



# Archaeological investigations of the Hollandse Kust (noord) Wind Farm Zone

ROBERT VAN LIL



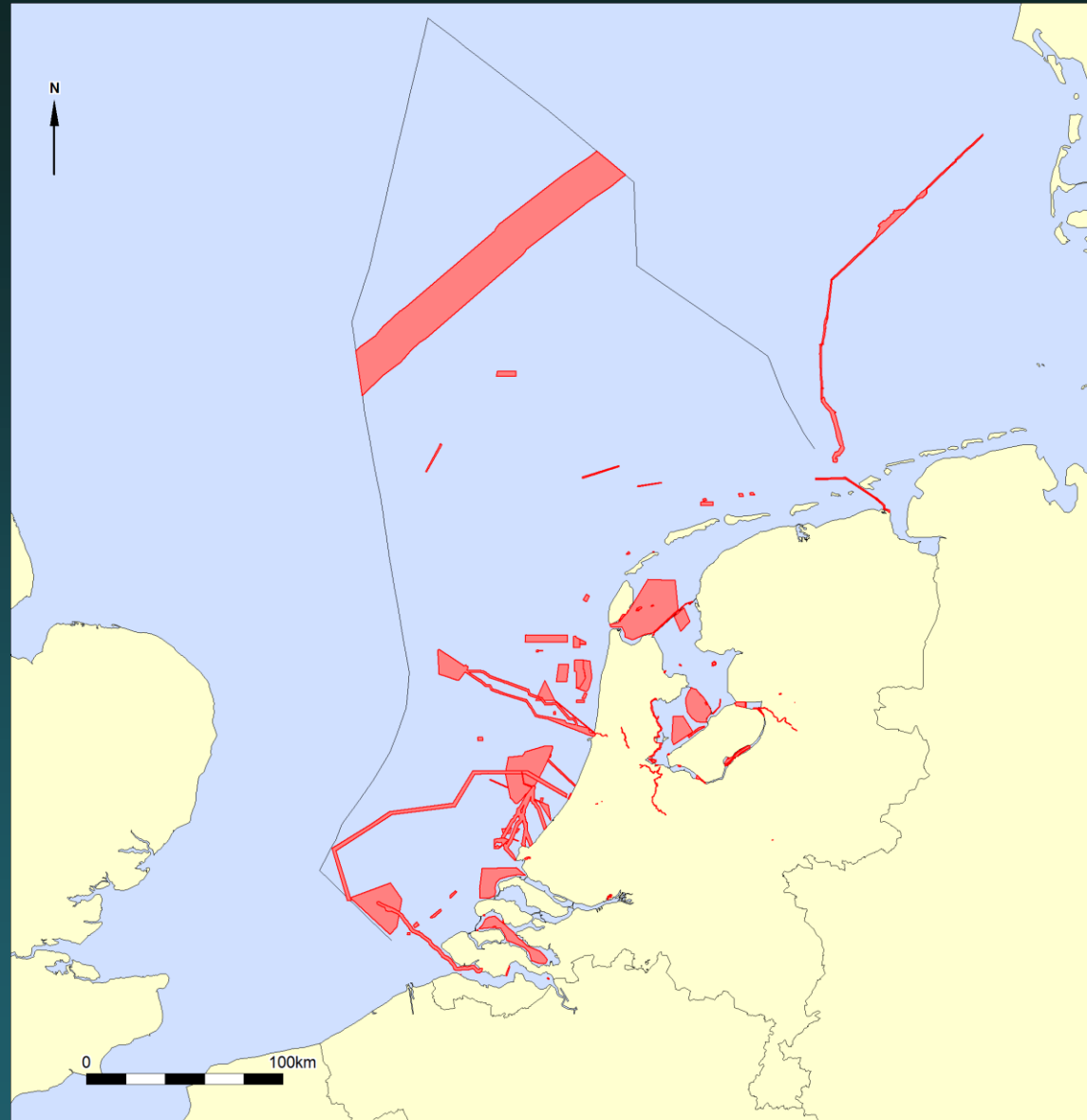
# Company profile



Office in Amsterdam

Founded in 2005

> 200 projects



# Introduction

- Archaeology and legislation
- Desk study
- Assessment geophysical survey
- Summary and conclusions

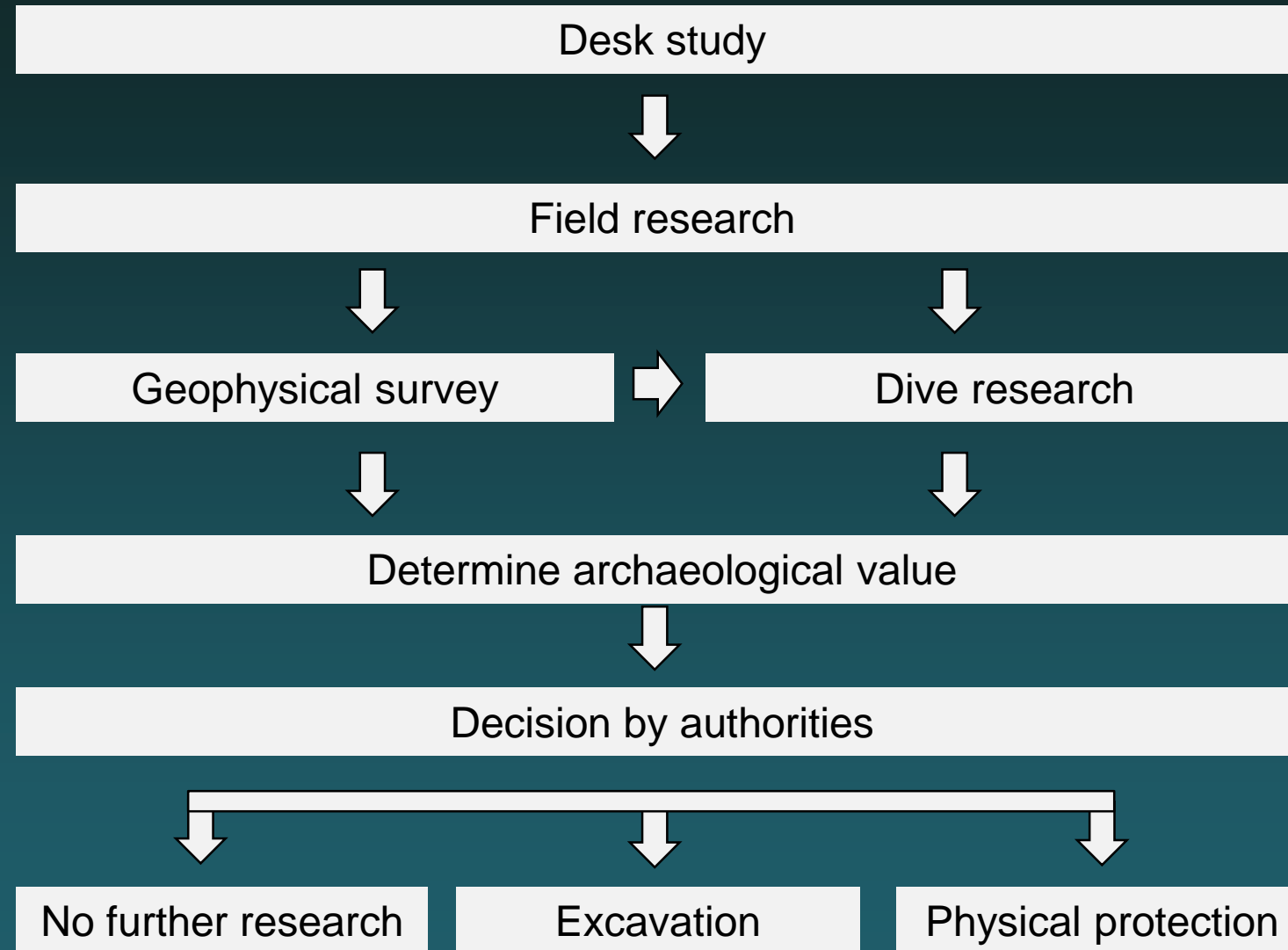
# Archaeology and legislation

Dutch legislation - Heritage Act (Erfgoedwet) 2016:

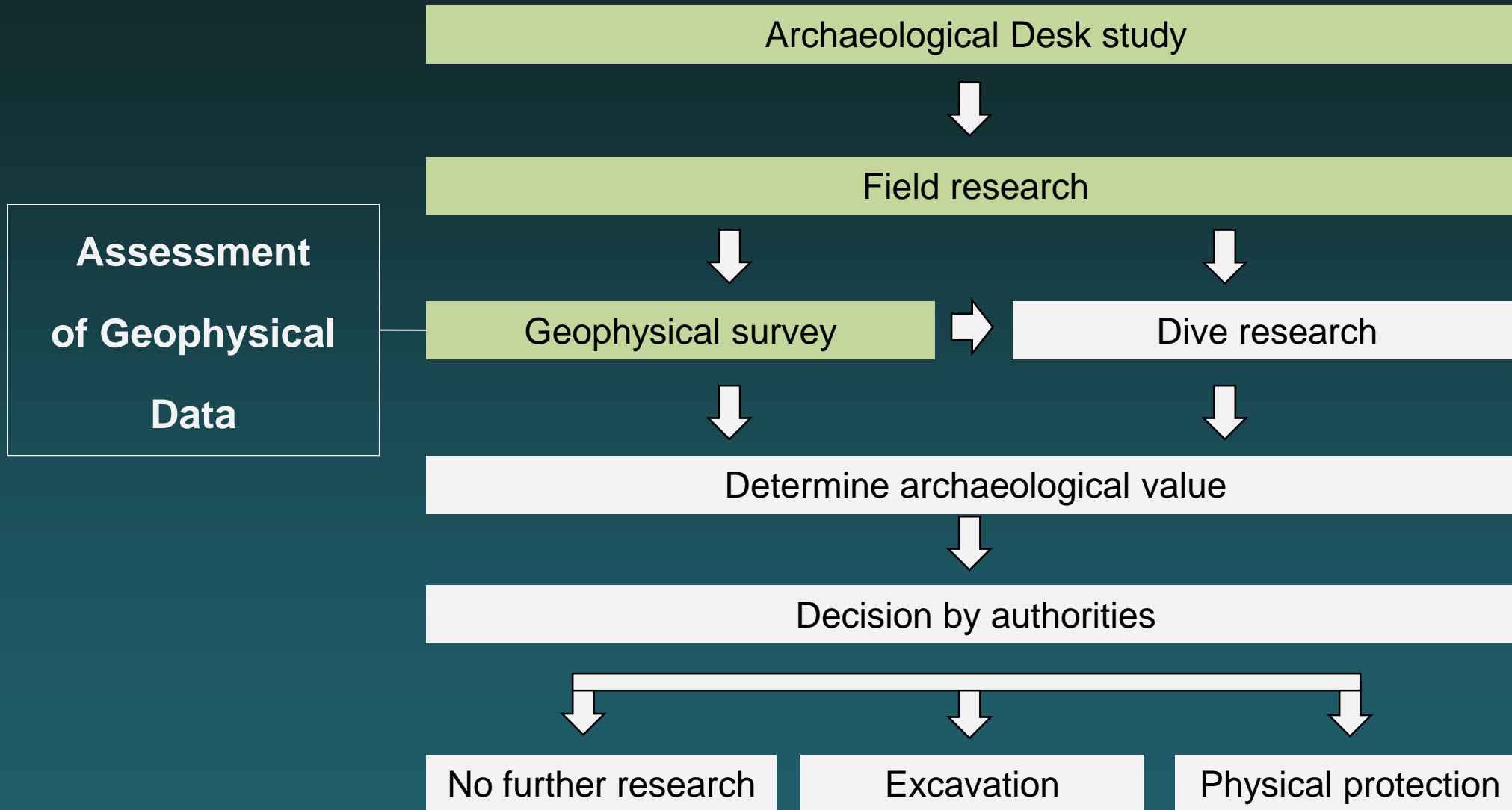
‘... strive to preserve archaeological remains *in situ* ...’

- If (possible) remains could be affected by activities:  
avoid locations or obligation to conduct additional  
research

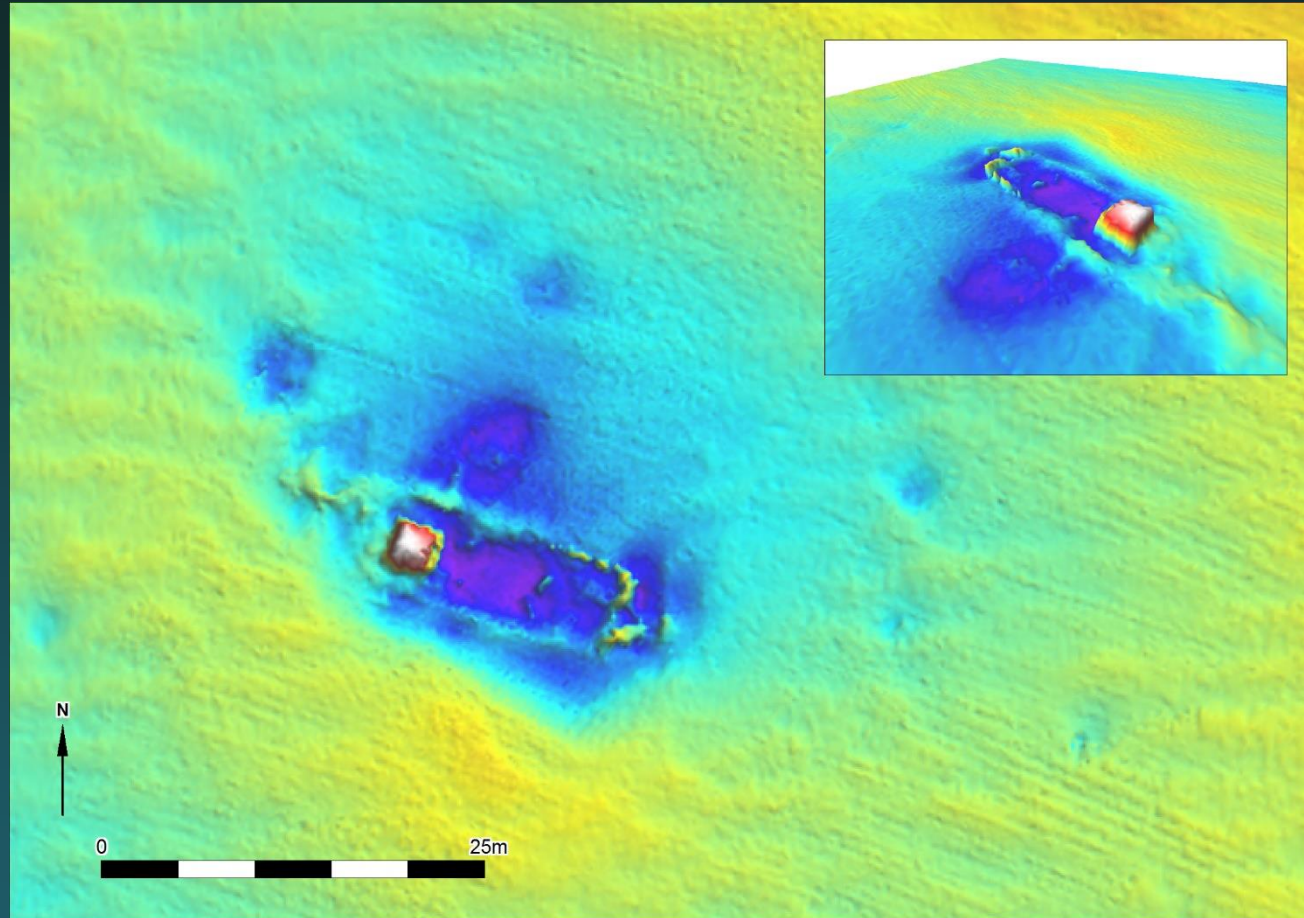
# Archaeology and legislation



# Archaeology and legislation



# General example



Unidentified ship wreck → Assumption: archeological value

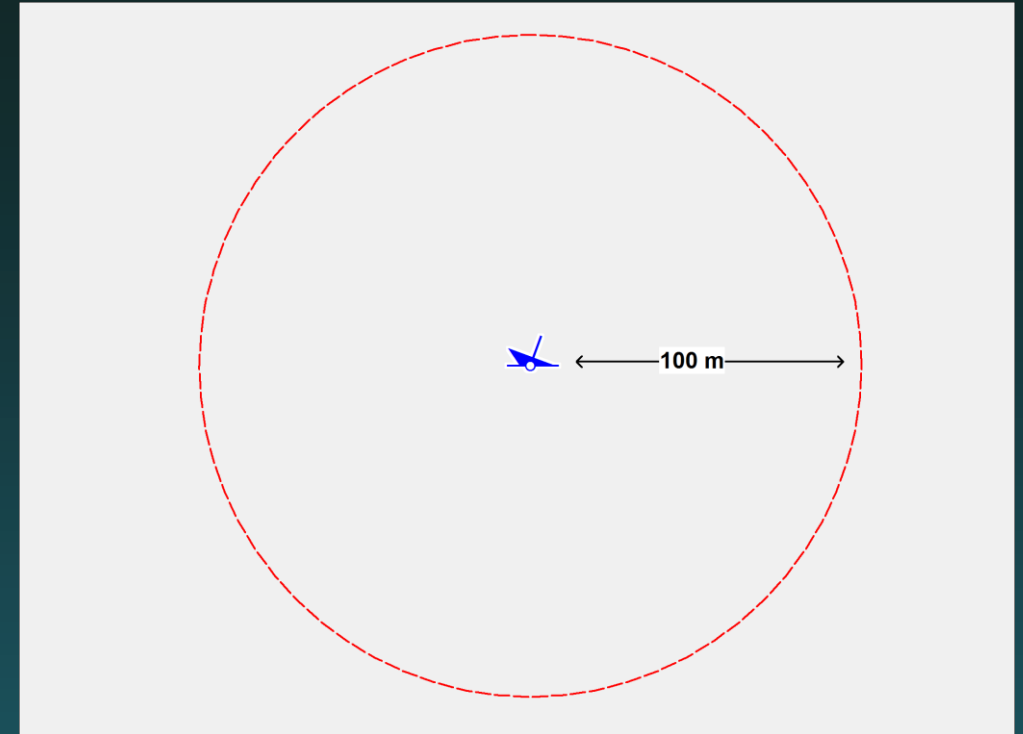
# General example

## Recommendation:

Avoid location (including a bufferzone of 100m)

or

Prove that site has no archaeological value  
(additional research)



