



# Infrastructure

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Excellence in project delivery across disciplines

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# Introduction

**This is an interactive version of NIRAS Infrastructure Brochure. You can easily navigate between the various sections using the menu in the left-hand column.**

**NIRAS is an international consultancy company founded in 1956 and one of the leading Scandinavian consultants. With our headquarters in Denmark and branch offices in Europe, Asia, North and South America, U.K. and Africa, we take part in 7,000 projects in more than 100 countries.**

Our services cover the full cycle of a project, from the preparation of master plans, and technical and financial analysis, through design and tendering, to supervision, commissioning, operation and maintenance. Our +3000 experts offer multidisciplinary specialist knowledge that guarantee holistic solutions.

In NIRAS, sustainability is at the very core of our endeavours and for many years our experts have been at the forefront of providing sustainable solutions in large infrastructure projects.

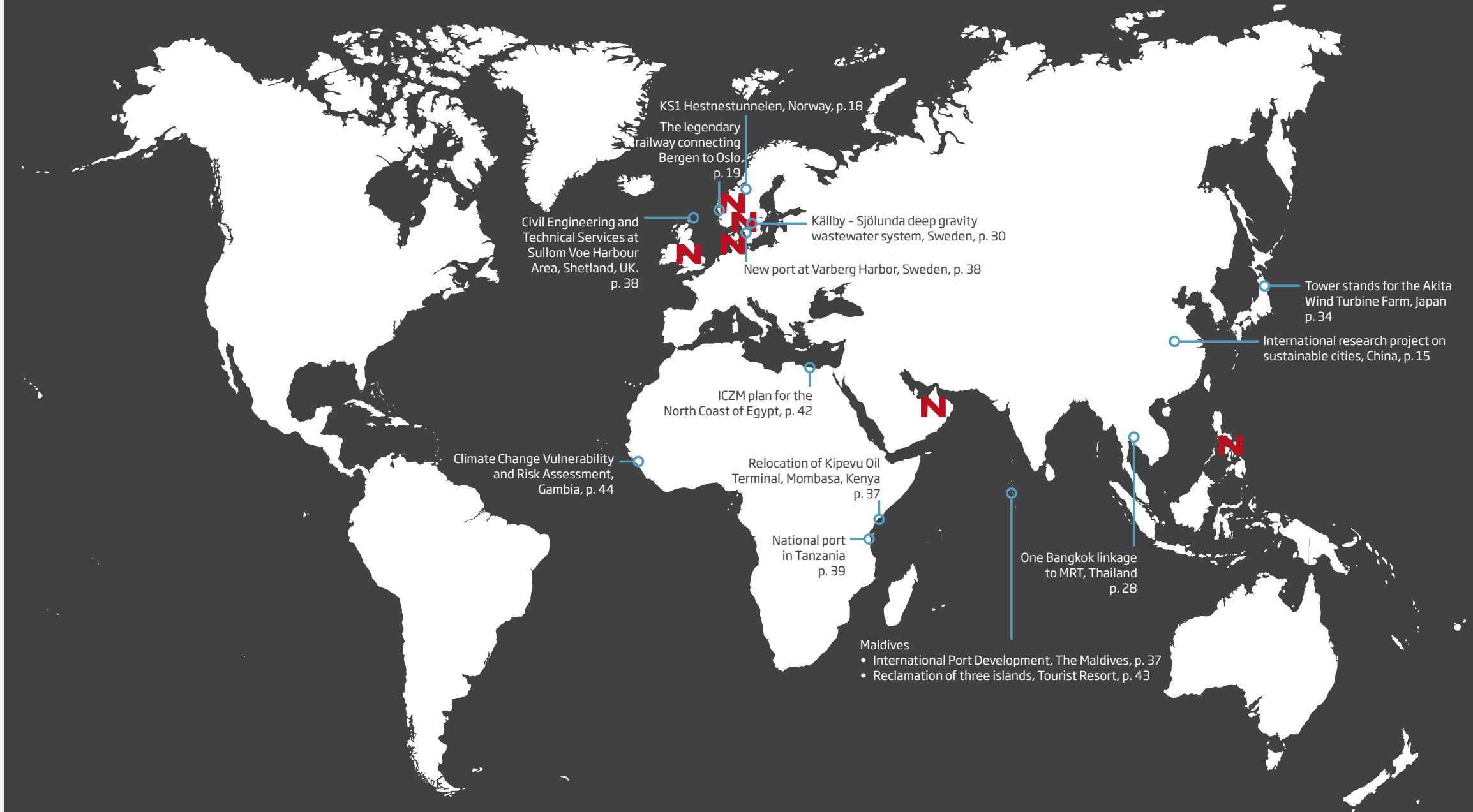
**We have vast experience in the following fields:**

- Sustainable mobility
- City planning and landscape
- Railways, metros and light railways
- Roads
- Tunnels
- Bridges and special structures
- Ports and marine
- Coastal stabilisation and flood risk management
- Geotechnical engineering
- Environment

This brochure covers some of our significant references and describes our services and expertise.

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## International growth



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# Sustainable mobility

**Sustainable mobility is part of a greener future. Developing and promoting public and active transport is fast becoming a central element in urban planning and in management of countryside living and development.**

NIRAS has a team dedicated to sustainable mobility. We have extensive experience in mobility analysis and planning for both public and private clients. All our projects focus on promoting public and active transport and integrating these into the mobility and infrastructure systems that underpin our societies. We work both in urban settings and rural districts, and always focus on the passenger experience.

## Our services include:

- Strategic mobility planning
- Mobility hub development
- Mobility behaviour analysis and design
- Crime prevention through urban design
- Analysis of passengers' perception of safety
- Cycling infrastructure analyses and development
- Public and active transport planning
- Traffic planning
- Recreative and tourism mobility analyses and planning

## What is the difference between sustainable mobility and green mobility?

### Sustainable mobility

Sustainable mobility is about the journey towards a future which is the best choice for all. In the city, more people should cycle, walk, and use public transportation, reducing the size of the car fleet, making it electric-powered, and implementing smart parking solutions. All of this for the benefit of a better urban life. In rural areas, we should support development by offering attractive mobility options and creating strong connections to cities and across regions.

### Green mobility

Green mobility is about transforming the transportation sector to consume less energy and utilize more sustainable fuels, so that the sector reduces its own CO2 emissions.



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## CASE - SUSTAINABLE MOBILITY

# New urban development project with decentralised hubs for micro-mobility and centralised parking with EV stations

Stigsborg Waterfront is one of Denmark's largest urban development projects, right on the coast in the city of Aalborg. Full development is expected to be completed in 25 years.

<b>Client:</b>	Stigsborg P/S
<b>Country:</b>	Denmark
<b>Period:</b>	2021-ongoing
<b>Architect:</b>	CF Møller

The new urban area is projected to become the home for 8,000 inhabitants and to host a wide range of public and private institutions.

NIRAS has conducted the traffic analysis and planning for Stigsborg, including the development and design of micromobility hubs. These hubs will become the infrastructural backbone of Stigsborg, which aims to minimize car usage within the area, and become a 15 minute neighborhood.

NIRAS has also prepared a strategy and plan for parking and charging electric vehicles (EV's). The parking are facilitated in 2 centralized parking houses, which also works as mobility hubs. The parking is houses are suited with EV charging stations and are prepared for scaling the charging stations in the future.

NIRAS prepared a plan for the locations of the micromobility hubs, and for what each individual hub should host of various active transport services. Each location is linked to the public transport service in Stigsborg and will thus allow the inhabitants and guests to use sustainable mobility solutions in and around this new urban area.



Illustration - courtesy of CF Møller

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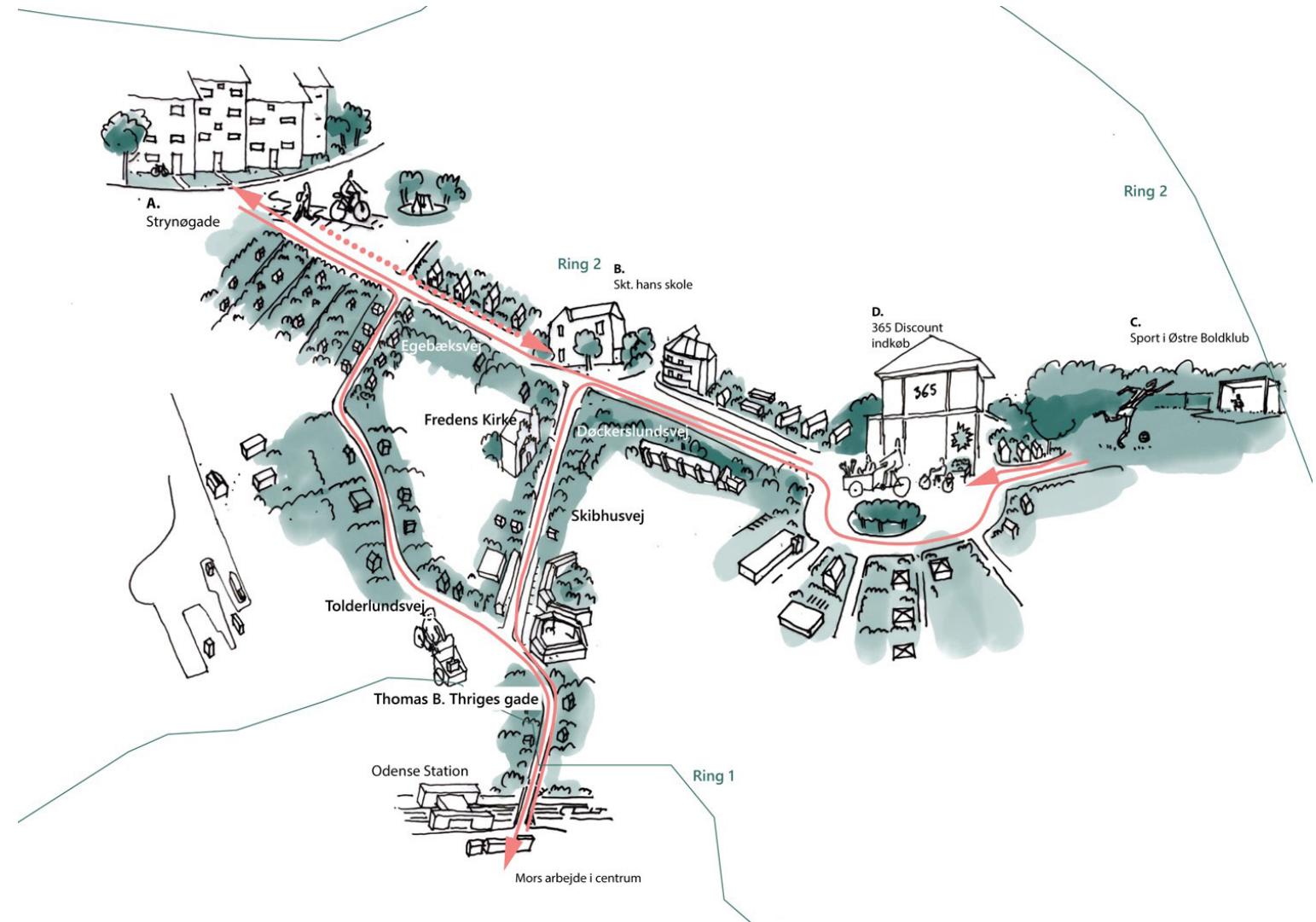
## CASE - SUSTAINABLE MOBILITY

### Odense Mobility Plan

NIRAS has made a mobility plan for Odense, to visualize how the municipality can achieve their goal of being climate neutral by 2040. Further the mobility plan demonstrates that the changes in infrastructure can be a catalyst for more attractive and livable environments for the citizens.

Part of the project was to narrow down key initiatives that will support change in mobility, to enhancing the use of sustainable transportation. In general, the greatest potential for reducing CO2 are to reduce private use of cars, measures to enhance electrical vehicles, how to make it more attractive to use bikes and put more money in public transportation. To attain a change in mobility behavior the initiatives should be supported by participatory processes. In the mobility plan was an overview that showed how big the savings on greenhouse emission would be for each project.

<b>Client:</b>	Odense Municipality
<b>Country:</b>	Denmark
<b>Period:</b>	2023



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## CASE - SUSTAINABLE MOBILITY

### Traffic plan for Viborg Municipality

For Viborg Municipality NIRAS is developing a traffic plan, an updated traffic model (in collaboration with ViaTrafik), and an analysis on the significance of the motorway for the municipality's road network. NIRAS is responsible for the overall project management and for drafting the municipality's new traffic plan. The traffic plan focuses on how Viborg Municipality can provide residents, businesses, and visitors with efficient and sustainable traffic management in the coming years, covering all types of transportation including cars, bicycles, pedestrians, and public transport.

