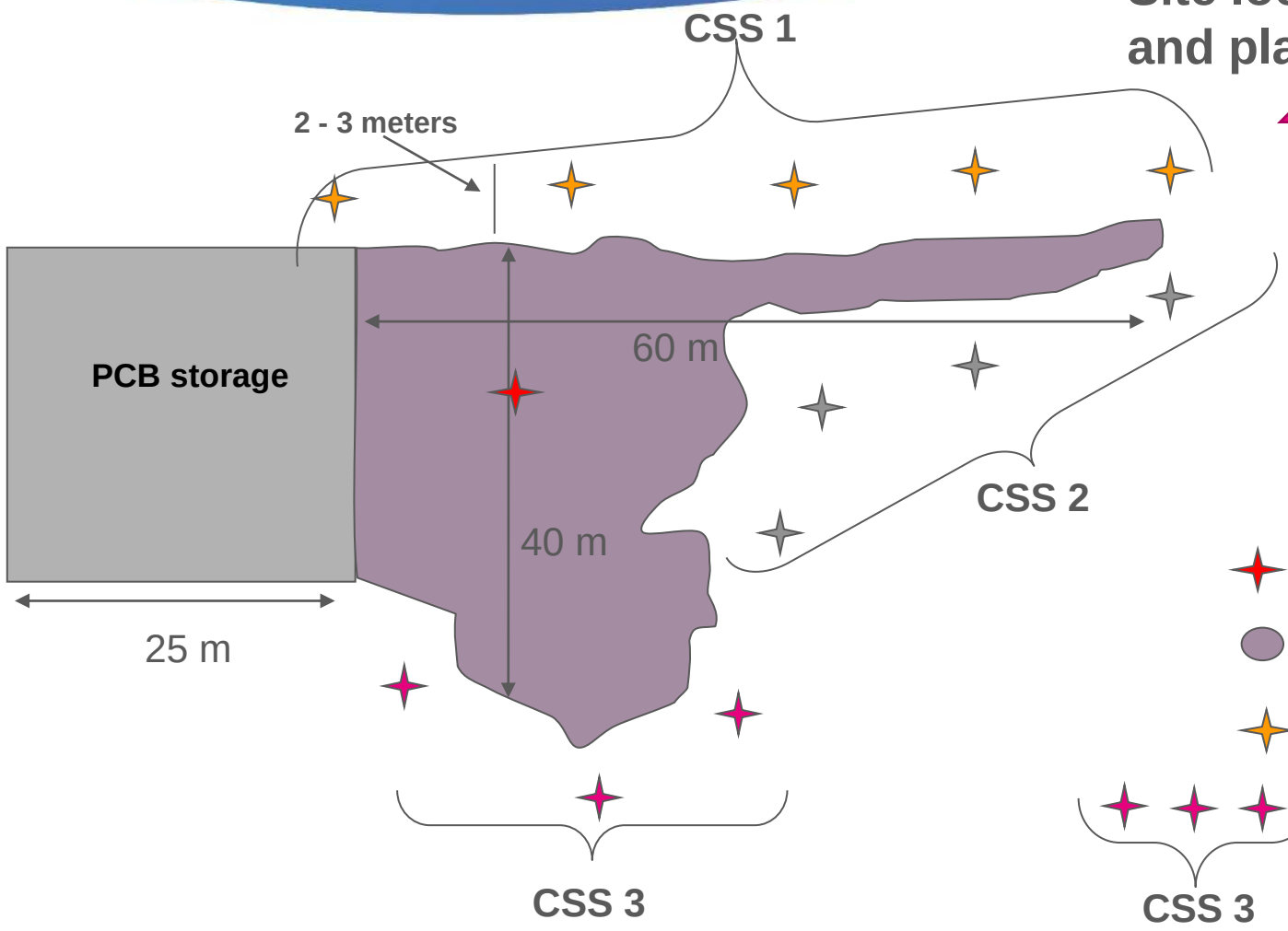
Content

- The basic site information
  - ✓ Address
  - ✓ Contact details
  - ✓ Accessibility
- The needed
  - ✓ PPE
  - ✓ Manpower and their qualifications
  - ✓ Sampling materials
  - ✓ Equipment
- Detailed planning
- A **scaled** map with
  - ✓ An arrow indicating the North
  - ✓ Legend
  - ✓ Expected location of the source area
  - ✓ Expected location of the contaminated soil and groundwater
- Proposed soil and groundwater sample points
- The necessary field forms
  - ✓ Logbook
  - ✓ Bore logs
  - ✓ Sample transport form
- Analysis
  - ✓ Number of soil and groundwater samples
  - ✓ The components to be analyzed

Contaminated soil and groundwater

Sampling & analyses plan

Site location map with source area / hotspot and planned boreholes



Borehole used for individual sampling of hotspot

Sings of spilled oil containing PCB / hotspot