Legal base:

Policy Rules for Earth Removal in National Waters  
(Beleidsregels ontgroningen in rijkswateren)

Heritage Act (Erfgoedwet)



# Archaeological Desk Study 2017

## Gather information on:

- current use of the area
- historical situation and possible disturbances
- known archaeological features and objects
- geological setting

## Result:

- specific archaeological expectation

# Archaeological Desk study 2017

HKNWFZ 304 km<sup>2</sup>  
Research Area 391 km<sup>2</sup>



# Bathymetry

## Water depth

Min 15.0 m LAT

Max 34.5 m LAT

Avg. 22.6 m LAT

## Morphology

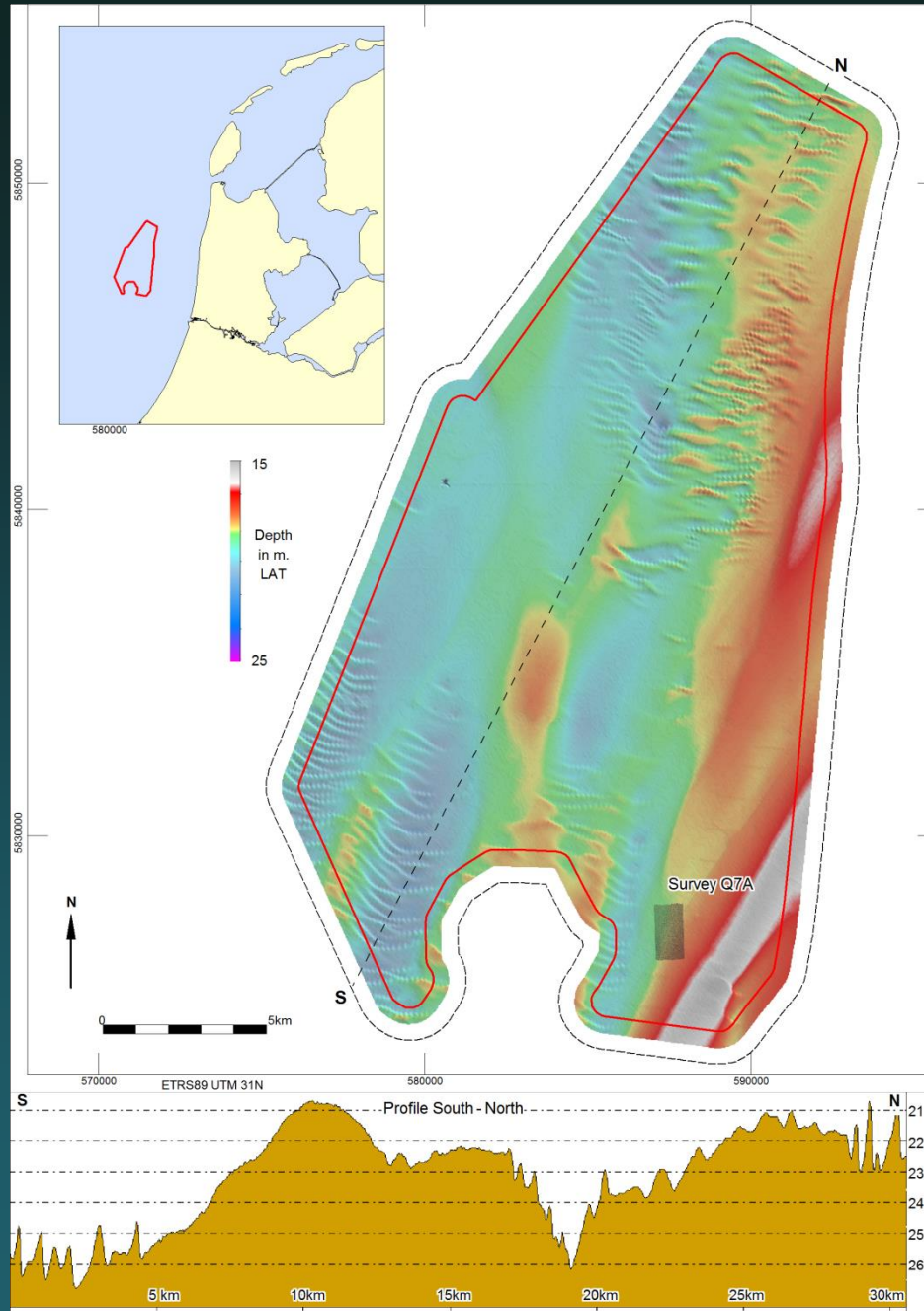
Ridges SSW – NNE

Height: 4m

Sand dunes WNW – ESE

Wavelength 500m; height 3m

Migration 2-4m NE direction





# Previous Research

All conducted by  
Periplus Archeomare



# Known disturbances

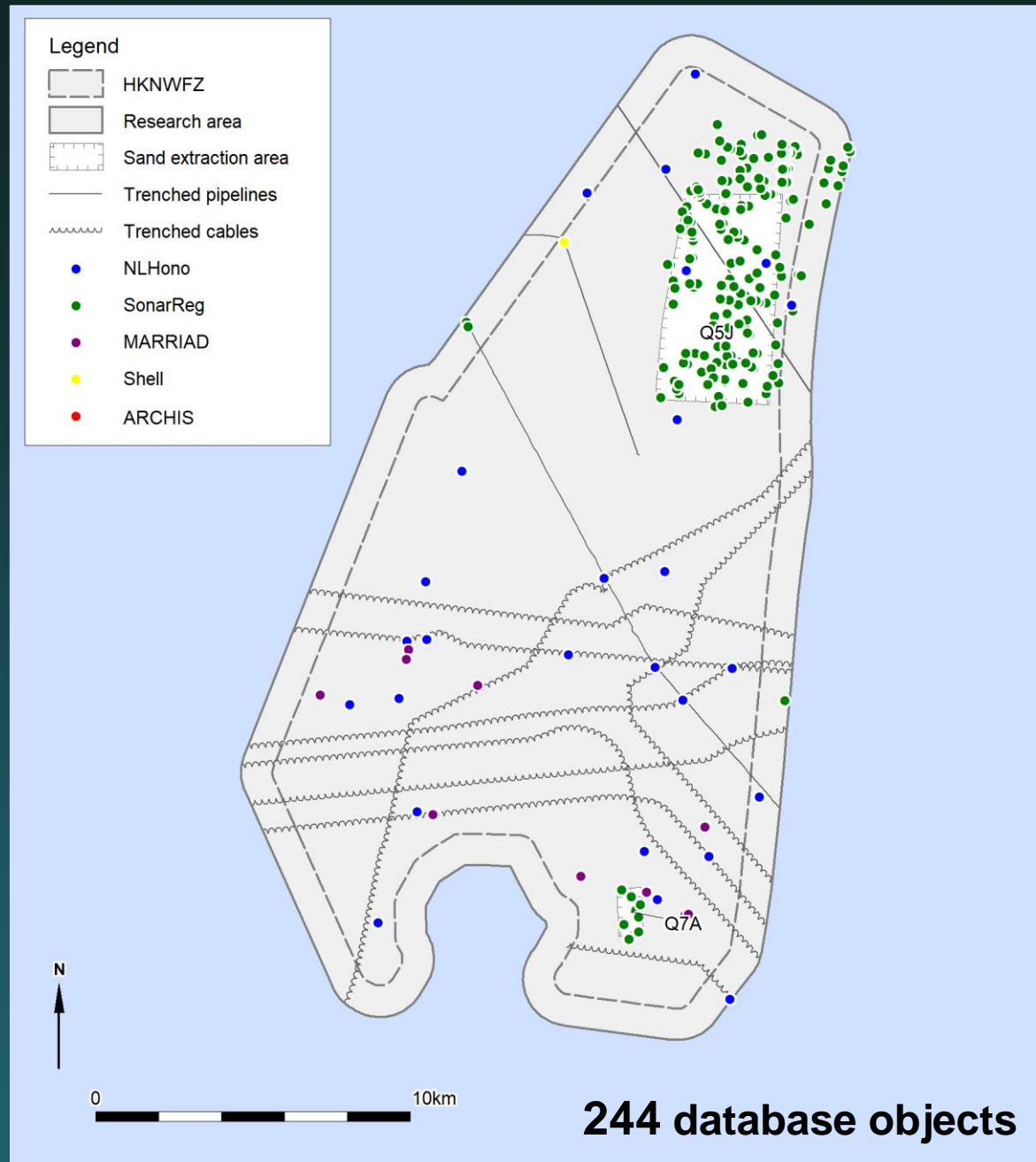
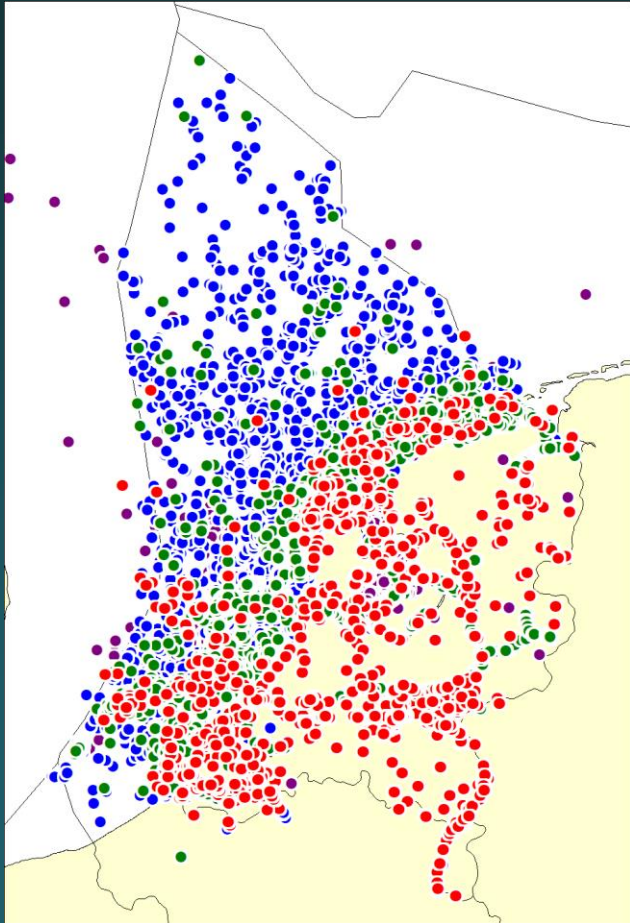


# Known wrecks and objects

## Sources:

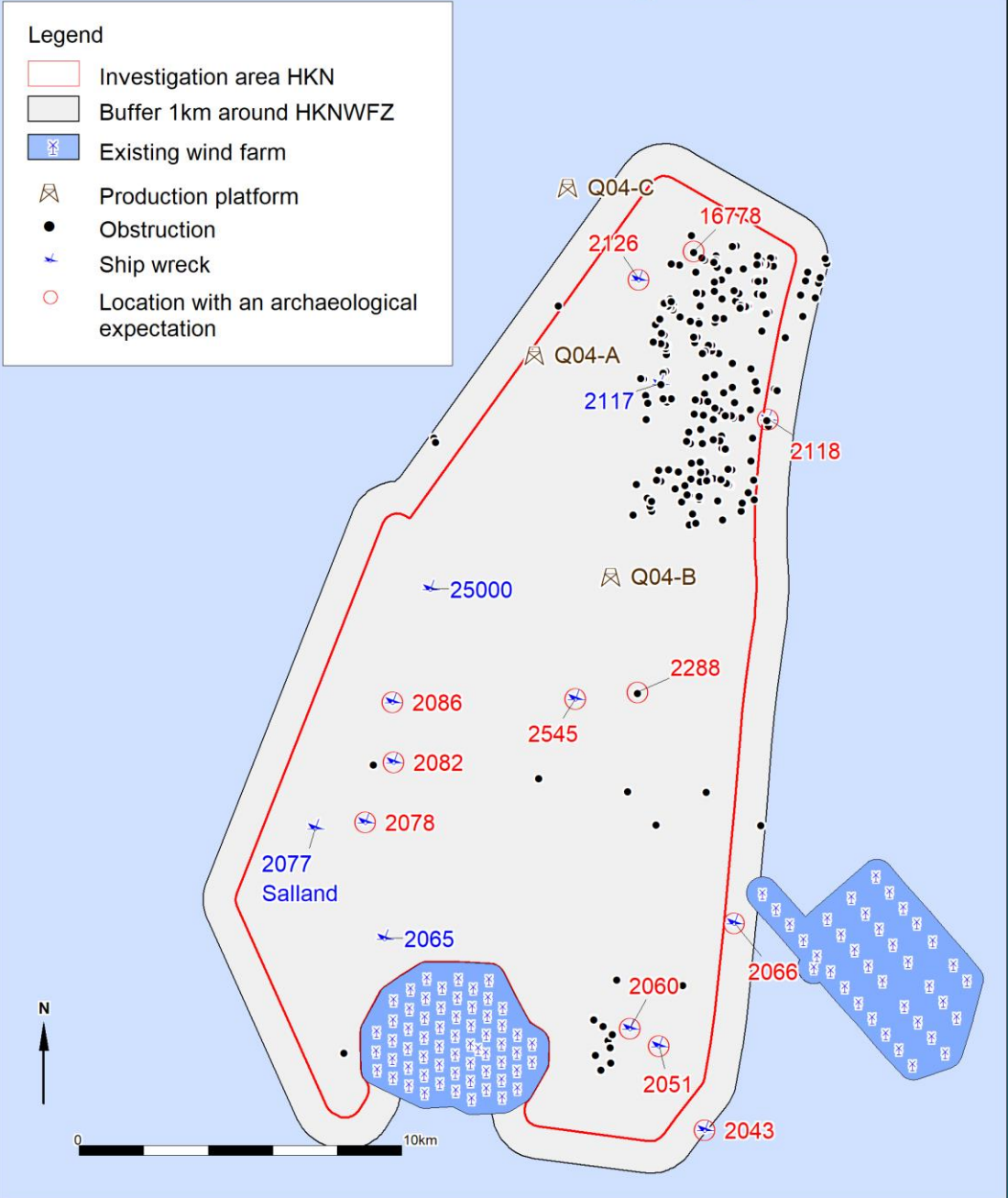
- Ministry of Cultural Heritage: ARCHIS  
MARIAD
- Rijkswaterstaat: SonarReg92
- Dutch Hydrographic Service: NLHono
- Periplus Archeomare

# Known objects



# Desk study results

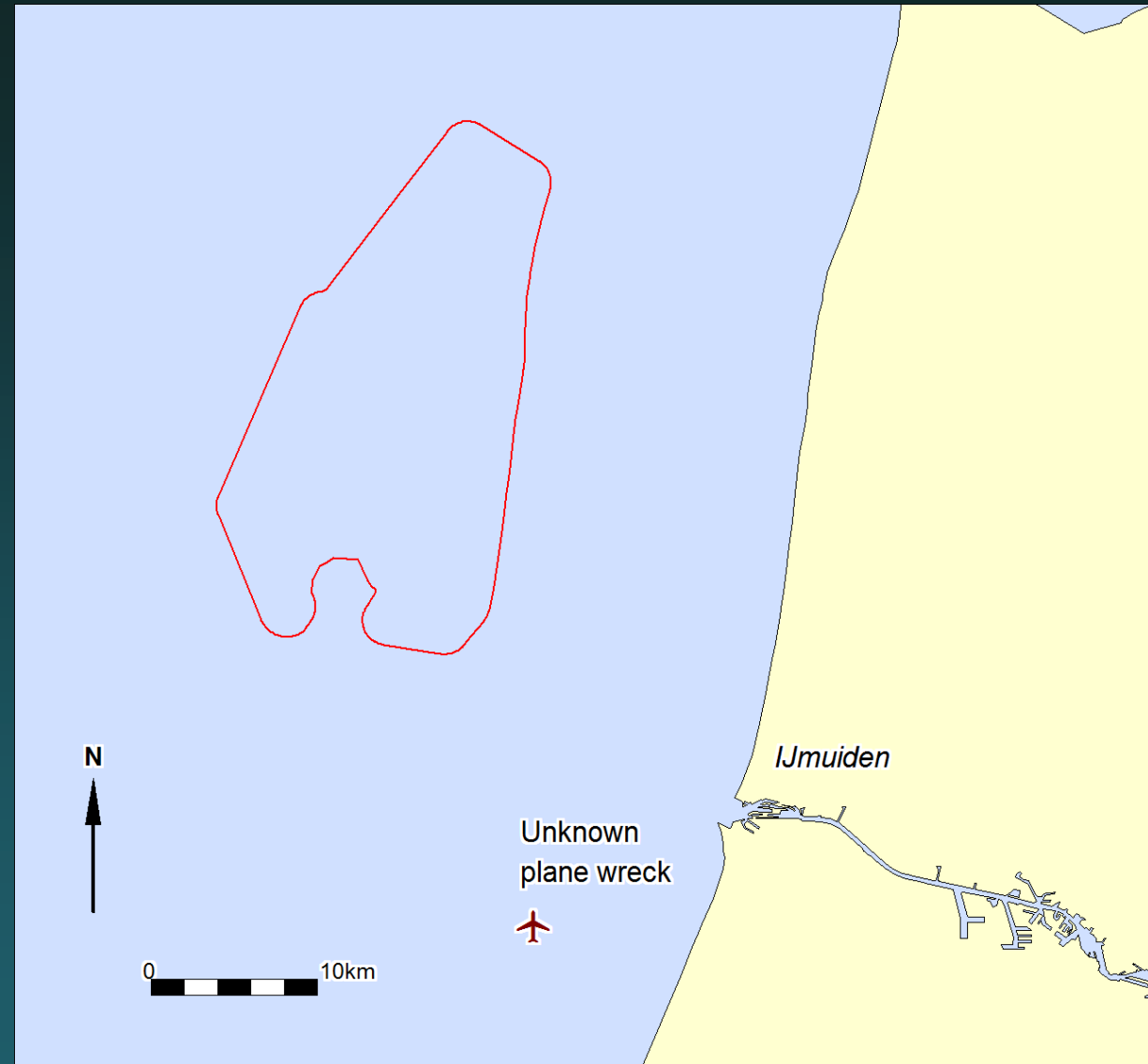
Database		Potential archaeological wreck sites	
Type	Number	No	Yes
Wrecks	14	4	10
Other	230	228	2
Total	244	232	12