The goal is to establish the foundation for sustainable mobility throughout Viborg Municipality's geography, ensuring accessibility and mobility in a safe and climate-conscious manner. ViaTrafik is responsible for updating the existing traffic model so that it can serve as the basis for planning and executing infrastructure projects in Viborg Municipality in the future.

Using the traffic model as a reference, an analysis is prepared to assess how both an eastern and western line of the Hærvejsmotorvejen (Highway) around Viborg will affect traffic load and flow on Viborg Municipality's road network. The traffic plan is developed in collaboration with Viborg Municipality through a political process that involves input and engagement from the administration, residents, and politicians in the creation of the traffic plan. As a part for the evaluation of the effects of the traffic plan NIRAS is using IOT sensors to measure noise levels and CO2 levels from the traffic.

<b>Client:</b>	Viborg Municipality
<b>Country:</b>	Denmark
<b>Period:</b>	2022-2023





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**CASE - SUSTAINABLE MOBILITY**

**Perceived safety around light rail stations and how it affect the use**

The new light rail around Copenhagen, going through 11 municipalities in the suburbs, is a 7,5 billion investment. The aim is to reduce the greenhouse emissions from private car use, by making it more attractive to use public transportation. Moreover, the project aims to enhance urban development around the new stations and create economic growth in the suburban municipalities.

The new infrastructure is placed along a ring road. In order to make the stations attractive for the users, NIRAS was hired to analyze how the environment around the light rail stations can feel more safe to be in for pedestrians. In the analysis focus was put on the potential fragile users, e.g. children, youth and night-shift workers.

The analysis showed that the users will change their behavior and traveling patterns according to how un-safe they feel in the area around the new stations. If it doesn't feel safe they will find other means of transportation. Potentially this means that the light rail will lose costumers if the stations are not nice to be in. As part of the assignment measures on how to make the surrounding areas more safe was given, e.g. enhancing flow of pedestrians and bikes, making sure that more eyes would be on the areas and thereby positive social control.

<b>Client:</b>	Capital region
<b>Country:</b>	Denmark
<b>Period:</b>	2022-2023



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## CASE - SUSTAINABLE MOBILITY

### Planning and design of a new recreational bicycle hub network in Denmark

“Improving Conditions for Cycling Tourism in Denmark” is an initiative aimed at providing recreational cyclists with better opportunities to plan their bicycle trips while also contributing to the creation of a new international competitiveness within coastal and nature tourism in Denmark. As part of the initiative, Danish Coastal and Nature Tourism has launched a project aimed at planning and designing nine recreational bicycle hub networks in Denmark, known as “PUK” (Projektet for Udpegning af Knudepunktsnetværk).

<b>Client:</b>	Danish Coastal and Nature Tourism (Dansk Kyst- og Naturturisme)
<b>Country:</b>	Denmark
<b>Period:</b>	2022-2023

#### PUK consists of three parts:

- Principles for the designation of the bicycle hub network.
- Demonstration networks in selected municipalities.
- Recommendations for scaling and rolling out the bicycle hub network on a national scale.

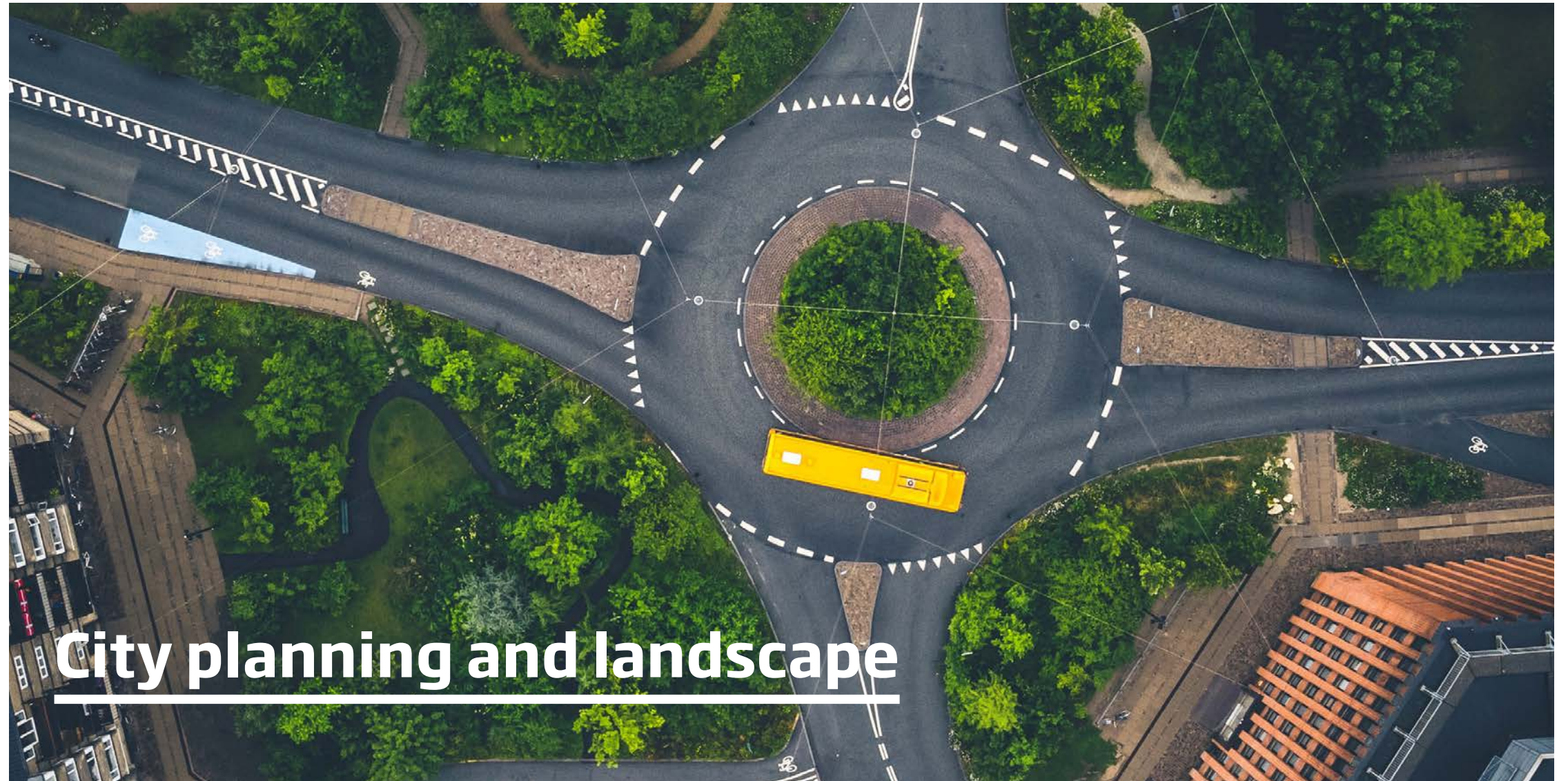
In collaboration with the Dutch consulate agencies Folkersma Routing en Sign and Mobycon, as well as the Danish Cyclists’ Federation, NIRAS is conducting this project. NIRAS is responsible for the overall project management and cooperation with the participating municipalities.

The project will conclude in 2023, at which point a bicycle hub network will have been established in nine selected municipalities, based on a data-driven approach for designing the routes.

Furthermore, there will be recommendations on how a recreational bicycle hub network can be expanded to a national scale.



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# City planning and landscape

**Our landscape architects solve urban and landscape design projects where aesthetics, function and sustainable solutions go hand in hand. We place great emphasis in realising projects on a sound, sustainable and well-considered basis ensuring increased quality of life for people and nature.**

The projects cover everything from large strategies and masterplans to designing and planning urban - and landscape projects. They cooperate closely with other disciplines in NIRAS to create sustainable attractive landscape architecture and to find the best solutions for both people and the environment.

The projects are made in close relation to infrastructure, institutions, housing, etc., and with a growing focus on climate adaptation. All projects and places are exceptional and therefore must be treated with care and consideration for the users as well as for the future generations.

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## CASE - CITY PLANNING AND LANDSCAPE

### Odense Light Rail

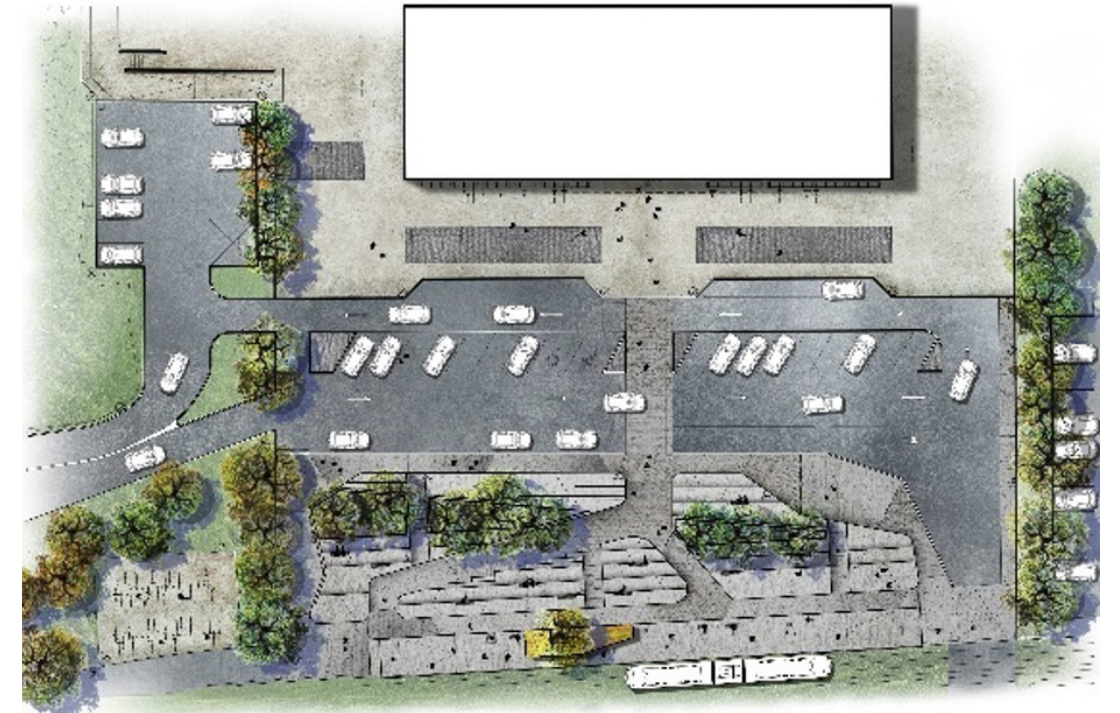
NIRAS was responsible for design and planning of the Odense light railway, including adaptation between the light rail route and the surrounding areas. An important focal point in the project is to both give the light railway its own identity and adapt it to the distinctive character of the urban spaces. The line is 14.5 km long and has 26 stations and our landscape architects was responsible for all the stations and all the stretches between. An example of the urban spaces in the project is the station at Israels Plads (Odense Sports Park). This station is included as part of the existing urban space. It is a complex plaza with many functional requirements, both everyday life activities, and major events.

The materials from the sports park building - glass and concrete - have been used in the design of the plaza, where concrete stairs and plinths utilise the terrain of the plaza for small areas that can be used for seating or training. As contrast to the hard concrete, wooden seats have been integrated.

The materials in the project integrate the light rail's concrete platform and makes the transition between the light rail stop and the plaza invisible. Trees, grass, and perennials have been planted creating a variety of landscape spaces and separating the functions in the plaza. The project includes both accessibility optimization and rainwater management, as the site is located on low previous marsh area.

The pictures are from Israels Plads.

<b>Client:</b>	Odense Letbane P/S
<b>Country:</b>	Denmark
<b>Period:</b>	2014-2021



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## CASE - CITY PLANNING AND LANDSCAPE

### Østervold, Randers

Østervold is a blue-green urban space in the city of Randers that serves both as a recreational area and as a new rainwater basin that cleans the water before it flows into Randers Fjord. In the long run, the basin will function as a climate adaptation of the medieval city. Randers has to deal with a series of water related threats, since the city faces flood risks from both the seaside in the form of storm surges from Randers Fjord, downpours in the higher parts of the city and floods coming from the Guden River which runs through the city. The basin becomes part of a cloudburst channel, which can receive large amounts of rainwater and thus prevent flooding.

<b>Client:</b>	Vandmiljø Randers (Aquatic Environment Randers) and Randers Municipality
<b>Country:</b>	Denmark
<b>Period:</b>	2021

The rainwater basin at Østervold is one of the first visible parts of the development plan 'Flodbyen Randers', which was launched in 2020. The ambition of the plan is

to bring attractive nature and high biodiversity very close to the city while at the same time making sure that urban development considers climate adaptation and storm surge protection.