Borehole used for individual sampling

Composite soil samples made from 3 individual samples

Contaminated soil and groundwater

Sampling & analyses plan

- Dutch authority have guidelines for standard soil surveys

- NEN 5740 VED-HE (strategy: heterogenous, possibly contaminated)

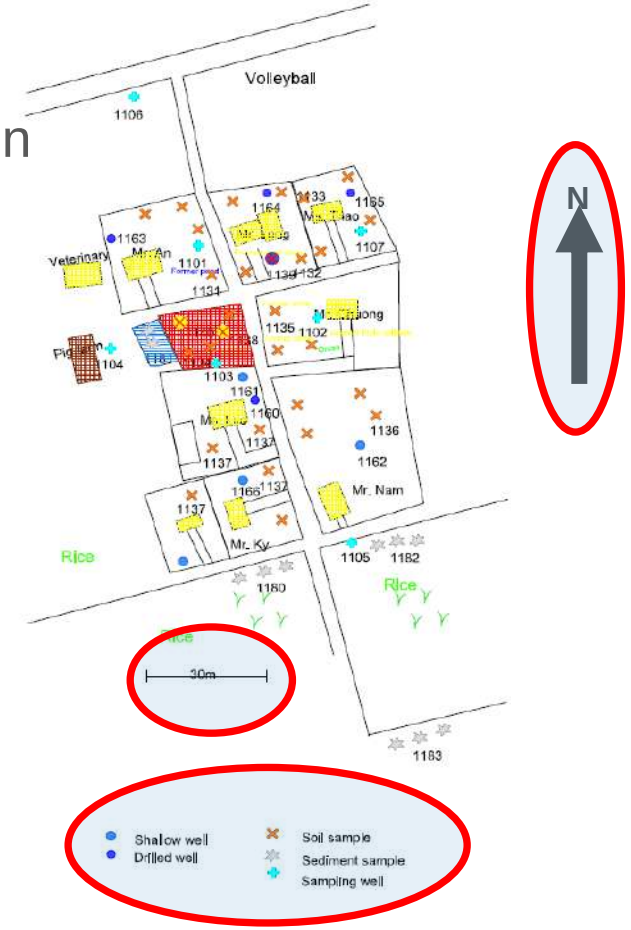
Oppervlakte locatie	Aantal boringen			Aantal te analyseren mengmonsters	
ha	Boring tot 0,5 m in de verdachte laag	Boring tot de onderzijde van de verdachte laag met een maximum van 2 m	Boring met peilbuis [a,b]	Grond (verdachte laag)	Grondwater [b]
< 0,01	2	1	1	1	1
0,01 ≤ 0,05	3	1	1	2	1
0,05 ≤ 0,10	5	1	1	3	1
0,10 ≤ 0,15	7	1	1	3	1
0,15 ≤ 0,20	10	2	1	3	1
0,20 ≤ 0,30	11	2	1	3	1
0,30 ≤ 0,40	12	2	1	3	1
0,40 ≤ 0,50	14	3	1	3	1
0,50 ≤ 0,70	15	3	1	3	1
0,70 ≤ 0,90	17	4	2	4	2
0,90 ≤ 1,0	18	4	2	4	2
2	27	6	3	6	3
3	36	8	4	8	4
5	54	12	6	12	6
10	99	22	11	22	11
p [c]	$9 + 9p$	$2 + 2p$	$1 + 1p$	$2 + 2p$	$1 + 1p$

