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MEDIA BRIEFING NOTE: CROSSRAIL TUNNEL CONTRACTS & TUNNELLING

Introduction:

A total of 21 km of twin-bore tunnel is required to be constructed for Crossrail.

The five tunnels to be constructed are:

- Royal Oak to Farringdon west (Drive X) - length of drive approximately 6.2 km;
- Limmo to Farringdon east (Drive Y) - length of drive approximately 8.3 km;
- Stepney Green to Pudding Mill Lane (Drive Z) - length of drive approximately 2.7 km;
- Limmo to Victoria Dock Portal (Drive G) - length of drive approximately 0.9 km; and
- Plumstead to North Woolwich (Drive H) - length of drive approximately 2.6 km.

All of this adds up to 42km of bored tunnels located below the busy streets of London.

Tunnelling activity will get underway in late 2011. In the second quarter of 2012, the first two tunnel boring machines (TBMs) will start on their journey from Royal Oak towards the west of Farringdon station. This will be followed later in the year by the launch of two further tunnel boring machines in Docklands that will head under central London towards the east of Farringdon. Further shorter tunnel drives will take place in the Royal Docks and east London.

Teams of dedicated construction workers will be working 24 hours a day to complete the tunnels for Europe's largest civil engineering project with thousands of others employed to upgrade the existing rail network and build major new stations along the central section of the route.

The tunnels will weave their way between existing underground lines, sewers, utility tunnels and building foundations from station to station at depths of up to 36m.

Tunnel portals will be constructed at Royal Oak, Pudding Mill Lane, North Woolwich, Victoria Dock, and Plumstead.

Tunnel contract awards:

Today's contract award announcement relates to the following tunnelling contracts:

- C300 - Western Running Tunnels: Royal Oak to Farringdon;
- C305 - Eastern Running Tunnels: Limmo Peninsula to Farringdon; Limmo Peninsula to Victoria Dock and Stepney Green to Pudding Mill Lane;
- C410 - Early Access Shafts and Sprayed Concrete Lining Works for Bond Street and Tottenham Court Road stations tunnels; and
- C510 - Early Access Shafts & Sprayed Concrete Lining Works for Whitechapel and Liverpool Street stations tunnels.

In December 2009, Crossrail confirmed the shortlist of bidders for the two principal tunnel contracts and works for the station platform tunnels at Bond Street, Tottenham Court Road, Whitechapel and Liverpool Street.

The shortlist who submitted bids for C300 (Western Running Tunnels), C305 (Eastern Running Tunnels), C410 (Early Access Shafts & Sprayed Concrete Lining Works at Bond Street and Tottenham Court Road), and C510 (Early Access Shafts & Sprayed Concrete Lining Works at Whitechapel and Liverpool Street) were:

- Joint venture comprising: BAM Nuttall Ltd, Ferrovial Agroman (UK) Ltd, Kier Construction Ltd;
- Joint venture comprising: Alpine BeMo Tunnelling GmbH, Balfour Beatty Civil Engineering Ltd, Morgan Sindall (Infrastructure) plc, VINCI Construction Grands Projects;
- Joint venture comprising: Bilfinger Berger (Ingenieurbau GmbH), Costain Ltd, Skanska Construction UK Ltd;
- Joint venture comprising: Dragados S.A., John Sisk & Son (Holdings) Ltd; and
- Joint venture comprising: Bouygues Travaux Publics S.A, Laing O'Rourke Construction Ltd, Strabag AG, (Bouygues are part of C300 JV only).

Other tunnel contract awards:

A further series of tunnelling contracts will be awarded in 2011 including the Thames Tunnel between Plumstead and Woolwich and remaining contracts for tunnel portals and station platform tunnels.

The shortlist invited to submit bids for C310 (Thames Tunnel - Plumstead to North Woolwich) were:

- Joint Venture comprising: BAM Nuttall Ltd, Ferrovial Agroman (UK) Ltd, Kier Construction Ltd;
- Joint Venture comprising: Balfour Beatty Civil Engineering Ltd, Alpine BeMo Tunnelling GmbH, Morgan Sindall (Infrastructure) plc, Vinci Construction Grand Projects;
- Joint Venture comprising: Costain Ltd, Skanska Construction UK Ltd, Bilfinger Berger Ingenieurbau GmbH Niederlassung Tunnelbau;
- Joint Venture comprising: Laing O'Rourke Construction Ltd, Strabag AG, Bouygues Travaux Publics; and
- Joint Venture comprising: Hochtief Construction AG, J Murphy & Sons Ltd.