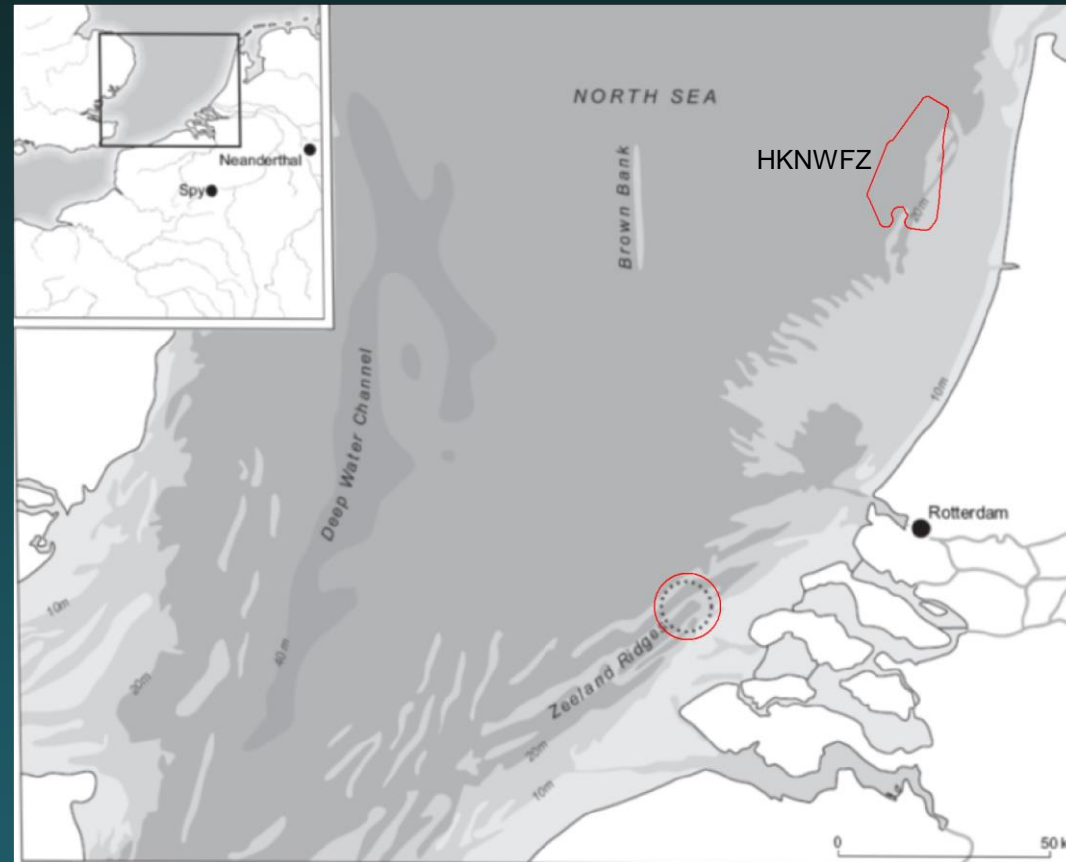


# Plane wrecks WOII

More than 200 planes  
still missing

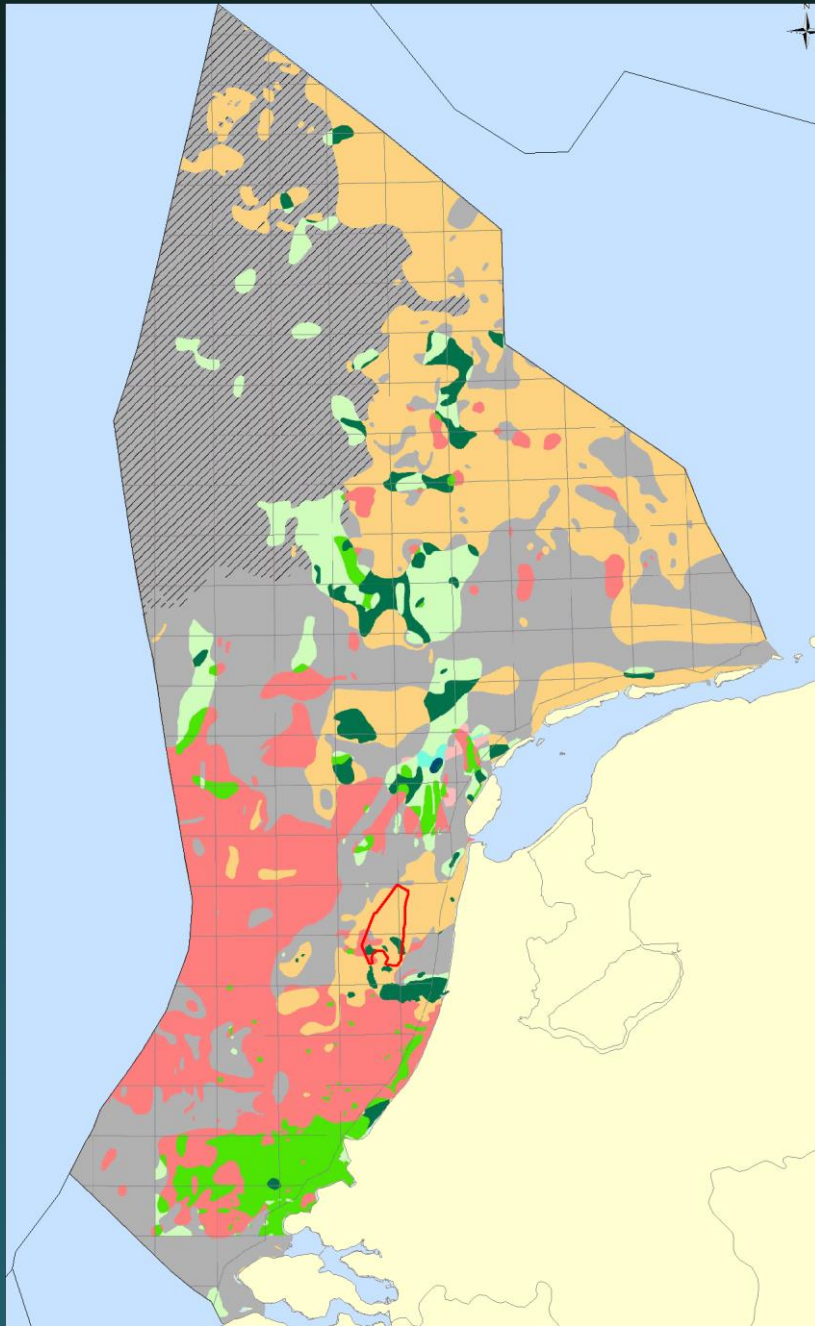


# Drowned prehistoric landscapes




2009: The Zeeland Ridges Neandertal

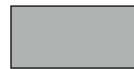



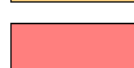
# Archaeological potential



## Legend

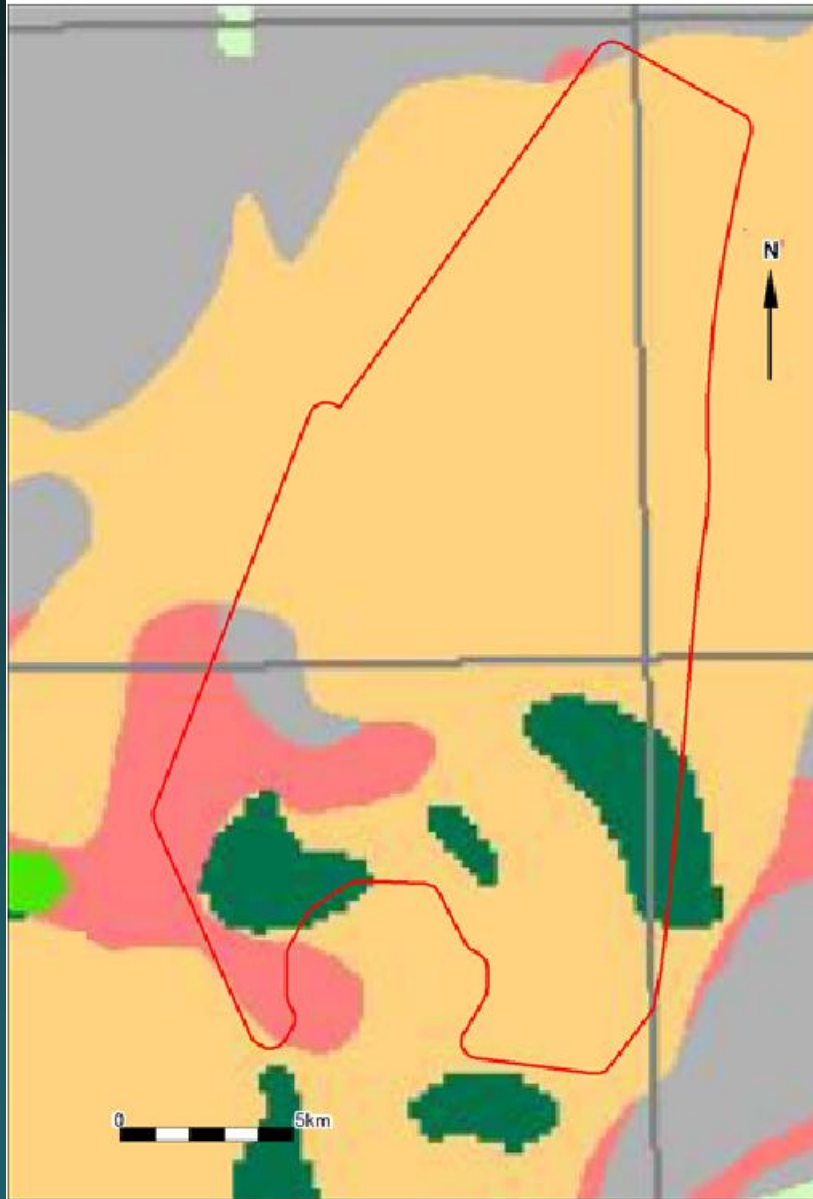
 Research area

## Expectancy prehistoric remains


-  No prehistoric remains intact
-  Mesolithicum + Late Paleolithicum
-  Mesolithicum + Middle Paleolithicum
-  Residual Mesolithicum + Late Paleolithicum
-  Middle Paleolithicum

*Source: Indicative model of archaeological potential of the North Sea. Deltares 2016*


# Archaeological potential





## Legend


 Research area


## Expectancy prehistoric remains

 No prehistoric remains intact

 Mesolithicum + Late Paleolithicum

 Mesolithicum + Middle Paleolithicum

 Residual Mesolithicum + Late Paleolithicum

 Middle Paleolithicum

*Source: Indicative model of  
archaeological potential of  
the North Sea. Deltares 2016*

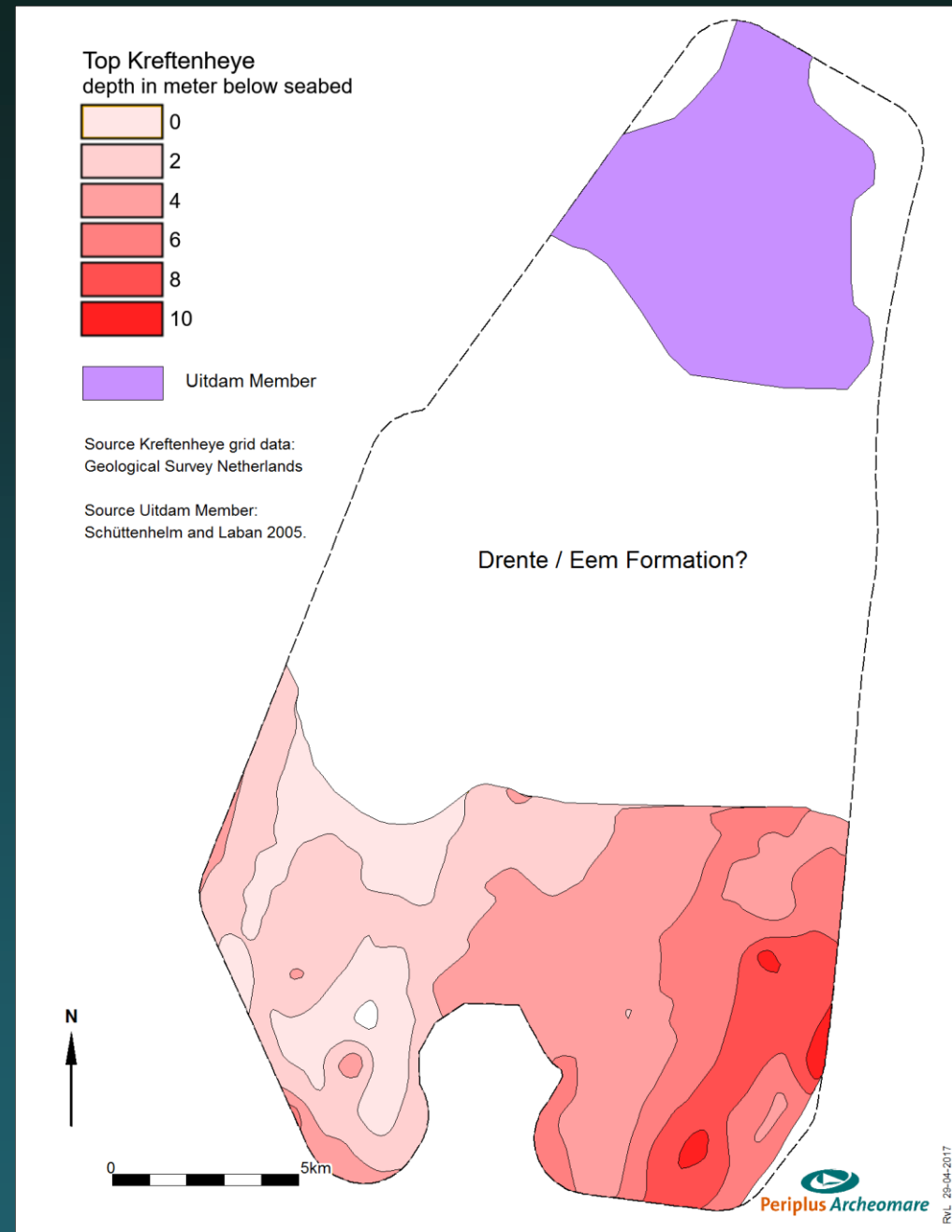
# Geological units

Archaeology - Landscape – Geology

## PLEISTOCENE UNITS

### Kreftenheye Formation

- braided river system



# Geological units

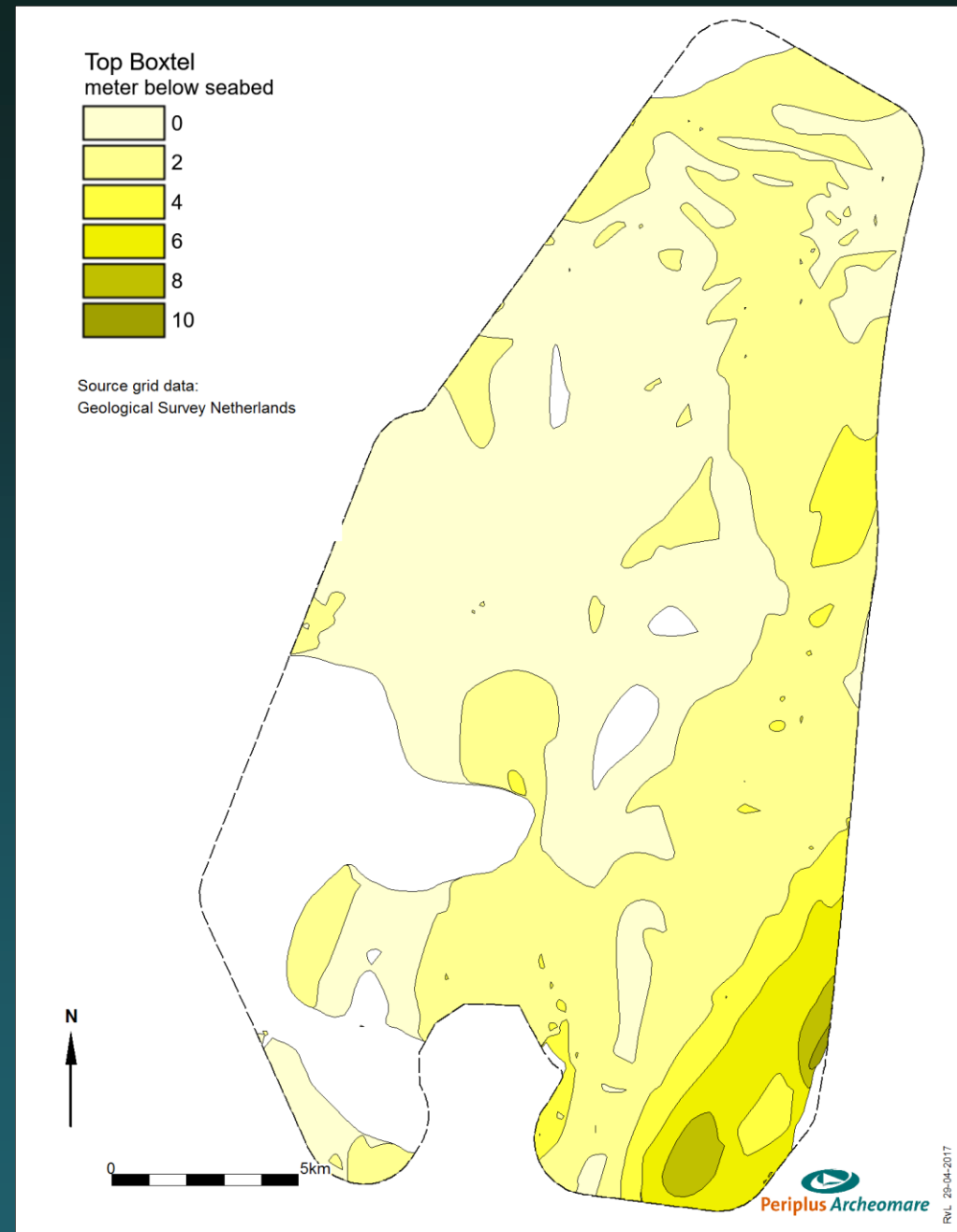
Archaeology - Landscape – Geology

## PLEISTOCENE UNITS

### Boxtel Formation

- cover sand landscape with dunes, ridges and beak valleys; vegetated in Early Holocene

