The Thames Estuary

London has served as a major port since Roman times and currently handles over 30,000 commercial vessel movements per year. The Thames Estuary, which, in navigation terms, connects the London conurbation to the North Sea, is a dynamic environment with a large tidal excursion. For example, on a large spring flood tide beginning at low water, a particle of water would move up the estuary about 12km if it started at Gravesend. If the particle started at Greenwich, the distance moved would be up to 17km (HR Wallingford, 2001).

The riverbed of the Thames Estuary, the tidal Thames, (from the upstream limit at Teddington to Mucking in Essex) consists primarily of a hard bed of gravel, stones, clay or chalk. There are two exceptions, one being the ‘mud reaches’ (Gallions, Barking and Halfway reaches) and the other being Gravesend Reach. Downstream of Mucking the seabed of the inner and outer estuary comprises fine sands interspersed with black mud in areas such as Southend Flats and Blyth Sands (Inglis and Allen, 1957 in HR Wallingford 2001).

The Thames Estuary is a sensitive natural environment as reflected by the national, European and International conservation designations. The majority of the designated sites are located in the inner estuary from Mucking on the Essex side and Shornmead Fort on the Kent side, and extend seawards to include much of the intertidal habitat. The importance of the Thames as a wildlife corridor is recognised by its designation as a Site of Importance for Nature Conservation (SINC) and the Tidal Thames Habitat Action Plan aims to provide for the protection and enhancement of its characteristic habitats and species populations. Environment Agency surveys have identified over 120 species of fish in the Thames and the area provides spawning and nursery habitats for a range of species (e.g. sole and bass).

The estuary supports an important commercial fishing industry providing high quality fresh products to both local and European markets. This local industry provides over 50% of all UK cockle landings and also significant catches of sole as well as herring, sprat, thornback ray, bass, grey mullet and cod to mention but a few. The large populations of cockles are maintained at a sustainable level by the Kent and Essex Sea Fisheries Committee under a Regulating Order and other fisheries are controlled under EU and national legislation.

The Thames Estuary also supports many other interests and activities including archaeology and recreation.

Commercial vessels of various sizes visit the Port of London delivering cargo or collecting cargo for export or transhipment. Some deeper-draughted vessels can only transit the Thames Estuary around high water. Leisure and fishing craft also use the estuary although, for the most part, these are shallower in their draught.
The Port of London Authority

The Port of London Authority (PLA) is the port authority for 150 km (95 miles) of the tidal Thames from Teddington to the sea. It provides navigational and pilotage services for ships using the Port of London, including the maintenance of shipping channels.

The PLA is a public trust, established in 1908 to administer, preserve and improve the Port of London. It is currently constituted under the 1968 Port of London Act. In addition, the PLA owns much of the river bed and foreshore to the high water mark.

The Port of London comprises over 70 independently owned terminals and port facilities, which handle a very wide range of cargoes. London is the second largest port in the UK and handles over 50 million tonnes of cargo every year.

The PLA provides navigational services for ships using the Port of London. These services include the continual monitoring: by hydrographic survey, and marking of the navigation channels in this dynamic environment; providing up to the minute information to ships’ masters and berth operators (including real time tide observation); the maintenance of shipping channels, moorings, lights, and buoys; and occasional maintenance dredging to remove sediments which have been deposited in the main navigation channels. The PLA also licences dredging by others including capital dredging associated with a new project or deepening exercise and maintenance dredging to restore approved or required depths. Such dredging is undertaken by or on behalf of the owners or operators of the operational wharves, terminals, berths, jetties and other private frontages along the Thames.

Figure 3 "Tug and Tow" near Canary Wharf. Copyright PLA
The Thames Estuary Partnership

The Thames Estuary is a valuable resource for all who live, work and play in the area. It is home to 12 million people and supports a diverse range of habitats and wildlife. It is a rich historical and cultural resource and a major focus for industry, commerce, transport, agriculture and recreation.

In recognition of the wide range of issues and organisations involved with the Thames Estuary, the Thames Estuary Partnership (TEP) has been formed to act as a neutral ‘umbrella’ body to assist and co-ordinate the wide range of organisations and sectors involved in the estuary. The TEP values the contributions of all the estuaries’ users and regulatory bodies and seeks to learn from, and work with, this expertise.

