EMSAGG

The bi-annual bulletin of the European Marine Sand And Gravel Group

ciria

Issue 21, December 2010

Chairman's foreword, the EMSAGG Maasvlakte 2 seminar and report on the 26th EMSAGG members' meeting

The 2010 EMSAGG learning seminar took place on 21 October 2010 at Maasvlakte 2, Rotterdam. The day included an exciting programme with presentations from leading figures involved with the Maasvlakte 2 project. In this bulletin we have included the main points from the day. I would like to thank the speakers for their contributions and also PUMA (Project Uitbreiding Maasvlakte) for sponsoring the networking lunch as well as Port of Rotterdam Authority for sponsoring the FutureLand Express, bringing delegates to the newest part of The Netherlands – the Maasvlakte 2 site.

The 26th EMSAGG members meeting was held at Rijkswaterstaat's offices in Rijswijk, The Netherlands on 22 October. The day included discussions of future seminars and also of the next EMSAGG tri-annual conference to be held in 2012. The day discussed some new developments including the new SEDMED project – described in this bulletin. I would like to express my thanks to Ad Stolk for hosting the meeting.

Finally, I would like to welcome a new member to EMSAGG: the Crown Estate, UK. This bulletin includes an introduction to the Crown Estate and a feature on the recent publication: Carbon footprint of marine aggregate extraction (Crown Estate, 2010).

I hope you will find the articles included of interest. Should you have any ideas and/or questions, please contact the EMSAGG secretariat on email: emsagg@ciria.org

Daniel Leggett
Chairman, **EMSAGG**

In this issue:

The 2010 EMSAGG seminar at Maasvlakte 2 in Rotterdam, The Netherlands

The 2010 EMSAGG learning seminar: Maasvlakte 2, the next level in sand and gravel took place at Maasvlakte 2, Rotterdam, The Netherlands on 21 October. The Maasvlakte 2 project is a mega land reclamation project in The Netherlands, which involves a port area expansion of about 2000 ha. During the first phase, an 11 km long sea defence will be constructed as well as circa 700 ha of harbour premises.

The seminar allowed delegates to gain an understanding of the latest environmental, technical, regulatory and economic issues relating to the Maasvlakte 2 project, and to share experiences and thoughts with international peers. The day included an exciting programme with presentations from leading figures involved with Maasvlakte 2 project, consisting:

- ***Welcome and opening of the seminar***
  Dirk Hamer, PUMA seminar chairman and Kristina Gamst, EMSAGG, seminar organiser

- ***Maasvlakte 2, a sustainable expansion of the Port of Rotterdam***
  Tiedo Vellinga, Port of Rotterdam Authority
- ***Maasvlakte 2, a mega sand reclamation work with innovative sea defence***
  Gerard Loman, PUMA
- ***Maasvlakte 2, predicting and monitoring of dredged sand quality***
  Fedor Meulenkamp and Joost van Duinen, PUMA
- ***Maasvlakte 2, monitoring of ecological effects: planning and preliminary results***
  Ad Stolk, Ministry of Transport, Public Works & Water Management, Rijkswaterstaat, North Sea Dept.

Figure 1 *Maasvlakte 2 (courtesy PUMA)*

The seminar included a lunch sponsored by PUMA, which offered delegates the opportunity to network. The seminar was followed by a tour of the Maasvlakte 2 site on the FutureLand Express, sponsored by the Port of Rotterdam Authority.

Presentations from the seminar are available from EMSAGG's website at: **<www.ciria.org/EMSAGG>**

Figure 2 *Maasvlakte 2 (courtesy J Slikker)*

The Crown Estate and marine aggregates

The UK leads the world in the extraction of marine sand and gravel and dredges 20 million tonnes annually from its surrounding seas, which provides 21 per cent of all aggregate used in England and Wales. Currently, there are 79 production licences in nine main dredge areas. The area of seabed licensed in 2009 covered 1286 km^2 and of this slightly less than 10 per cent was actively dredged during 2009, equating to an area of seabed of 123 km^2.

The Crown Estate plays an important role in the marine aggregate industry issuing companies with licences for commercial aggregate extraction, after they receive dredging consent from the UK Government. On behalf of the UK, the Crown Estate manages a highly diverse £6bn property portfolio with extensive marine assets including virtually the entire seabed out to 12 nautical miles. They are a commercial organisation, balancing this commercialism with a strong sense of stewardship and take the responsibility of managing their assets sustainably very seriously. The role of the organisation is laid down by Parliament: to improve the value of the estates they manage and to earn a surplus for the benefit of the nation. The multi-billion pound property and land portfolio annually contributes over £200m to the Treasury.

Figure 3 *Aggregate dredging (courtesy British Marine Aggregate Producers Association (BMAPA))*

Currently marine aggregate is distributed via multiple often small-scale wharfs and during the next few decades it is likely the construction of larger wharfs will consolidate this process. It is envisaged that aggregate will then be redistributed in bulk using smaller ships or rail links that will be more sustainable reducing the need for road transport, which limits carbon impact. Also, sustainability will be greatly

improved by replacing the ships used for dredging, many of which are now 20 to 25 years old. Updated designs and more technologically advanced dredging equipment could improve the energy efficiency of new ships by up to a third or more.

Compared to aggregate extracted from land, marine aggregate is arguably a more sustainable resource. Formed where ancient river tides moved back and forth to meet the sea thousands of years ago, it is usually good quality and very clean, requiring no intensive washing and minimal crushing. The Crown Estate tightly manages the areas permitted for dredging to ensure minimal effect on the environment.