Due to Randers' specific risk profile regarding floods, the utility company Vandmiljø Randers (Aquatic Environment Randers) and Randers Municipality have started working on the plan 'Flodbyen Randers' (River City Randers) to make sure that water solutions and water risk assessment will form an integral part of all future urban development.

NIRAS has advised Vandmiljø Randers on all the engineering disciplines in connection with the planning and construction of the new blue-green urban space. In addition, the basin is designed by our landscape architects, who have been responsible for the idea, design and planning of the parts of the project that are related to the urban space - including planting, paving and furniture in close collaboration and dialogue with Randers Municipality.

Due to the close interaction between the classical engineering disciplines and the landscape architects, we have found a solution that combines the technical rainwater management solutions with an accessible urban space. The interaction between water and planting draws the beautiful nature around Randers Fjord into the city, and it has given Østervold new energy and has created great recreational value for the inhabitants of Randers.



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## CASE - CITY PLANNING AND LANDSCAPE

### Griffenfeldsgade

**In this project urban spaces in different locations have been redesigned and planned:**

- Peblinge Dossering
- Wesselsgade
- Gartnergade
- and Griffenfeldsgade.

The project was implemented in connection with a large traffic renovation project at Nørrebro, Copenhagen.

The project involves expansion of the pedestrian areas to create more room for informal living utilising site-specific materials and to give urban spaces a unique (sometimes existing) identity.

In the different locations at Griffenfeldsgade, the visual expression was to let steps or seating areas almost “grow out” of the pavement. This is achieved through an organic pavement design around geometrically sharp concrete plinths. Both granite and concrete are classic materials for urban spaces in Nørrebro, but here they meet in a slightly different way, creating unpredictability in the city’s floor.

In contrast to the pavement, plant beds have been established with a base of white-flowering Geranium Sanguineum and light deciduous trees as a flickering roof. The pictures are from Griffenfeldsgade.

<b>Client:</b>	Copenhagen Municipality
<b>Country:</b>	Denmark
<b>Period:</b>	2019-2023



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## CASE - CITY PLANNING AND LANDSCAPE

### International research project on sustainable cities

NIRAS is part of the international research project called Transit Oriented Development 2 (TOD2), along with leading researchers from Nanjing University and Tongji University from China, as well as with researchers from Stockholm University and KTH Royal Institute of Technology in Sweden. In addition, the Danish startup, UrbanDigital, participates in the project. Together we will create a framework for integrating sustainable mobility hubs into the urban space into the urban space.

The TOD2 project will particularly focus on how changes in new urban development and existing urban planning can contribute to making it easy, safe and flexible to make a more sustainable transport choice. The project contains several innovative measures to validate the influence of the visual environment, the street network, and variables from urban activities on parameters such as particle pollution, CO2 emission and public transport.

TOD, an acronym for Transit-Oriented Development, is a term that has been used since the 1990s and focuses on urban planning centred around public transport mobility hubs. The goal of the TOD2 research project is to produce an updated version of principles for transit-oriented development. The transport sector accounts for a third of the world's total climate burden, and it is absolutely central to include transport in the solution to the climate crisis, especially the transport in our cities.

#### Facts about the TOD2 project

The TOD2 project is carried out with support from JPI Urban Europe, and NIRAS' share is financed by Innovationsfonden (The Danish Innovation Foundation) and the NIRAS Alectia Foundation.

The project is carried out in collaboration between NIRAS, UrbanDigital, KTH Royal Institute of Technology, Stockholm University, Nanjing University and Tongji University. KTH Stockholm and Nanjing University lead the project. The project has a total budget of 1.3 million euros, and will start on May 1, 2023, and have a duration of three years.

<b>Client:</b>	UrbanDigital, KTH Royal Institute of Technology, Stockholm University, Nanjing University and Tongji University
<b>Country:</b>	China
<b>Period:</b>	2023 - 2026



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# Railways, metros and light rails

**NIRAS has ample experience with all aspects of projects related to railways, metro and light rails. We have carried out a series of large rail projects in the Nordic countries. Our experts handle all stages of railway projects and have specialised knowledge within all areas of expertise from planning, design and construction.**

NIRAS handles all railway project stages, from idea to construction inspection and subsequent operations and maintenance. We cover all technical skills required for planning, designing and constructing railways.

**Our services include:**

- Railway technology
- Rolling stock and operations
- Traffic planning

- Civil engineering and construction
- Road construction
- Stations
- Environment
- Operational and socioeconomics
- Capacity simulations
- Assistance for tendering on large supply, construction or operating contracts
- Operation and maintenance
- Feasibility studies and business economics

In addition, we handle a range of interdisciplinary tasks, such as interface management, construction cost estimates and risk management, regulatory processing and approvals, and common safety method (CSM) assessment. We often work across disciplines to achieve an optimum solution.



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## CASE - RAILWAYS, METROS AND LIGHT RAILS

### Danish railway station, Hillerød Station undergoes a comprehensive renovation

NIRAS wins a major contract, in collaboration with Banedanmark, Lokaltog, and Hillerød Municipality, which will ensure that Hillerød Station remains a central hub in the North Zealand train network. This will be achieved through an upgrade of the station's infrastructure and track renewal.

Hillerød Station plays a crucial role as a vital hub for train traffic in North Zealand of Denmark. It serves as the terminus for several important railway lines, including S-train Line A, the Little North/Gribskov Line, and the Frederiksværk Line. Soon, Hillerød Station will also become a connecting point to the brand new Favrholm Station, which will serve commuters heading to the new North Zealand Hospital. The project is part of the infrastructure plan leading up to 2035.



NIRAS is responsible for project planning and technical consultancy in all phases of the project through interdisciplinary collaboration among departments specializing in railways, geotechnics, structures, drainage, electrical systems, and the environment.

#### Efficient passenger flow and reduced travel time

The project includes the establishment of new track connections and track renewal at the northern and southern ends of the station, which will result in a significant reduction in travel times. This upgrade is also expected to lead to an increase in the total number of journeys to between 215,000 and 263,000 by 2027

However, the last stretch from Herredsvejen to Isterødvejen has not been prepared with the same purpose initially. The western side of the road will be widened by 1.5 meters to accommodate future emergency lanes and road water runoff.

In addition to the extension of the Hillerød Motorway, NIRAS has won a number of other exciting projects for the Danish Road Directorate in recent months.

These projects include a preliminary investigation for the partial demolition of Bispeengbuen in Copenhagen, an Environmental Impact Assessment (EIA) and outline project for Route 26 Aarhus - Viborg, as well as an interchange at the junction of Connection Facility 26 Aalborg East

<b>Client:</b>	Banedanmark
<b>Country:</b>	Denmark
<b>Period:</b>	2023 - 2026

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## CASE - RAILWAYS, METROS AND LIGHT RAILS

### KS1 Hestnestunnelen

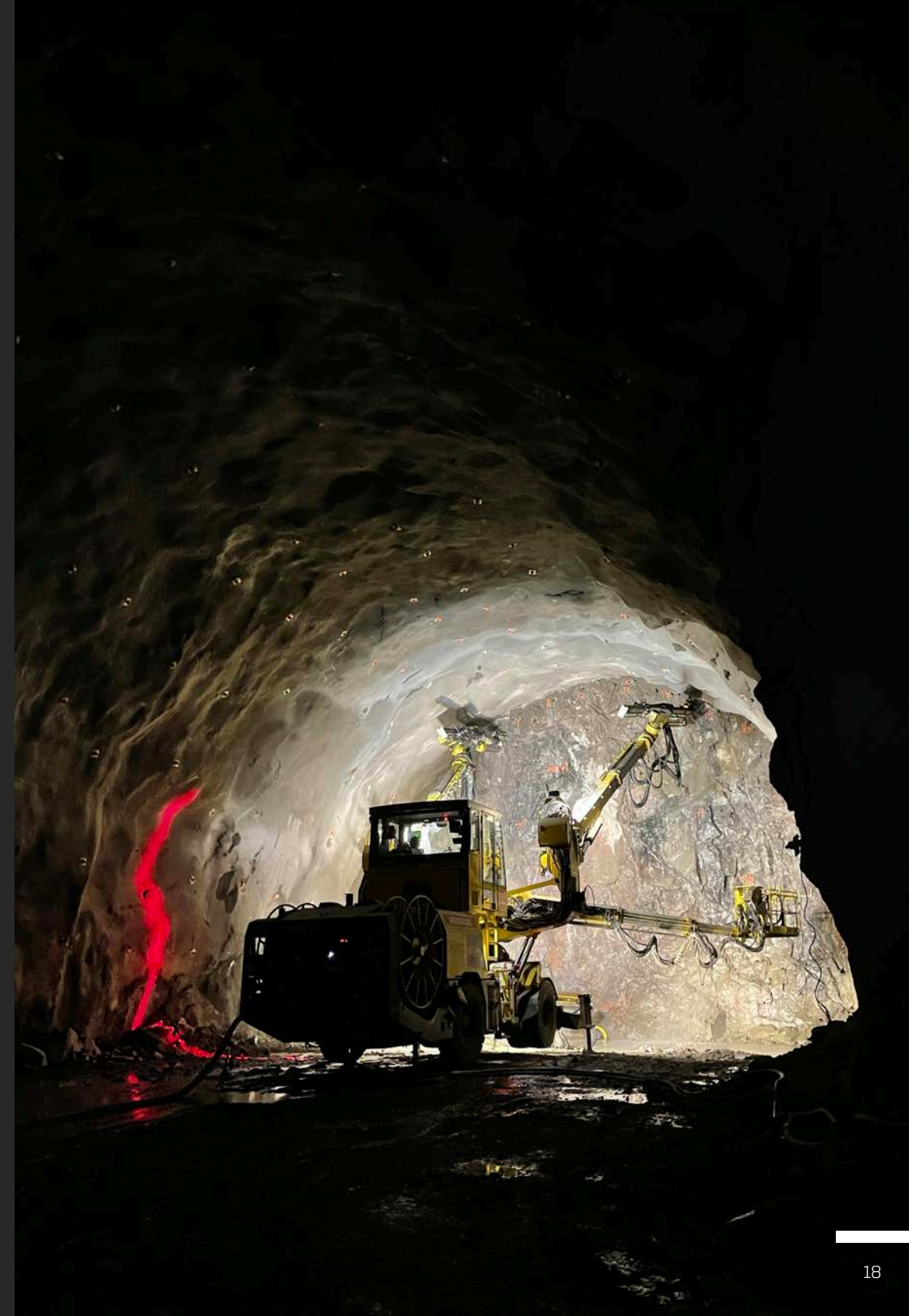
NIRAS has assisted Bane NOR with the planning of the 3.1 kilometer Hestnestunnelen. The railway tunnel is being blasted through a mountain and runs from Kleverud to Espå situated some 100 km north of Oslo. It has been a both demanding and interesting project for NIRAS in terms of delivering complex 3D digital models. As part of the project it is necessary to carry out laser scanning of the tunnel profiles for use in the models.

The tunnel is being built as a single-lane, double-track tunnel with crosscuts every 1,000 meters (length crosscuts approx. 340 and 610 meters). The track in the tunnel will lead directly onto the Tangenvika railway bridge. Therefore, it is necessary to lower County Road 229 to meet the clearance requirements under this bridge.

The tunnel is to be equipped with niches for technical equipment and extensions for visibility which safeguard lines of sight to signals. Rock protection of the tunnel will be based on mapping the rock mass and protection classes according to the Q system. The transverse layers will function as escape tunnels during the operational phase.

The Hestnestunnel will be operated from Kleverud's southern portal and southern cross section.

<b>Client:</b>	Bane NOR
<b>Country:</b>	Norway
<b>Period:</b>	2020 - 2025



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## CASE - RAILWAYS, METROS AND LIGHT RAILS

### The legendary railway connecting Bergen to Oslo



NIRAS and Bane NOR, Norway's national railway, has entered into a contract in the development of a technical master plan and a detailed technical plan to strengthen the capacity for freight traffic between Oslo and Bergen and has now initiated the work on three passing loops at Dale, Veme, and Sandermosen. The project will improve conditions for longer freight trains by extending the existing passing loops, and also aims to improve the stability and flexibility of train traffic for both passenger and freight trains. The task began in 2023 and will continue until mid-2025.

<b>Client:</b>	Bane NOR
<b>Country:</b>	Norway
<b>Period:</b>	2023 - 2025

Although the Bergen Line is already a very busy route with high capacity utilization, it still has significant potential for growth in freight traffic. Through the expansion of existing passing loops, the project's purpose is to facilitate an increase in the share of freight on the railway between Oslo and Bergen.