The Thames Estuary Partnership:
- is a charity providing a framework for the management of the estuary;
- co-ordinates a programme of projects;
- facilitates new projects and forums for joint working;
- seeks to further the interests of local communities, the local economy and the environment; and
- holds regular events and workshops.

Figure 4 “Thames at Barking.” Copyright Ian Yarham
The Dredging Liaison Group

Maintenance dredging in the Thames Estuary is an issue of importance to a range of organisations and sectors. The Dredging Liaison Group (DLG) was established by the Thames Estuary Partnership in January 2001. It has been shown to provide an effective, neutral and open forum within which the requirements for planning and implementation of maintenance dredging operations on the tidal Thames can be discussed, and any associated concerns can be addressed.

What does the DLG aim to achieve?

Amongst the objectives of the DLG are the following:

• to highlight, discuss and resolve concerns about the potential environmental impacts of maintenance dredging, and where possible suggest measures to limit any demonstrated impacts;
• to exchange ideas;
• to encourage collaboration and inter-agency co-operation in the discussion of dredging proposals, facilitating the resolution of potential conflicts and offering opportunities for value-added solutions;
• to agree common research needs and methodologies, and encourage, where possible, the sharing of relevant data;
• to promote the beneficial reuse of dredged materials; and
• to further a joint understanding of the hydrodynamic processes within the estuary and how they affect the management of dredging operations.

Since its inception, the DLG has typically met two or three times a year. The PLA is a key partner of the Dredging Liaison Group and has worked closely with other DLG members to develop its environmentally responsible approach to maintenance dredging decision-making in the Thames Estuary.

Dredging Liaison Group members, in alphabetical order, include:

Central Dredging Association (CEDA), Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Crown Estate, Department for Transport (DfT), Department of Environment Food and Rural Affairs (Defra), English Nature, Environment Agency, Greater Thames Archaeological Steering Committee (GTASC), Kent & Essex Sea Fisheries Committee (K&ESFC), Port of London Authority, Port of Tilbury London Ltd., The Royal Society for the Protection of Birds (RSPB), Thames Estuary Partnership (as facilitator secretariat), Van Oord, Westminster Dredging Co. Ltd.

Since it was established, by working in partnership, members of the Dredging Liaison Group have:

• arrived at a point of consensus on many issues of mutual interest;
• supported the development of initiatives taken forward by the PLA as components of the Maintenance Dredging Framework; and
• played a leading role in pioneering an environmentally sustainable approach to maintenance dredging in the UK.
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Maintenance Dredging

In common with many navigable waterways in the UK, maintenance dredging is regularly carried out in the tidal Thames. Maintenance dredging is necessary to maintain safe operational water depths for navigation, and to facilitate continued access to many of the 70 plus berths, docks, wharves, and jetties. The term “maintenance dredging” describes the removal of sediment that has accumulated in a previously dredged area (i.e., where the original (“maintained”) depth of water is no longer available).

Maintenance dredging can be required in the Thames Estuary for a number of reasons:

- when a storm or other hydrodynamic event leads to the deposition of materials - possibly as sand waves or ‘fingers’ extending into the navigation channels, or in areas of lower flow velocity. Such dredging tends to be undertaken irregularly in response to specific events.

- when sediment builds up in the dock entrances or ‘berth boxes’. The latter are dredged areas adjacent to a quay or jetty, often with deeper water than the approach channel due to the fact that vessels need to load, unload or wait over low water and require sufficient water depth to do so safely. Such dredging tends to be undertaken routinely, often several times each year.

- when vessels need access to facilities that are infrequently used (or infrequently used by deeper-draughted vessels). Such dredging needs to be undertaken on an ad hoc basis.

Where does maintenance dredging take place?

There are currently some 20 locations (see Figure 5) where operators undertake maintenance dredging on a regular basis, from several times each year to once every 18 months or so. The quantity removed is dependent upon the sedimentation characteristics at each location and can vary from <2,000 m³ to >45,000 m³ of silt and/or sand per dredging campaign. Dredging also takes place in other locations, although generally less frequently.