NOTE:  
known level for remains of prehistoric settlements onshore



# Geological units

Archaeology - Landscape – Geology

## HOLOCENE UNITS (12.000BP – NOW)

Basal Peat Bed

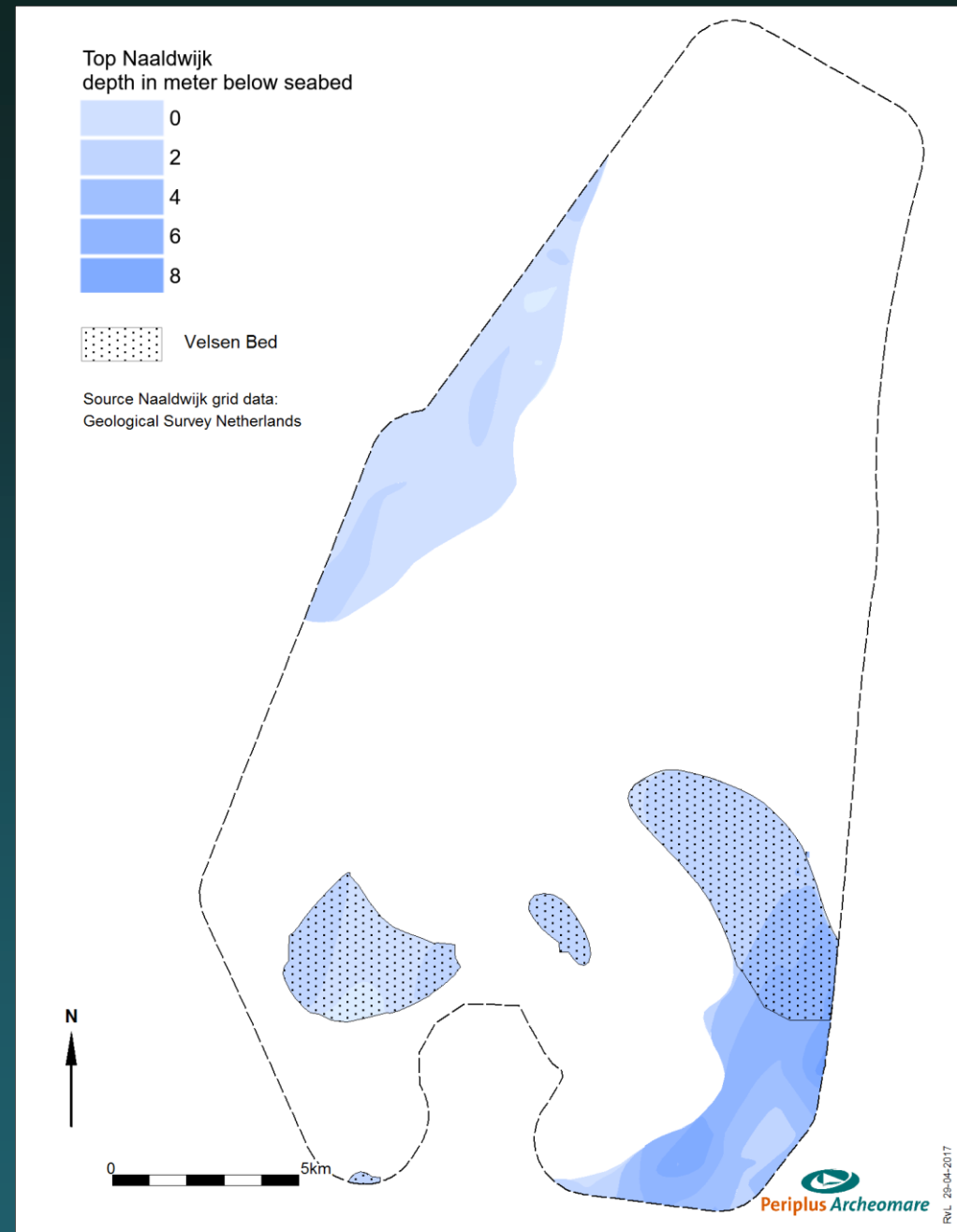
- peat

Naaldwijk Formation

- tidal flat

including Velsen Bed

- humic clay





# Archaeological levels

Unit	Depth	Archaeological remains
<b>Bligh Bank Member</b>	0	reworked flint and bone artifacts
<b>Velsen Bed</b>	0 - 8	lost objects, dumps
<b>Basal Peat Bed</b>	0 - 10	lost objects, dumps
<b>Boxtel Formation</b> - Wierden Member - Delwijnen Member	0 - 10	camp sites of hunters and gatherers; flint and bone artifacts; burnt nuts and seeds; charcoal; hunting gear
<b>Kreftenheye Formation</b>	6 - 10	reworked flint and bone artifacts lost objects, dumps; possible camp sites
<b>Eem Formation</b> - Brown Bank Member	?	reworked flint and bone artifacts camp sites Neanderthaler; flint artifacts
<b>Drente Formation</b> - Gieten Member - Uitdam Member	?	camp sites Neanderthaler; flint artifacts



# Conclusions desk study

## Facts:

- 12 known wreck sites of possible archeological interest
- Late Pleistocene landscape covered by Holocene deposits
- Integrity of Pleistocene landscape and possible prehistoric remains is unknown

## Expected remains:

- Undiscovered ship wrecks and WWII aircraft
- *In situ* buried prehistoric remains

# Recommendations: geophysical survey

In order to map wrecks and confirm known locations:

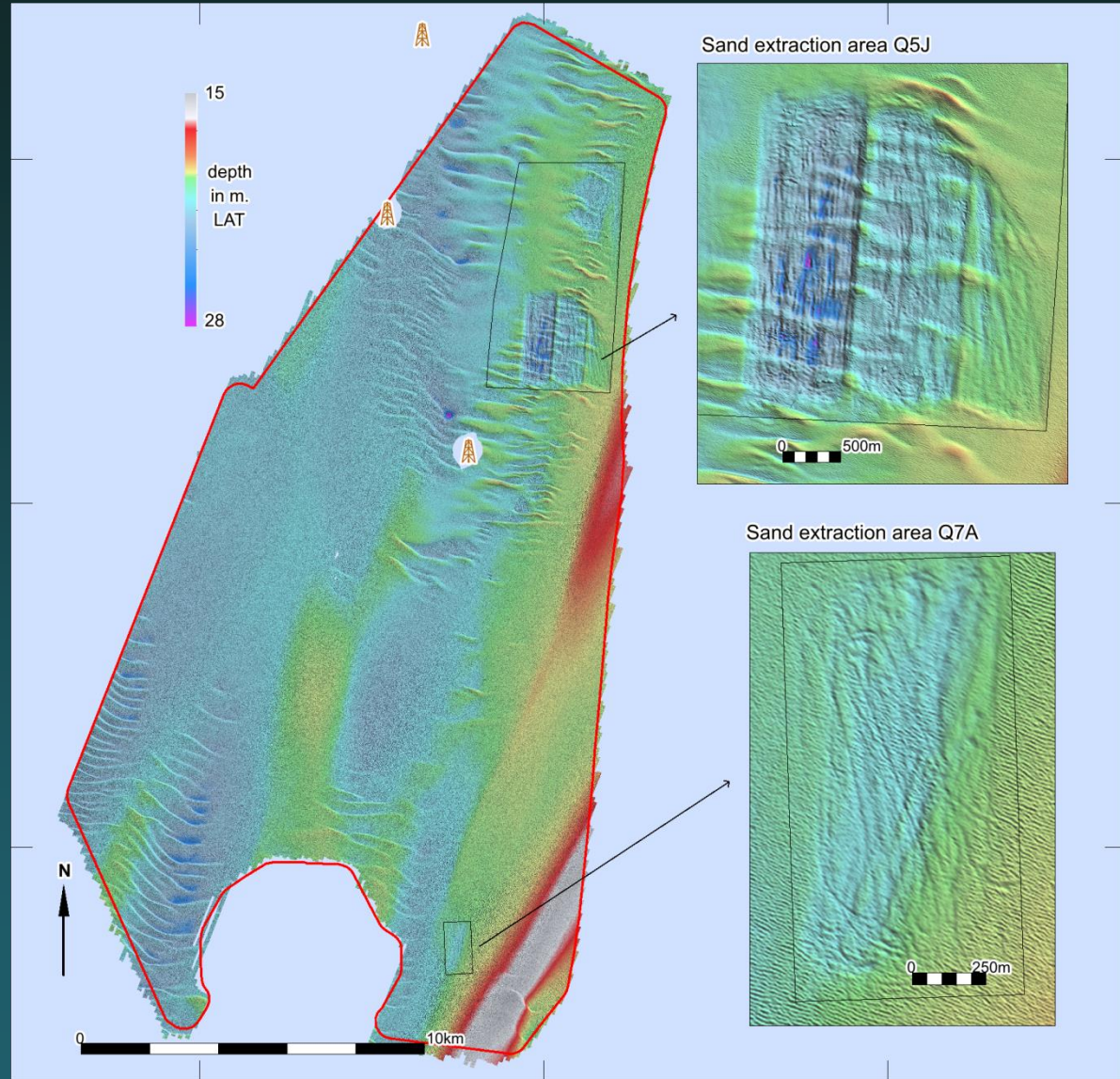
- **Side scan sonar and magnetometer survey**

In order to map the prehistoric landscape:

- **Subbottom profiling**

# Geophysical survey Fugro 2017

- side scan sonar
- single beam echo sounder
- magnetometer
- multibeam echo sounder
- sub-bottom profiler; pinger
- ultra high resolution seismic



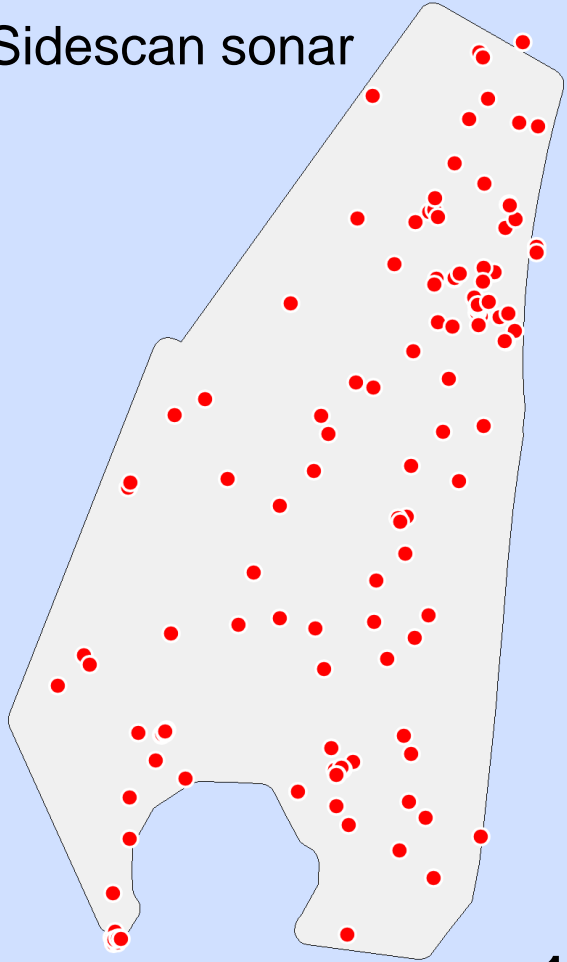
# Assessment geophysical survey data

The goals set for this assessment were:

- Validate the locations of known wrecks and objects
- Assess the possible value of newly found contacts
- Assess the prehistoric landscape based on the seismic data