The three passing loops to be extended are located at Dale in Vaksdal municipality, Veme in Ringerike municipality, and Sandermosen on the Gjøvik Line in Oslo municipality. Extending these crossing loops will allow freight trains with a length of up to 640 meters to meet. These three passing loops are interdisciplinary and complex projects, where coordination between disciplines as well as other projects on the route will be a significant factor.

This project demonstrates NIRAS' strong position in the Norwegian market and encompass all disciplines and allow NIRAS to leverage the strengths we have in Sweden, Denmark, and Norway. It underscores our desire and the importance of working across national borders.

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## CASE - RAILWAYS, METROS AND LIGHT RAILS

### Total consultancy for a new railway line across West Funen

NIRAS act as a subcontractor to Atkins Denmark A/S, who has been selected as the lead consultant for one of Denmark’s largest railway projects, as the Danish Road Directorate and Banedanmark oversee the construction of a new double-track high-speed railway from Odense to Kauslund east of Middelfart.

In the coming years, a new double-track and electrified railway of approximately 35 kilometers will be constructed between Odense West and Kauslund, east of Middelfart. The new railway will follow a more direct alignment than the existing one, allowing passenger trains to operate at speeds of up to 250 km/h, significantly reducing travel time across West Funen.



This new railway is part of the goal to achieve the so-called “hour model,” which aims to reduce travel time between Odense and Aarhus to one hour.

#### Railway and motorway combined in a shared transportation corridor.

NIRAS and Atkins will jointly undertake the design of both the railway and the intersecting roads. The project also includes the design of approximately 3.4 kilometers of motorway and a single bridge in connection with the Fynske Motorway (E20) south of Odense, which will be expanded on the stretch west of the existing railway.

The railway and motorway will be integrated into a common transportation corridor, which will limit noise disturbances and the impact on the surrounding landscape, as both car and train traffic will be concentrated within a smaller area. With the construction of the new high-speed railway, capacity will also be freed up on the existing railway, allowing for increased handling of regional freight and passenger trains on the existing rail line.

The Danish Road Directorate is the client for the overall construction project and the authority responsible for the railway project, which is carried out in collaboration with Banedanmark. Additionally, Energinet is the authority responsible for the relocation of an existing natural gas pipeline on the route. The total construction project is budgeted at DKK 4.9 billion. The new railway is expected to be operational by the end of 2028.

<b>Client:</b>	Banedanmark and Vejdirektoratet (Danish Road Directorate)
<b>Country:</b>	Denmark
<b>Period:</b>	2022-2028

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**We pave the way for the roads of the future and assist with status evaluations, design of roads and pathways, and land development**

Accessibility, safety and sustainability are the keywords, when we work with roads at NIRAS. We design roads in open landscapes with respect to sensitive nature, and we lay out urban streets and areas in a way that optimises space utilisation and creates a safe and attractive environment.

We design safe bicycle and pedestrian paths, and we have expert knowhow in assisting municipalities, authorities and utilities companies with status evaluations and tendering of operation of roads, parks and green areas as well as winter services for same. We also have extensive land development experience, addressing and handling all challenges related to climate adaptation, nature, soil, environment, traffic, road and pathway construction, green areas and utility installations.

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## CASE - ROADS

### The design of the extension of the Hillerød Motorway

NIRAS, with Atkins Denmark A/S as a subcontractor, has been tasked with the design of a 13 km extension of the Hillerød Motorway. The expanded motorway is expected to be operational in 2027.

The Hillerød Motorway is undergoing a 13 km extension project between the Lillerød South exit and Isterødvejen with the aim of improving traffic flow and safety.

Calculations have indicated that there will be a need for increased capacity on this stretch in the future, partly due to the construction of the new super hospital in Hillerød. NIRAS has won the project in collaboration with Atkins Denmark as a subcontractor.

#### Expressway already prepared for expansion

The stretch will be established as a four-lane motorway designed for speeds of up to 110 km/h. The expansion will involve incorporating and widening the existing expressway, which already covers the section between Hillerød and Allerød.

The expressway was originally planned to allow for expansion into a motorway, and it will also be retained as one side of the new motorway. The actual expansion into a motorway will primarily take place along the eastern part of the stretch, where there is already space under the existing bridges.

Thus, the larger bridges between Allerød and Herredsvejen have already been constructed with motorway expansion in mind, as the expressway was initially intended to be established as a motorway.

However, the last stretch from Herredsvejen to Isterødvejen has not been prepared with the same purpose initially. The western side of the road will be widened by 1.5 meters to accommodate future emergency lanes and road water runoff.

In addition to the extension of the Hillerød Motorway, NIRAS has won a number of other exciting projects for the Danish Road Directorate in recent months.



These projects include a preliminary investigation for the partial demolition of Bispeengbuen in Copenhagen, an Environmental Impact Assessment (EIA) and outline project for Route 26 Aarhus - Viborg, as well as an interchange at the junction of Connection Facility 26 Aalborg East

<b>Client:</b>	Vejdirektoratet (Danish Road Directorate)
<b>Country:</b>	Denmark
<b>Period:</b>	2022 - 2027

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## CASE - ROADS

### NIRAS prepares a preliminary study for partial demolition of Bispeengbuen

NIRAS has been tasked by the Danish Road Directorate to prepare a comprehensive preliminary study for the partial demolition of Bispeengbuen in Copenhagen. The project includes preliminary investigations, conceptual design, environmental assessments, and a plan for recycling demolition materials.

This encompasses the structural capacity assessment of existing structures, strengthening of permanent structures, preliminary design of road and intersection layouts, as well as consideration of utility conditions. The feasibility study should provide the basis for a subsequent political decision on whether or not to proceed with the project.

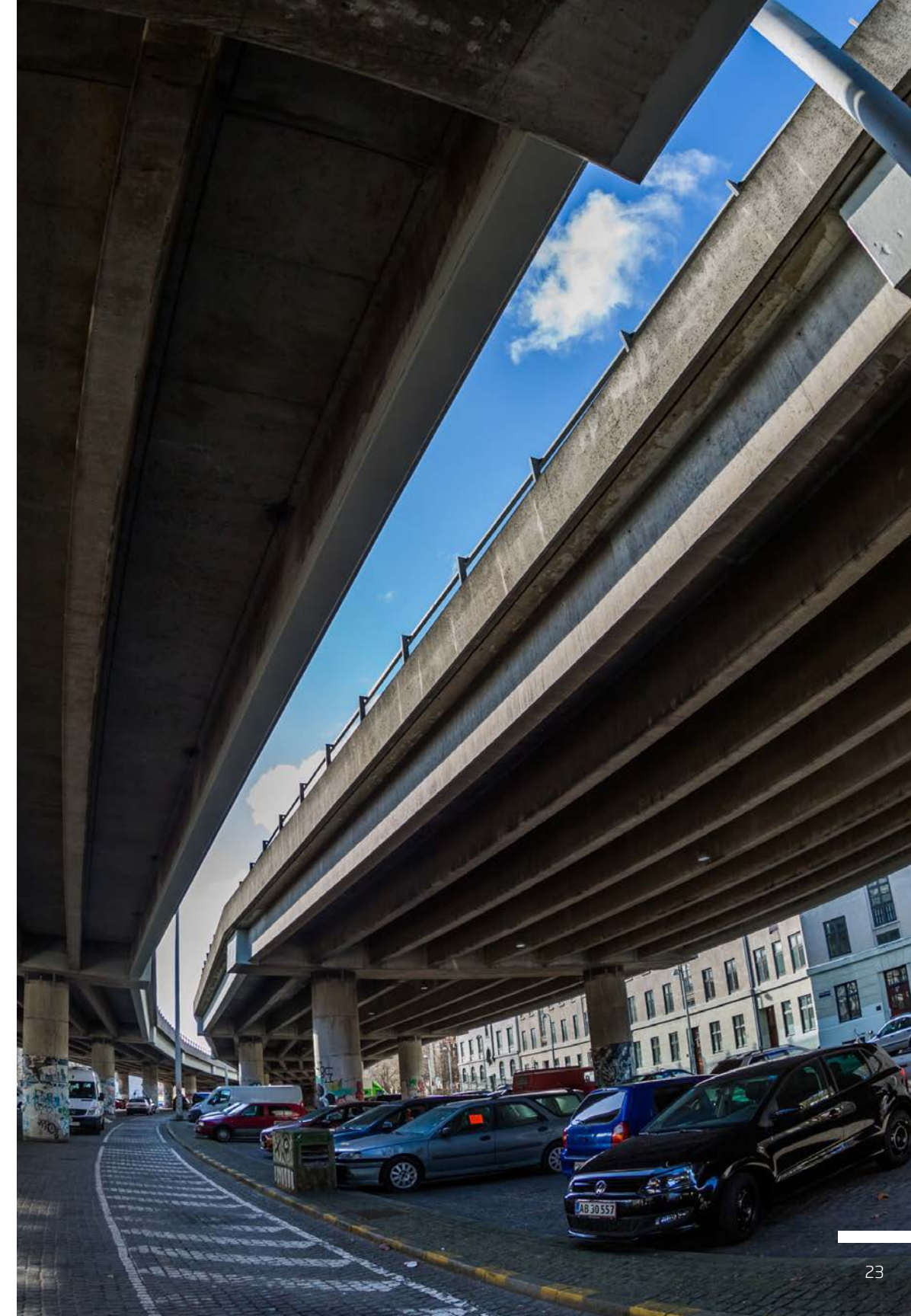
The feasibility study should investigate the traffic conditions, the road and bridge engineering effects, the associated environmental factors, as well as the construction and socio-economic impacts.

#### Interdisciplinary collaboration is crucial

The interaction between various disciplines is crucial for the successful and timely completion of the project.

At NIRAS, we are delighted to have the opportunity to offer solutions for such a complex project that has posed challenges for local politicians and urban planners for several years. One of our significant strengths is that our experts in mobility, bridge construction, demolition, and the environment are accustomed to working across different disciplines, giving us the ideal conditions to carry out this project. Hopefully, we will also contribute to improving the daily lives of many Copenhagen residents.

<b>Client:</b>	Vejdirektoratet (Danish Road Directorate)
<b>Country:</b>	Denmark
<b>Period:</b>	2022



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## CASE - ROADS

### The Future of Vollsmose - new urban area in the city

NIRAS is the consultant for a new urban city area in Vollsmose in Odense. The infrastructure project encompasses the realisation of the Infrastructure Plan - Future Vollsmose, and its key elements involve creating new infrastructure with improved connections to, from, and through Vollsmose. The area will be opened up with new roads and pathways, ensuring that the district is connected to Odense city center, the surrounding neighborhoods, and green spaces. Future Vollsmose is intended to be a safe and sustainable urban area where green spaces, city life, and commerce coexist harmoniously. The district is opened up in relation to its surroundings, and accessibility to the area is to be increased. Specifically, the Infrastructure Plan includes the addition of the following main elements to the existing residences and functions:

<b>Client:</b>	Odense Municipality, Civica, Fyns Almennyttige Boligselskab (FAB)
<b>Country:</b>	Denmark
<b>Period:</b>	2018 - 2023

- New road connections through Vollsmose in the form of main arteries and local streets
- New urban spaces
- Integrated pedestrian pathways with a focus on improved lighting, safety, and security

Future Vollsmose is a plan for how Vollsmose should be developed to a greater extent, so that the district becomes a positive component of Odense's overall urban development strategy.

The physical and social conditions for life in the neighborhood need to be improved, thereby supporting important goals of increased safety, strengthened civil society, and the transformation from a disadvantaged residential area to a contributing, regular neighborhood.





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**NIRAS is one of Scandinavia's leading consulting engineering companies at the forefront of complex tunnelling & underground engineering challenges.**

NIRAS has a long history of delivering successful tunnelling infrastructure projects. Through the last decade, NIRAS has delivered tunnelling projects in Denmark, Sweden, Norway and Thailand, and has established a broad level of expertise in segmental lining, pipe jacking, pipe roofing, pedestrian underpasses, deep shafts and underground structures.

Key to success in all tunnelling projects is the interdisciplinary coordination, where NIRAS is uniquely positioned to provide a comprehensive range of services by utilizing virtual design and construction tools.

From inception to operation, NIRAS' holistic design approach has assisted our project owners, developers and contractors, to receive an integrated and cost-effective design solution. Our inhouse specialists cover a vast spectrum of tunnel related services including:

- Concept design to detailed design
- Tender documentation
- Alignment feasibility studies
- TBM selection (mechanized tunnelling)
- Instrumentation & monitoring
- Settlement prediction analysis
- Construction impact assessment
- Tunnel construction logistics
- Construction time schedule
- Cost estimate
- Risk assessment
- Environment

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## CASE - TUNNELS

### Kalvebod Brygge cloudburst tunnel

In 2011, Copenhagen witnessed an unprecedented cloudburst that flooded large parts of the city and caused damages for approximately 500800 million USD. Due to climate change, these events of extreme weather are expected more frequently in years to come. Consequently, HOFOR (Greater Copenhagen Utility) has undertaken the construction of a number of cloudburst tunnels in the underground of Copenhagen, which will protect the Danish capital against floods. One of these tunnels is Kalvebod Brygge cloudburst tunnel.