How is maintenance dredging carried out and what happens to the dredged material?

Most dredging on the lower Thames (from Tilbury seawards), particularly at berths and dock entrances - and the greatest amount in terms of overall quantities dredged - takes place using a water injection dredger. Further upstream, mechanical (e.g., backhoe) or hydraulic (e.g., trailer suction hopper) dredgers tend to be used.

Water injection dredging uses water jets to move accumulated sediment along the bed of the estuary (as a density current) to locations from which it is re-distributed by natural currents. It is widely considered that the retention of sediments within the natural estuarine system is a potentially significant environmental advantage of water injection dredging.

A trailer suction dredger operates rather like a vacuum cleaner, sucking material up from the bed of the river and depositing it in its own hopper or
barge. On the Thames, such material is typically taken to a land-based site for disposal; over recent years it has been relatively unusual for sediment dredged from the Thames to be taken out to sea for disposal at a licensed site. The two main land placement sites on the Thames Estuary are at Rainham Marshes (London Borough of Havering) and Cliffe Pooles (Kent). At Rainham, the PLA is working closely with the Royal Society for the Protection of Birds (RSPB), the lease holders of the site to manage the area as a conservation site. The dredged material is used beneficially to create and maintain the habitats that support the birds. The placement site at Cliffe is also managed by the RSPB to enhance its nature conservation interest: again, the careful placement of dredged material is an important part of site management.

How is maintenance dredging controlled?

The PLA has the power to dredge within its area of jurisdiction under Section 60 of the Port of London Act 1968. Other port authorities (e.g. Harwich Haven Authority) have similar powers. All dredging carried out by third parties (for example, at locations listed on the map) is licensed by the PLA under Section 73 of the Port of London Act. The key difference in how dredging is managed in the PLA area compared to the rest of England and Wales is the application of the Coast Protection Act (CPA) 1949. A PLA licence must be obtained prior to any dredging commencing and the holder of such a licence is then exempted from the usual CPA consent requirements. This places the PLA in the unique and responsible position of carrying out and licensing dredging in the Thames Estuary without an additional formal input from central government.

The PLA has general environmental responsibilities under Section 48a of the 1964 Harbours Act. In addition, the PLA, as a public body, must take account of EU environmental directives. These include the Wild Birds, Habitats, Environmental Impact Assessment, Shellfish Waters and Water Framework directives and, in future, the proposed Environmental Liability Directive. Although the issues covered by these directives are not usually the primary responsibility of the PLA, in the case of dredging the PLA is the only regulatory authority and must therefore ensure compliance.

Where potential impacts are identified, mitigation measures will be sought. Where appropriate, dredging licences may therefore be granted subject to certain restrictions or conditions being met (e.g. dredging on the ebb tide only). Such conditions can be required to reduce or eliminate potential impacts on navigation or on other berth operators as well as on the natural or physical environment.
As shown above, the ‘Maintenance Dredging Framework’ comprises an ongoing and continually evolving collection of initiatives:

- an information exchange system;
- environmental impact assessment and appraisal procedures;
- a beneficial uses register;
- information for berth owners and operators;
- consultation mechanisms;
- data collection and monitoring; and
- collaborative research.

An important consideration in developing this framework is the need to understand the estuary at a strategic (ie. ‘whole estuary’) level, and to make decisions in full awareness of strategic as well as site-specific issues. In combination, the components of the framework will help to ensure that the PLA is aware of such issues and is able to take them into account.

As part of the development and implementation of this framework, the PLA intends to encourage improved forward planning along with an explanation and justification for maintenance dredging campaigns.
wherever this is practical. This is particularly relevant in the case of berths that are dredged regularly (sometimes several times each year). The decision making framework should enable many of the potential environmental issues associated with maintenance dredging to be identified and resolved well in advance of dredging taking place. It must, however, also be recognised that either storm events (eg. moving sediments into the navigation channel) or certain operational requirements (eg. the need to dredge a berth which is only used infrequently) will continue to lead to situations in which dredging needs to be undertaken more quickly. The framework needs to be able to cope with such situations equally well.
Guidance to Berth Owners and Operators

Whilst many of the berth owners and operators carrying out dredging on the Thames have been doing so for many years, there have been a number of changes in both the licensing procedure and, more generally, expectations in terms of environmental accountability. In 2002, the PLA made a number of important changes to its licensing procedure for both river works and dredging licences. The objectives of these changes included improving both accountability and the transparency of the decision-making process. The payment of fees was introduced; consultation and notification procedures were formalised, as was the reporting process, and provision was made to set and enforce conditions. These changes coincided with the development of the maintenance dredging framework, with its associated requirements for environmental and other information.