On 2 September 2010 Crossrail announced the shortlist for the refurbishment of the Connaught Tunnel, a major part of the Abbey Wood branch, and the Pudding Mill Lane Tunnel Portal.

The shortlist invited to submit bids for C315 (Connaught Tunnel) were:

- Vinci Construction UK Ltd;
- Joint Venture comprising: Hochtief Construction AG, J Murphy & Sons Ltd;
- BAM Nuttall Ltd; and
- Joint Venture comprising: VolkerFitzpatrick Limited, Barhale Construction plc.

The shortlist invited to submit bids for C350 (Pudding Mill Lane Tunnel Portal) were:

- Vinci Construction UK Ltd;
- Carillion Construction Ltd;
- Joint Venture comprising: Dragados S.A., John Sisk & Son (Holdings) Limited; and
- Morgan Sindall plc.

About the Tunnel Portals:

The Western and Eastern running tunnels will have tunnel portals at Royal Oak, Pudding Mill Lane and Victoria Dock. The tunnel boring machines or TBMs will commence their eastbound journey under London from Royal Oak and westbound from the Royal Docks.

In addition, the Crossrail south east spur will involve the construction of the Thames Tunnel between North Woolwich and Plumstead. Tunnel portals will be constructed at either end in advance of main tunnelling works.

Preparatory works for the tunnel portal at Royal Oak, beside the Hammersmith & City line and A40 flyover, got underway in January 2010. The first piece of the portal foundation wall was slotted into place in August. Enabling work for the Pudding Mill Lane portal is also underway.

About the Tunnel Boring Machines (TBMs):

To construct the 42km of tunnel required for Crossrail, seven tunnel boring machines will be used and will undertake ten individual tunnel drives and construct the 6m diameter rail tunnels.

Each TBM will be up to 120m in length with an external diameter of 7m. This allows for an inside tunnel diameter of 6m once the concrete tunnel segments are in place.

At the front of the TBM is a full face cutter head which rotates at 1 to 3 rpm. As the TBM advances forward the cutter head excavates the ground.

Seven TBMs will be used in total. The first two TBMs will be delivered to Royal Oak Portal, just west of Paddington; a further four TBMs will be delivered to Limmo Peninsula in the Royal Docks. One further TBM will be delivered to the Plumstead Portal site for the Thames Tunnel but will have two cutter heads - the main section will be attached to a new cutter head to complete the tunnel.

There will be two different types of TBM to reflect the differing ground conditions along the Crossrail route. Six TBMs will be Earth Pressure Balance Machines, which will be used for the main running tunnels between Royal Oak and Pudding Mill Lane. These will pass through ground which is predominantly London clay, sand and gravels. The Thames Tunnel, which is predominantly constructed through chalk will use a Slurry TBM.

The seven tunnel boring machines will be used as follows:

- Royal Oak to Farringdon (Drive X) – 2 x earth pressure balanced TBMs;
- Limmo Peninsula to Farringdon (Drive Y) – 2 x earth pressure balanced TBMs
- Stepney Green to Pudding Mill Lane (Drive Z) – 2 x earth pressure balanced TBMs;
- Limmo Peninsula to Victoria Dock Portal (Drive G) – 2 x earth pressure balanced TBMs re-used from the Stepney Green to Pudding Mill Lane drive; and
- Plumstead to North Woolwich (Drive H) – 1 x slurry TBM (two cutter heads).

To reduce the likelihood of settlement while the tunnels are constructed, the TBMs have to run nearly 24 hours a day, 7 days a week, 365 days a year. There will be scheduled breaks to allow maintenance on the TBMs to take place.

Each TBM will be operated by a 'tunnel gang' comprised of around twenty people - twelve people on the TBM itself and eight people working from the rear of the machine to above ground.

The TBMs will be purchased by the main tunnels contractors from European manufacturers. There are no UK-based companies that manufacture TBMs.

Precise delivery plans for the TBMs will be confirmed during discussions with each of the successful bidders in early 2011. The TBMs are scheduled start arriving in the UK in early 2012.