While marine aggregate is a finite resource there is no foreseeable shortage in the many decades ahead. The Crown Estate ensures that it is extracted economically and imposes environmental restrictions. Long-term, extracting aggregate from land will become more difficult. Many sites have already been developed and with new sites there are population and development factors to consider. Marine aggregate is an efficient, economical source for coastal defences and reclamation, and the volumes required would be difficult to source from land.

The Crown Estate also works closely with the Government via the Marine Management Organisation (MMO), providing research and scientific information to enable greater understanding of marine issues. This has resulted in increased regulation through legislation such as the Marine Coastal and Access Act 2009, which aims to develop marine and coastal environments sustainably. Government regulation of the marine industry is beneficial as it provides a concentrated expertise and a framework to operate within. For the marine aggregates sector, regulation will enable it to work more efficiently as well as permitting proper monitoring of the seabed to protect resources.

With factors such as increasing focus on sustainable construction processes and the success of the renewable energy industry, the future for marine aggregates is bright. Marine aggregate dredging is a well-established industry, while policy envisages a steady growth in demand for sand and gravel. The Crown Estate has leased four rounds of offshore wind farms and investing with the Round 3 developers up to the point of consent. Marine aggregate is ideally located and available in sufficient quantities to construct the concrete foundations required for gravity-based wind turbines.

During the coming years The Crown Estate intends to work closely alongside regulators, stakeholders and government agencies to recognise the quantity and quality of marine aggregate resources available, ensuring that these resources and the environment that provides them are safeguarded for the future.

Maasvlakte 2 project: reclaiming future land with historical sand

Introduction

The Maasvlakte 2 project is a mega land reclamation project in The Netherlands, extending the port of Rotterdam seawards with about 2000 ha. For this land reclamation in marine depths up to about 18 m, about 200 million m^3 of sand will be borrowed by contractor PUMA (Project Uitbreiding Maasvlakte) from one of the designated offshore borrow areas. These borrow areas are situated about eight nautical miles offshore from the project site. PUMA was contracted after an international call for tenders of the contracting consortium to build the first sites. PUMA is a consortium consisting of Koninklijke Boskalis Westminster NV and Van Oord NV and will deliver the first sites for the first customers in 2013.

Several trailer suction dredgers dredge sand daily from these areas with original seabed levels of about 20 m below MSL (mean sea level) to reclaim new land at the project site in water depths up to about 18 m-MSL by dumping and “rainbowing”, and pumping ashore. Before the project started 3D models of the soil characteristics in the borrow areas up to a depth of 20 m below original seabed were created based on extensive desk studies and further soil investigations. These soil models are used in the present construction phase to optimise the quality control of the sand and to ensure that the specific sand deposits in the borrow areas are used for the right locations in the construction of Maasvlakte 2.

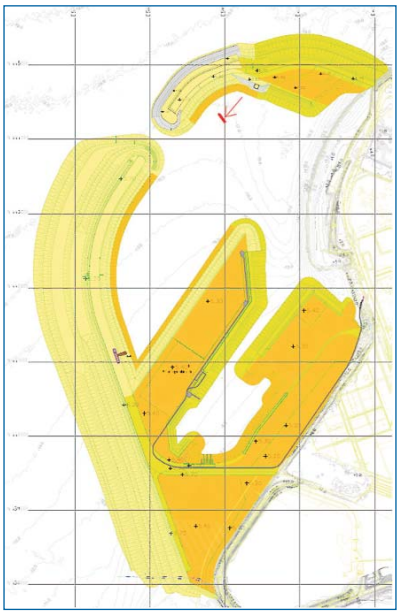

Figure 4
Top view of the Maasvlakte 2 project under construction. The coloured areas are being reclaimed with different sand types. Red arrow indicates location of TSHD (trailer suction hopper dredger) Oranje (see Figure 5) (courtesy PUMA)

Figure 5 *TSHD Oranje, pumping "old" offshore sand (deposited between 100 000–300 000 years ago) ashore via a floating line, and reclaiming the outer Maasvlakte 2 area from sea (courtesy PUMA)*

Local geology

The local geology at the project site and the borrow areas can be subdivided into Pleistocene deposits with dominating formations of Kreftenheye and Kedichem, and Holocene deposits with the Bligh Bank, Elbow and Banjaard as geological formations. The Kreftenheye formation consists of medium coarse to coarse sub-angular fluvial sands that was deposited when the sea level was about 150 m lower than today (glacial period of the Weichselien).

These sands were deposited by the rivers Rijn and Maas and were dominated by quartz and volcanic minerals from the Eifel region (located in south-east Germany). The present coastline clay layers were deposited during the late Weichselien (about 11 700 years ago) when the sea level started to rise and the ice caps retreated. After this period the sea level rose quickly towards the present coastline and an environment was created similar to the "waddengebied" we know today. Holocene formations of the Bligh Bank (Atlanticum era, 2500 years ago to present), Banjaard (Atlanticum era 9000–5000 years ago), Buitenbanken (Boreaal era, 10 000–9000 years ago) and Elbow (Boreaal era) were deposited in this inter-glacial period creating the upper few metres below seabed.