Knowledge gaps	Recommendation investigation	Human resources	Equipment and collaborating agencies
• Past & present site layout • Past & present site use	• Site visit • Interviews • Consult site administration	At least 1 experienced persons	• Questionnaires & interviewees • Map surrounding • Site location map • Stationery Collaborate with • Local authorities • Site owner / site caretaker
• Past & present layout surrounding area • Past & present use surrounding area	• Visit site surrounding • Interviews		
• Geo-hydrological information • Local climatic conditions	• Collect information from relevant authority • Consult reports, websites and literature	1 trained person	• Local authorities • Local institutes
• Baseline surrounding soil, groundwater & surface water	• Sample soil, groundwater & surface water • Analyze samples	Trained fieldwork team of at least 3 persons	• Site owner(s) / site caretaker(s) • Local authorities
• Groundwater level on-site • Groundwater flow direction on-site	• Determine slope of the area. • Install groundwater monitoring wells • Survey well heads • Measure groundwater levels • Determine flow direction		• PPE • Photo camera • Stationery • Map surrounding • Site location map • Map underground utilities • Drilling & sampling equipment • Monitoring well materials • Sampling containers & labels • Land surveying equipment Collaborate with • Site owner / site caretaker
• Type, degree and extent (vert & hour) source area(s) • Type, degree and extent (vert & hor) of the contamination in soil and groundwater	• Install boreholes and wells, • Describe soil profile and wells on bore logs • Take samples & mark on site location map • Analyze samples. • Field work order is from clean to contaminated ✓ First baseline ✓ Second from the soil and groundwater ✓ Last from source area(s)		

Contaminated soil and groundwater

Tasks soil and groundwater survey

- Locate the source area(s) and suspected area of contamination
- Install boreholes and monitoring wells
- Describe soil cuttings on bore logs max 0.5-meter intervals
- Make scaled site layout map with
  - ✓ North arrow
  - ✓ Legend
  - ✓ Installed boreholes and monitoring wells
  - ✓ Contour of source area
- Take photos
  - ✓ Location source area(s)
  - ✓ Suspected area(s) contamination
  - ✓ Boreholes and monitoring wells



Contaminated soil and groundwater

Tasks soil and groundwater survey

Bore logs installed boreholes

- Project number
- Project title
- Drilling order number
- Name of foreman driller
- Date of execution
- Number of sampling point
- Number of samples taken, and sampling section
- Added quantities of working water (in liters), and the EC measured in the working water
- Groundwater level (in cm in relation to ground level)
- Clean pumping volume
- Depths of the bottoms of the various soil layers
- Texture of the various soil layers
- Details on the various soil layers, including the estimated quantities
- Odors given off by the various soil layers
- Colors of the various soil layers
- Boring systems used (including the use of lost casings)
- Result of the use of an oil detection pan
- Depth of the filter's bottom expressed in cm bgl (at monitoring well)
- Groundwater EC

Example bore logs

Contaminated soil and groundwater

Tasks soil and groundwater survey

Consideration

- Mapping team includes all needed experts
  - ✓ Soil technician
  - ✓ Fieldworker
  - ✓ Team leader
  - ✓ Decision making process well-defined
  - ✓ Decision making power in the field