#### Challenging alignment

The alignment of the tunnel has been highly challenging, since it is located in the heart of the capital and is crossing a number of sensitive assets including a historical theatre, a series of metro tunnels, the tracks of Copenhagen Central Station, etc.

In the event of massive cloudbursts, this underground tunnel will lead the rainwater to a large pumping station which will subsequently pump the water into Copenhagen harbour. The pumping station will be equipped with six powerful pumps which will yield a capacity of 20 m<sup>3</sup> of water per second. The total cost of construction will be approximately 52 million USD for Kalvebod Brygge cloudburst tunnel. The Kalvebod Brygge tunnel is part of a wider climate resilience programme in Copenhagen, and it will have a capacity to discharge up to 20.4 m<sup>3</sup>/s of flows to the harbour during peak storm events.

#### Facts:

- Service life 100 years
- Tunnel ID 2,400mm & 3,000mm
- Tunnel total length 1,625m
- Three shafts
- Two connecting structures
- Pump shaft flow capacity of 20.4 m<sup>3</sup>/s
- Budget: DKK 590 million

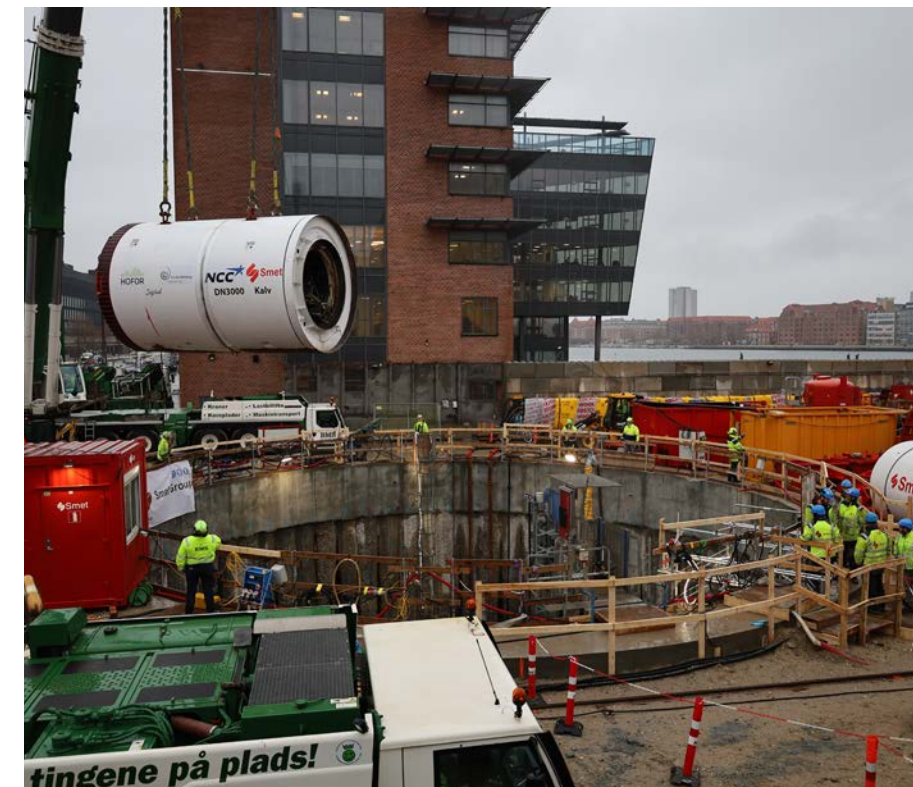
#### Kalvebod Brygge Stormwater Tunnel over the years:

- 2017: The advisory team led by NIRAS is selected.
- 2018-2020: Tunnel project planning takes place.
- 2020-2021: Contractors are chosen, and the construction phase begins.
- 2022: The contractor starts working.
- 2023: The first part of the tunneling is completed.
- 2023: December: Tender for installation work at one of Northern Europe's largest pump stations.
- 2023: Inauguration of Sigrid - the second part of the tunneling begins.
- 2024: Concrete work and installation work in the shafts commence.
- 2025: Installation work for the pump station at Kalvebod Brygge begins.
- 2026: The stormwater tunnel is ready.
- 2026: The stormwater tunnel is ready.

**Client:** HOFOR A/S

**Country:** Denmark

**Period:** 2017 - 2026



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## CASE - ROADS

### Valby cloudburst tunnel

The Valby cloudburst tunnel is part of a wider climate resilience programme of infrastructure works in Copenhagen that HOFOR (Greater Copenhagen Utility) is implementing with the assistance of NIRAS and other engineering companies and contractors.

The purpose of the tunnel is to divert the excess rainwater from the cloudburst catchment in the areas of Valby and Frederiksberg in the western part of Copenhagen. The Valby tunnel will be part of the "Den Urbane Strøm" (The Urban Stream) which will run north-south from Lindevangs parken in Frederiksberg to the outlet in the sea at Kalveboderne.

In addition to handling cloudburst water in relation to overflows to the recipient, the tunnel will also be used as a pool line to reduce the number of overflows during everyday rain which will also contribute to cleaner sea water.

<b>Client:</b>	HOFOR A/S
<b>Country:</b>	Denmark
<b>Period:</b>	2017 ongoing

#### Facts:

- Service life 100 years
- Tunnel ID 3,400mm
- Tunnel total length 2,500m with a long tunnel drive of approximately 1,300m
- Four shafts
- Microtunnelling connection Ø1,000mm with a length of 203m



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## CASE - ROADS

### One Bangkok linkage to MRT

One Bangkok is a Bt120 billion (DKK26.7 billion) landmark development and the largest privatesector property development initiative ever undertaken in Thailand. NIRAS together with NAWARAT Construction have been assigned to deliver, under a Design & Built contract, the pedestrian underpass which will be connecting One Bangkok development with Lumpini MRT Station under one of Bangkok's most busy roads, Rama IV.

During tunnelling operations, the 9 lane road sitting directly above the tunnel would have to remain fully operational, hence the "pipe roofing" construction methodology with interlocked steel hollow sections would.

#### Facts:

- Pedestrian underpass 71.0m long and 20.6m wide
- Permanent diaphragm walls for the cut & cover section
- Pipe roofing methodology comprising 46 CHS of 36.0m length
- Underpinning existing operational concrete culvert for wastewater

The company participated in the construction supervision, as part of NIRAS advisory services for this Design & Build project.

<b>Client:</b>	NAWARAT Construction
<b>Country:</b>	Thailand
<b>Period:</b>	2019-2020



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## CASE - ROADS

### Nordhavn Tunnel

The Danish Road Directorate (Vejdirektoratet) has awarded the design and construction of the Nordhavn Tunnel to a joint venture consortium between NIRAS, the Belgian company N.V. BESIX S.A. and MT Højgaard. NIRAS is undertaking the design of the permanent works. The total value of the contract is at DKK 2.6 billion (approximately USD 348 million).

The 1.4 km tunnel will be constructed under Svanemølle Havn - a part of the port of Copenhagen - and among other things the project includes the construction of a temporary marina for some 750 sailing boats. The new tunnel will improve infrastructure access to the newly developed area of Nordhavn in Copenhagen and will also help relieve certain parts of the heavily populated area of Østerbro from heavy traffic. The level of traffic is expected to be around 8,200 cars per day.

The Nordhavn Tunnel is just the latest in an impressive series of tunnel projects in NIRAS in recent years.

#### Facts:

- 1.4 km tunnel under the Svanemølle Harbour in Copenhagen
- Technical Building
- Two (2) Pump Stations
- Largest scale dewatering system ever installed in Copenhagen

The company participated in the construction supervision, as part of NIRAS advisory services for this Design & Build project.

<b>Client:</b>	Vejdirektoratet (Danish Road Directorate)
<b>Country:</b>	Denmark
<b>Period:</b>	2022-2027



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## CASE - ROADS

### Källby - Sjölunda deep gravity wastewater system

The Källby to Sjölunda tunnel is part of a large wastewater upgrade program which is intended to take wastewater flows from Lund together with flows from several communities between Lund and Malmö to the main wastewater treatment plant at Sjölunda. The wastewater tunnel has a total length of 10.5 km and it is planned to be excavated mechanically with pipe jacking method using micro TBM technology.

#### Facts:

- Service life 100 years
- Tunnel ID 3,000mm
- Tunnel total length ~10.5 km
- Nine TBM launching & receiving shafts



<b>Client:</b>	VA SYD
<b>Country:</b>	Sweden
<b>Period:</b>	2019 - ongoing

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# Bridges and special structures



**Our specialists assist with planning and design of bridges and special structures. This also include marine and tunnel projects and the renovation of steel and concrete structures.**

We work with railway-, road- and footbridges as well as many diverse special and advanced structures. This work also covers marine and tunnel projects and other subterranean structures.

Furthermore we deals with all kinds of special structures as towers, cable structures, stages and dynamically sensitive structures etc. This also include assisting in building projects where diverse special structure should are included. In order to guarantee design quality, our design experts combine their high expertise with the use of advanced 3D Finite Element programmes and calculation modules developed inhouse.

We frequently engage with experts from the fields of building, railroads, drainage, roads, traffic, environment, and geotechnology, so interfaces between are highly prioritized.

We also assist with the renovation of steel and concrete bridges and structures, and with the planning and managing of demolition once installations once installations are finish.

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## CASE - BRIDGES AND SPECIAL STRUCTURES

### Lille Langebro

Copenhagen is by many considered the world capital of cycling and bicycles form an integral part of daily transportation in the Danish capital. But the thousands of cyclists in the city also call for innovative and sustainable infrastructure solutions.

NIRAS designed a new bridge for bicyclists and pedestrians called Lille Langebro, which has up to 10,500 users daily. The beautiful new bridge relieves traffic from nearby bridges and connects historical parts of the old city centre. Ambitions for the project were to create a wider variety for active city life and recreation for the residents of Copenhagen and to establish another essential connection across the water. It is part of Copenhagen's ambition of becoming a green and sustainable city where cyclists are thriving.

The turning bridge is a gift from Realdania and designed by Wilkinson Eyre Architects. It was estimated that the new bridge would get 6,000 - 10,500 users on a daily base.

NIRAS participated in the preparation phase of the bridge, which have two compartments which open allowing ships to pass by. The bridge is 5.4 meter high and 20 meters long.

#### Facts:

- The new bridge is to relief Langebro, which is used by approximately 35,000 cyclists on weekdays
- Between 6,000 and 10,500 users are expected on a daily base
- Copenhagen has approximately 359 km of bicycle lanes
- There are 650,000 bicycles in Copenhagen
- 1.27 million km is cycled in Copenhagen on a daily base

<b>Client:</b>	Realdania / Municipality of Copenhagen
<b>Country:</b>	Denmark
<b>Period:</b>	2015-2019





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## CASE - BRIDGES AND SPECIAL STRUCTURES

### Sluseholmen bridges

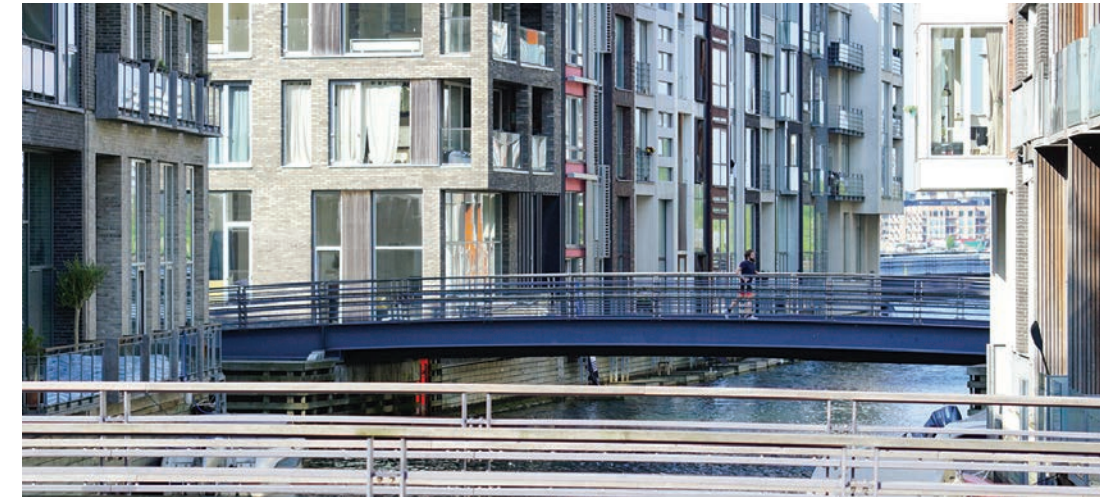
Tradition and modernity meet in the southern part of Copenhagen where a whole new channel city, Sluseholmen, is being constructed, following the well-known Dutch model of combining pleasant channels and small islets. The channel islets are connected by slender steel bridges for cyclists and pedestrians, allowing inhabitants and visitors to move around the area freely, and thereby creating both dynamic and intimate urban spaces.