Generally, these deposits consist of reworked marine and fluvial sands and are much finer in grain size (about 100 microns) than the Pleistocene sands of the Kreftenheye era. Near the coast pre Boreaal and Boreaal clay layers of the Elbow formation are found (up to 8 m thick) locally eroded by ancient gullies and filled with Banjaard and Bligh Bank deposits of fine sands.

3D soil modelling of borrow area and project site

In 2006–2007 soil models were engineered of the soil conditions in the borrow areas and beneath the project site up to depths of 47 m-MSL. For these models extensive desk studies were done on existing data, such as geophysical results, geological maps and borehole data. During this time extra soil investigation campaigns consisting of boreholes and cone penetration tests (CPT's) were done (see Figure 6) to supplement the existing data and to fill in blank spots. The work was carried out by Fugro and Gemeente Werken Rotterdam (GWR), andworks and reporting were undertaken in accordance to Nederlandse Norm (NEN) standards.

Figure 6 *Soil investigation in 2007, drilling in the borrow area from seabed level (>20 m-MSL up to 47 m-MSL) (courtesy PUMA)*

All soil information such as individual layer thickness with soil properties at D50 (grain size characteristic) from more than 950 boreholes and CPT's, 9500 sieve analysis and geophysical data from TNO-NITG, were interpolated into 3D models (see Figure 7).

The models formed the basis of geotechnical engineering of the Maasvlakte 2, including planning and production of the dredgers, and quality control of reclaimed sands.

However, the historic value of these sand deposits was not included in these 3D models. During the hopper loading in the borrow area as well as during the unloading at the reclamation site, many different ancient relics such as those from the mammoth to the Neolithicum and the present became exposed.

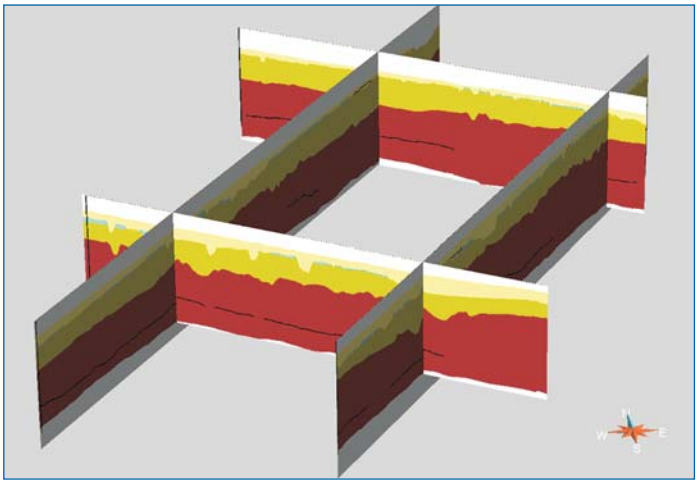

Figure 7 *Visualisation of the 3D soil layer model of Maasvlakte 2. Brown layer represents the Kreftenheye formation*

Dredging historical sands

The 200 million m³ sand dredged from the designated offshore borrow area, is partly of Pleistocene age, a period when the mammoth lived. In those times the mammoth walked in tundra or steppe climates at the location of the present borrow areas. These areas were dry land because the sea level was about 150 m lower than today. At the end of the Pleistocene, when the climate became warmer and the sea level rose, the mammoth became extinct. Many metres of Pleistocene and Holocene sediments covered the bones of extinct mammals including the mammoth. In some parts of the borrow area the seabed level is already up to 40 m-MSL deep.

Combining knowledge of dredging location and depth with soil characteristics, an estimate of the period in which particular sand is dredged can be made. For example, shell content in combination with the grain size distribution might reveal what kind of depositional environment was present in a particular time period. Different depositional environments, such as fluvial, marine or eolian are related to certain geological periods. Also, Kedichem sand (deposited between 0.8 and 1.6 million years ago) is finer grained than Kreftenheye sand. Shallow silt and clay layers or lenses indicate Holocene deposits. Figure 7 shows a representative borehole from the 2007 soil investigation campaign. In this borehole up to about 21 m-MSL Holocene deposits can be seen (roughly younger than 10 000 years). Beneath these Holocene deposits are Pleistocene sands.

Based on the shell content it is estimated that from between 21 m-MSL and 34 m-MSL the sands deposited were during the late Pleistocene (more precisely the Eemien era from 128 000 to 116 000 years ago). It can be seen from the log that below 33.8 m-MSL the shell content disappears and a gravel fraction is introduced. These deposits are related to the late Salien period (around 128 000 years ago). It is at these depths in the borrow area where, for example, the TSHD Oranje was dredging historical sand on the 30 July 2010, putting it back into the new created Maasvlakte 2, just one hour later by pumping ashore (see Figure 8).

