

PIANC WORLD CONGRESS PANAMA CITY, PANAMA 2018

**THE CHALLENGES OF LIMITING THE ENVIRONMENTAL
IMPACT OF FAIRWAY PROJECTS**

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KEYWORDS: ENVIRONMENT, MANAGEMENT, FAIRWAYS,
KNOWLEDGE, RESEARCH

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by

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INTRODUCTION

The Norwegian Coastal Administration (NCA) is an agency of the Norwegian Ministry of Transport and Communications responsible for services related to maritime safety, maritime infrastructure, transport planning and efficiency, and emergency response to acute pollution. NCA activities encompass the maritime sector of the National Transport Plan (NTP). The NTP outlines how the Norwegian government intends to prioritize resources within the transport sector. Further, the NCA executes authority and administrative tasks related to the laws and regulations for ports, fairways, and compulsory pilot services.

By the example of a recent projects the NCA aims to share experiences and solutions on how to avoid negative environmental impacts in the execution phase of projects for new or improved fairways. The focus in this article is underwater noise pollution and fairway pollution. The NCA present both what went well through pre-project planning and execution, what could have been performed better as well as ongoing internal projects on mitigating measures. Through this, we hope that others who faces similar challenges will be encouraged to contact the NCA for future collaboration and international experience exchange.

THE NCA PORTFOLIO – THE COAST

The coast has always been a lifeline for the Norwegian society. Today, 90 % of the Norwegian export revenue origins from activity and resources connected to the sea (1). Increasing the quality of fairways is a well-known risk reducing measure for vessel traffic. The Norwegian mainland's coastline is almost 29 000 km long, only exceeded by the Canadian coastline. By including islands, the total coastline is just over 100 000 km. The coastline has its southernmost point at 57° south and the northernmost at 71° north. This presents an environment where one must take into account a high diversity, both of biological- and geological factors, when construction projects are planned and conducted. The climate also represents seasonal challenges such as ice, cold and severe storms.

When a new fairway is developed, existing fairways are improved, or a harbor is dredged, pollution is often an issue. Industry, including i.e. fisheries, oil and gas support services, and shipyards has been traditionally, and still are, located along the coast and other large water bodies connected to the sea. For decades, it was common practice to use the sea as an easy way for waste dumping. For the Norwegian ports and fairways, we like to think of this as something that is a closed chapter when it comes to "waste management". Nevertheless, our past environmental sins become present, also for NCA projects. Deep layers of various types and degrees of pollution create challenges and severely increase the cost and complexity of remediation projects. The removing of toxins and other type of pollution through a fairway or harbor project is in most cases positive for the environment – if conducted right. Considerations must be made to prevent the spreading of both clean and polluted sediments. This also includes e.g. runoff containing toxins from a disposal site or damages on the environment by increased turbidity. Dredging of polluted harbors and the safe storage of polluted sediments, reduction in greenhouse gas emission through shortened fairways, reduction of risk of accidental spills by improving fairways are important parts of NCAs work.

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THE NEW FOCUS - UNDERWATER NOISE FROM CONSTRUCTION AND EXPLOSIVES

In total 16 out of Norway's 20 counties (not including Svalbard) has a coastline. When preparing and executing projects, the NCA applies for an environmental permit at the County Governors environmental department which has the governing authority. The NCA as the states naval construction developer has the burden of proof for whether or not the construction plan, mitigating measures and considerations in regard of environmental issues are satisfactory.

Due to a lack of factual knowledge in regards to some of the challenges NCA projects faces, permits and terms are at times characterized by precautionary measures. In recent years, this has in particular been the case when explosives are used to remove bedrock. How do shock waves from seabed-blasts affect fish, marine mammals and other wildlife? There is no doubt that physical damage is the result when in close proximity, but what can be considered to be a safe distance?

Will blasting of bedrock disturb spawning areas two kilometers away from the site? If yes, what mitigating measures can be used to prevent this? These questions have resulted in a NCA-initiated project measuring underwater noise and pressure from both ramming of piles and the use of explosives.

