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Rudus

RAMBOLL

LIFE09 ENV/FI/575 ABSOILS

## Annex 29

# Final Report of Civil Engineering and Environmental Survey 2014



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## 1. Introduction

The piloting of 2011 includes Arcada II and dog park sites where soft soil, mainly clay, is stabilised. In Arcada the stabilised soft soil is used in replacing the old structure. In Arcada a new light weight stabilisation is being tested in which the density of the stabilised soil is being controlled and reduced by adding water in to the soil. In Dog park abandoned soft soil is used to increase the level of the "ground" in order to prevent the flooding. The soils in Dog park are stabilised to form a stir ground for the dog park activities.

Also two other pilots might be implemented during 2011. The first unsure pilot introduced here is the stabilisation in the Jätkäsaari area where a new living area is being built. The last of the introduced pilots is the reinforcement of soil in the Rudus storage area, where new storage area is released to for Rudus.

The piloting of 2013 embrace two locations, namely Jätkäsaari III and Honkasuo. According to the plans and the schedule of work progress, it is expected that the stabilisation works in Jätkäsaari III will start in December 2013 and will proceed at the beginning of the year 2014. For the Honkasuo pilot, the preparatory works including sampling, material testing and preliminary planning have started this year and will proceed at the beginning of 2014. It is expected that the stabilisation works will be carried out in the early autumn 2014 and finish before the end of the project.

## 2. Arcada II

Arcada II is located in Kyläsaari, Helsinki. The site is an old road, which was built on top of soft soil by using crushed aggregate. The area has low stability and load bearing capacity. The weight of the aggregate together with the low load bearing soils has caused e.g. the settlement of the mains about one meter lower from the original position even though it was based on friction pile. This has caused deflection on the sewage pipeline and the breakage of a pipe. The mistakes made in the original construction work are now being repaired.

In the Figure 1 is represented the Arcada 2 area before construction.



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Figure 1. Arcada 2 before construction. (Google maps)

On Figure 2 it can be seen that some of the road has been "pached" with asphalt and the last part of the road has been blocked for entrance.



Figure 2. The last part of the road blocked for entrance and the road has been pached with asphalt. (Google maps)

Several different tasks are performed in the area which of one (light weight structure) is done to provide information to Absoils project. The work in the area consists of re-constructing a 190 m



long road (Kyläsaarenkuja), treatment of contaminated soil in the area (the gas stations on Figure 1), lightning excavating and constructing a new junction to Hermanninrantatie.

The road is being opened and the aggregate material is dug out of the road. The aggregate material is treated by Rudus and is being reused. The pits from the aggregate area are filled with abandoned soil, which is transported from near located construction site where the clay could not be utilised. Because of the high density of the utilised clay, some water needed to be mixed with the clay to reduce the density of the material. Because of the good stability of the light weight structure, there is no need for cutoff wall, which was used in previous structures on the area. During the pilot is implemented also the improvement of the stabilisation equipment is done.

### 3. **Dog Park**

New dog park is built in Espoo, Perkkää as a pilot for the Absoils project. The area of the park is 3 500 m<sup>2</sup> in the land use plan. New dog park must be built because a new building is built on the old dog park site. The soil of the area is soft soil (clay), with low load bearing. Currently the area has some outdoor routes. The vegetation of the area is mainly bushes and young trees. The ground level varies from +0,5 to +1,0 and flood covers the area from time to time. The clay thickness is about 12...14 m and the area is classified as very difficult constructing area of deep soft soil.

On the south and west side of the park are some outdoor routes and on the east side of the park is an embankment (level +6). Between the park and the embankment is a flume filled with water. On the northern and southern side of the park are some ditches. Some low ditches are on the future dog park area. The flooding water rises rapidly to these ditches and flumes but they don't have a runoff towards the sea.

On the Figure 3 the outdoor route surrounding the Dog park area can be seen. It can also be seen that the vegetation of the area is quite bushy with young trees.

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**Figure 3. Outdoor route surrounding the dog park area.**

On the Figure 4 is the ditch surrounding the dog park area.



**Figure 4. Ditch surrounding the dog park area.**



A natural gas pipe runs on the northern edge of the area which probably limits the construction work. The ground level of the area needs to be raised to prevent the flooding and the "new" ground level determined in the land use plan is +2...+2,5. For the rising of the ground level, soil material must be transported to the site. The material used is abandoned soft soil material, which is stabilised together with the top soil. The rising of the ground level must be done so that the probable settling is considered. The target is to reduce the flooding to less than once in 20 years.

The routes leading to the dog park must be designed to the same level as the dog park. Usually underground waste containers have been used in dog park areas. However, in the site the level of ground water is so high, that the force of buoyancy could lift the containers. The use of some other kinds of waste containers or bins must be considered.