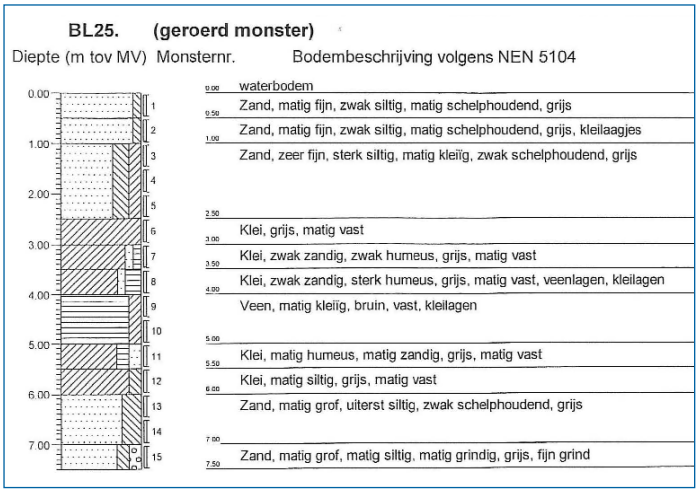

Figure 8 *Borelog representing the different sediments and depths. First used for engineering purposes to determine the historic time period. (courtesy PUMA)*

Figure 9 shows a bone dredged at 37 m-MSL by the TSHD Oranje. Based on the dredging depth, location and the characteristics of the dredged sand, it is expected that the bone is of a mammoth, which lived in the late Salien era. Collected bones and other relics found during dredging operations are collected, analysed and stored. The most interesting bones are exposed in FutureLand, the information centre of the Port of Rotterdam.

For more information, please contact Fedor Meulenkamp, Boskalis on email: **t.meulenkamp@boskalis.nl**

Figure 9 *Bone of a mammoth, sailing back with TSHD Oranje to the Maasvlakte 2 on 30 July 2010 (courtesy PUMA)*

The way ahead for long-term beach nourishment projects in Italy

In Italy, up to today, the use of marine aggregates from offshore sand deposits has been limited only to beach nourishment. Together with the projects, Arenaria has always tried to promote a culture for beach nourishment. At present, while the necessary know-how for designing the projects is constantly updated, Italy is faced with the lack of public funding for construction projects resulting in more than 30 per cent of public works being co-funded by private capital. Considering coastal works, only project financing for marina construction comes from private sources. The main challenge now is to activate public-private partnerships for beach nourishment projects.

It is surprising that these options are still to be explored in Italy, as it is estimated that 2400 out of 8000 km of coast is suffering from erosion (Institute for Environmental Protection and Research, ISPRA), a major problem that interests many coastal municipalities, even those with high tourist value. However, beach nourishment is an investment, not a bare cost: economic studies have shown that the value of a beach can be considered about €2.000 per m^2 and that for €1 invested in beach nourishment, €50 can be earned after three years and €100 after 10 years, if periodic maintenance is carried out (see *EMSAGG Bulletin Issue 16*, 2008).

Legal frame – regional jurisdiction

In all of Europe there is a lack of a unitary law considering all the aspects involved in sediment management, from dredging to beneficial use of (polluted) sediments. In Italy, the jurisdiction on coastal defence belongs to the Regional Administrations, on the basis of Law 112/1998. In some cases, regions delegated local municipalities with regional laws, but the bottom-up approach is considered quite bad for coastal planning, that needs a large spatial and temporal scale (ie a physiographic unit scale and five years planning).

Also, recent and future development of legal framework in Italy plan to give more power to the Regional Administration. In the future a region will have not only the responsibility for coastal works, but also for the former state-owned coastal properties (including beaches), and the income from the fares for coastal land grants.

This new legal implication is expected to make things easier for procedures when activating coastal defence works tenders.

Legal frame – public-private partnership

The Italian law includes instruments of public-private partnership (PPP) (Law 163/2006). The most adopted is a project financing scheme called Concessione per lavori pubblici (Article 143), in which the administration identify a project of investment and call a tender for private competitors to participate in the work. At the moment, the Italian Parliament is discussing the improvement for the so called “third generation” project financing, which is based on the idea that the private party could have a more active role, not for waiting for tenders to go out from public bodies.

Appropriate tender procedures for long-term planning and PPP

Given the peculiarity of nourishment works, it can be said that the content of a tender should follow slightly different rules from any other public work, including these issues:

1. Often the most difficult part of the tender is where to find compatible sand for the intervention. The legal aspects on how to define the sand “compatible” are still open, and it is an issue that can lead to many tenders to be withdrawn. It is advisable that almost all the aspects related to the compatibility of the borrow sand should be discussed before the tender is out.
2. No nourishment project can be considered without an estimation of its life time and a monitoring and maintenance plan. The periodic maintenance should be included in the same tender, and if the funding are enough only for the first intervention, the efficiency of the nourishment may be compromised.
3. Sometimes administrators have to deal with complex coastal defence projects, for which they do not have the necessary know-how. Coastal engineering is in Italy a young discipline developing very quickly. This has highlighted the need to up-skill the staff at the Italian Public Administration.
4. Nourishment should be set, as any other coastal activity, in the context of integrated coastal zone management (ICZM). A project should consider not only the environmental aspects, but also the socio-economic contest, including all the stakeholders that could play a role in an integrated project. From the discussion and study after Recommendation 2002/413/CE and the results from the European projects (Eurosion, Beachmed, Sandpit, Cadsealand), the ICZM protocol, signed by EU members in Madrid in January 2008, will form part of EU law by 2011.

For these reasons, the nourishment tenders could adopt PPP options. According to Eurostat Decision 18/2004, if the private partner carries the construction risk with at least one of either availability or demand risk, the assets involved in a PPP should be classified as non-government assets, and recorded off the balance sheet for government.

Under the present laws in Italy, the most suitable types of PPP for coastal defence projects involving beach nourishment are described as follows:

Framework agreement: a long-term contract (four years maximum) suitable for serial works with the same technical features, as a periodic renourishment could be. Also, it allows to consider the projects (and the funding) related to the same physiographic unit, at a regional or interregional scale, together in the same tender. Besides being the instrument needed for homogeneous and well planned actions on the shoreline, its use can lead to many cost savings for the Public Administration. It has been shown that considering the total cost for nourishment interventions in the Emilia Romagna Region in 2004–2007, adopting a framework agreement instead of the classical separated tenders would have saved almost two-thirds of the funding spent (Bracci, 2008).