Mapping

- Mapping scale / mapping detail agreed upon
  - ✓ Soil + 10 meters
  - ✓ Groundwater + 20 meters
- Soil type knows
  - ✓ Potential pathways
  - ✓ Tracer or indicator of presence of contaminants
- Max depth soil profile influenced
- Max depth of groundwater influenced

Contaminated soil and groundwater

Tasks soil and groundwater survey





Photo report soil & groundwater survey

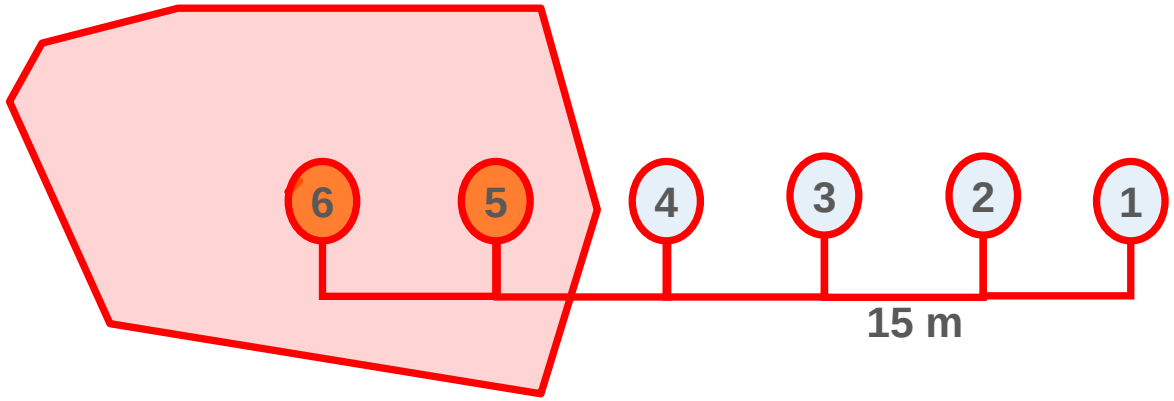



Contaminated soil and groundwater

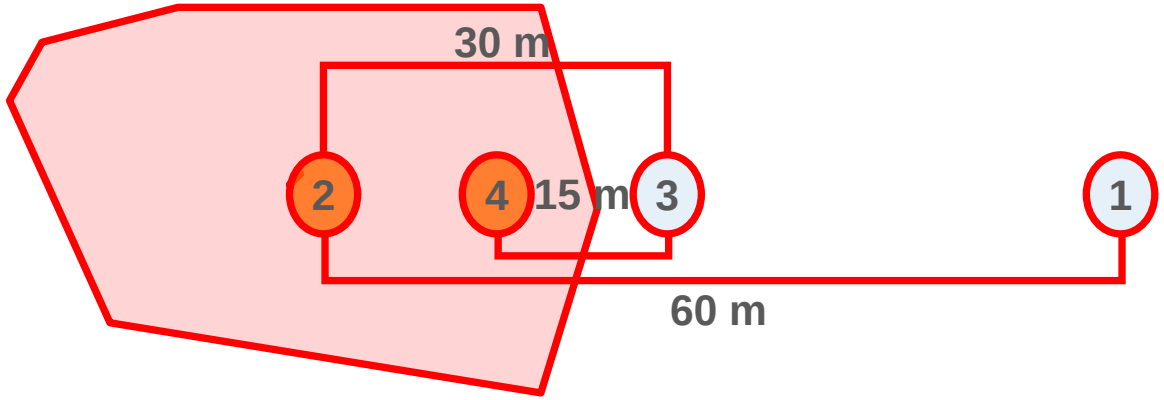