The restrictions often connected to the noise from construction and blasts comes "on top" of other restrictions. Construction work is often not permitted to be carried out in the period 15th of May - 20th of August. This corresponds to the spring – summer breeding season for birds and other wildlife. Spawning-season for various types of fish is largely stretched between February to October. Based on local knowledge this will also be set as restrictions when work is planned in the vicinity of spawning areas or seasonal migration ways.

As the governing authorities have had an increased focus on underwater noise, the demands set for NCA projects have been colored by this. The NCA experienced that the safety zone set between a blast-site and e.g. a spawning area is very varying from permit to permit. In some projects, this will to a large degree afflict the time-window given for the construction phase.

Case-study - Kvalsundet

The fairway project through Kvalsundet (**Figure 1**) is a case that got its fair share of media attention at the end of 2016, with the majority of this being negative and based on the public not understanding the project and the way the construction was conducted. The Kvalsundet project was triggered by the need of a safer and shorter fairway into the city of Tromsø. The existing fairway was



Figure 1. The Norwegian coastline. Red arrow indicates Kvalsundet, yellow arrow Baatsfjord (map: wikipedia.org).

limited for large ships by the height of bridges connecting the island, where Tromsøe is located, to the mainland and neighboring islands. By removing shallows and broadening the fairway through Kvalsundet, the detour many large ships had to make to avoid bridges was reduced with 80 km when northbound. If Tromsøe was the final destination before returning south, the ships will now be spared a sailing distance of 160 km. The new fairway was also upgraded with new and better navigational marks, significantly improving safety and reducing the risk of collisions or foundering.

The fairway project was originally planned to be finished by the 1st of October 2016, but due to delays the construction work was by this date expected to pass the original date by several months. The main concern for the NCA was that by the end of November, the waters in the surrounding area are packed with winter migrating herring and a great number of whales feeding on the herring (**Picture 1**).

The NCA and the County Governors environmental department discussed the case when it became apparent what was happening. The migrating herring's had visited this area at that time of the year for a couple of years, and it was decided by the NCA that the construction work had to be paused. The ongoing work at that time was the removing of shallows to broaden the fairway. Explosives were used for this purpose, and there was no data to be found on the potential impact of noise and shockwaves inflicted on herring and whales. Both fisheries and tourism followed in the wake of the herring and the whales. Fishermen were worried that their livelihood could be damaged, tourist providers that the whales would leave. The risk was too great, both with uncertainty of the potential damage the blast could bring and the potential negative attention the continuation of the project would bring through media and social media. Therefore, the work was completed during early spring 2017. In hindsight, the NCA could have foreseen the possible complication the contractors delay would cause, and this will be taken into consideration in future projects.



Picture 1. Pod of orcas in Kvalsundet (photo Lene Gjelsvik, NCA).

By the end of September 2017 concern was raised again, this time regarding the delay in constructing navigation installations. The project was not completed, and it was a possibility that the herring and whales could migrate into the same area again. The remaining work by this time on the navigational marks (tripods) was the ramming of piles into the bedrock (**Picture 2**). The governing authorities were not concerned that this work could impact fish and wildlife in a negative way, but the NCA wanted to be prepared – just in case. It was decided that the noise from the ramming was to be monitored and measured, and a surveillance program was implemented that the contractor had to follow. The work

needed to be stopped immediately if herring and whales were observed and predefined measures on how to proceed were given.

However, the herring winter migration for 2017 changed from the previous year. The schools turned up much further north – and stayed there for the extent of the period. This also included the great number of whales following in the wake of the herring. Nevertheless, the already planned measurements were performed in Kvalsundet. The value of this work might not be crucial at that time, but it was clear that it would be important to collect the data for future projects.



Picture 2. Positioning of pile - Kvalsundet (photo: NCA).