Competitive dialogue: a contract suitable for complicated tenders for which the administration is not able to define the technical or legal features for the design and/or the realisation. The administration search for a group of private companies interested in the works to organise a technical and economic negotiation. The object of the tender will be the result of the negotiation procedures.

Project financing: as mentioned before, in Italy the most popular form of project financing are through tenders in which the Public Administration invites private companies with financial capacity and technical expertise to be the promoter of public works and project designer. After completion it is normally adopted for projects that could generate large cash flow to pay for the risk capital invested at the start. Generally the technical administrative process takes at least two years and the project can still have a high rate of mortality.

Institutional PPP: this mode implies the starting of a new public-private company with the precise scope of carrying out a single but large and integrated project finalised to the development of areas at sub-regional level.

The nature of coastal defence tenders including nourishment intervention could have benefits from the activation of PPP schemes for fundraising, technical, administrative and ICZM reasons, even if in Italy it is still a procedure not yet activated. Generally the PPP scheme is applied through project financing on large public works, which implies direct income for the promoters, such as hospitals, highways and power stations (especially photovoltaic).

The obstacles for carrying out these procedures on beach nourishment projects are the fragmentation of competences between the administrations and the difficulty to quantify the socio-economic benefits deriving from a nourishment intervention (for tourist beaches there are economic benefits for supporting intervention). The lack of funding generated by the present economic crisis means that one of the most important incomes for the Italian economy, ie coastal tourism, may be financed only through private capitals.

In Italy the Technical Unit for Project Finance (UTFP) at the Department of Economic Planning is the institution that could give support to local coastal administrations to develop the necessary instruments and connections with private companies to activate the tenders. Also, the same inputs could come from the European PPP Expertise Centre (EPEC) of the European Investment Bank (EIB) that offers collaborative work streams, policy and programme support and a helpdesk facility to public sector members.

In the following months it is expected that these institution could provide a PPP model for the activation of coastal projects, and even though there could be a European standard, it has to be adapted to the different devolution policy of the central government to the regional administrations.

The hope for the future is that, while Public Administration set up the necessary know-how for the different approach to tenders, also Private Finance Initiative (PFI) could be awarded by the Government. This follows positive case studies such as Pevensey Bay, East Sussex, where in 2000 the UK Government awarded, for the improvement of a rapidly failing shingle embankment, sea defence and its ongoing maintenance until 2025 (see *Special conference issue*, 2009).

For more information, please contact Damiano Scarcella, Arenaria S.r.l. on email: **d.scarcella@arenariasabbie.com**

EMSAGG participation in SEDMED

EMSAGG will participate as an associated partner to the strategic project *SEDMED: safe access to and pollution risks prevention in Mediterranean harbours: sustainable handling and re-utilisation of harbour sediments for an integrated coastal zone management*, headed by Lazio Region as lead partner. An application form has been submitted to the JTS of the MED programme for the March 2011 call.

SEDMED focuses on port dredging, one of the most problematic issues related to maritime safety in the

Mediterranean basin: the management of trapped sediments has serious environmental implications along the whole Mediterranean coast. These sediments can deposit high pollutant levels or precious resources for helping restore marine and coastal sediment equilibrium. SEDMED uses a strategic approach through the realisation of maritime planning actions in all Mediterranean countries to effectively contribute and solve the problem at MED scale. SEDMED aims to increase the maritime environmental safety of harbours and their nearby marine areas around the Mediterranean by producing and adopting common solutions for port sediment management planning and incorporating them in EU legal instruments (such as Water and Maritime Strategy Directives) as an adopted protocol.

SEDMED involves partners representing all member states facing the Mediterranean basin, and in particular, public authorities having full competences and action capacity on the respective coastal territories. The actions foreseen by SEDMED will have a specific effect on the partners' coastal zone, not only due to the adoption of the pilot projects, but also at the administrative level of the partners. This is ensured by the partners' institutional need to adopt a coastal planning approach at the territory level, due to their fully institutional competence (at different administrative levels according to the member state's institutional level of competence on the coastal zone), as well as their role of policy makers and managers of the coastal zone. The pilot projects have been tailored by the SEDMED partnership to guarantee a full geographic coverage, to adopt specific and complementary coastal management experiences.

The strategic effect of the project includes the drafting and the real test of a shared and EU wide-applicable manual for the designing of harbour sediment management plans. It is expected to ensure a concrete and strategic effect on EU maritime thematic policies. Thanks to the activities of CPMR, Arco Latino, EMSAGG, the manual will be proposed and supported as an adoption tool for the Maritime Spatial Planning Directive, the Integrated Coastal Zone Management Recommendation and the Integrated Coastal Zone Management MAP Protocol, as well as the Water Directive. Also, the harbour sediment management plans will have an effect on the governance of MED harbours with specific regard to the operations of harbours maintenance, to allow safe access and guarantee the quality of the port environment (sediments and water). Thanks to its structure, the *Manual for harbour sediment management plans* can be applied to all MED/EU ports. With reference to the governance of MED ports, SEDMED results are expected to change the current approach to emergency status interventions (short-term management), replacing it with a preventative and sustainable approach (long-term management).