Tasks soil and groundwater survey

Mapping methods

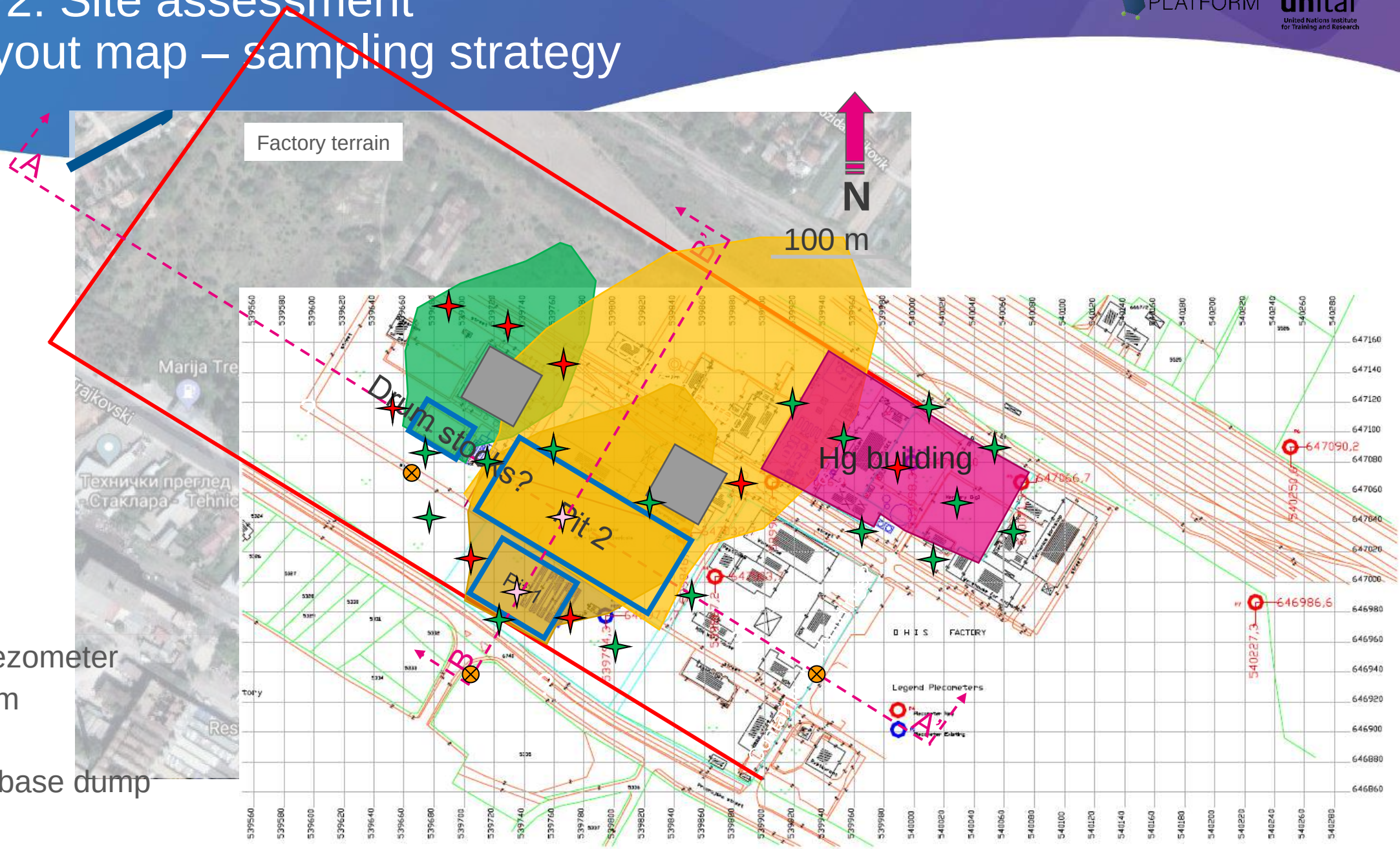
Sampling in a grid



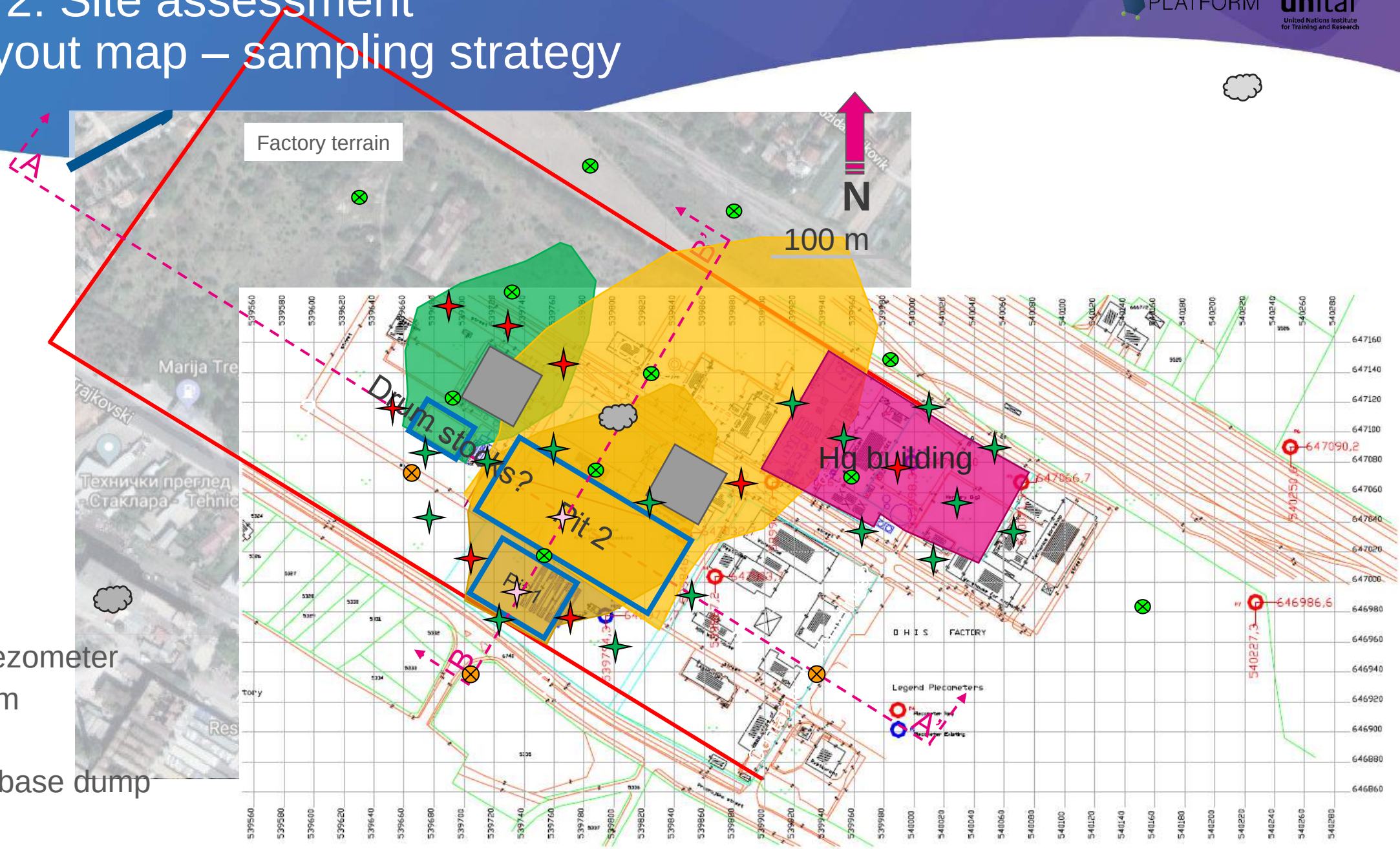
Dynamic work plan



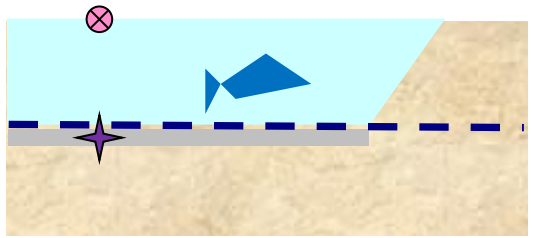
Phase 2: Site assessment
Site layout map – sampling strategy