NIRAS has designed and supervised 15 independent pedestrian bridges in steel, and designed all the channels in Sluseholmen. In addition, we have designed three combined road and pedestrian bridges in concrete that ensures the connection between the residential area and the access road leading to the rest of city. The project has also included an upgrade of the utilities in the residential area. These have been incorporated below the access road, involving a lot of utility restructuring in a very limited space.

As project and design manager, NIRAS has prepared draft, authority and retail project for the three bridges and the road in close collaboration with landscape architect Kragh & Berglund.

In addition to the road and bridge project, NIRAS has designed the utility system for the entire area. The project requires extensive communication with authorities and interdisciplinary collaboration, both internally in NIRAS and externally with architect and contractor.

<b>Client:</b>	HOFOR A/S
<b>Country:</b>	Denmark
<b>Period:</b>	2017-2020



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## CASE - BRIDGES AND SPECIAL STRUCTURES

### Tower stands for the Akita Wind Turbine Farm

KAJIMA Corporation in Japan has chosen NIRAS for the design and calculation of tower stands for the preparation of wind turbine towers for the Akita Offshore Wind Farm.

Akita Offshore Wind Farm is one of the first offshore wind turbine farms in Japan and will in combination with the Noshiro Offshore Wind Farm have a capacity of approximately 140 MW.

Tower stands are used during the preparation of the wind turbine towers. The tower stands are typically a 12 meter high steel structure, whose purpose it is to distribute forces from the tower to the concrete foundation.

The towers are erected in vertical position and the major part of outfitting is done on-

shore prior to transportation to the installation site at sea. For this purpose a number of tower stands are positioned on the quay.

Since Japan is in a region prone to both typhoons and earthquakes, it is crucial that the calculations take a series of extreme events into account. The project is executed in collaboration between our highly experienced experts in Taiwan, Bangkok and Denmark.

NIRAS has carried out a series of offshore wind projects in Asia in places such as Taiwan and Vietnam, and in recent years we have strengthened our ties with the growing offshore wind industry in Japan.



<b>Client:</b>	KAJIMA Corporation
<b>Country:</b>	Japan
<b>Period:</b>	2020-2021

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**NIRAS carries out ports and marine projects worldwide in a variety of conditions - from the Arctic to the tropics.**

We have more than 300 experts involved in ports and marine structure projects all over the world. Our experts are based in our offices in Denmark and in different locations around the globe. Our expertise covers all phases of project cycles - from embryonic planning to lifecycle care and maintenance, and all stages in between.

NIRAS provides comprehensive consulting services in relation to port terminals, coastal and marine civil works.

Services are rendered for all project phases including master planning, feasibility studies, input to and preparation of environmental impact assessments (EIAs), permitting, due

diligence, design, construction supervision and project management. Along with our traditional consultancy services, we provide multidisciplinary planning and engineering consultancy services to port operators, owners and authorities wanting to realise the potential of smart and green technology in their ports and terminals. We provide our clients with access to world class expertise in the development of smart and green technology, which varies from specialist providers of port equipment, such as smart electronic plant, to unique services such as laser scanning of port structures.

NIRAS is at the forefront of whole lifecycle management of marine assets, providing innovative inspection and maintenance services through the use of the latest technology. We develop tailored Digital Asset Management programmes and systems to assist ports and terminals with their ongoing operational maintenance and asset management processes.

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## CASE - PORTS AND MARINE

### Expansion of Port of Rønne, Stages 1 & 2

As an important part of securing a continuous supply to the community of Bornholm, the Port of Rønne is currently expanding in order to futureproof the port facilities and to accommodate port calls from the increasing ship sizes. As client advisor (in collaboration with the legal advisor of the port), NIRAS has prepared the tender material for expansion stages 1 and 2, which was subsequently sent to EU tender as turnkey contracts.

Stage 1 consists of a 300m long multifunctional quay and approximately 270m of heavy duty offloading quay. Both quays are designed for an initial alongside depth of 11m, with future provision for 13m. 15ha of reclaimed land was established as a yard to support the quays. The reclaimed land is protected from the south by a 510m permanent revetment. For the overall protection of the new port basin, a new 750m breakwater was constructed. The harbour entrance was excavated to a water depth of 11m.

Stage 2 consists of a 400m extension to the breakwater and a new 300m heavy duty extension of the multifunctional quay established in Stage 1, and approximately 5ha of new port area intended for heavy loads. In collaboration with Port of Rønne and the municipality, NIRAS has prepared the local area development plans, prepared an EIA as part of application works as well as completed the necessary preliminary investigations. These have included environmental and geotechnical investigations, noise simulations, wave simulations, current and sediment conditions, and extensive Metocean studies. The studies create an exact basis for further planning of the port expansion. Data from the completed Metocean studies has been used to define the necessary crest level and quay levels accounting for the wishes of Port of Rønne to secure the port against a changing climate.



As the client advisor, NIRAS has been in charge of preparing the project design with associated construction cost estimates, guidelines for the application process in order to obtain the necessary permits from the authorities and tenders for turnkey contracts according to EU legislation.

<b>Client:</b>	Rønne Havn A/S
<b>Country:</b>	Denmark
<b>Period:</b>	2016 - ongoing

Furthermore, NIRAS was responsible for construction management as the client's representative during the subsequent detailed design and construction phases.

In parallel with the consultancy of the port expansion Stages 1 and 2, NIRAS has assisted Port of Rønne with load studies of existing quays and yard areas. Investigations have especially been made within the offshore wind industry, as the Port of Rønne operates as an assembly port for the loadout of wind turbines within the Baltic Sea.

Planning and design of phases 3 and 4 are in preparation.

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## CASE - PORTS AND MARINE

### Relocation of Kipevu Oil Terminal, Mombasa, Kenya



**Client:** Kenya Ports Authority  
**Country:** Kenya  
**Period:** 2014 - 2023

The Port of Mombasa is the main entry point for all cargo not only for Kenya, but also for the land locked countries in the region - Uganda, Burundi, Rwanda and Eastern part of DR Congo. Import of refined oil products has increased in recent years and the capacity of the existing oil terminal has become too small. Consequently a new terminal was needed.

The project includes design of a large new island liquid bulk terminal with four berths, which replaces the existing Kipevu Oil Terminal. Kenya Ports Authority decided to assign NIRAS to assist in identifying and implementing a replacement. The project includes berthing and mooring facilities for four berths for up to 170,000 dwt oil tankers, pile supported concrete platforms, fitting with marine loading arms, oil piping installations, supplies, sewerage, water, power, lighting, onshore piping, subsea piping, and dredging of 15 million m<sup>3</sup> for tuning basins and berthing areas. NIRAS performs consultancy services related to preparation of preliminary design and tender design, including design, preparation of tender documents for an EPC tender and further preparation of tender documents for geotechnical investigations and bathymetric soundings. NIRAS' work also includes further client consultancy and coordination of external stakeholders in cooperation with the client. The services include construction management (2019 to 2022), as well as preparation of environmental scoping and specification for EIA.

### International Port Development, The Maldives



The capital of The Maldives is Malé, which is an island with a population of over 140,000 people in barely more than 2 km<sup>2</sup>. The existing port of Male is the primary port in the Maldives and is used as the hub for the importation of container, bulk and general cargo to serve the local population as well as the numerous resort islands in the country.

The current port is surrounded by rapid urban development which renders any expansion impossible. As such NIRAS in partnership with MTBS and local consultants led the development of an ambitious project to relocate the primary international port to a new reclaimed island.

The scope of works includes masterplanning the new island and port, surveys and modelling detailed design of land reclamation and shore protection, EIA, EPC tender design for the port, production of tender documents, assistance during the EPC tender period and preparation of management and training plans for the completed port. Sustainability was at the core of the design as well as provision to future expansion.

**Client:** Government of Maldives  
**Country:** Maldives  
**Period:** 2019-2022

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**CASE - PORTS AND MARINE**

**New port at Varberg Harbor, Sweden**

NIRAS is the consultant for Per Aarsleff A/S in connection with the execution of a turnkey contract, which includes the establishment of a new part of Varberg Port, Sweden. The port will be used for the storage and shipment of timber products.

The project includes the construction of a 324-meter-long quay and a 140-meter-long pier. Both the quay and pier are built as jetty quays, with the structures supported by piles underneath a concrete deck. Beneath the concrete deck, a stone revetment has been established. The quay is equipped with fenders, bollards, and connections for water and electricity. The quay is constructed on soft deposits, necessitating extensive ground improvement to ensure the stability of the quay. Throughout the project, NIRAS has closely collaborated with the executing contractor. This ensures that all solutions are designed to best match the contractor’s machinery, skills, and construction methods, thereby achieving the optimal project outcome. All structures have been modeled in 3D to ensure a smooth transfer of the project to the executing contractor.

<b>Client:</b>	Per Aarsleff A/S
<b>Country:</b>	Sweden
<b>Period:</b>	2023-2024



**Civil Engineering and Technical Services at Sullom Voe Harbour Area, Shetland, UK.**

The Port of Sullom Voe is a major deep-water harbour owned and operated by Shetland Islands Council, exporting oil and liquefied gas from the adjacent Sullom Voe Terminal (SVT) since the 1970s. The terminal accommodates vessels up to 365 meters long, with displacements of up to 285,000 tonnes and drafts up to 24 meters. For nearly five decades, the Port has significantly contributed to the economy of Shetland, Scotland and the United Kingdom.

NIRAS has been involved with the Port of Sullom Voe almost continuously since the 1970s, starting with designing the main import/export jetties and other harbour infrastructure. We are delighted to have been awarded a recent 8-year contract extension, which strengthens our consultant-client relationship with Shetland Islands Council—a partnership that spans 50 years.

As SVT looks forward to ambitious plans for energy transformation, NIRAS is proud to continue supporting Shetland Islands Council with ongoing maintenance, life extension, and green energy consultancy for this nationally significant energy infrastructure.

<b>Client:</b>	Shetland Islands Council
<b>Country:</b>	United Kingdom
<b>Period:</b>	2021



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**CASE - PORTS AND MARINE**

**National port in Tanzania**

NIRAS has signed a contract for study and design of a new oil terminal and expansion of Tanzania’s second largest port in Tanga. The agreement includes a masterplan for the strategic development of the ports of Tanzania during the next 25 years.

Tanzania has three international ports, with Dar es Salaam being the largest. Recent developments in the region has made it necessary to expand both Port of Mtwara in the South and Port of Tanga in the North to meet increased demands for international port capacity.

NIRAS will lead the study and design of the upgrading of the existing Port of Tanga, the second largest port in the country. The port project also encompasses the construction of a new fully fledged oil terminal in Tanga, which is a hub for rail and ship traffic in northern Tanzania.

In order to undertake this challenging task, NIRAS has formed a consortium consisting of ANOVA Consult from Tanzania, MTBS from the Netherlands and ILF from Germany. The construction phase is expected to start in a year, and the expansion of the Port of Tanga is projected to have a duration of two and a half years.

The contract strengthens the presence of NIRAS in East Africa. From our offices in Kenya, Tanzania and Ethiopia, we have been a strong partner in the development of the civil and public infrastructure of East Africa for the past 25 years. The new port project in Tanzania will consolidate our record of major international ports project.



<b>Client:</b>	Tanzania Ports Authority
<b>Country:</b>	Tanzania
<b>Period:</b>	2019-2022

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# Coastal engineering and climate adaptation



**NIRAS has extensive experience with all aspects of projects related to coasts, climate change, and offshore structures. We have carried out a series of large coastal and offshore projects in Denmark and around the world.**

Our experts handle all stages of these projects. They have specialized knowledge within all areas of expertise, ranging from survey and analysis to planning, design and construction. NIRAS has established a broad level of experience in coastal and offshore engineering through many integrated coastal and offshore projects that we have implemented across the world. This is a complex discipline that requires extensive theoretical knowledge and genuine practical experience. Additionally, coastal and offshore engineering projects are often multidisciplinary and concern several stakeholders, making it crucial to successfully manage and combine all interfaces involved.