Given the expertise of EMSAGG in sediment dredging and management, members of EMSAGG have agreed to support the activities scheduled in the working plan. In particular, EMSAGG will provide support to provide a technical terms of reference document for harbour sediment management plans to assure the full efficiency of public calls for dredging works.

Arenaria S.r.l will co-ordinate input from EMSAGG and keep it informed on developments with the proposals and later project work. The project start date is scheduled for July 2011 with a prospective end date in June 2014.

For more information and for a complete list of project partners, please contact Damiano Scarcella, Arenaria S.r.l on email: **d.scarcella@arenariasabbie.com**
A brochure with further information on SEDMED can be downloaded from:
<www.arenariasabbie.com/nqcontent.cfm?a_id=1350>

Carbon footprint of marine aggregate extraction

Environmental Resource Management ltd (ERM) were contracted by The Crown Estate to undertake this study, to provide a better understanding of the current carbon footprint of the extraction of marine aggregates from the seabed areas around England and Wales.

The study was conducted using primary data collected for the dredging vessels and wharves, and secondary data elsewhere. The carbon footprint data collected from vessel and wharf operators for the study is presented in two scenarios: short haul and long haul. The characteristics of each scenario are summarised in Table 1.

Table 1 *Carbon footprint data for short and long hauls*

	Short haul	Long haul
Capacity	< 3000 tonnes	> 3000 tonnes
Cycle time	12 hours	24–36 hours
Cycle distance	92 km	404 km
Cargoes/year	400+	200–230

The data collected are considered to be a robust and accurate representation of the marine aggregate dredging operations carried out on the marine estate. The results can

be used as baseline data to inform decision making and as a foundation for any analyses of process change. Additionally, the non-greenhouse gas emissions to air associated with the combustion of fossil fuels have been calculated.

A cradle to grave scenario was considered to determine the significance of distribution, use and disposal life cycle stages within context of this study's results. The scope of this streamlined carbon footprint is from 'cradle to gate', which includes the life cycle stages related to the vessel and wharf operations. These stages are identified below:

- **prospecting:** activities prior to winning licenses.
- **transit:** empty vessel sails from wharf to licence area.
- **loading:** sediment is dredged from the licence area and loaded into the vessel.
- **transit:** fully laden vessel sails from licence area to wharf. Often a different wharf from its origin
- **discharge:** offloading the cargo from the vessel at the wharf
- **wharf operations:** processing of the aggregate including: conveyors, feeder devices, screening, crushing and separation (where applicable)
- **post-dredging monitoring:** activities after dredging of the licensed area is complete
- **capital burdens:** associated with the embedded carbon in the vessel itself.

The operation and maintenance of the vessels were outside the scope of the study, but are fundamental in reducing fuel consumption and therefore lowering the overall carbon footprint.

Proximity to market is a key principle of the industry, with wharves strategically in place close to end users, which shortens travel distances. Efforts to promote low carbon solutions for the use and disposal stages are recommended to reduce the overall cradle to grave footprint.

Distribution of the aggregates to market can have a significant impact on the overall carbon footprint and lower carbon transport modes such as shipping should be used where possible. One of the main benefits in using marine sources of aggregate is that ships can deliver the material directly to wharves in urban areas, which minimises road and rail transport. Emissions from a lorry are up to 25 times more than those from a large sea vessel, whilst those from rail are approximately four times more than shipping.

The key conclusions from the study are:

- the total carbon footprint per tonne of aggregate landed was calculated to be 6.41 kg CO_2-eq for the short haul scenario, 11.73 kg CO_2-eq for the long haul scenario or an average of 10.01 kg CO_2-eq for all vessels
- over 75 per cent of the carbon footprint is related to vessel activities, with the vast majority from transit/steaming to and from the dredge sites
- as expected, the fuel used during vessel activities is also responsible for the majority of non-GHG air emissions analysed in this study
- the wharves are responsible for 14 per cent (short haul) and 19 per cent (long haul) of the footprint while prospecting/monitoring and capital burdens can be considered to have minimal contributions
- distribution of the aggregates to market can have a significant impact on the overall carbon footprint. Lower carbon transport modes, such as shipping, should be used where possible
- proximity to market is a key principle of the industry, with wharves strategically in place close to end users, which shortens travel distances
- efforts to promote low carbon solutions for the use and disposal stages are recommended, so as to reduce the overall cradle to grave footprint.

Further information

AUMONIER, S, HARTLIN, B and PEIRCE, A (2010) *Carbon footprint of marine aggregate extraction*, The Crown Estate, London (ISBN: 978-1-906410-18-6). Go to: <www.thecrownestate.co.uk/mrf_aggregates>

Reuse and disposal of dredged material to land in England and Wales, a new CIRIA proposal

The reuse and disposal of dredged material on land was unregulated before the introduction of the Waste Management Licensing Regulations (WML) in 1994. These Regulations established a uniform licensing regime for the management of waste on land – where waste is defined according to the EC Waste Framework Directive (WFD) (as amended) 2008 (Directive 2008/98/EC). The regulators made it known that most dredged material would qualify as waste, even if beneficially reused.

Accordingly, CIRIA published R157 *Guidance on the disposal of dredged material to land* (1996) Since its publication, there have been many changes to the waste regulatory framework in the UK, and at a European level. So it has become increasingly difficult to assess the legal requirements for the reuse or disposal of dredged material on land, particularly for contaminated and/or treated material. International guidance has existed for many years to minimise the ecological effects of dredging and open water disposal, however, European legislation for handling dredged material is complex as dredged material sits on the borderline of water, soil and waste policies.