Excavated material will be removed from the tunnel face at a controlled rate and deposited onto a series of belt conveyors (pipes for a slurry machine) which remove the excavated material through the TBM and out of the tunnel. The TBM advances forward by using a series of hydraulic rams at the back of the cutter shield which push forward from the last precast concrete ring erected.

Precast concrete segments will be designed to be built in rings behind the TBMs. Once the cutter shield has advanced forward by a defined distance the next precast concrete ring can be erected.

These concrete segments will be made in a factory and transported to the tunnelling worksite. Arrangements for the production of the concrete segments will be confirmed with successful bidders in early 2011.

Sprayed Concrete Lining will be used to build the larger platform tunnels at stations and the shorter passenger circulation tunnels at stations. The sprayed concrete lining is applied in layers to the excavated ground to form a robust lining. This method of lining is slower to construct but is more suited to irregular shaped tunnels and tunnel connections. The tunnel lining will have a design life of at least 120 years. Materials, including concrete tunnel segments, will be brought to the TBM by a temporary railway constructed in the tunnel.

Connaught Tunnel Refurbishment:

To deliver the Crossrail branch to Abbey Wood, a major proportion of the construction work involves reusing disused rail infrastructure including the Connaught Tunnel on the former North London Line branch to North Woolwich and disused National Rail tracks to Custom House - which both closed to passenger traffic in December 2006.

The Connaught Tunnel is around 550 metres long and runs between Royal Victoria Dock and Royal Albert Dock close to London City Airport. The tunnel dates back to 1878.

Crossrail will be enlarging the existing tunnel so that it can accommodate Crossrail trains and overhead line equipment. Sections of the existing tunnel are in a poor structural condition. Around 100 metres of tunnel wall will be removed and will be replaced with a new tunnel lining. The existing brick arches, part of the tunnel approaches, will be retained and repaired.

Ventilation and access shafts:

In April 2009 Crossrail reached agreement with the London Fire Brigade (LFB) to remove eight of the proposed permanent access and ventilation shafts from the central tunnelled section of the new railway.

This decision particularly benefits communities in east London where four of the permanent shafts were to be located. The removal of the shafts means the elimination of construction works impacts, including lorry journeys, in these areas. In addition, a number of properties in Hanbury Street in east London will no longer need to be compulsorily purchased and demolished.

The eight shafts no longer required are located at: Westbourne Bridge W2, Hyde Park W2, Park Lane W1, Hanbury Street E1, Lowell Street E14, Hertsmere Road E14, Blackwall Way E14 and Warren Lane SE18.

Tunnel construction schedule:

Location of Tunnel Drive	TBM Launch	Tunnel Drive Complete
Royal Oak to Farringdon (Drive X)	Second Quarter 2012	Third Quarter 2013
Limmo Peninsula to Farringdon (Drive Y)	Third Quarter 2012	Third Quarter 2014
Stepney Green to Pudding Mill Lane (Drive Z)	Fourth Quarter 2013	Third Quarter 2014
Limmo Peninsula to Victoria Dock Portal (Drive G)	Second Quarter 2014	Third Quarter 2014
Plumstead to North Woolwich (Drive H)	Fourth Quarter 2012	Second Quarter 2014

Excavated material:

All construction projects by their nature will result in some degree of disruption but it is critically important that Crossrail's impact on central London is kept to a minimum while construction is underway.

Excavated material from tunnelling will generally be removed by rail and water while construction material from stations and station related work such as permanent access and ventilation shafts will generally be initially removed by road and then transferred to the river.

Crossrail is working with the Port of London Authority and British Waterways to promote and maximise the use of water transport for delivery of construction materials and the removal of construction material and waste, and with the rail industry to ensure a joined-up approach to the use of rail for transportation of materials.

During the delivery of Crossrail, a total of 7.3 million m³ of material will be excavated, which is the equivalent of covering the whole of Hyde Park and Kensington Gardens with a three metre layer of soil. Close to 100% of the 7.3 million m³ of excavated material is expected to be clean and uncontaminated and can be reused elsewhere.