NIRAS stresses the importance of establishing a fundamental understanding of the natural environment and local conditions when developing sustainable solutions. We hold state-of-the-art numerical models (MIKE software and CFD models), GIS and 3D CAD software, which enable us to assist our clients in managing and monitoring the coastal environment as well as developing, optimizing and presenting our assessments and designs.

**Our inhouse specialists cover all required disciplines and have decades of experience in solving complex coastal and offshore challenges, including:**

- Numerical modelling of waves, water levels and sediment transport
- Site and structure assessments
- Shoreline management plans
- Climate adaptation plans for coastal zones
- Coastal and marine structures
- Flood protection
- Integrated coastal zone management
- Sedimentation of access channels to ports and estuaries
- Dredging, reclamation and beach nourishment
- Coastal and waterfront development
- Environmental modelling
- Environmental Impact Assessment
- Risk assessment
- Cost-benefit analysis
- Concept design and detailed design
- Tender documents and tendering
- Contract management and site supervision



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## CASE - COASTAL ENGINEERING AND CLIMATE ADAPTATION

### Future of the North Coast of Zealand - Shoreline management plan and EIA



<b>Client:</b>	Gribskov Municipality
<b>Country:</b>	Denmark
<b>Period:</b>	2017 -2025

The North Coast of Zealand, Denmark, erodes along most of the stretch between Hundested and Elsinore due to a general deficit in the sediment budget.

Over the past 100 years extensive hard

coastal protection has been constructed along more than half of the 60 km coast. The coastal and shore protection structures help protect the properties along the beach, but they cannot mitigate the ongoing erosion problem.

Despite having hard coastal and shore protection along the coast, the erosion continues in front of these structures which leads to gradually undermining them as the water depth increases.

NIRAS is developing a longterm sustainable shoreline management plan for the entire 60 km coast for the three municipalities Halsnæs, Gribskov and Elsinore.

The study is based on extensive numerical modelling of waves, water levels, and sediment transport as well as extensive field surveys.

The shoreline management plan primarily concerns large scale regionally coordinated beach nourishment at threatened properties. The nourishment scheme includes approximately 35 km of beach in total and covers all three municipalities.

The nourishment strategy includes initial beach nourishment and maintenance nourishment at yearly intervals.

The beach nourishment will protect the existing coastal and shore protection structures and properties increasing the durability of the scheme. Additionally, the scheme extends the sandy beaches and hereby providing access along the coast and increases the recreational value of the coast.

The conditions of the existing hard coastal and shore protection structures (approx. 800) are assessed based on a series of scenarios excluding and including beach nourishment in order to optimize the nourishment scheme and protect the threatened properties at present and for the next 50 years.

Revetments and beach nourishment are included in a costeffectiveness analysis to assess the total cost of the proposed coastal protection scheme compared to the present management strategy applying hard coastal protection only for the 50 year design life of the project.

The shoreline management plan forms the basic guidelines for authorities future evaluation of applications from private plot owners for additional and strengthened hard coastal and shore protection structures.

The shoreline management plan defines standard cross sections for revetments and beach breakwaters that are optimized according to the beach nourishment scheme. NIRAS has prepared a full EIA for the beach nourishment scheme.



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**CASE - COASTAL ENGINEERING AND CLIMATE ADAPTATION**

**ICZM plan for the North Coast of Egypt**

The Enhancing Climate Change Adaptation in the North Coast and Nile Delta Regions in Egypt Project (ECCADP) aims at supporting the adaptation efforts of Egypt in the North coast and in particular Nile Delta. The delta is identified by the Intergovernmental Panel on Climate Change (IPCC) in its Fourth Assessment Report as one of the world’s three extremely vulnerable deltas in the world.

The objective of the ECCADP is to reduce coastal flooding risks in Egypt’s North Coast due to the combination of projected sea level rise and more frequent and intense extreme storm events.

Output 1 focuses on constructing 69 km of sand dune dikes at five vulnerable hotspots within the Nile Delta that were identified during an engineering scoping assessment and technical feasibility study.

Output 2 focuses on the development of a climate resilient Integrated Coastal Zone Management (ICZM) plan for the entire North Coast of Egypt, to manage longterm risks including climate change.

The ECCADP will facilitate transformational change in the shortterm by reducing coastal flooding threats along vulnerable hotspots in the delta and in the longterm by

integrating additional risks of climate change into coastal management and planning, budgeting and implementation of risk reduction measures. The ECCADP is implemented by the Ministry of Water Resources and Irrigation (MWRI) and is jointly funded by the Government of Egypt (GoE), the Green Climate Fund (GCF) and the United Nations Development Programme (UNDP).

<b>Client:</b>	UNDP Egypt
<b>Country:</b>	Egypt
<b>Period:</b>	2021 - 2024



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**CASE - COASTAL ENGINEERING AND CLIMATE ADAPTATION**

**Reclamation of three islands, Tourist Resort**

The client is a world renowned resort operator with several resorts in the Maldives and elsewhere in the Asian region. The client has drawn up plans for three artificial islands to be reclaimed in the archipelago. The three islands shall cater for different themes and clientele.

<b>Client:</b>	Centara Maldives Private Limited
<b>Country:</b>	Maldives
<b>Period:</b>	2016 - 2021

NIRAS was assigned to execute the planning and design of the three artificial islands as well as preparation of tender documents for international competitive bidding. Extensive hydraulic modelling was carried out to model the reclamation and the beaches - with the objective to minimise maintenance replenishment of the beaches.

The retaining structures include groynes and revetments - retaining the 1.8 million m<sup>3</sup> of dredged sand. Construction started autumn 2019 and was supervised by NIRAS' team on site.

The reclamation project adds to the long list of projects NIRAS has carried out in the Maldives over a period of 25 years.



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**CASE - COASTAL ENGINEERING AND CLIMATE ADAPTATION**

**Climate Change Vulnerability and Risk Assessment**



The beaches and the physical infrastructure of the hotels along the 1 km long Kololi Beach are highly exposed and vulnerable to the weather and climate induced hazards causing an annual erosion moving the shoreline 0.5 to 1 m landwards every year.

To mitigate this erosion a coastal protection scheme was developed by NIRAS in 2015. It consists of 1 km long revetment, 4 detached beach breakwaters and 75,000 m3 of sand beach nourishment. The revetment was finished in 2019. However, the remaining part of the protection is still pending on available funding.

With the implementation of the shores are protected against further erosion, the width of the beach extended and the risk of physical impact on the properties diminished.

The scope of the present project is to conduct a Vulnerability and Risk Assessment of the impact of the coastal protection scheme along Kololi Beach and adjacent beaches due to climate changes - a Climate Change Vulnerability and Risk Assessment (CVRA).

The project began with an Inception phase where various stakeholders met and information about the coast line and areas of interest were obtained particularly in the impact zone. As part of the CVRA numerical modelling is undertaken to assess the physical impacts from the climate changes along the project area. The physical impacts are mainly

changes in erosion and accretion along the shoreline. Both the scenario without coastal protection along Kololi Beach and with the coastal protection are investigated. The analysis takes the changes in wave climate into account.

<b>Client:</b>	UNDP
<b>Country:</b>	Gambia
<b>Period:</b>	2019 2020

An initial assessment was carried out to analyze the social and economic consequences for the hotel owners, employees and their families in relation to the two scenarios with and without coastal protection.

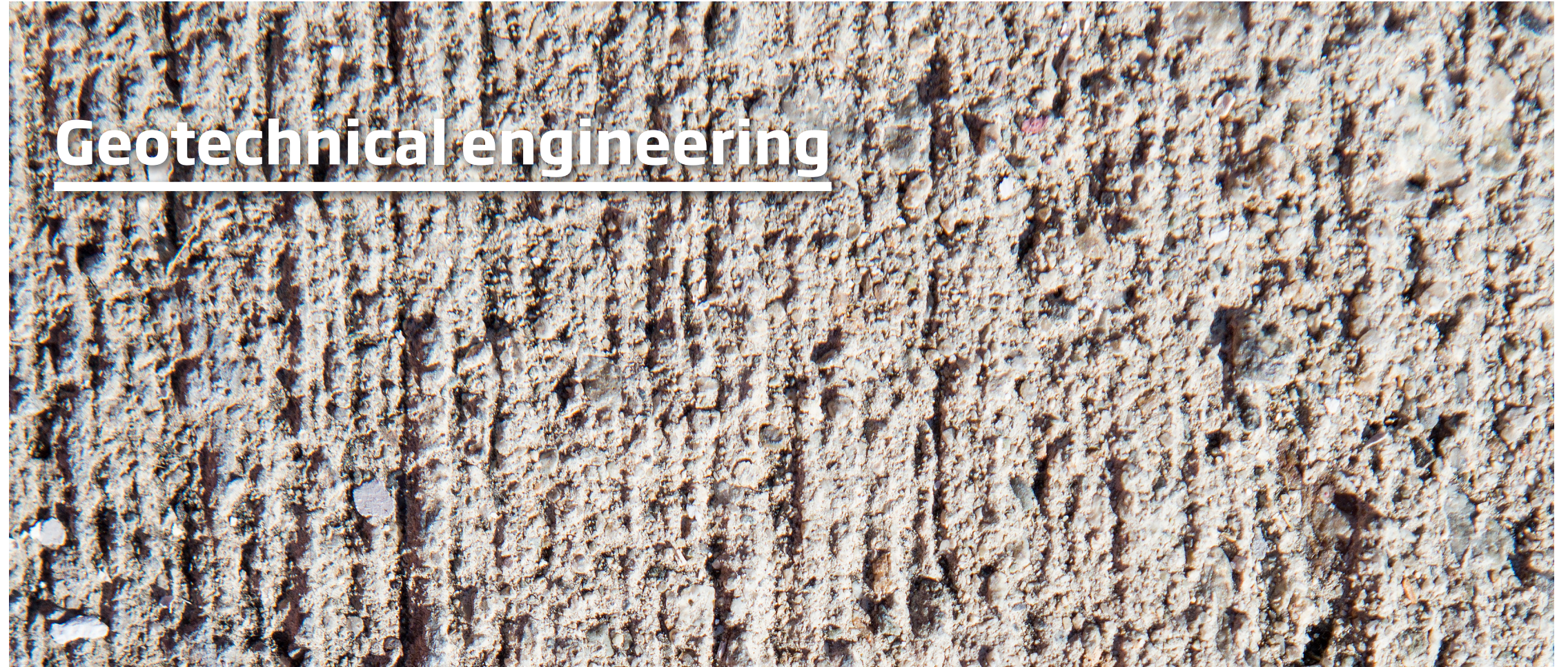
**The main conclusions were:**

As a consequence of the coastal protection an erosion of the adjacent shoreline to the south in front of Bijilo Forest Park is expected taking place over time. This will reduce the park area with 4 % and 6 % of the entire part area in 2050 and 2075, respectively.

After the design of the coastal protection a Conference Hall has been constructed south of Kololi Beach. The leeside erosion will be significant in front of the International Conference Hall. This can be avoided by extending the southern breakwater or adding an additional breakwater and increasing the initial and maintenance nourishment to the maintenance programme for the coastal protection.

The fully implemented coastal protection combined with an annual sand nourishment in the order of 36,000 m3 will secure the wider beach and umbrella areas in front the hotel. Thus, the most important attractions for the tourist to spend their holidays in Gambia is secured the next 60 years. This will establish a safe economic background for further tourist investment and development in the area.

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**NIRAS geotechnical experts provide profound knowledge of soil conditions and soil-structure interaction.**

Correct understanding of ground conditions is paramount for a successful project execution.

NIRAS stresses the importance of establishing a fundamental understanding of project and ground conditions when developing sustainable solutions.

We offer comprehensive geotechnical services ranging from planning, execution and reporting of geotechnical surveys, including handling and presentation of extensive geotechnical data. This provides a sound foundation for design of infrastructure projects.

Our geotechnical design appreciates the complex interaction between structure and surroundings both during construction and service.

NIRAS holds state of the art numerical modelling tools and has developed software tools that enable us in assisting our clients with geotechnical engineering.

Our expertise is gained through experience from design of large infrastructure like railways, roads, tunnels, bridges, embankments, ports and offshore installations all over the world.

NIRAS has the expertise to design geotechnical structures in challenging soil conditions such as piled supports in sloping soft marine clay or construction of foundations in excavated in Norwegian quick clay to mention a few.

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## CASE - GEOTECHNICAL ENGINEERING

### Hillerød Motorway

The project upgrades the final stretch towards Hillerød from road to motorway, thus improving safety and mobility connecting Copenhagen and Hillerød.

Comprising of around 180 new geotechnical boreholes along the 13.2 km alignment (accumulating to a total of 2 km boreholes), the Hillerød Motorway geotechnical investigation is a leading example of a large infrastructure project.