Amendments to Environmental Permitting (England and Wales) Regulations (EPR) in 2007 and 2010

The situation has been heightened in the UK by the recent amendments to the Environmental Permitting (England and Wales) Regulations (EPR) in 2007 and 2010. The Environmental permitting programme is a major Defra, Environment Agency and Welsh Assembly Government initiative created to offer a single permitting and compliance system combining the previous Waste Management Licensing and Pollution Prevention and Control regimes. The new system aims to simplify permit applications, amendments and variations for both the industry and regulators. It should allow regulators to focus resources on medium and high risk operations while continuing to protect the environment and human health.

The WML regime introduced the concept of waste exemptions. These were for certain activities where it was not considered appropriate for the person carrying out the activity to have to obtain and maintain a waste management licence (or permit) to carry out that activity. The list of exemptions included activities that could be applied to the management of dredged sediment on land. The waste exemption regime relating to certain activities involving the management of dredged sediment on land has been largely unchanged since 1994 including the 2007 amendment to the EPR.

The latest amendment to the EPR came into force in April 2010 in England and Wales. One fundamental aspect of this amendment was to adopt a proportionate regulation of low risk waste activities because of a comprehensive permitting review of waste exemptions, which reviewed activities suitable for exemption from permit requirements. It completely revokes the previous waste exemption regime in England and Wales, which has been in place since the adoption of the Waste Management Licensing Regulations in 1994. Some exemptions remain, but have been amended and grouped according to the type of activity: use of waste, treatment, disposal (note there are very few disposal exemptions) and storage. Some exempt activities that could involve the use of dredged material have been removed and instead these will be part of the permitting regime under EPR. This is on the grounds that they present a higher degree of risk, largely because of the quantities involved, but also because of potential contamination.

Defining dredged material as waste and associated reuse and disposal options

The European definition of waste is provided in the WFD. Sediment that is dredged because of capital or maintenance activities in the marine or coastal environment is likely to meet the definition of waste.

Where dredged material is suitable for a particular use without treatment, it can be reused within the development boundary without being considered waste as long as certain criteria apply. The criteria are defined in Definition of waste – development industry code of practice by Contaminated Land: Applications in Real Environments (CL:AIRE), which has regulator approval and covers the reuse of dredged sediment on land. The criteria apply where the dredging activity is part of a wider development including land, ie within a port estate. However, if the dredged material is exported beyond the development boundary, it will be considered waste, even if it is suitable for use on another site without treatment.

In theory, it may be possible for waste producers to treat the dredged waste material to a point where it ceases to be waste so it can be used as a recovered product, by adopting principles that are similar to a regulator approved quality protocol, such as the aggregates quality protocol, where the treated output meets a defined engineering standard. It is important to note that dewatering is considered to be a waste treatment activity by the regulator and must be carried out under an environmental permit. However, dewatering alone may not be sufficient to treat contaminated dredged material to a suitable engineering standard, so further treatment may be required.

The regulator has ruled out a generic quality protocol for marine dredged material, following the publication of the Technical report on the beneficial use of marine sediments from capital and maintenance dredging in land-based projects (Environment Agency, 2010). However, they do recognise the benefit of using these materials in port development, flood defence and the construction sector.

Classifying dredged material as non-hazardous or hazardous waste and associated disposal options

Where waste dredged material is managed on land, the material must be classified as either non-hazardous or hazardous to determine appropriate waste management options, including options potentially exempt from permitting. This requires waste producers and holders of waste dredged material to identify the appropriate six digit list of waste code (also known as the European Waste Catalogue (EWC) code) for the waste.

To complete the hazardous waste classification assessment and to identify any potential hazardous properties with the material, producers must undertake sampling and analysis of the material to be dredged in relation to several specific dangerous substances.

The resulting data have to be worked (eg to calculate their ecotoxicity) and then compared against thresholds and criteria identified in the Hazardous Waste Regulations 2005 and also in the joint regulators' guidance *WM2 Hazardous waste – interpretation of the definition and classification of hazardous waste* (Environment Agency, 2005). The findings will determine whether dredged material is hazardous or not and whether it needs to be disposed of at a landfill dedicated to receiving hazardous waste. Note that none of the waste exemptions allow for the use of hazardous dredged material. However, the CL:AIRE code of practice does allow for the use of material that meets the definition of hazardous waste as long as it fulfils the bullet-point criteria in Section 3 of this bulletin.

If any dredged material is required to be disposed, it must first be pre-treated (which can be met by dewatering) before it can be landfilled. If the material is classified as hazardous, it can only go to a hazardous class of landfill. But before it can be accepted it must first pass the hazardous waste acceptance criteria (hazardous WAC). WAC tests are another series of chemical tests designed to identify the behaviour of the waste in a landfill. If the hazardous dredged material fails the hazardous WAC, they cannot be landfilled without undergoing further treatment to lower contaminants below the WAC standard. Note that this WAC test is different to the hazardous waste classification assessment previously discussed.

Non-hazardous dredged material can be managed through many other options, including use of waste exemptions or disposal to landfill. There is no chemical WAC test for non-hazardous waste destined for non-hazardous class of landfill.