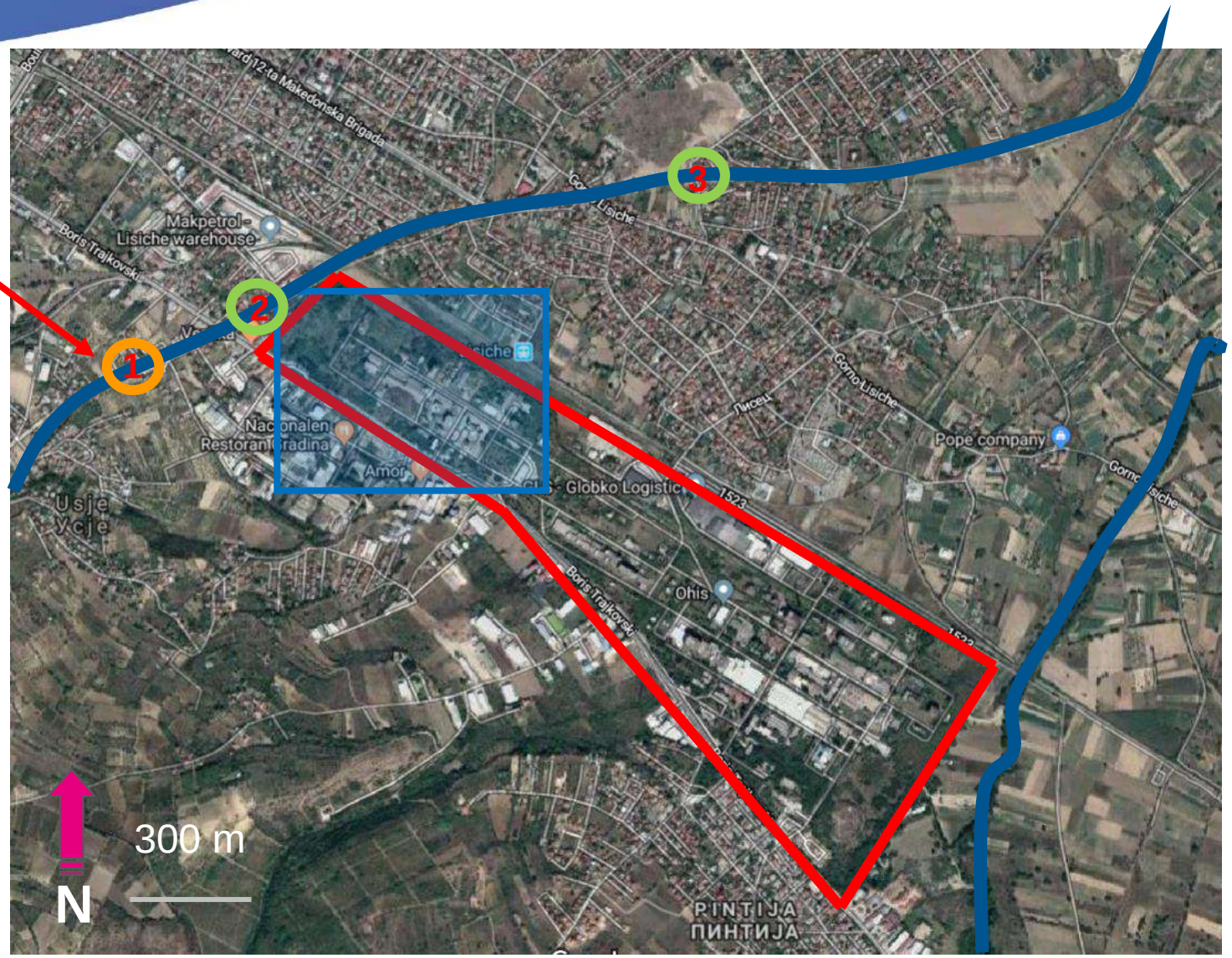
Phase 2: Site assessment
Site layout map – sampling strategy