In 2002, some berth owners and operators attended workshops to discuss the developing strategy and a Notice to Berth Operators (similar to a Notice to Mariners) was issued to advise them of the likely environmental data requirements when submitting a dredging licence application. More detailed guidance will be provided as required to ensure that all berth owners and operators are fully familiar with the PLA’s requirements.

Specifically, the guidance will describe the maintenance dredging framework and the information requirements for licence applications. Summary information will be provided on the dredging licence application process, relevant environmental legislation and its implications for both the PLA and licence applicants, and an indication of conditions which could be imposed. In addition, this guidance will set out the requirements for sediment sampling and analysis, and provide advice on the environmental issues that berth operators should consider when planning their dredging campaigns.
Environmental Assessment

The PLA is committed to applying Environmental Impact Assessment (EIA) principles to both its own dredging and dredging by third parties. Each proposed dredging activity is therefore subject to a scientific and environmental assessment.

The checklist as a starting point

In the first instance, a standard checklist is used to ensure that the full range of potential environmental issues associated with a particular dredge can be identified, and to determine which issues are likely to be significant. In completing this first step, data provided by the applicant, existing information from previous applications, and the output from the Information Exchange System (IES, see page 20), are all referred to. In particular, interrogation of the IES should immediately provide an overview of the key environmental characteristics and interests in the area, including any constraints. Further, where potential impacts are identified, the PLA may then consult with the responsible agency. Where the proposed works are within, adjacent to, or likely to affect, a Special Protection Area or Special Area of Conservation, advice will be sought from English Nature and consideration will be given as to whether an Appropriate Assessment is required under the terms of the Habitats Regulations.

The environmental checklist considers potential impacts on:
- coastal processes and hydrodynamics, including sediment transport;
- water quality and sediment quality;
- ecology (birds, fish, invertebrates etc., including protected habitats and species);
- fisheries and shellfisheries;
- archaeology and heritage;
- local community; and
- navigation, including water-based recreational activity.

In all cases, the completed checklist, supplemented with additional information as necessary, forms an important input into the decision making process. However, in cases where the checklist identifies potentially significant environmental impacts, the PLA will consider whether an environmental appraisal or a full Environmental Impact Assessment needs to be prepared under the relevant legislation.

Habitats Regulations and CRoW Act

Both the 1994 Habitats Regulations (implementing the 1979 EU Birds Directive and the 1992 EU Habitats Directive) and the Countryside and Rights of Way (CRoW) Act 2000 have implications for the PLA. If the proposed dredging is likely to significantly affect a European site (ie. a Special Protection Area, a Special Area of Conservation) or a Site of Special Scientific Interest, additional requirements are likely to apply.

As a competent authority under the Conservation (Natural Habitats &c.) Regulations 1994, the PLA must carry out an Appropriate Assessment of any plan or project which, either alone or in combination with other plans or projects would be likely to have a significant effect on a European site; and is not directly connected with the management of the site for nature conservation. If the Appropriate Assessment identifies that - even with mitigation - the scheme is likely to have an adverse effect on the integrity of the site in question, the PLA must be satisfied that there are no alternatives, and that there are imperative reasons of overriding public interest for the project to proceed. Further, as owner of much of the seabed within the Thames Estuary, the PLA is similarly required under Section 19 of the Habitats Regulations to consult with English Nature and potentially carry out an Appropriate Assessment, before carrying out or agreeing to works within a European Marine Site.