Non-hazardous dredged material and associated exempt activities

Where dredged material is classified as non-hazardous waste, its reuse may be exempt from permitting requirements. Exemptions are highly desirable for waste producers because they mean an environmental permit is not required for undertaking the proposed activity, assuming that the proposed use meets the exemption criteria. Also, they involve less bureaucracy and are free to register.

Typically exempt activities have strict limitations on the volume and/or depth of dredged material that can be used and the circumstances of the proposed use, and are dependant on whether the material will be recovered/recycled/reused or disposed. Also, they may require planning permission. These limitations can be very restrictive given the volume of dredged material that can arise from dredging at ports.

The EPR 2010 amendment fundamentally changed the waste management activities that are exempt from permitting. High risk exemptions (previously known as "complex exemptions" to the regulator), which were previously allowed under the exemptions regime were removed and no longer apply. Any new exemption involving dredged material must be in accordance with the new requirements in EPR 2010. If the limits cannot be complied with the activity must be covered by an environmental permit.

However, if the waste producer was operating under a complex exemption when the 2010 EPR regulations were adopted (on 6 April 2010) then the activity will be subject to a transitional programme that will end no later than 1 October 2011.

Given the scope of the changes, guidance for the industry's waste producers on the activities that are covered by waste exemptions would be beneficial.

To find out more about the project or to become involved please contact Kristina Gamst, CIRIA, on email: **kristina.gamst@ciria.org**

CIRIA publication news

Beach management manual (second edition) (C685)

Beaches play an important role either as the sole barriers to coastal flooding and erosion, or as part of manmade defences. Beach management in the UK has evolved in

design and execution over the last 10 years moving towards performance and risk based flood and erosion management, aided by the first edition of the *Beach management manual* (R153), which was published by CIRIA in 1996.

This second edition includes the latest information on state-of-art methods, guidance on beach monitoring and maintenance, evaluation of the state and performance of a beach, design, procurement, execution and the after-care of beach improvement schemes. The manual is divided into four parts and makes use of case studies to illustrate popular management techniques and draw from experience of existing management approaches, reflecting the wealth of experience gained since 1996.

The new manual can be downloaded as a PDF free of charge from CIRIA's website: **www.ciria.org** either as one low resolution document or chapter by chapter in a high resolution format. Alternatively, the manual is available for sale from the CIRIA bookshop as a book or CD-Rom.

Figure 10 Beach management manual (second edition) (C685)

The use of concrete in maritime engineering – a guide to good practice (C674)

The use of concrete in maritime engineering – a good practice guide is for use within the maritime engineering industry. It aims to distil conclusions from existing research and practical experience, develop good practice guidance on marine concrete materials selection and design, and set out guidance on pre-casting.

The guide can be downloaded as a PDF free from CIRIA's website: **www.ciria.org**. Alternatively, the guide is available for sale as a book from the CIRIA bookshop.

Figure 11 The use of concrete in maritime engineering – a guide to good practice (C674)

EMSAGG membership opportunity

EMSAGG was established in 1998 by European professionals and is an independent body that draws together stakeholders from across industry, including dredging organisations, European government departments and agencies, regulators, economists, resource planners, environmental bodies and academia as well as research bodies. EMSAGG provides a forum for the exchange of ideas and learning across Europe.

Marine sand and gravel continues to make an important contribution to the development of European economies, with demand expanding for numerous end-uses. Planning to meet future demand, by ensuring long-term resources are available and responsibly managed, is an important factor towards achieving sustainable development at a European level. To address the potential for increased demand of marine sand and gravel around Europe, techniques for the investigation, development and management of marine sand and gravel require continuous improvement. EMSAGG:

- helps identify developments and information needs for the marine sand and gravel constituents, concerning all aspects of the industry
- enables exchange of information on, and experiences of, the research, licensing, execution and monitoring relating to the extraction and use of marine sand and gravel throughout Europe
- allows for the wider interest groups, such as clients, government, regulators, planners, economists and environmentalists to share information and discussion of

the issues – particularly at a European level. Improved communication and understanding of the issues will be of benefit to all involved in marine sand and gravel
- manages information and knowledge sharing visits to European countries, to discuss developments and information needs concerning sand and gravel and to identify specific EMSAGG initiatives
- disseminates information to public and private marine sand and gravel stakeholders through bi-annual meetings, its bulletins, the web and its popular conference.

EMSAGG's activities?

- the group meets formally twice a year to discuss innovation and developments within the industry
- the group produces a bi-annual bulletin including articles highlighting work of interest to its contacts and the latest information from across the industry
- the group organises a popular information sharing conference every three years
- the group has a website hosted by CIRIA that includes downloadable bulletins, conference reports and papers, details of members, details of relevant CIRIA publications, projects and proposals and also useful links to industry stakeholders.

Figure 12 *EMSAGG Bulletin*

Why join EMSAGG?

There are many benefits of being a member of EMSAGG, including:

- network and develop contacts throughout the marine aggregate and related industries, linking with suppliers, regulators, users and leading research organisations
- keep ahead and become part of a forum for the rapid exchange of information relevant to marine aggregates and improve your access to current research, best practice and case studies
- raise the profile of your organisation and its role in an international forum
- take advantage of opportunities to guide and participate in future international research and cross-industry initiatives.

We would be delighted to hear from you so please contact the EMSAGG secretariat on email: **emsagg@ciria.org** to discuss membership opportunities.

Figure 13 *2009 EMSAGG conference*