Methods and preliminary results

Measurements from piling

During the 21st and 22nd of November, four recordings of the ramming of two piles were conducted. This included a total of data of 580 hammer strikes (**Figure 2**). As the analysis of the measurements of the piling work is not complete at the present time, a conclusion cannot be presented in this paper. However, preliminary results show that the frequencies that were recorded were found to be much higher than expected.

New case study - measurements from blasting bedrock and test of mitigating measures

The NCA also has an ongoing fairway-project in Baatsfjord, Finnmark County (**Figure 1**, indicated by yellow arrow). Bedrock is removed to increase sailing depth in several parts of the harbor (**Figure 3**). Underwater measurements of noise and sound pressure from blasting of bedrock will be performed during April 2018. The plan so far is that measurements are to be made at three various distances from the explosion. This is to get an overview of a spread pattern depending on blast-size (amount of explosives, single/sequential blast). If possible, dependent on time and weather conditions, the NCA would like to test mitigating measures such as a “bubble curtain” and covering/capping of the blast site with gravel. There will be live cod stored in the fjord (**Figure 3**, marked with red star). Fish reactions to the blasts will also be observed and commented on in the final report for this study.

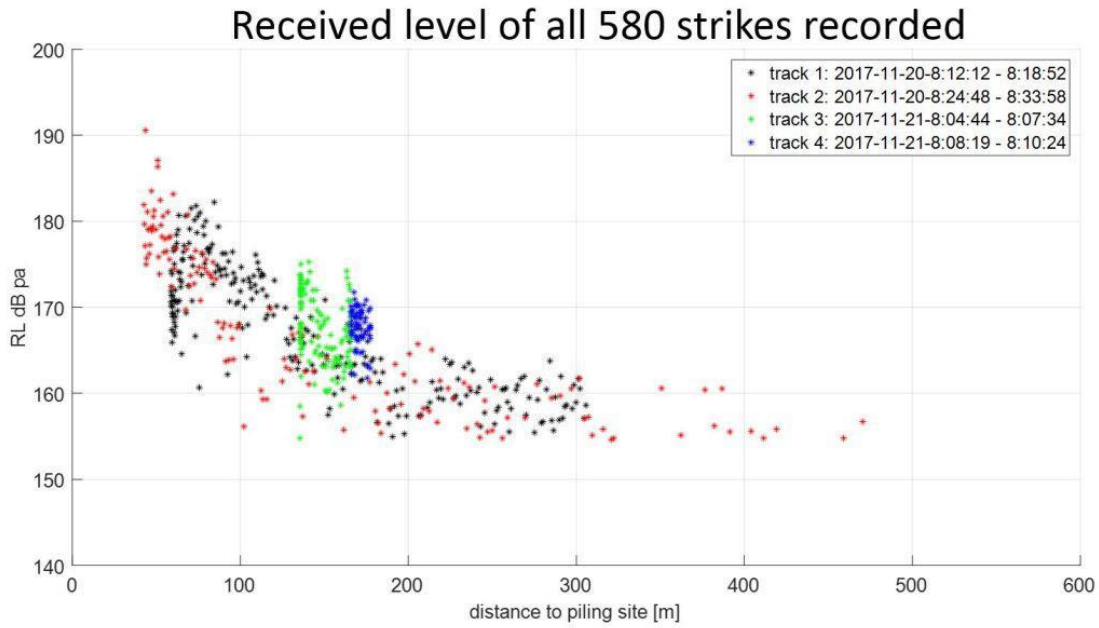


Figure 2 Track of recorded piling noise (J. Koblitz, unpublished).