In addition to the above, as a Section 28g Authority under the Wildlife and Countryside Act 1981, as incorporated by the CRoW Act, the PLA is
In line with national and international requirements, the PLA promotes the use of dredged material for beneficial re-use, ranging from environmental enhancement initiatives to construction projects. In order to facilitate the beneficial re-use of dredged materials arising from dredging projects in the Thames, a beneficial uses register has been initiated and will continue to be held by the PLA. This register will provide a record of known demand for materials (quantity, material type, etc.) for initiatives which are likely to be within an economically viable distance of dredging sites in the PLA’s area of jurisdiction. Such a register aims to avoid, on the one hand, disposing of dredged material whilst, on the other, dredging additional marine aggregates of a similar nature and quantity from elsewhere to meet a defined need.

Consideration will also be given to habitats and species identified as important by the UK Biodiversity Action Plan or the Tidal Thames Habitat Action Plan.

Finally, the 1997 implementation of the 1979 EU Shellfish Waters Directive can already affect decisions on some dredging activities, and it is anticipated that the EU Water Framework Directive could have similar - and potentially more wide-ranging - implications for some of the PLA’s activities and others within the estuary.
Information Exchange System

Background

In order to improve the process of considering environmental information when making decisions on dredging, a data management system is necessary. To be of maximum use, such a system must meet the following criteria:

- accessible: capable of being employed quickly and cost-effectively;
- supported: must help bring together the PLA, the industry and stakeholders, as partners in the process;
- practical: must not be too complicated, too time consuming or too intrusive;
- long lasting: aim for a valued system, one which will still be in use in 10 years time; and
- relevant: carefully targeted, and where appropriate, easily-updated information on both maintenance dredging and selected environmental parameters

Whilst discussions identified that much of the required information was available, it was in a variety of forms and levels of detail; further, some data requires regular updating. These considerations, combined with the need for ready access to the information by both the PLA and DLG members, meant that a paper-based system of data storage and retrieval would quickly become unwieldy. It was therefore decided to develop a Geographic Information System that would allow rapid interrogation of electronically held data, and provide both the PLA and other DLG members with an overview of the environmental characteristics, interests and possible constraints in a defined area of interest. Initially the PLA and TEP guided the preparation of a prototype with the help of an MSc student from University College London. The PLA further developed this into the current tidal Thames ‘Information Exchange System’ (IES).

What are Geographical Information Systems (GIS)?

These are computer mapping systems that link information about where things are, with information about what things are like. The advantages over a paper map is that information can be queried, for example to find the closest water quality sampling point to a proposed dredging location. Also the information is contained in layers that can be switched on and off, so the user need not be overwhelmed with information they are not interested in.

The ‘Information Exchange System’

The IES has been created using Cadcorp ASC (Active Server Component) Software and is deployed over the Internet using a secure connection to ensure that only named members of the DLG can access the site. Security is important due to confidentiality issues with some of the data contained in the system.

Facilities within the system allow the user to search for a specific dredge site, either by name or by using the map, and then to display the environmental information that is applicable to that site. This allows the user to find the necessary information to inform decision making regarding the possible effects of maintenance dredging on the surrounding area. The interface also uses the standard GIS tools for zoom, pan and measurement and allows the environmental data to be queried.

What data is included?

PLA and TEP jointly held meetings with stakeholders to discuss data requirements, and to agree the format of the data, its availability and any updating requirements. In the interests of efficiency and cost-effectiveness for all stakeholders, and noting that the primary purpose of the system is to inform (rather than to make) decisions on maintenance dredging proposals, data requirements were defined based on indicators rather than
comprehensive coverage wherever possible. When using the system, if the data indicates the potential for a significant effect on a particular resource, contact will be established with the responsible agency. If appropriate, additional, more detailed data can then be introduced at this stage.

The data used in the IES has been supplied by members of the DLG. It includes dredged sites within the tidal Thames (from the PLA and dredging companies), water and sediment quality data (Environment Agency), fish and shellfish information (Kent and Essex Sea Fisheries Committee), and environmental designations (English Nature). Each partner has agreed to provide updates to their data every quarter; they remain the owners of the data and are responsible for ensuring that the data provided to the system remains current.