More than 5 million m³ of material excavated from the project will be transported by boat along the Thames for use in landscaping projects. These include a new 1,500 acre RSPB nature reserve at Wallasea Island in Essex, eight miles north of Southend-on-Sea, and regeneration sites in Kent. Crossrail is presently discussing with South East England Development Agency the location of the Kent sites.

Over 4 million m³ of the excavated material generated from construction of the new tunnels will be used for the island. The proposals, which have been approved by Government and Essex County Council, will create one of the largest new wetland nature reserves in Europe for some 50 years.

Excavated materials from eastern tunnelling sites will go direct by river to Wallasea Island in Essex and Kent. Material from the western tunnelling site at Royal Oak near Paddington will go by rail to Kent while some material will go by river to Wallasea Island. The Grand Union Canal is located in close proximity to the Royal Oak tunnelling site and Crossrail is considering what potential role it can play with the transfer of excavated material and the delivery of construction materials.

If the equivalent five million tonnes were to be transported by road they would require up to half a million lorry journeys.

There will however be some journeys that will require the use of lorries. Crossrail lorries will be required to travel on designated routes that have been approved by local authorities under the Crossrail Act. Lorries will not generally operate at night. The standard delivery hours are 07.00 to 19.00 Monday to Friday and 07.00 to 14.00 on Saturdays.

The safety of all road users is paramount. Crossrail has introduced a training programme for every lorry driver regularly working on the construction of Crossrail to be trained on how to drive carefully near cyclists. The programme aims to give drivers the skills they need to navigate London's busy roads safely. It is estimated that over the coming years approximately 3,500 professional drivers will complete the tailored training course, which has been developed in consultation with cycling and road safety campaign groups and is supported by the freight industry.

Tunnelling and Underground Construction Academy and skills:

As well as delivering much needed additional rail capacity, Crossrail has an important role to play in supporting regeneration and the economy as well as creating a skills legacy.

Construction work started last month on the new Tunnelling and Underground Construction Academy (TUCA) at Aldersbrook sidings near Ilford Town Centre. £5m in funding for the Tunnelling and Underground Construction Academy has been provided by the Department of Business Innovation and Skills (BIS) via the Skills Funding Agency (SFA).

The Academy aims to address the shortage of people with the necessary skills to work on Crossrail and other tunnelling projects across the UK. It will provide training on the key skills required to work in tunnel excavation and underground construction. Whilst the UK has tunnelling expertise and knowledge there is not a purpose-built training facility in the UK to act as a focal point for the industry. Currently the nearest tunnelling and underground training centre is in Switzerland.

The volume of tunnelling and underground construction work taking place in the UK over the next decade is unprecedented. Aside from Crossrail, Thames Water will be constructing the Thames Tideway Tunnel sewerage scheme while National Grid will be constructing new electricity cable tunnels under London. The Tunnelling and Underground Construction Academy will provide training for contractors working on other major London tunnelling projects, as well as the potential to assist European projects including Dublin Metro. The new Academy will ensure that there are

sufficient numbers of people with the skills to work safely in underground construction to satisfy industry demand.

The Academy will start to offer training in spring 2011 and the building will be fully open by summer 2011. The Academy will offer training to at least 3,500 people in underground construction alone over the lifetime of the project.

Following the completion of Crossrail the academy will remain providing a lasting legacy for London and the UK construction industry. The Academy will be operated as an independent organisation once the Crossrail construction is complete and become a long-term provider of tunnelling skills to the construction industry.

Crossrail is also committed to delivering at least 400 Apprenticeships through its supply chain over the lifetime of the project – this is a high number by industry standards. Apprenticeships will be offered from late 2010 as contracts are awarded. Crossrail is working in partnership with the National Apprenticeship Service (NAS).

Crossrail has also formed partnership with Jobcentre Plus (JCP) which aims to provide local people with opportunities to work on the Crossrail project. Jobcentre Plus works with a network of local job brokerage and outreach agencies to match vacancies to suitable candidates and arrange interviews for short-listed applicants.

Crossrail opening strategy and budget:

Over the last year Crossrail has been looking at all aspects of the project to identify where savings can be realised.

Over £1 billion in savings to Crossrail construction have been identified, due to improved station and engineering solutions. A more efficient construction timetable will mean the Crossrail central section now being delivered in 2018 rather than 2017.

It is expected that Crossrail services will commence on the central section by the end of 2018 following by a phased introduction of services along the rest of the Crossrail route.