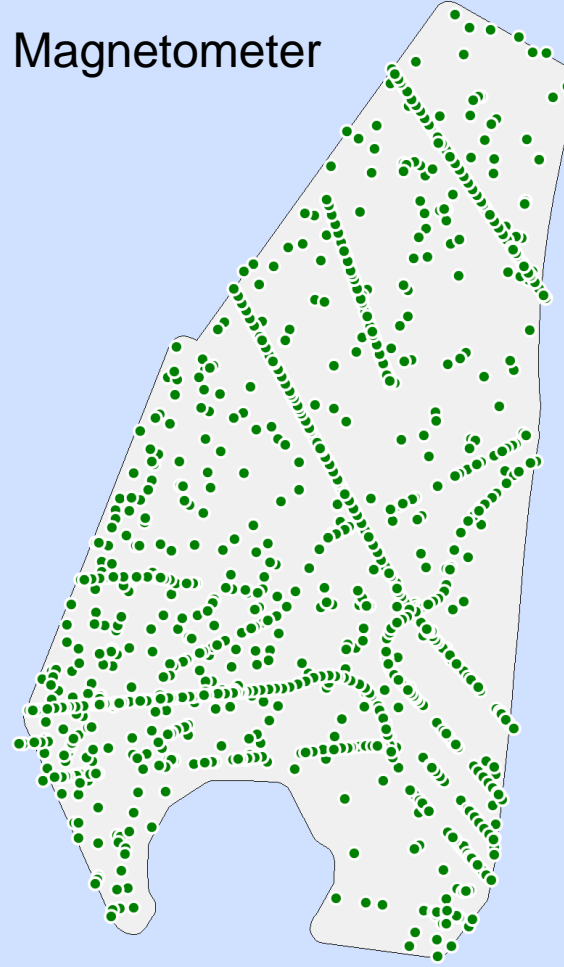
# Results sonar & magnetometer

Sidescan sonar



**131 contacts**

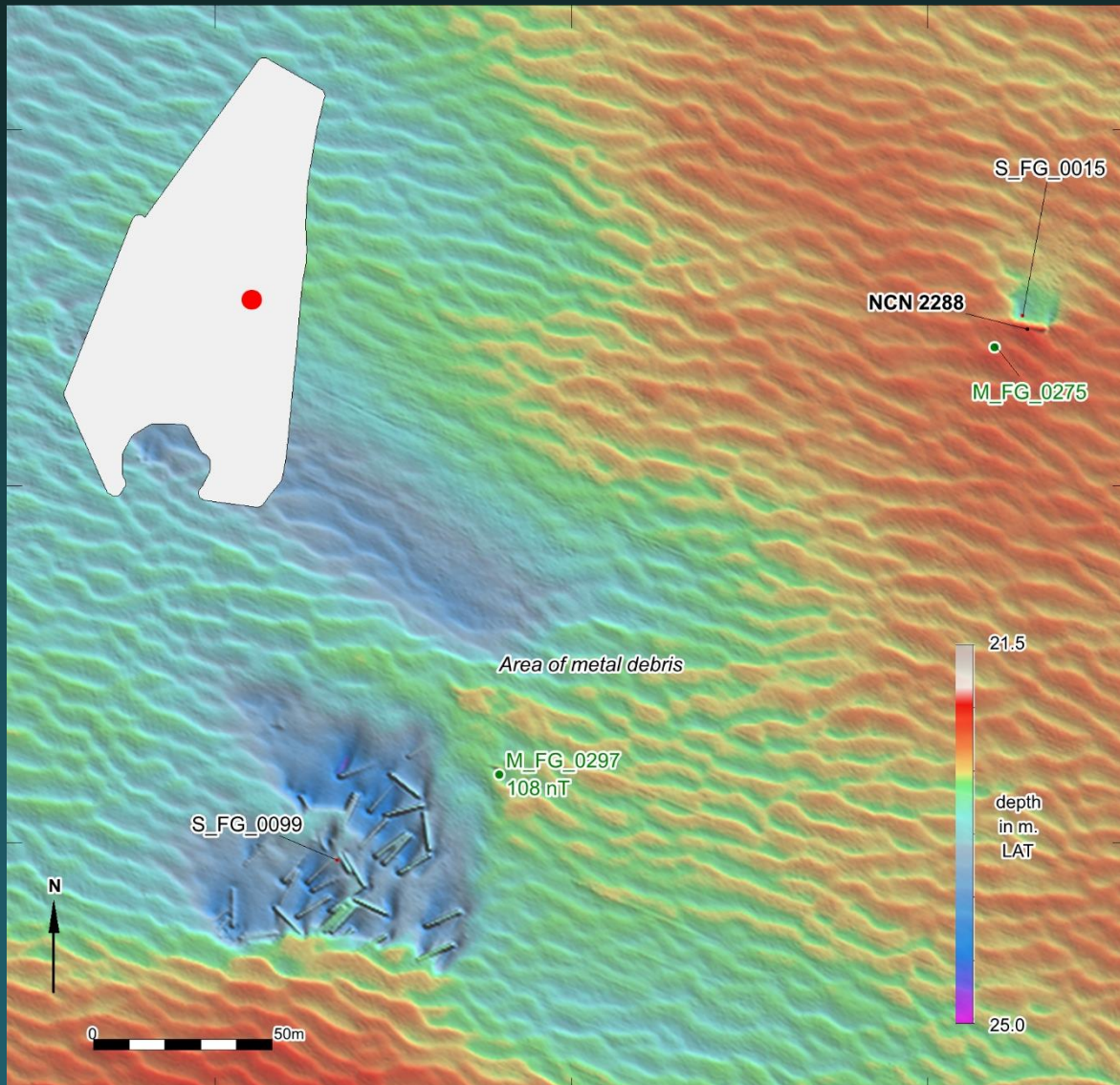
Magnetometer



**1035 anomalies**



# Verification known objects

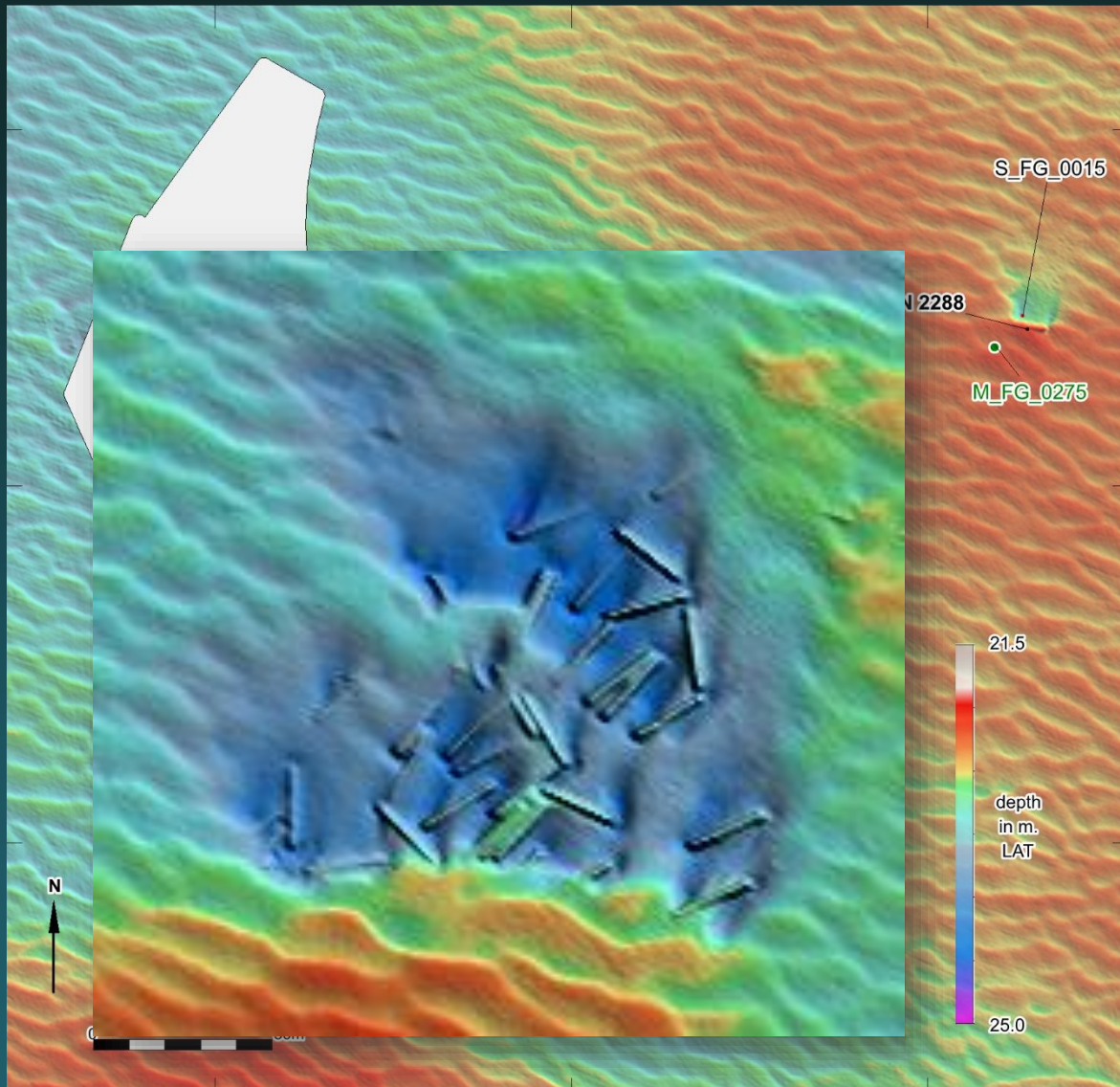


NCN 2288

Database description:

“An obstruction with wreck remains ca 300 x 100m”

# Verification known objects



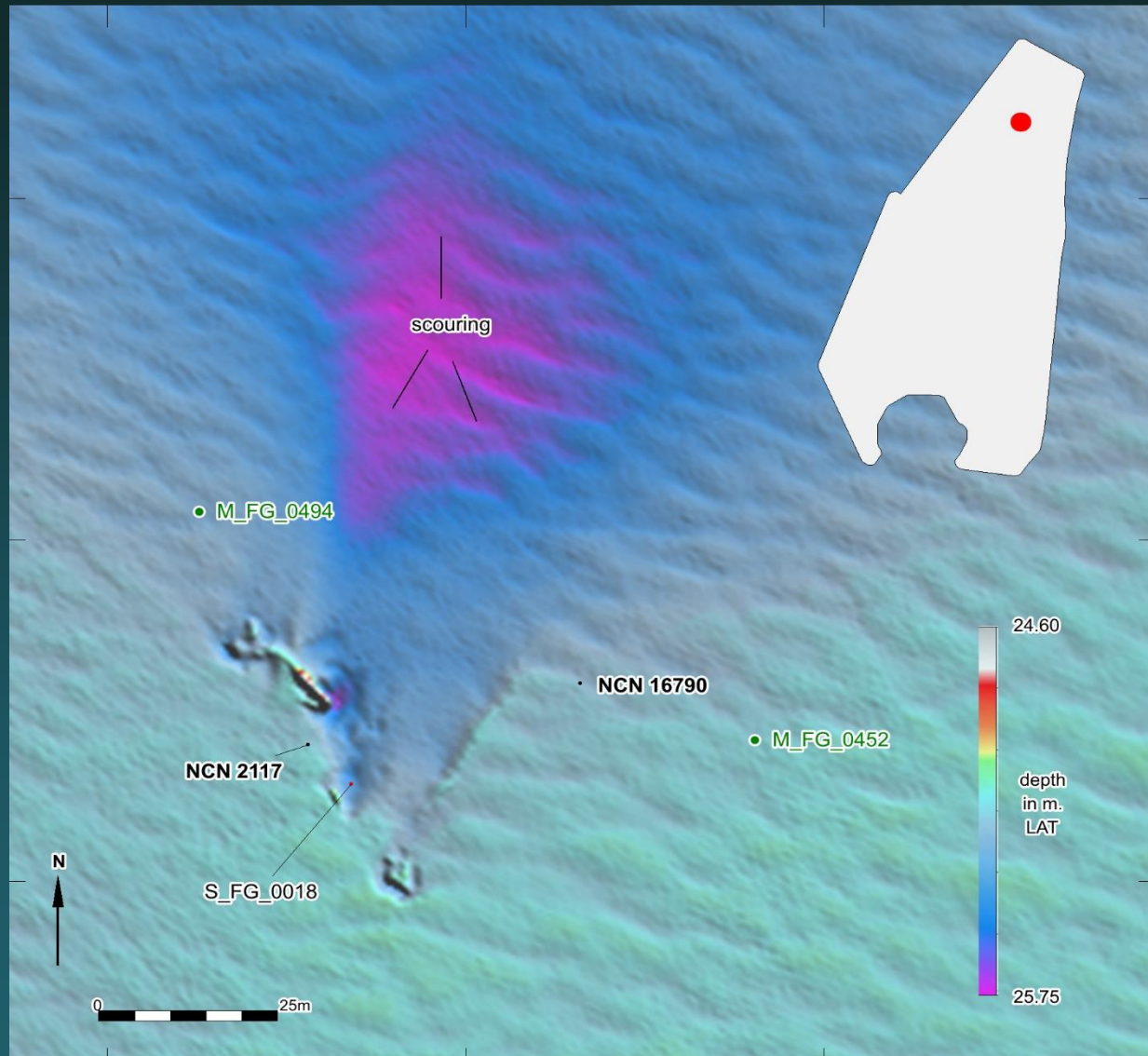
NCN 2288

Database description:

“An obstruction with wreck  
remains ca 300 x 100m”



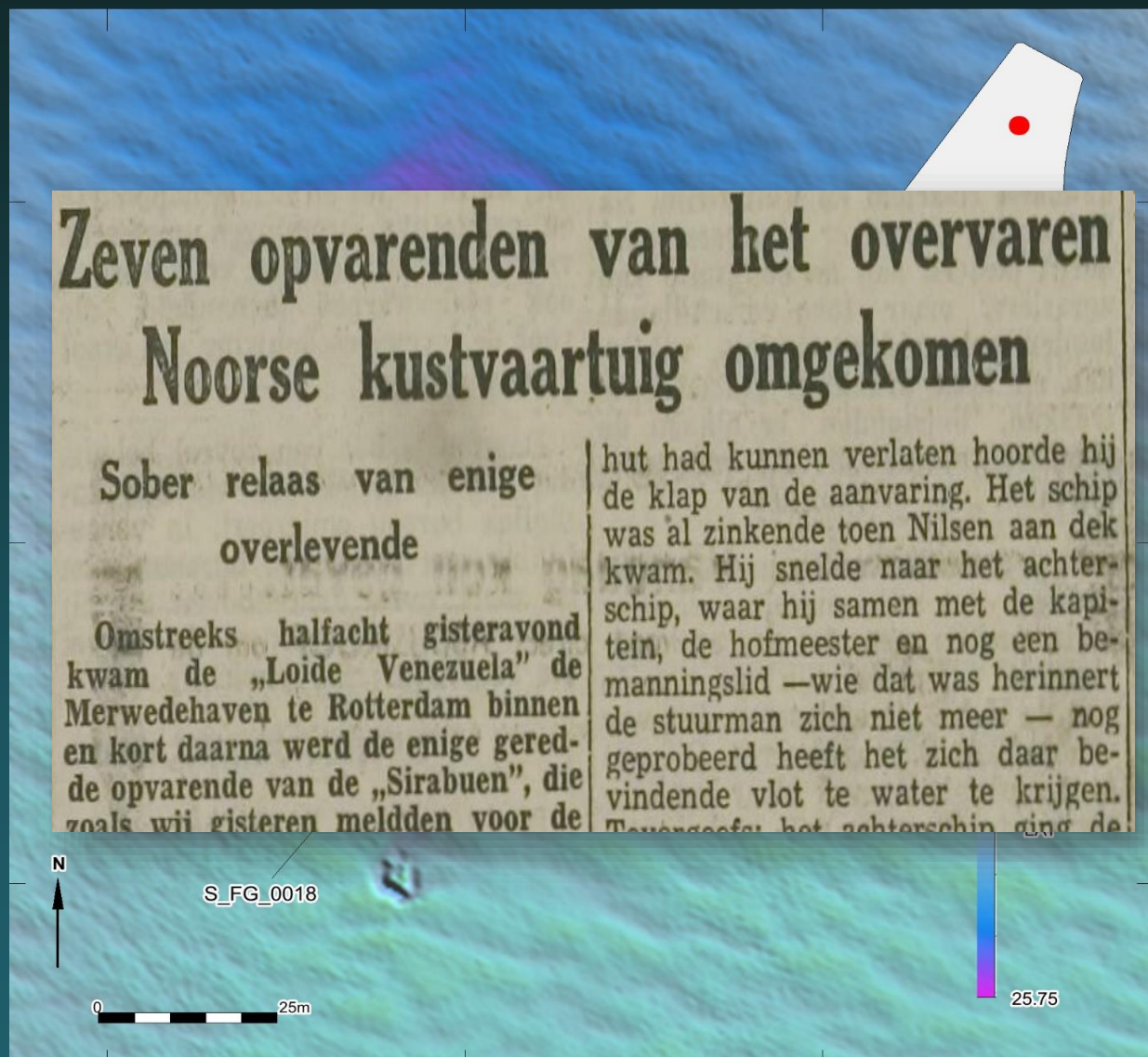
## Verification known objects



NCN 2117 and NCN  
16790 represent the  
wreck of the Norwegian  
cargo vessel Sirabuen,  
sunk in January 10, 1956



# Verification known objects



NCN 2117 and NCN 16790 represent the wreck of the Norwegian cargo vessel Sirabuen, sunk in January 10, 1956

# Geophysical Survey

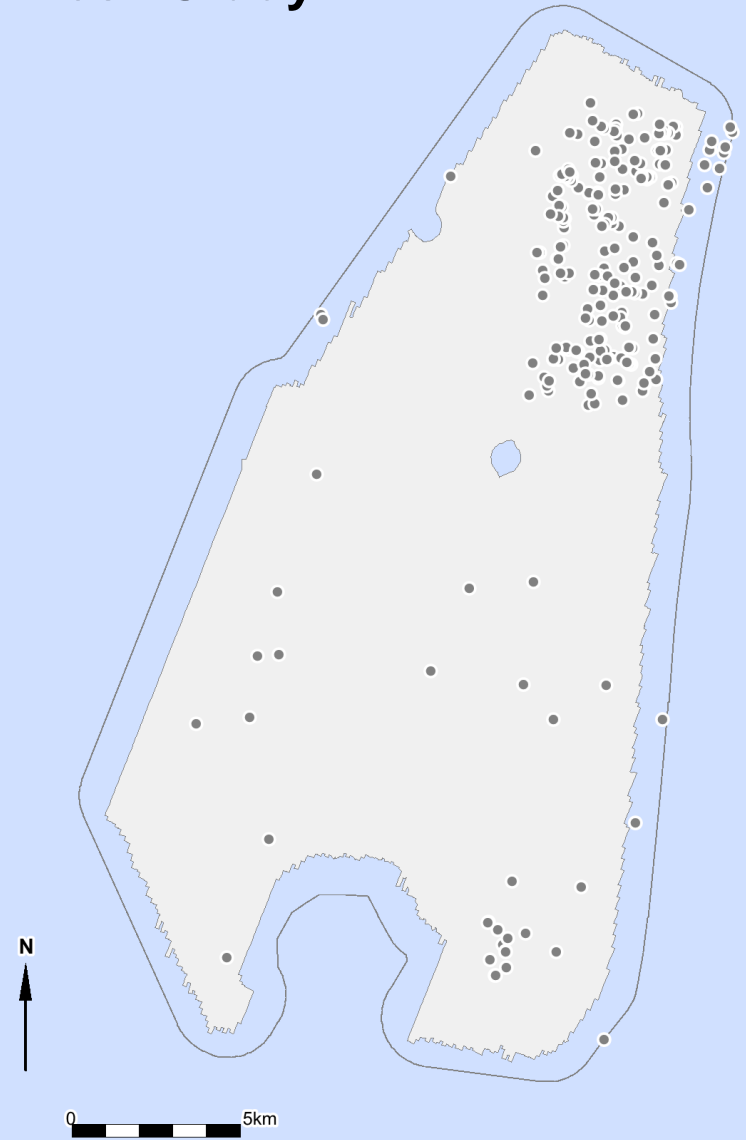
Outcome of the archaeological desk study:

**Known Objects:** 244

Of which:

**Wrecks:** 14

## Desk Study



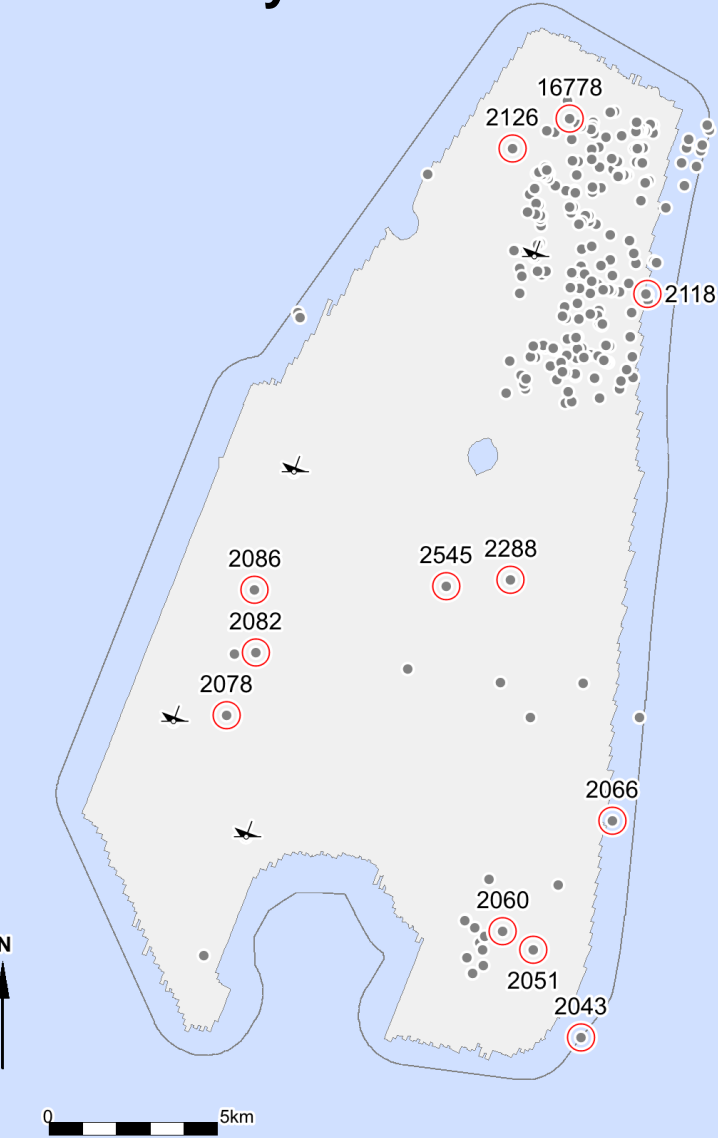
# Geophysical Survey

Outcome of the archaeological desk study:

## Known Wrecks

Possible Archaeological	12
Non-archaeological	4
Total	16

## Desk Study



# Geophysical Survey

Known Wrecks

Possible Archeological (12 Known):

FOUND 2

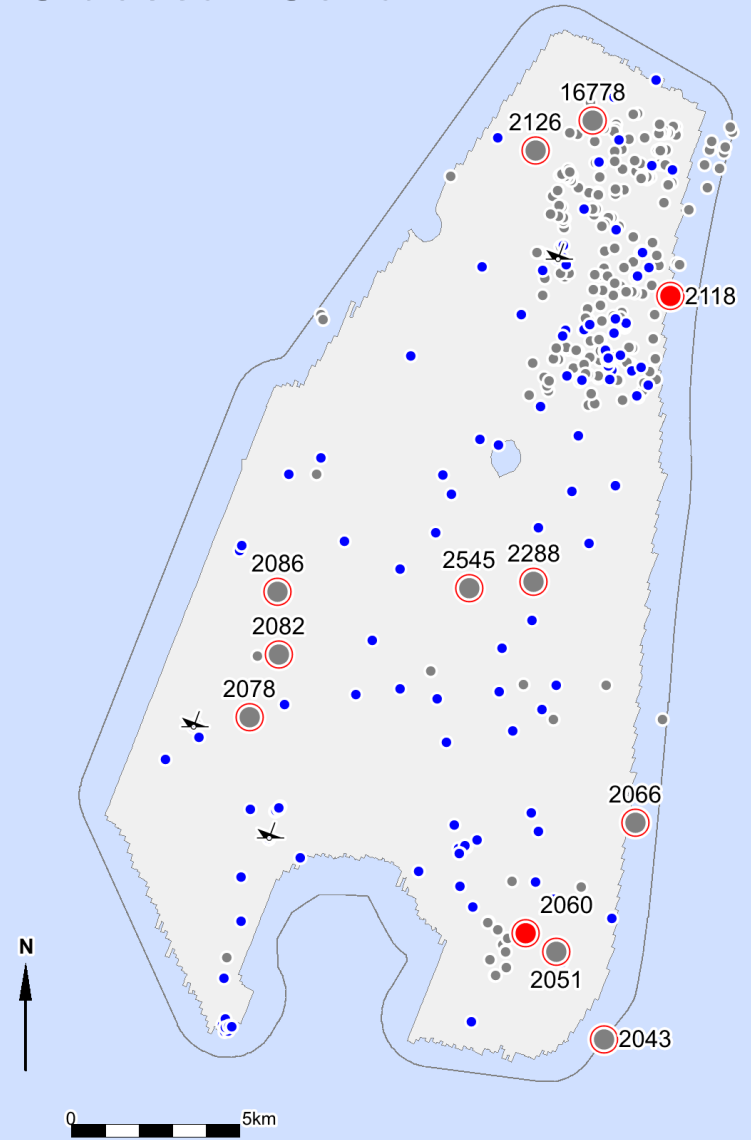
NOT Found 10

Non-archaeological (4 Known):

FOUND 3

NOT Found 1 (Removed)

## Sidescan Sonar



# Geophysical Survey

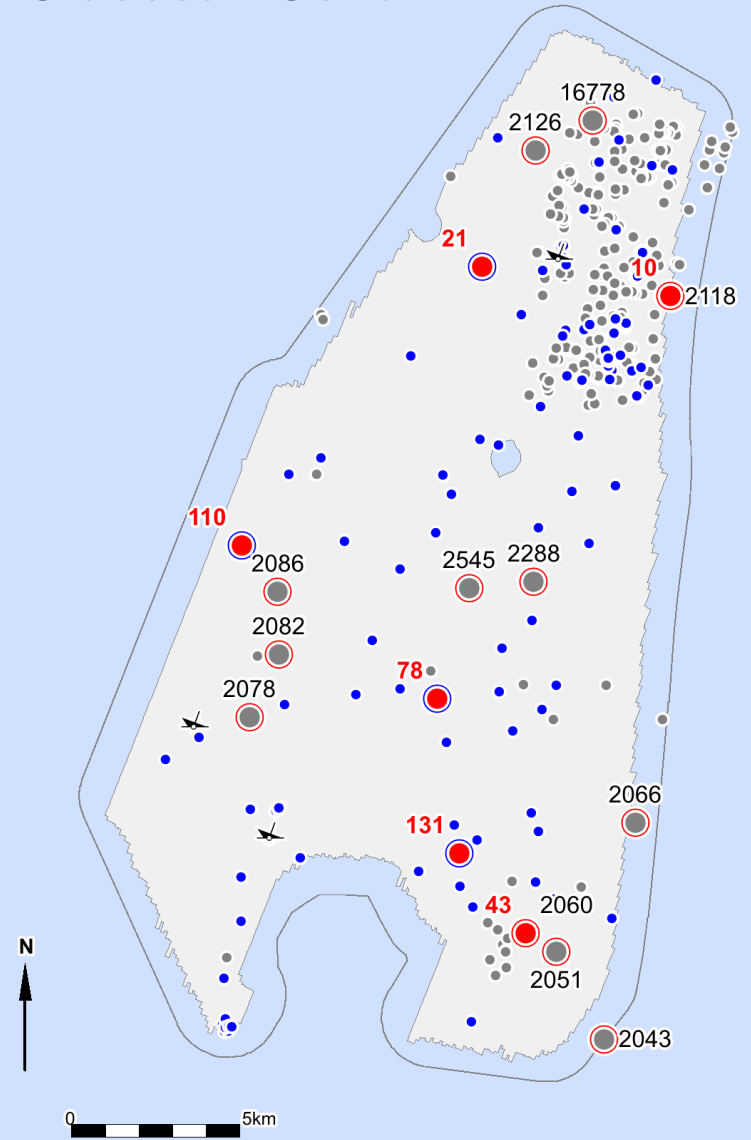
Possible Archaeological Wrecks **FOUND**:

Known wrecks 2

New wrecks 4

Total 6

## Sidescan Sonar



# Geophysical Survey

## Wrecks within the Wind Farm Site:

### FOUND:

Possible Archaeological (Known wrecks) 0

Possible Archaeological (New wrecks ) 3

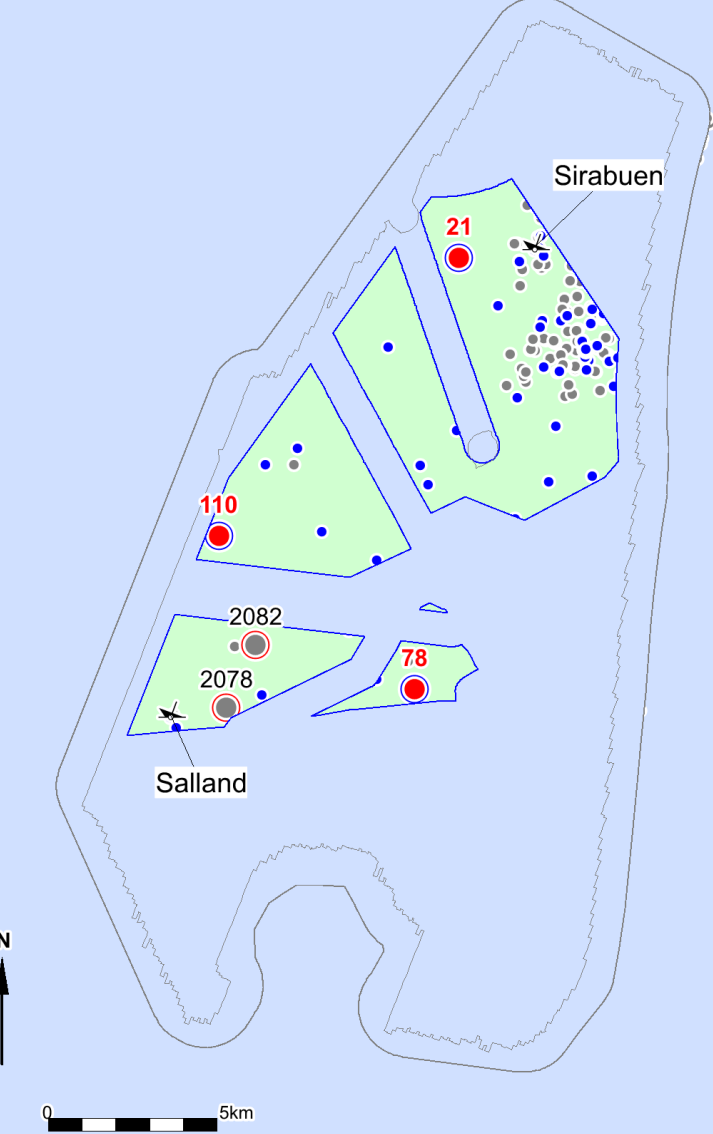
Non-archaeological (Known wrecks) 2

Total FOUND: 5

### NOT FOUND:

Possible Archaeological (Known wrecks) 2

## Sidescan Sonar



# Geophysical Survey

Within the Wind Farm Site:

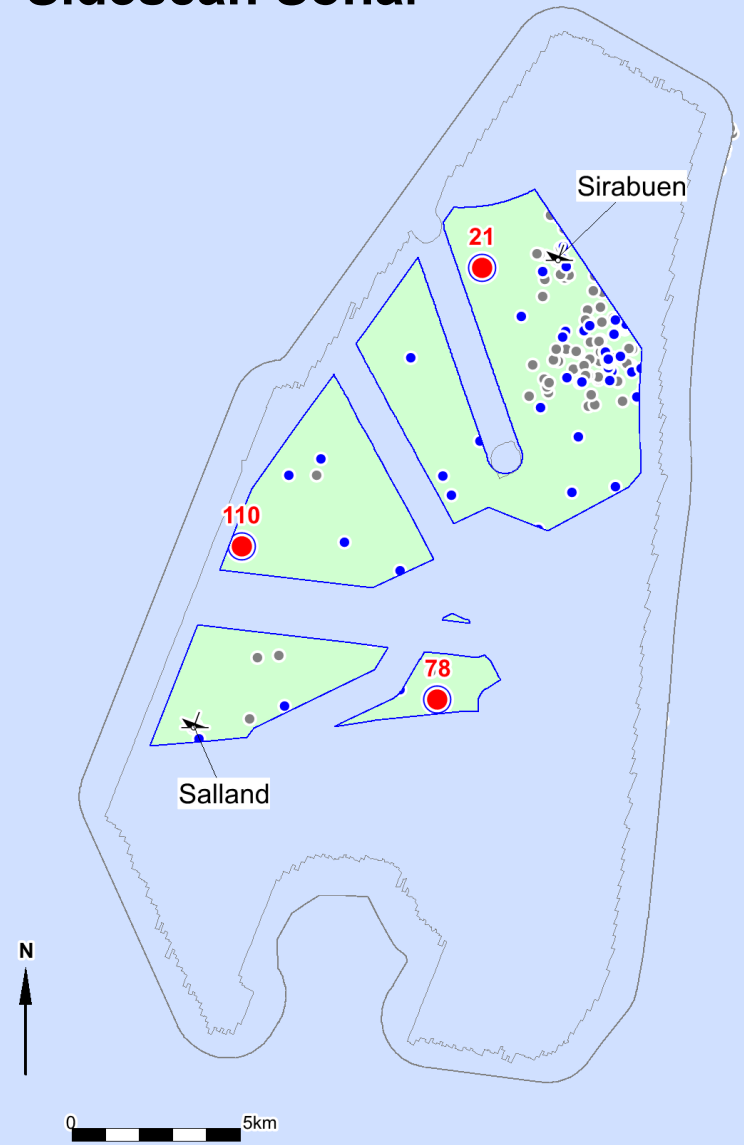
**NOT FOUND:**

Possible Archaeological Known wrecks 2

**BUT:**

Accuracy of wrecks positions less than 1000m,  
therefore the locations of the wrecks is very uncertain  
and could even lie outside the Wind Farm Site.