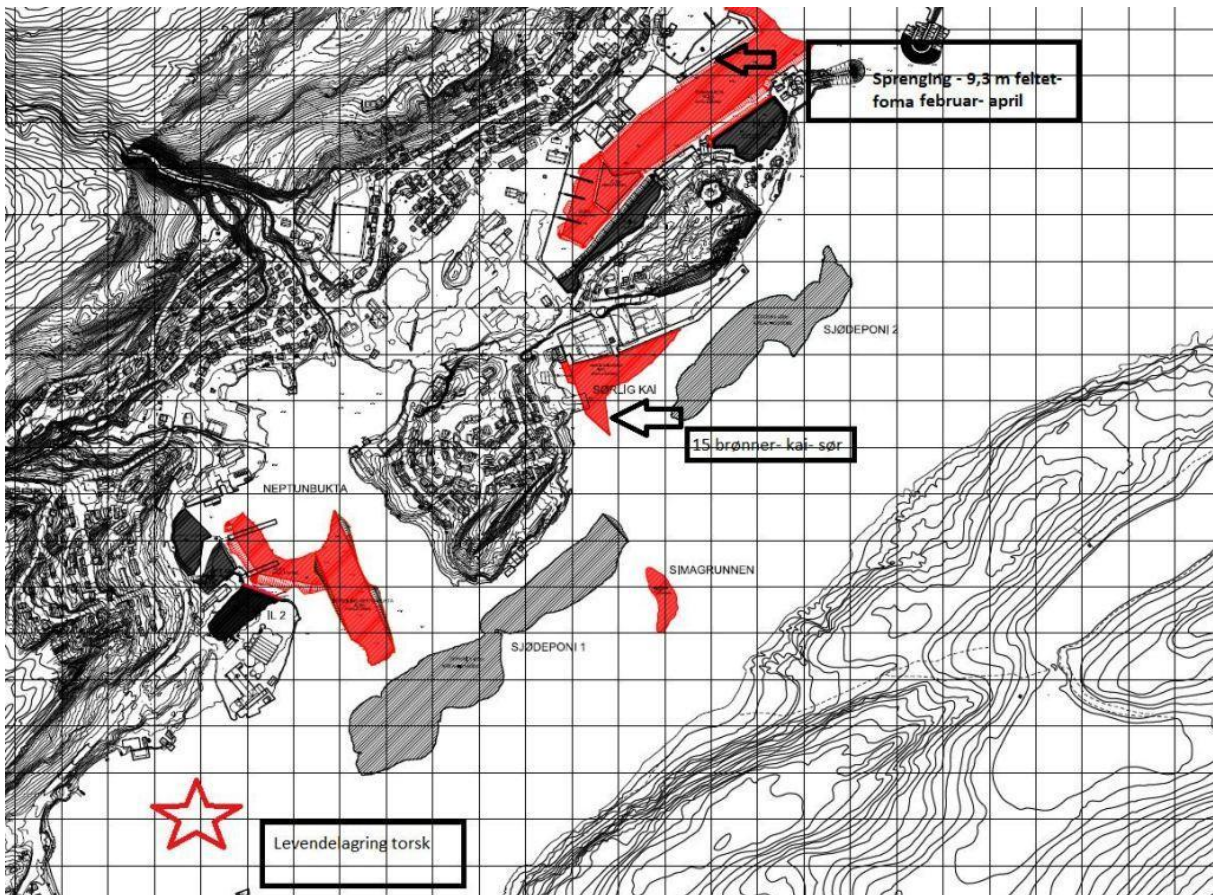


Figure 3. Construction plan for Baatsfjord. Red areas are for increased depth, grey indicates dumping site. Red star marks area for live storing of cod (Map: NCA).

The reason why these measurements are conducted in Baatsfjord is that there are no terms in the work permit from the County Governor connected to surveillance of underwater noise. The Baatsfjord-project will be a pilot project before the next two projects with planned start-up for later in 2018. These two projects do have terms connected to the surveillance of underwater noise and sound pressure. The terms have a threshold value for how far pressure sound can spread, and if the spread surpasses a given area, the loading of the blast must e.g. be reduced. By testing methods in Baatsfjord, the risk for causing a delay in the next projects will be reduced.

The main objective in this initial phase of this project is to test equipment and methods and to assess how much and what type of information and knowledge can be extracted for the work that is done.