Crossrail progress:

Crossrail continues to make significant progress. Main construction works started earlier this year with work underway at five central route station sites - Bond Street, Canary Wharf, Farringdon, Paddington and Tottenham Court Road. Crossrail's enabling works for the central section are now 25% complete:

Progress across the Crossrail route includes:

Royal Oak Portal - Preparatory work at the Royal Oak tunnel portal site got underway in January 2010. Work on the Royal Oak tunnel portal involves construction of a 190 metre diaphragm walled box to form the foundation for a tunnel boring machine launch. Construction of the actual tunnel portal got underway in late August with the first section of the diaphragm wall installed. 85% of the Royal Oak Portal foundation wall is now complete and permanent sheet piling for the portal approaches is also substantially complete.

Pudding Mill Lane Portal - Demolition of buildings near Cooks Road, E15 is now complete. Preparatory work for piling is complete.

Bond Street - Demolitions and utility diversions are well advanced, with archaeological investigations now taking place prior to main construction work.

Canary Wharf - Our partners at Canary Wharf Group continue to make excellent progress. Construction is on time and on budget, with a section of the North Dock fully drained in the first quarter of the year, with nearly 100 million litres of water removed. Piling is complete, a concrete slab has been laid on the dock floor and excavation of the station continues.

Farringdon - Network Rail has completed the demolition of Cardinal Tower and started the piling for the foundations of the new western ticket hall to serve Thameslink and Crossrail. Demolition work to facilitate construction of the eastern ticket hall is almost complete.

Liverpool Street - Contracts have been awarded for demolitions, site facilities and enabling works at Finsbury Circus, Moorgate and Blomfield Street. As part of the contracts enabling works are also being undertaken to Liverpool Street station. Demolitions will commence shortly.

Paddington - The disused taxi ramp at Paddington has been demolished along with a redundant London Underground ticket hall. Piling work for the foundations of the new Hammersmith & City line station is almost complete. Over 300 tonnes of concrete and other material has been removed from site. Main construction is underway.

Tottenham Court Road - Following the excellent progress that has been made by London Underground on the eastern ticket hall, enabling works for the western ticket hall are now underway with good progress being made with demolitions and necessary utility diversions in advance of main construction work.

Whitechapel - The construction of a working platform and protective deck over the East London Line has commenced. The protective deck will ensure London Overground services can continue to safely operate while Crossrail works at the station are undertaken.

Rolling stock and depots - Crossrail announced the start of rolling stock and depot procurement in December 2010. Around 60 new trains will be required to provide the Crossrail service, each train being approximately 200 metres in length and able to carry up to 1,500 passengers.

Stations - Further central route station planning applications will be submitted to relevant planning authorities during the coming months including station oversite developments. The major station construction contracts will not be awarded until 2011.

About Crossrail:

Crossrail will run 118 km from Maidenhead and Heathrow in the west, through new twin-bore 21 km tunnels under central London to Shenfield and Abbey Wood in the east. It will bring an additional 1.5 million people within 45 minutes commuting distance of London's key business districts.

When Crossrail opens it will increase London's rail-based transport network capacity by 10%, supporting regeneration across the capital, helping to secure London's position as a world leading financial centre, and cutting journey times across the city.

Crossrail will deliver substantial economic benefits for all of London and the South East. Latest economic forecasts suggest that Crossrail will add £42bn to the economy, resulting in a £17bn tax boost for the Treasury. Previous estimates were that Crossrail would deliver up to a £36bn boost to the UK economy.

Up to 14,000 people will be employed at the peak of construction in 2013/2015, with an estimated further 7000 jobs created indirectly.

Crossrail is being delivered by Crossrail Limited (CRL). CRL is a wholly owned subsidiary of Transport for London. Crossrail is jointly sponsored by the Department for Transport and Transport for London.

Crossrail will significantly improve the connectivity of London and the South East by reducing journey times (and the need to change) to key destinations across London.

Journey	2010 Journey Time	Crossrail Journey Time
Slough to Tottenham Court Road	55mins	36mins
Ilford to Bond Street	35mins	22mins
Heathrow to Liverpool Street	55mins	36mins
Liverpool Street to Abbey Wood	40mins	22mins
Paddington to Canary Wharf	30mins	17mins