The targeted shear strength of the area is about 30...40 kPa. The stabilised area is 5240 m<sup>2</sup> and according to the preliminary calculations the thickness of the stabilisation would be about 3 m and the volume 15720 m<sup>3</sup>. No wells for the rain water are built but the drainage is done by inclination. Big openings or holes cannot be formed below the fences of the area, where the dogs could run off, which must be assured by building a good basis for the fences. This will be done by mass stabilisation.

The roads that lead there have low load-bearings which cause problems when the transportation of the materials as well as the stabilisation equipment is considered. Thus probably some site access roads must be made.

The soil material for the rising of the ground level is probably available from the old dog park area. Also some other construction sites are located near the pilot area where it is possible to get some soil material.

The dog park area is a bird reserve area so the constructing can be done only after nesting.

For the area there is no other sensible method for the constructing of the dog park except mass stabilisation method. The soil exchange would be a massive operation with high costs and environmentally much worse than the mass stabilisation. No high load bearing is required from the area, so the utilisation amount of binders will be small. The area is owned by ABSOILS steering group member, the city of Espoo.

#### 4. **Jätkäsaari**

Jätkäsaari is a whole new living area, which is being built to Helsinki on an old container harbour area. The area has originally been a group of islands (Jätkäsaari, Hietasaari and Saukko) and the sea area between the islands and the continent has been filled in 1930's, creating a peninsula. The area was built for the harbour area, but since the harbour has moved to Vuosaari in 2008 the area has been freed for better purposes.

The new design for the area includes filling the sea area a little further and also dredging the fairway as the port for the cruisers, for example to Estonia, stays in the area. The uncontaminated dredged sediments are utilised in the fillings and the contaminated sediments are being treated on the area. The sediments could also be stabilised with by-products in the area and utilised in the park areas and possibly also in the fillings. Also soil material from other sites in Helsinki are utilised in the construction. Also the low quality materials could be utilised there with the use of stabilisation. However the environmental permit of the area does not yet allow the use of by-products in the stabilisation and thus the piloting in the area is not yet confirmed.



Figure 5. Jätkäsaari area plan. The striped areas in the end of the peninsula are new areas that are filled in to the sea and the striped areas in the sea are being dredged.

The Jätkäsaari area has already a treatment area where they treat for example the contaminated sediments of the area. The stabilisation work is planned to do in basins form where the stabilised mass could be moved to the utilisation site. One good utilisation site would be the "hyväntoivonpuisto" –park area.

The construction project is long and will continue to year 2024 or even longer. About 3,6 milj.m<sup>3</sup> of fillings are made in the area and about 2,6 milj.m<sup>3</sup> of sediments are being dredged.

Some stabilisation with using only cement as a binder has been done in area. The stabilised masses have been moved to the "hyväntoivonpuisto" –park area. However the cement stabilisation is not regarded as a part of the Absoils project.





## 5. **Länsisalmi**

Länsisalmi is one possible piloting site located in Vantaa. The piloting area is located beside Rudus's storage area where some new field area is released for storage area. The new area was formerly administered by Hyvinkään Tieluiska Oy where they have been refined soil (mould). The area needs to be reinforced as the area is used in future as storage area for Betoroc, rock material and the crushing of the rock material is also planned to be done on the site.

The reinforcement is done partially with Betoroc – an aggregate product of Rudus made from recycled material. The reinforcement could be done partially also with mass stabilisation by utilising industrial by-products in the stabilisation.

## 6. **Pirttiranta**

Pirttiranta pilot was built on a site that flooded yearly and the houses on the area were exposed to the flood. On the area a flood embankment was built on abandoned soils.



Figure 6. Pirttiranta site before building the flood embankments on dry time.

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Figure 7. Pirttiranta on two different flooding periods on the left side spring flood 1966 and on the right side flooding in 2004.

The area was built by a member of the steering group and Ramboll Finland Oy was used as an advisor only in small parts of the project. The Abandoned soils (dry crust clays) were rather dry and were not stabilised. The water content of the abandoned soils was 35–50 % and the strength was about 25–50 kPa. Calculations were made to find out the adequate ground bearing capacity and the stability of the structure. The abandoned soils were transported from close by locations. The total volume of utilised soils was 4 000 m<sup>3</sup>.

## 7. Jätkäsaari III



Figure 8. The Jätkäsaari area in Helsinki

The Jätkäsaari III is a continuation of the Jätkäsaari I and II projects carried out in 2011 and 2012. Jätkäsaari is a whole new living area, which is being built to Helsinki on an old container harbour area. The area has originally been a group of islands (Jätkäsaari, Hietasaari and Saukko) and the sea

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**Figure 9. Jätkäsaari area plan. The striped areas in the end of the peninsula are new areas that are filled in to the sea and the striped areas in the sea are being dredged.**

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## 8. Honkasuo

Honkasuo is a new area in Helsinki on the border with Vantaa planned for the housing purposes. It has been planned that after construction is finished about 1500 people will live in the area. The project will be carried out in stages and will last for several years. The first stage is preparation of the area and the so called pre-construction.