Development of the IES

At the time of writing, agreements have been concluded with most DLG member organisations and much of the data is now in the system. The IES was ‘launched’ in July 2003, and is available on-line to named DLG members. As the IES is used, enhancements are completed based on feedback and additional data becoming available: data to be added in the immediate future include bird count data from the RSPB and fisheries data for the up-river sections from the Environment Agency.
Consultation and participation in decision making

An important element of improving accountability and the transparency of decision making is the involvement of stakeholders. As demonstrated by the wide range of organisations represented on the Dredging Liaison Group, there is widespread interest in maintenance dredging activities on the Thames Estuary.

The PLA, in partnership with the TEP through the DLG, continues to work hard to improve partners’ understanding of its operations, including maintenance dredging. Many of the concerns and misconceptions resulting from the lack of effective means of communication have been addressed. An important part of the Maintenance Dredging Framework, however, is the ongoing involvement of key stakeholders in the decision-making process if sensitive environmental resources could potentially be affected by dredging activities. In addition to providing and disseminating information on maintenance dredging, the development of the decision making framework and other technical material, the PLA is committed to consulting stakeholder organisations where their interests could potentially be affected by a proposed maintenance dredging initiative. For example, it will be appropriate to consult English Nature, the Environment Agency and/or Kent & Essex Sea Fisheries Committee for those applications where conservation sites, water quality and/or fisheries may be adversely affected.

The challenge for the PLA and the TEP is to get the balance right. Too little consultation and stakeholders may be concerned that they are not being involved as much as they might think appropriate. Too much consultation on the other hand - consultation for its own sake - can waste everybody’s time. In this respect, the IES (to which all parties have contributed relevant data) plays an important role.
Role of the IES in determining when consultation is required

The data contained in the IES, when used to inform the completion of an environmental checklist and when supplemented by any necessary additional information, should enable all maintenance dredging initiatives to be reviewed very quickly and categorised as follows:

- no apparent constraints; need to review system prior to each dredging campaign to ensure no additional data has been added, but dredging can go ahead;
- some constraints; seasonal restrictions, for example, may place limits on when dredging can be carried out; the decision maker can then either suggest re-programming the dredging or, if this is not possible, consult relevant interested parties;
- possible constraints or no data: new data may need to be collected or an investigation undertaken; depending on the outcome, subsequent dredging initiatives should fall into another category;
- potentially significant constraints: consultation will be required to resolve the issues.

Given that future maintenance dredging is most likely to take place in areas which are already regularly dredged, consultation may in future only be necessary for a small proportion of initiatives. Further, in many cases where consultation is initially required (and/or data collection is needed) in order to resolve a particular issue, it is possible that subsequent maintenance dredging will be able to proceed without further consultation.
Data collection, monitoring and research

Keeping data up-to-date

Data collection, monitoring and research are vital if understanding of maintenance dredging and its possible environmental implications is to continue to improve, and if decisions on maintenance dredging are to be well-informed. As demonstrated by the wide range of data which forms the information exchange system, relevant data might be collected from various sources. Data might be collected by organisations as a result of routine monitoring of background or baseline parameters (e.g. water quality information collected by the Environment Agency). Targeted monitoring of specific initiatives may be required by the PLA as part of the consenting process for dredging (e.g. to determine whether mitigation or compensation measures are performing as required). Relevant data may also be produced as an output of research projects.

In all cases, the monitoring data need to be fed through into the IES to ensure that the system is - and remains - as up to date as possible. Further, to ensure that the data is and remains of maximum value, the regular or occasional review of the information is essential. Such a review may aim to ensure data accuracy or identify possible changes in the way data is collected; to confirm predictions, or to identify trends. Particularly in the case of data which are being collected to determine the effectiveness of predictions or mitigation measures, a further commitment to act on any significant or atypical findings is also vital. The PLA will continue to endeavour to ensure that such reviews take place, involving appropriate third parties.

The PLA is actively involved in the TEP’s Thames Estuary Research Forum and it is anticipated that dredging associated research will be identified both through the DLG and the Thames Estuary Research Forum. In addition, the PLA is undertaking specific research that is considered necessary to inform its maintenance dredging decisions.