Phase 2: Site assessment
Site layout map – sampling strategy

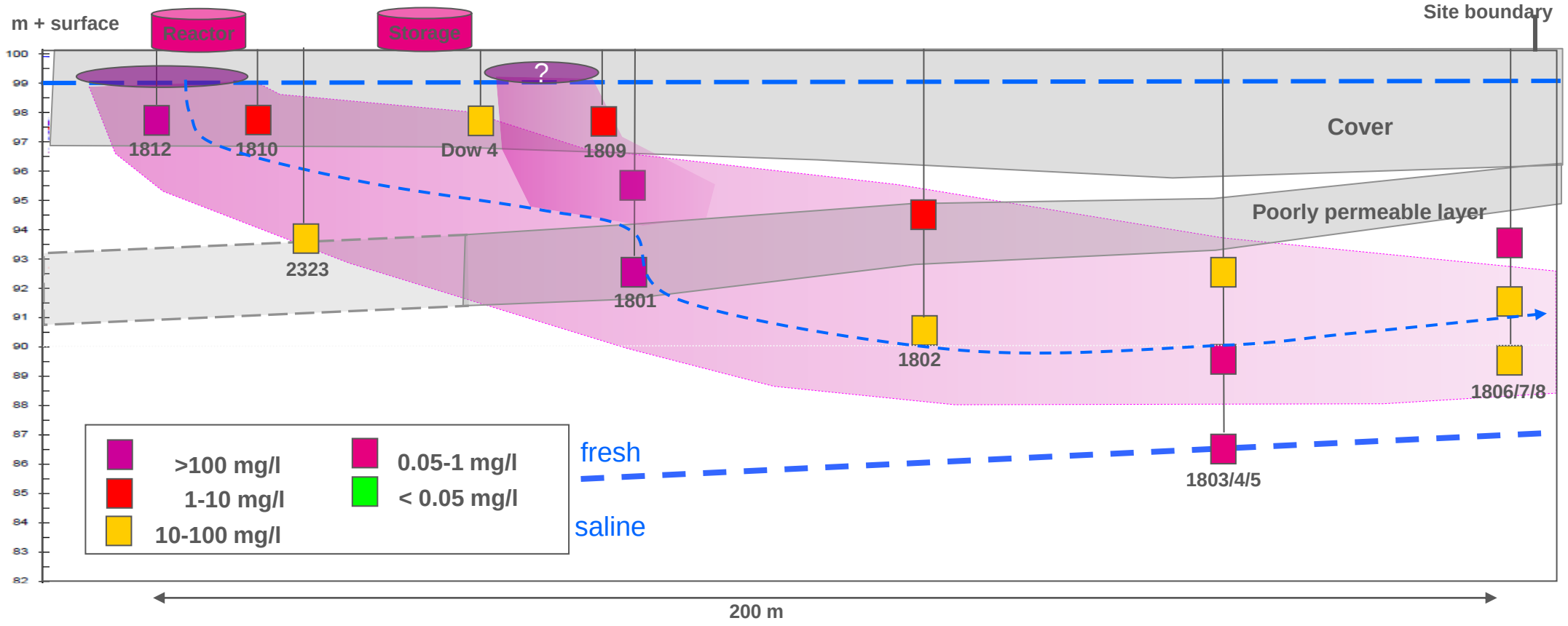


- Bottom sediment sample
- Surface water sample



Results soil & groundwater survey

Results soil & groundwater survey



Questions?

Contact

Thank you for your attention

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