Because the area is challenging from the geotechnological point of view as the soils at the site are mostly peat and soft clay, it will require pre-construction in order to carry on with the infrastructure and house building. Peat and soft clays are too soft and have too low bearing capacity. In the traditional approach, peat and soft clays are excavated and transported to landfill. The current transportation distance in Helsinki is about 40 km.

The approach propose by the project includes stabilisation of the peat in situ and the use of surplus soft clays after stabilisation as filling or for the level raising purposes.



Figure 10. The aerial photo of Honkasuo in 1976



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Figure 11. The current aerial picture of the Honkasuo area.

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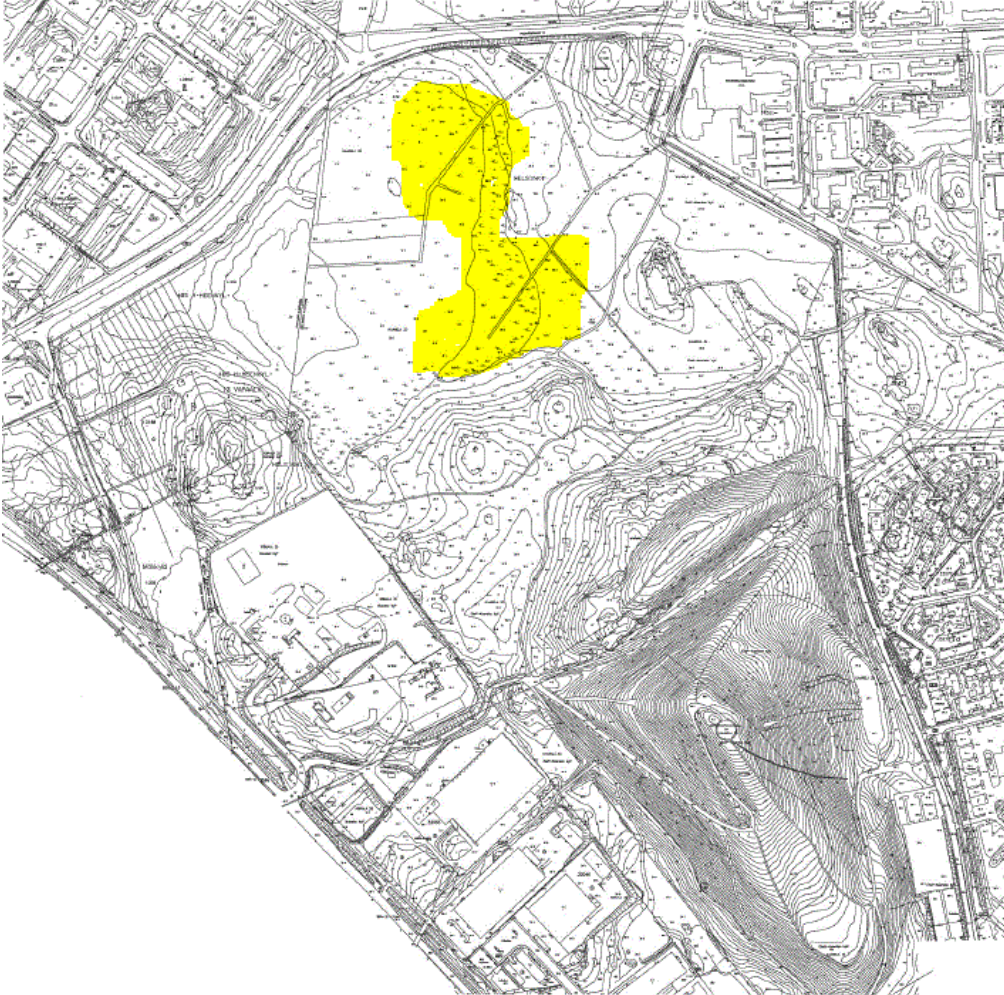


Figure 12. The location of the Honkasuo pilot area.

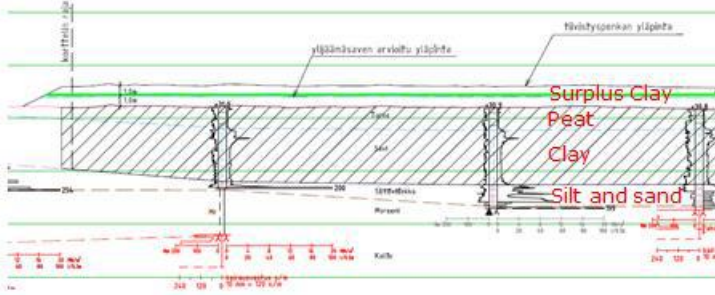


Figure 13. Current situation in the Honkasuo area.



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SUPPORTING BANKS



Cross section: Geology and the mass stabilisation

Mass stabilization of peat layer with clay addition and binder



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Figure 15. Activities foreseen in the pilot area.