## Sidescan Sonar



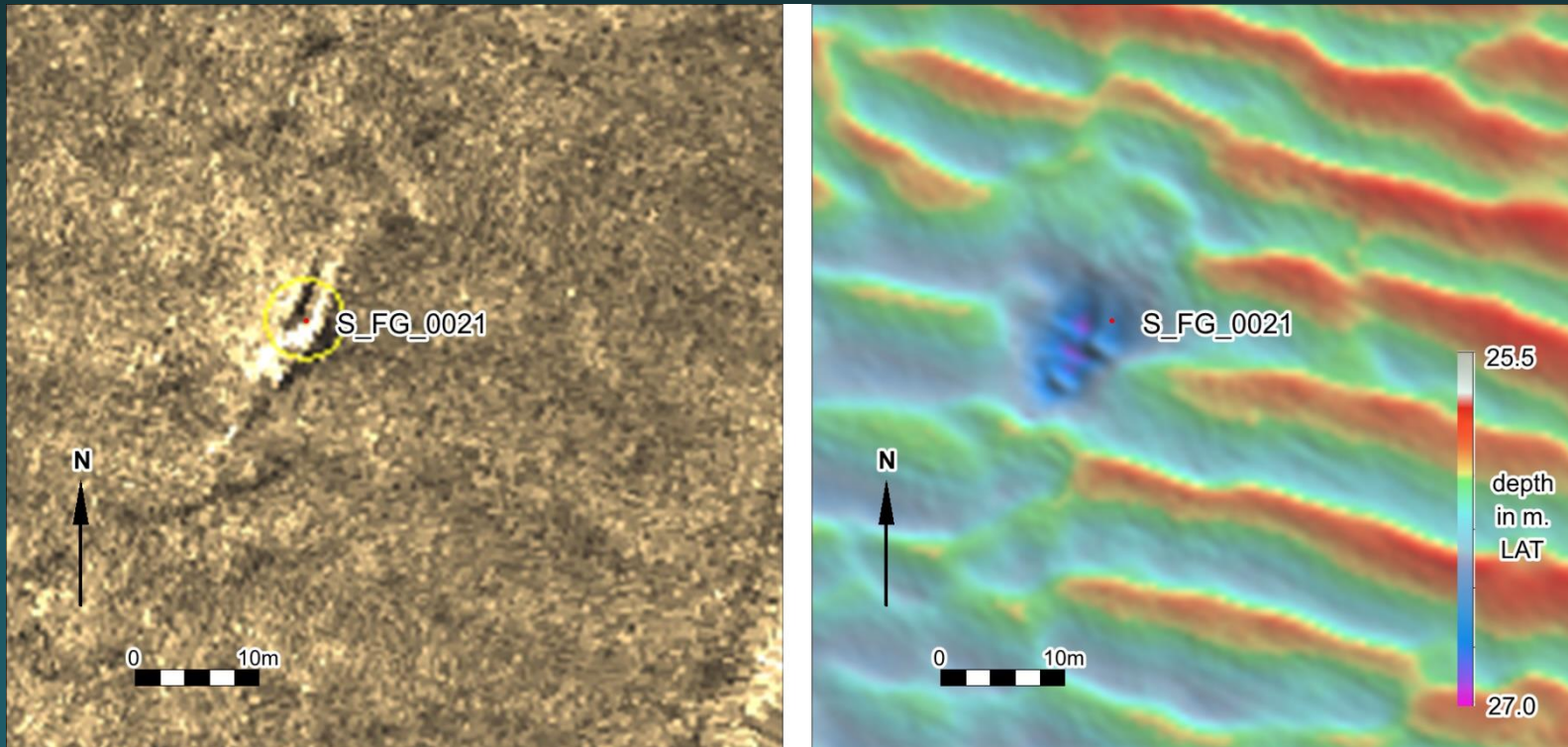


# New objects

Example

Sonar contact S\_FG\_0021

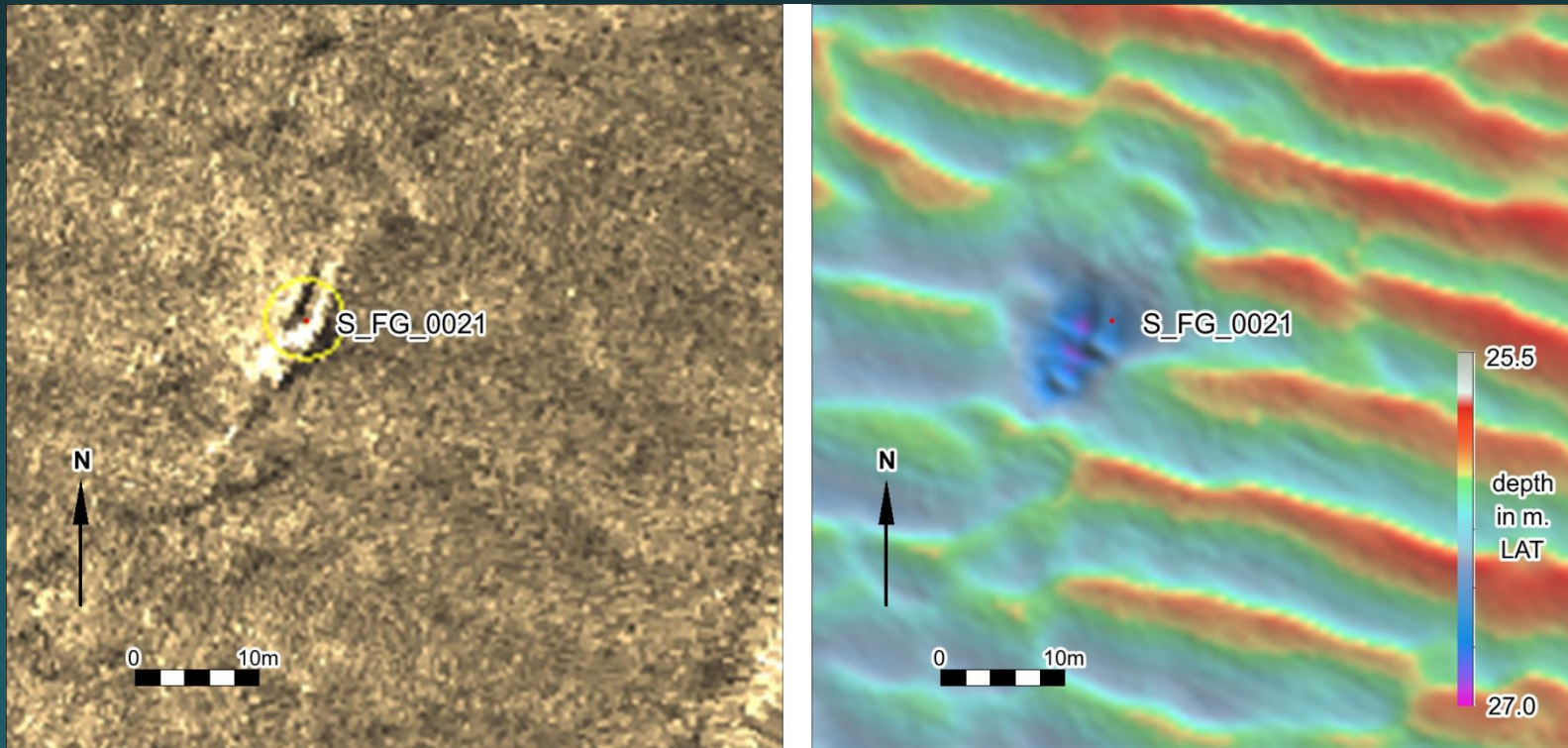
“strong contact with shadow - DEBRIS”



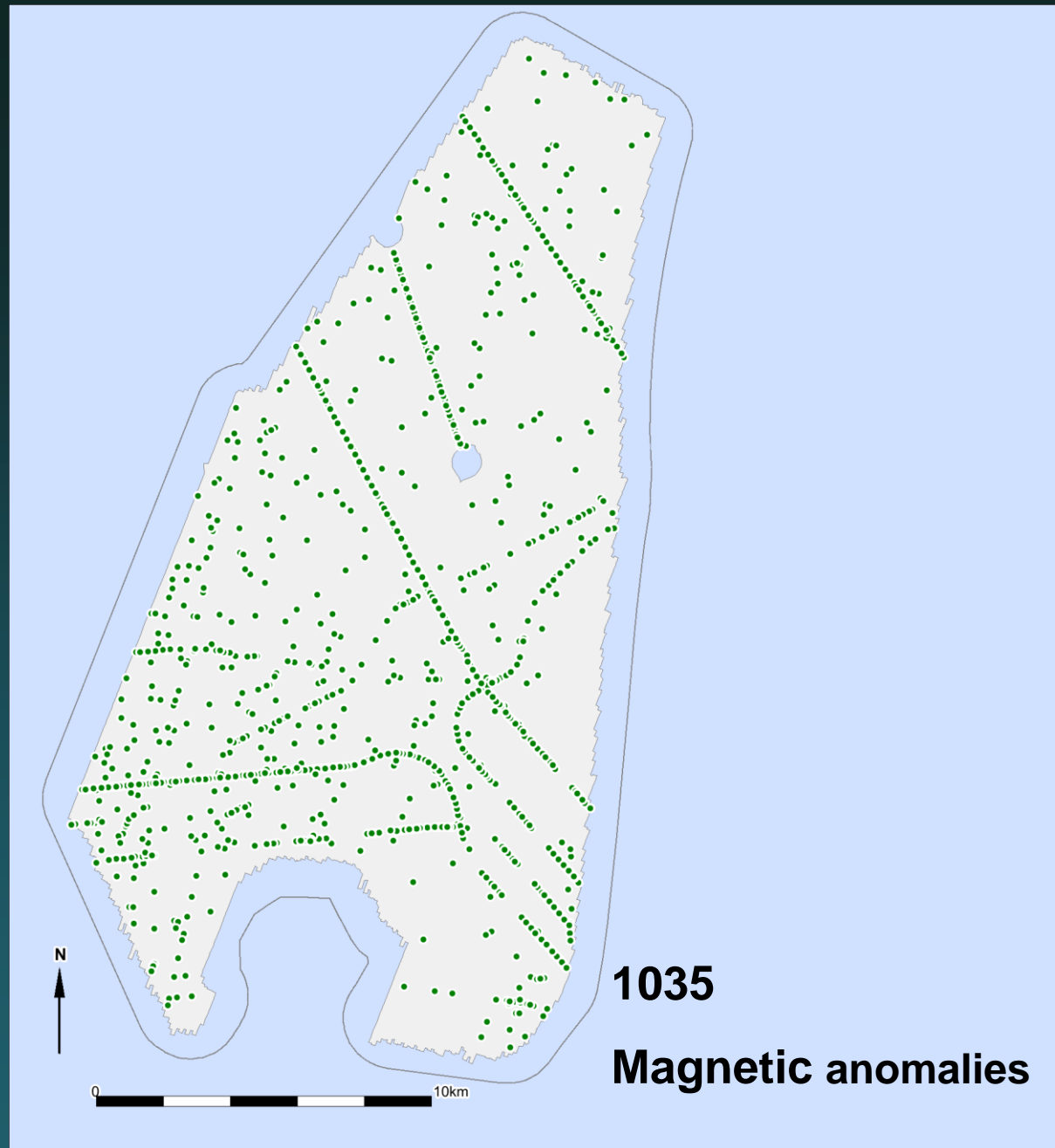


# New objects

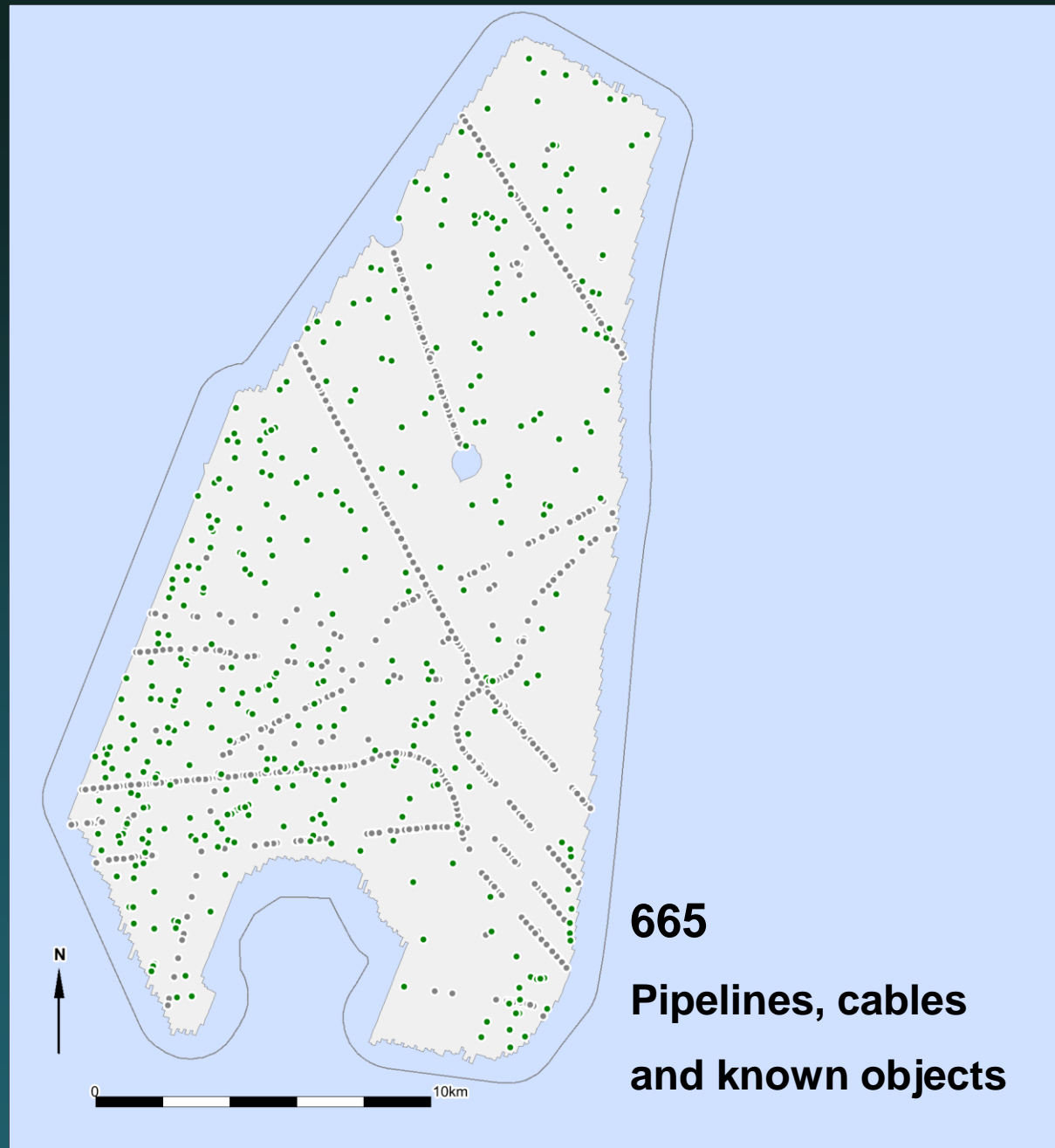
Interpretation:  
POSSIBLE WRECK REMAINS