The geotechnical investigation offers synergy with the design project which is also executed by NIRAS.

<b>Client:</b>	VD (Danish Road Directorate)
<b>Country:</b>	Denmark
<b>Period:</b>	June 2022 ongoing



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**CASE - GEOTECHNICAL ENGINEERING**

**Universitetsstien (bicycle path)**

The scope of the project is to improve the connection between University of Roskilde and the city center of Roskilde for cyclists and pedestrians.

The path runs 600 m along the railway, which required deep piled foundation of a steel bridge carrying the path over a road.

The vicinity of the railway to the cycle path and the tight spatial conditions led to a highly complex project, both during design and execution with the railway remaining in service.



**Client:** Municipality of Roskilde  
**Country:** Denmark  
**Period:** 2016 - 2021



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## CASE - GEOTECHNICAL ENGINEERING

### Geotechnical laboratory services

In our in-house geotechnical lab our experienced geologists perform tests for classification, identification and description of the collected soil samples. Our methods comply with the Eurocode requirements and the national DGF-guidelines for soil description.

Further to the identification and description of the soil samples, we perform in-house tests comprising water content, organic content, bulk density and grainsize distribution.

The ability to perform these tests in-house contributes to the quality of both our reporting of geotechnical investigations as well as of the following geotechnical design.

For more advanced geotechnical testing like oedometer and triaxial testing we collaborated with certified external geotechnical laboratories. Our experienced geotechnical engineers can both plan advanced geotechnical laboratory testing and interpret the results. Thus we can deliver the “full package” of geotechnical laboratory testing.





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**For more than two decades NIRAS has been focusing on protecting the environment. We have vast experience in preparing Environmental Impact Assessments (EIA) and Strategic Environmental Assessments (SEA) for all types of projects, including railways, roads, wind farms, harbours, coastal protection, and cable systems.**

Careful planning for impact assessment is essential, and NIRAS is keen to engage early in the development process. Early consideration of environmental issues, particularly where these lead to a requirement for EIA, SEA, or assessment under Natura 2000 regulations, allows cost-effective design options to be identified and evaluated.

NIRAS offers specialist advice on investigation, cleanup and development of contaminated sites. We have experience from thousands of contamination tasks covering both sites with new developments and those to be used for new purposes. We have extensive experience in all contaminant components such as oil, solvents, PFAS, pesticides, landfill gas, etc.

**Our services include:**

- Environmental and Strategic Impact Assessments (EIA and SEA)
- Nature restoration and protection
- Water and nature management
- Noise calculations, reduction level measurements (authorized by the Danish Environmental Protection Agency), and underwater noise calculations
- LCAs (Life Cycle Analyses)
- Climate Account
- Socio-economic analyses
- EU taxonomy and CSRD
- Environmental applications, company approvals, BAT, BTR, permits for connection, leaching and discharge
- Soil management and investigation, clean-up and development of contaminated sites
- Geoprobe® work and development of contaminated sites
- Mobile drilling rigs with associated mobile laboratory equipment for onsite sampling and analysis of contaminated soil, water and soil gas at depths down to 50 meters

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**CASE - ENVIRONMENT**

**Environmental Impact Assessment (EIA) for the expansion of the Hillerød motorway from Ring 4 to Farum**



The project comprises an EIA for the extension of the Hillerød motorway with a third lane.

The motorway crosses several Natura 2000 areas with designated habitat types and also crosses the Fiskebæk Bridge between Farum Sø and Furesø. Thus, extensive field studies of both animal and plant life, as well as the water environment, are being carried

out with a special focus on the discharge of road water to recipients. A 0-alternative with a reduced scope is also considered in case it is not possible to widen the motorway due to the Natura 2000 areas.

The Hillerød motorway runs through areas with dense housing and many recreational activities and there is considerable focus on investigating possible noise reduction measures. The project further includes investigations into the possibility of covering e.g. the Fiskebæk Bridge, as well as a visualisations and an architectural assessment of the possible types of covering of the motorway through Farum city.

NIRAS has prepared a digital environmental and nature mapping report as a basis for the assessments and is carrying out a digital environmental impact assessment (EIA) in which all data and associated text appear on interactive maps.

<b>Client:</b>	VD (Danish Road Directorate)
<b>Country:</b>	Denmark
<b>Period:</b>	2022 ongoing

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## CASE - ENVIRONMENT

### Valby Cloudburst Tunnel

As part of a cloudburst management scheme in the Copenhagen and Frederiksberg municipalities, tunnels are being constructed beneath Vesterbro in Copenhagen which drain into the Port of Copenhagen, beneath Valby and into Kalveboderne. The tunnels are constructed by HOFOR and Frederiksberg Utility accordingly. The work includes two EIA reports covering the construction and operation of the cloudburst tunnels. Areas of particular attention include noise and traffic during the construction phase, as well as water quality and key requirements relating to Natura 2000 areas.

NIRAS was appointed lead consultant for the EIA and further assisted during the public hearing phase. As the tunnel is situated in a dense urban area, it was necessary to ensure adequate protection for listed buildings and Natura 2000 areas. Furthermore, all aspects and environmental impacts and related remedial actions were reported in order to comply with local regulations.

<b>Client:</b>	HOFOR A/S
<b>Country:</b>	Denmark
<b>Period:</b>	2017 ongoing



### Køge Dige

Køge Bugt has been designated as a risk area for flooding in accordance with the EU's Floods Directive. Køge Municipality has therefore launched a coastal protection project - Køge Dige - which will protect the coastal urban areas against flooding from the sea. The project comprises protection along approximately 11 km of coastline.

<b>Client:</b>	Køge Kommune
<b>Country:</b>	Denmark
<b>Period:</b>	2020 ongoing

The northern part of the project affects a Natura 2000 area, and it is not possible to implement the coastal protection project without including designated land with the habitat type "salt marsh". The project is therefore undergoing a derogation process from the Natura 2000 protection in order to be implemented. This includes a comprehensive and detailed Natura 2000 impact assessment as well as a statement documenting that requirements for deviation have been met, together with a detailed description of compensatory measures in order to compensate for the damage to the Natura 2000 area.

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## CASE - ENVIRONMENT

### Expansion of the Port of Rønne - Environmental Impact Assessment

In connection with the ongoing stage-by-stage expansion of the Port of Rønne beginning in 2017, NIRAS has prepared both Environmental Assessments and Environmental Impact Assessments (EIA) of plans (a local plan and a municipal plan supplement) and projects for stages 1-3 of the expansion. Stage 1 was completed in 2019, stage 2 in 2022/2023, and stage 3 will be completed in 2024.

NIRAS is now preparing an EIA of the plan and project for stage 4 of the port expansion. The port expansions in Rønne include e.g. establishment of a new southern breakwater, the provision of new land areas via infilling, establishment of quays, and increasing the water depth in the harbour basin via dredging.

**The environmental impact assessment describes and assesses direct and indirect impact on the following factors:** Landscape and visual relationship, terrestrial nature, traffic, coastal morphology, sediment dispersion, marine biology, material assets and cultural heritage, and socio-economic consequences, as well as noise, soil and water.

In addition, the reports contain a screening and appropriate assessment in accordance with the rules set out in the Habitat and Coastal Habitat Directive as well as for relevant Annex IV species. Furthermore, the reports include comprehensive assessments of the expected impacts to water bodies targeted in accordance with the Water Framework Directive and the Marine Strategy Framework Directive.

<b>Client:</b>	Rønne Havn A/S
<b>Country:</b>	Denmark
<b>Period:</b>	2017 ongoing



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## CASE - ENVIRONMENT

### EIA of the motorway in Central Jutland (Klode Mølle - Løvel)

NIRAS has prepared a comprehensive onshore infrastructure EIA for the Danish Road Directorate consisting of an EIA for two motorway proposals, including a 0-alternative for the expansion of the existing route 13.

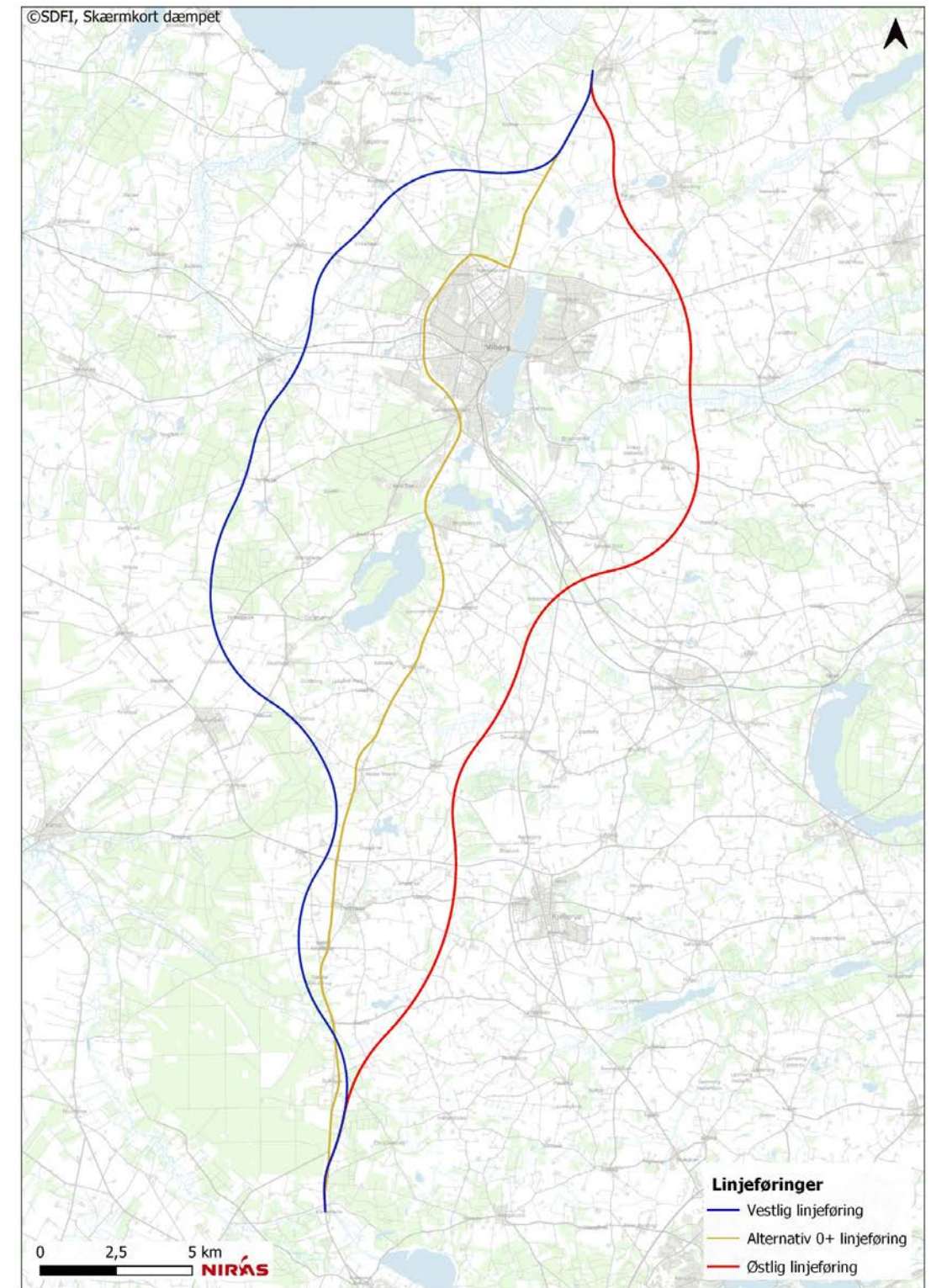
Mapping and assessment of impacts on the environment were carried out and incorporated dedicated field surveys of flora and fauna, airborne noise calculations, landscape analysis and visualizations. The investigations and assessments cover a stretch of motorway approximately 120 km long.

A prerequisite note, mapping report, environmental impact report and contribution to a summary report were also prepared.

<b>Client:</b>	The Danish Road Directive
<b>Country:</b>	Denmark
<b>Period:</b>	2021 ongoing

#### Overview map

Yellow line marking indicates Route 13 expansion, and the red and blue corridors represent the eastern and western stretches bypassing Viborg, respectively. The purpose of a new highway through Jutland is twofold: to enhance road connections in Jutland and to relieve congestion on Route 13 and E45.



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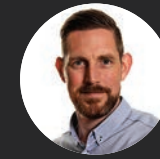
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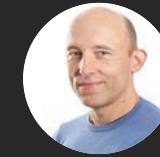
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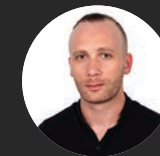
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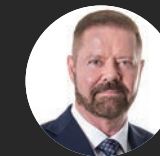
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