If quality assured data and verifiable methods show that the sound pressure from a given type of blast will not spread further than e.g. 1000 m, future projects will be easier to plan. The tests can also result in the NCA identifying that noise and sound pressure spreads further than anticipated. This will also be positive for planning, because we would then know how to focus on mitigating measures, and when in doubt – plan projects to a time of the year where spawning areas, breeding birds and pods of whale are not present.

THE NCA ENVIRONMENTAL STANDARD FOR PROJECTS

All NCA projects go through a checklist in the initial phase. The need for a number of environmental surveys are assessed. Mapping and risk assessment based on factual knowledge are crucial for project planning and execution. These are typically:

- *Environmental geological and geotechnical surveys:* Site conditions must be known, both for planning of fairway projects and establishing new infrastructure.
- *Mapping of biological diversity and habitat types:* It is important that when planning projects, it is done in a way that e.g. infrastructure such as a wave breaker do not fragment habitat or damage local flora and fauna.
- *Mapping of currents and tidal patterns*

Currents: Fjords can have a very local current pattern. This is important to map so that when, for instance, dredging sediments it can be done in a controlled way that does not result in unwanted harmful spreading of sediments. This applies both to polluted sediments as well as clean sediments, which shall not harm marine flora or fauna.

Tide: Due to the length of the Norwegian coast, the tide will also vary greatly. The difference between the highest and lowest astronomical tide is from 0,72 meters in Oslo to 3,95 meters in Vadsoe.

Other measures taken to maintain the environmental focus in NCA projects are:

The Environmental compliance plan (EC-plan)

During 2016 a thorough revision was made of the NCAs EC-plan template. While the implementation of this plan is ongoing, the NCA has received good feedback from the supervisory bodies that have inspected our construction sites. Even though the sites will have different contractors, the EC-plan is to be implemented for all. The plan will be adapted to local conditions, and an environmental risk analysis is to be performed for each specific site. The plan is a discussion point on weekly on-site construction meetings, and is to be revised if needed. The EC-plan is a part of the NCAs environmental focus, and includes everything from accidental spills, not letting machinery run idle to the sorting of trash.

Environmental requirements in procurement is standard from 2018. It is an increased focus on not just consider price when awarding a contract, the solution on how the contractor plans to safeguard the

environment will also be assessed. All state transport agencies are implementing this procedure at the same time. This is also in line with demands given from the acting government. The reduction of greenhouse gas (GHG) emissions comes under the same “umbrella”, and steps are made to cut GHG-emissions with 50 % by 2030.

Another environmental issue is plastic debris from charging tubes in the sea floor, the lack of alternatives to nonel initiation systems and the plastic waste from detonating cords (**Picture 3**). The NCA does not want to be a contributor to the already enormous plastic-waste issue in the world’s oceans. Therefore, we continuously work on reducing waste from our activities. One way of doing this is to have a contractual term for collecting plastic used in the project. If e.g. 500 kg of detonating cords and other plastic is used while blasting, the contractor must collect as much as possible after a blast. In addition a “positive plastic account” is set for the project, meaning that with using 500 kg plastic, 1000 kg must be collected (including detonating cords) and plastic found along nearby coastline. The contractors have so far not done the majority of the shore-cleaning themselves, but payed local volunteer organizations or school classes to do this. By this, the local community will get a better fairway, cleaned shoreline and income for a good cause or extra funding for a class excursion.



Picture 3. Detonating cords and explosives, a source for plastic waste in the sea (Photo: NCA).

CONCLUSION

Through the mentioned case-studies, the NCA aims to close some of the gap regarding the lack of factual knowledge the challenges NCA projects faces. By publishing our findings and collected data we hope to contribute to further work in this field, both nationally and internationally.

The NCA will continue to develop and improve our effort for preserving the environment. By this we also fulfill the goal set for our organization:

to make our coast and waters the safest and purest in the world.

Acknowledgements: Sound measurements in Kvalsundet was performed by Dr. Jens C. Koblitz, BioAcoustic Network, for the NCA. Report and results to be published during first half of 2018.

References

- (1) The Norwegian Government, www.regjeringen.no