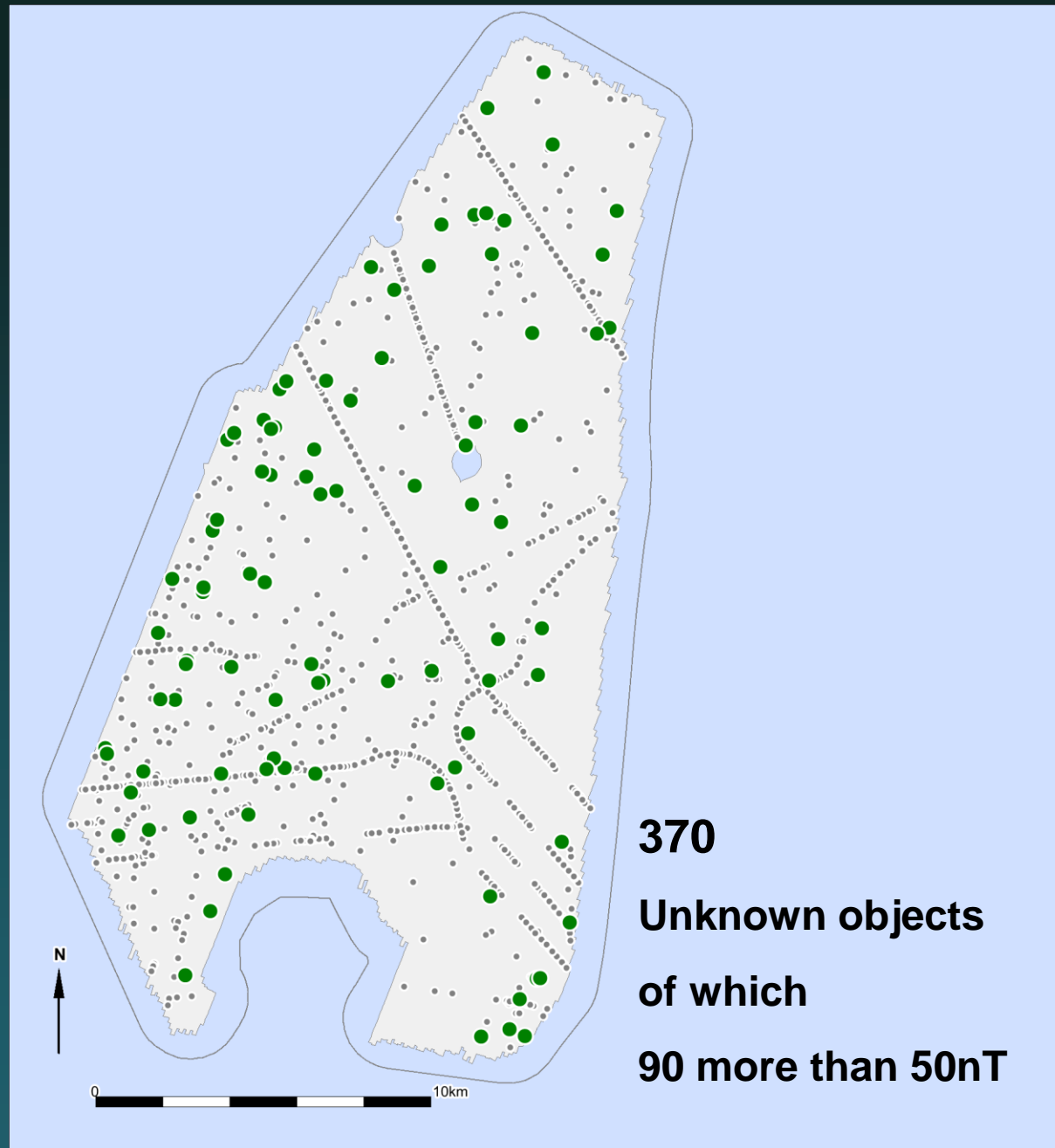
# Magnetic Anomalies



# Magnetic Anomalies



# Magnetic Anomalies

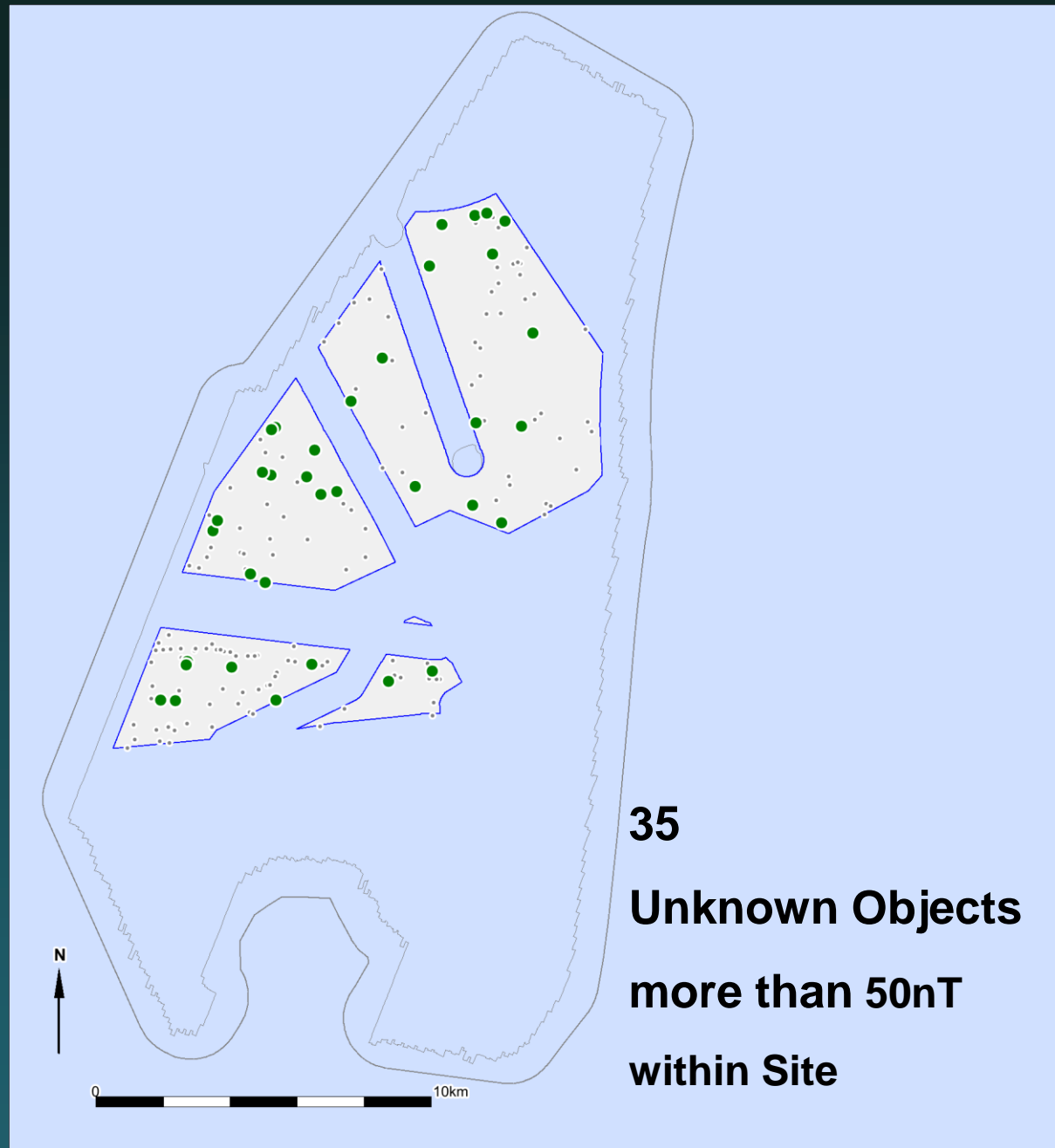


# Magnetic Anomalies

More than 50nT

=

Object of Possible  
Archaeological Interest





# Objects with an archaeological expectation

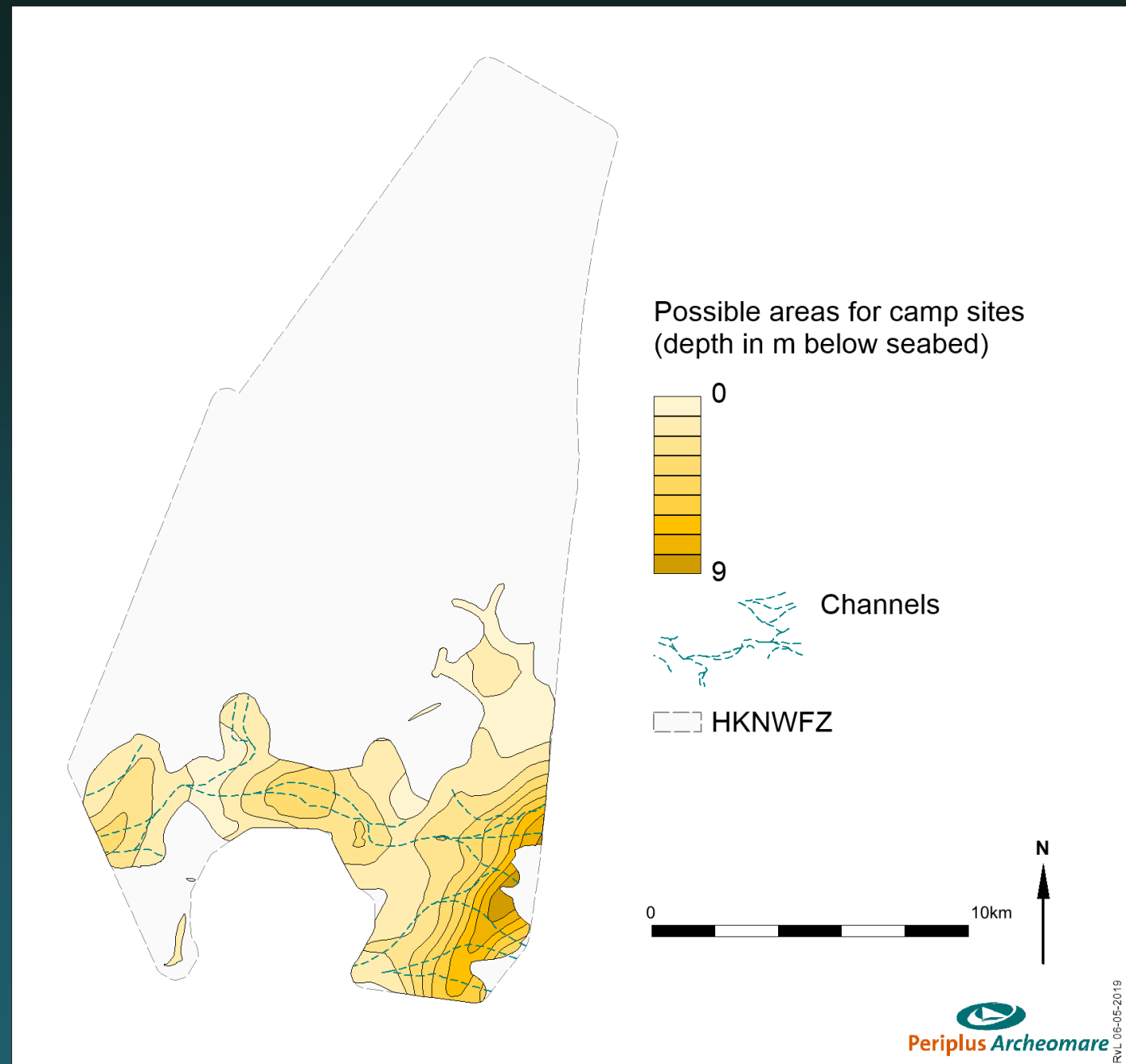
Potential Archaeological objects	TOTAL AREA			SITE		
	NOT FOUND	FOUND		NOT FOUND	FOUND	
		Known	New		Known	New
Exposed (sidescan sonar)	10*	2	4	2*	0	3
Covered (magnetometer)	0	0	90	0	0	35
Total	10	2	94	10	0	38

\* The uncertainty of the locations of 5 known possible archaeological wrecks including 2 within Site is very UNCERTAIN (Accuracy = less than 1000m)

# Prehistory

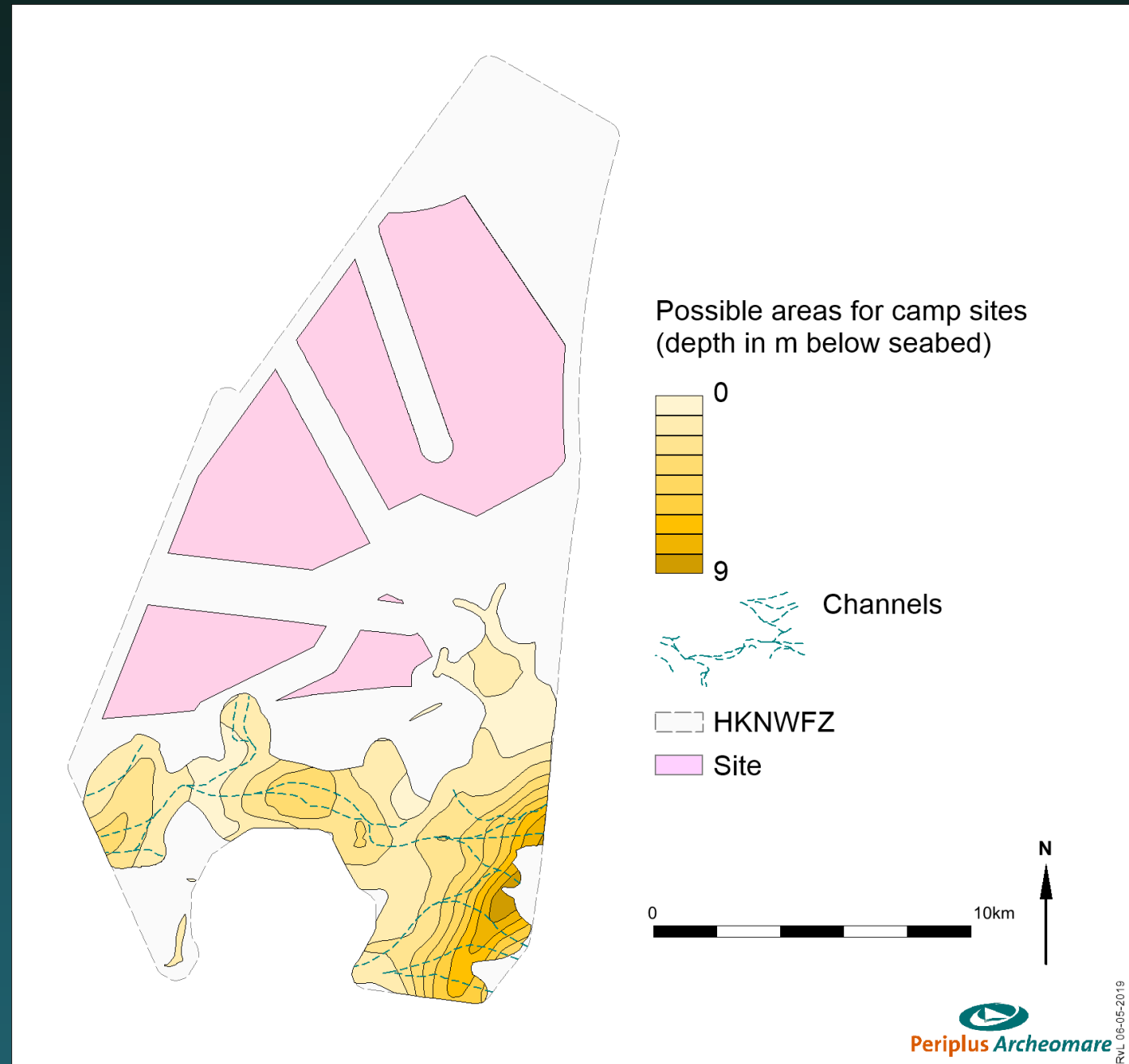
## Late Paleolithic & Mesolithic camp sites related to:

- River Valley
- Late Pleistocene – Early Holocene
- Boxtel Formation
- Vegetated Landscape with sand  
dunes, ridges and streams
- covered by peat and clay

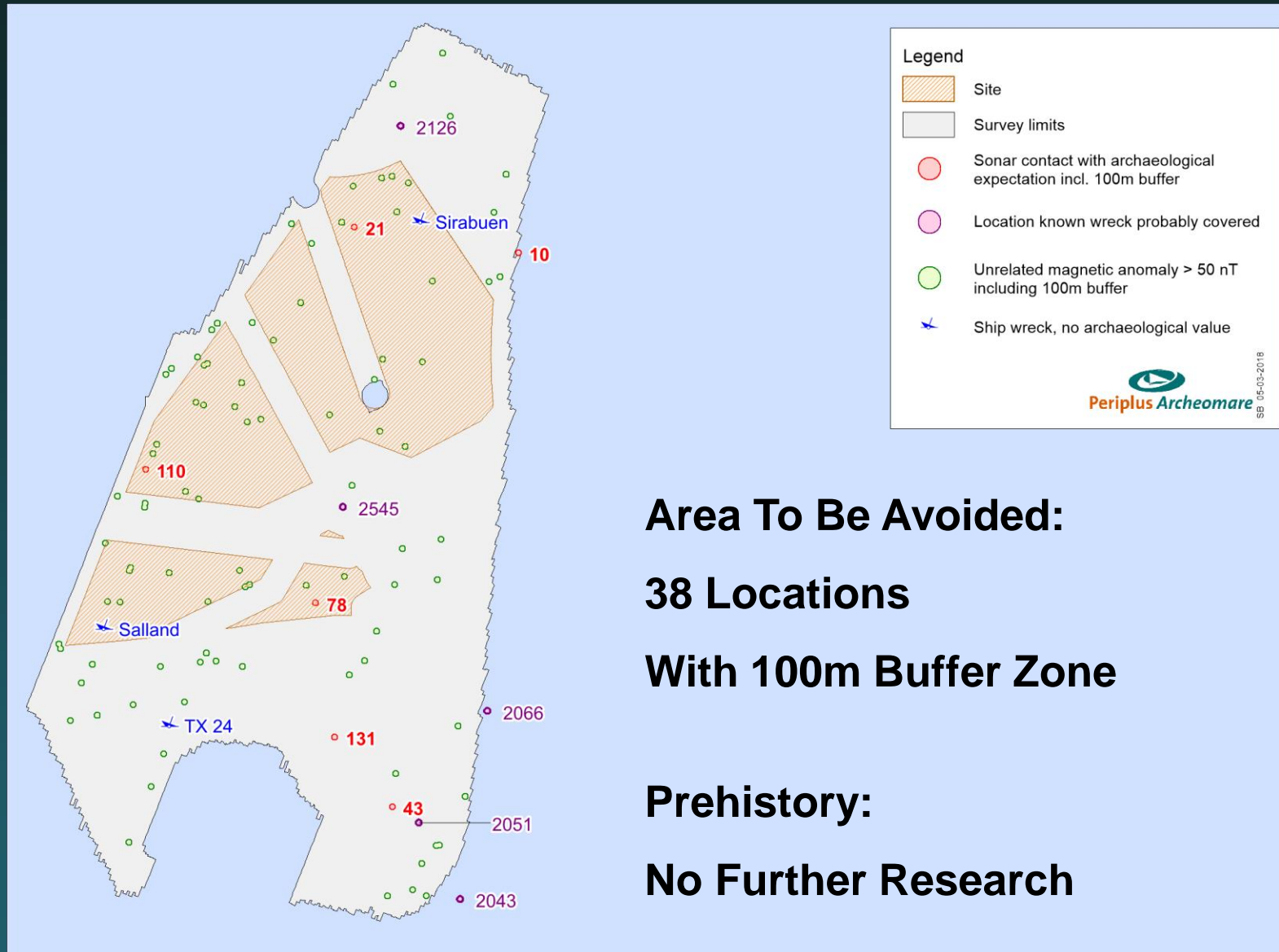


# Prehistory

Prehistoric landscape and prehistoric remains herein will not be affected by HKNWFZ development



# Summary



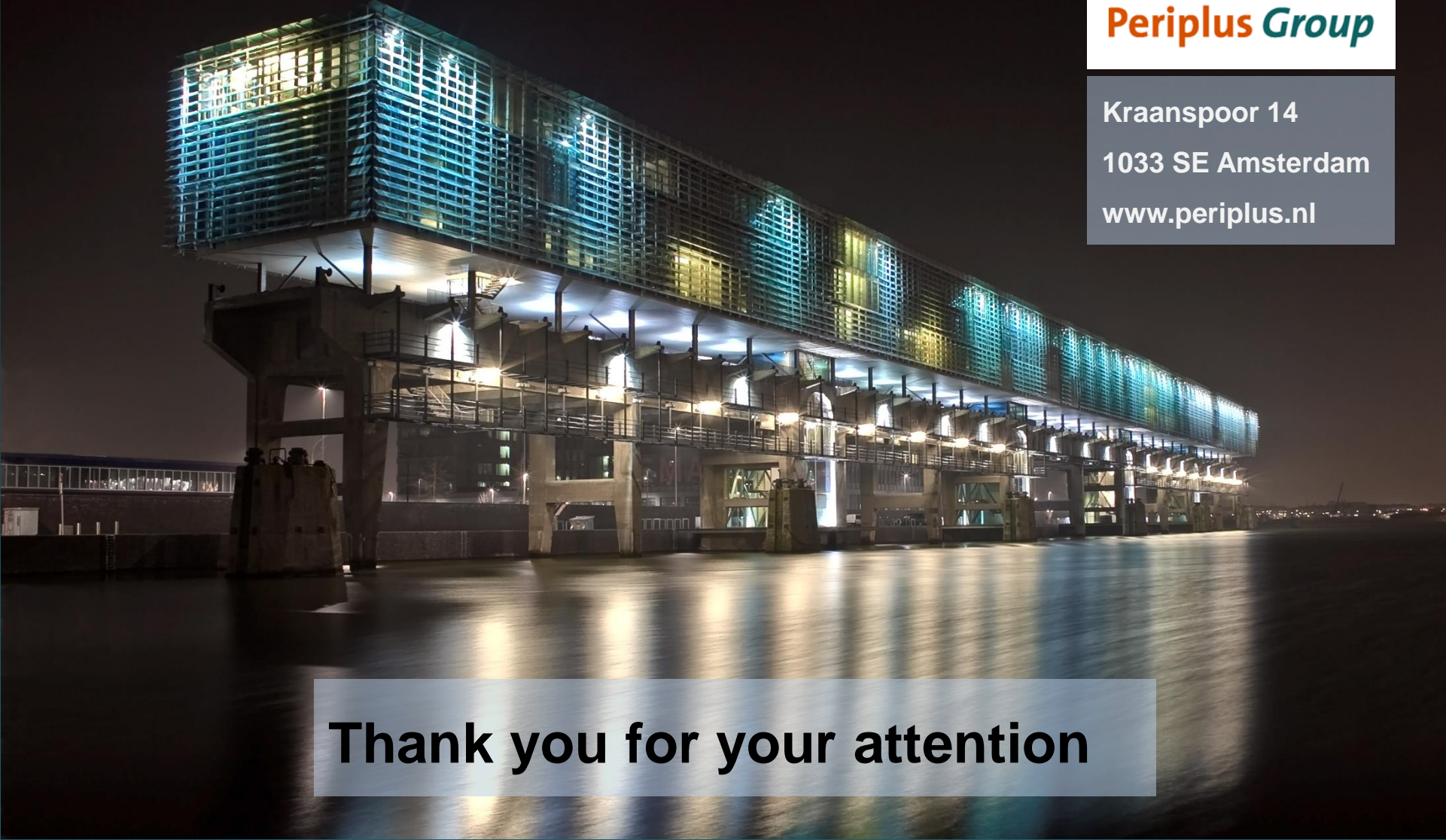
# Recommendations

Avoid possible archeological locations (including a buffer zone of 100 meters)

Not feasible? → Additional research required

During construction: Unexpected find? → Report to the authorities





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**Thank you for your attention**