

## **Typical Construction Methods**

### **1.1 Introduction**

- 1.1.1 This Appendix provides an outline of typical construction methods and plant likely to be used for the main roadworks, structures including bridges, and environmental mitigation works for the AWPR.

### **1.2 Roadworks**

#### **Establishment of the Site Compound**

- 1.2.1 Preliminary activities include the setting up of the contractor's compounds and offices for the Contractor and Engineer. This also includes cabins, stores, welfare facilities and car park. The contractor will determine the location of the main site compound and seek all necessary approvals for its design and construction. Due to the size of the scheme, other smaller offices and compounds are likely to be established along the route. Preparatory works for the temporary site establishments will involve some site clearance work, minor earthworks operations to level the site, drainage and pavement works for the car park and service installation. Typical plant will be similar to that described for the various roadworks operations below.
- 1.2.2 Services to the site cabins and offices will include electrical, communications, water and sewerage facilities. The site compound will to be erected, maintained and subsequently removed in a manner that will have minimum impact on the locality.
- 1.2.3 Specific facilities and structures identified in the Contract will be surveyed to determine their structural condition prior to any works commencing in the neighbourhood. Restrictions will apply to activities undertaken in the vicinity of these properties relating to working hours, movements of site personnel, control of dust, noise and vibration levels induced during construction. These measures aim to minimize or control nuisance during construction and also avoid damage to nearby structures and buildings.
- 1.2.4 Site operatives and site staff will use the site establishments, on a daily basis, when the facilities are significantly completed and access is available for personal vehicles and other forms of transport. Construction plant will be established in the site compound and in working areas of the route, when the relevant work permits and licenses are issued.
- 1.2.5 The initial actions will involve the construction of site access and egress points. Wherever practicable, haul routes will also be established to ensure that construction traffic is contained within the confines of the site, as far as possible. However, since the route intersects rivers, main roads, local roads and other obstructions the use of other public roads is likely to be required and approval for this will be sought by the contractor with the relevant authorities.

#### **Temporary and Permanent Fencing**

- 1.2.6 The land area occupied by the permanent works will be identified accurately on the ground, by surveying and installing appropriate pegs and posts, prior to the works commencing. The area defined will be the area of land acquired through the Compulsory Purchase Order (CPO) and any other areas the contractor has acquired by agreement to facilitate construction of the works due to his own method of working.
- 1.2.7 This will involve the installation of permanent fencing with temporary fencing erected where it is not possible to install the permanent fence, for example at areas where land will be returned to agriculture following completion of the works, or if the contractor considers that there is a risk of damage to the permanent works during construction.

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- 1.2.8 The permanent fencing, required to denote the permanent highway boundary will generally be a 1.4m high timber post and four-rail fence. This would, however be supplemented with additional measures suitable for the exclusion of badgers, otters, rabbits and other wildlife. Temporary fencing will generally be a post and wire or chesplate fence.
- 1.2.9 Other specific fencing that may be required temporarily will include silt/sediment fences to prevent sediment reaching watercourses and higher security fences at compounds or where additional security of the works is required.
- 1.2.10 Fence materials such as posts, rails, wires and mesh will be delivered to the site, either to the main compound or directly to satellite compound. Typically, materials will be transported along the site by tractor and trailer mounted with hydraulic plant for driving the fence posts. Some fences may require a concrete foundation, or the ground may be too hard for driven fence posts. In this instance a small excavator will be used. Following fence post installation, the rails, wires and mesh will be attached manually.
- 1.2.11 Environmental fencing eg otter fencing and badger fencing, requires to extend below ground level and this requires an element of excavation which will be undertaken using a small excavator or by hand digging.

**Site Clearance and Demolition**

- 1.2.12 Site clearance and demolition works includes the following:
- isolation and diversion of live services;
  - general clearance;
  - demolition of building, walls and bridges;
  - removal of pipelines, public and privately owned services or supplies; and
  - tree felling and removal of stumps, removal of fencing, hedges, bushes and undergrowth.
- 1.2.13 Plant required for the site clearance activities will include, but not be limited to:
- crane mounted, hydraulic operated demolition apparatus;
  - cranes, excavators, bulldozers;
  - tracked vehicles, dump trucks, lorries; and
  - mechanical saws, portable electric and pneumatic tools, cutting and burning sets.
- 1.2.14 Any material to be reused in the permanent works (eg dry stone walls) will be stockpiled.
- 1.2.15 Surplus and unsuitable materials arising from the site clearance operations will be disposed of at appropriate, approved landfill sites in the Aberdeen City or Aberdeenshire area. Burning of materials on site will not be permitted, except when specifically required for which approvals will be required. Materials for disposal will be transported in appropriate wagons along prescribed routes which are likely to include the A90, A96, A956, A93, A944, A947, B9077 and B979. Prescribed routes will be included in the main construction contract documents. The contractor will be required to seek approval from the relevant authority should he wish to use any other routes.
- 1.2.16 The contractor will be responsible for the timing of demolition and site clearance activities and he will be required to take account of seasonal incidents, such as such as bird breeding seasons and relocation of any species in his works programme. The detailed timetable for ecological constraints will comply with the ES and will also be agreed with Scottish Natural Heritage (SNH).

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**Contaminated Materials**

- 1.2.17 The treatment of hazardous materials encountered in site clearance will comply with specific contract requirements and will require an assessment in accordance with current health and safety regulations including the Control of Substances Hazardous To Health Regulations (COSHH) Regulations. Contaminated materials may have to be disposed of outside the Aberdeenshire area if there are no licensed sites nearby.

**Temporary and Permanent Surface Water Outfalls**

- 1.2.18 Temporary arrangements will be made to control surface water run-off, during construction, where surface water could affect the works or the environmental performance of mitigation measures. Measures implemented may include temporary settlement ponds which will allow sediment to settle before clean water is discharged via a temporary outfall pipe or ditch to receiving watercourses. Other options for disposal of water include discharging to sewers if they have sufficient capacity or taking water off site in bowsers or tankers for disposal. It is likely that the permanent drainage basins and ponds will be constructed and used during construction. These will be cleaned and maintained following the main construction works for incorporation in the final scheme drainage network. During the construction period, and particularly the earthworks construction phase, water will be directed to these ponds using temporary cut off ditches within the works. Temporary ponds will require to be maintained during the course of the works, to remove sediment and silt, for example, and ensure that the ponds operate to an acceptable level.
- 1.2.19 Construction of the ponds will involve earthworks operations including excavation, placement of fill and compaction. Typical plant will include:
- excavators, bulldozers; and
  - tracked vehicles, dump trucks, lorries.

**Service Diversions**

- 1.2.20 It is possible that some service diversions will be undertaken in advance of the main construction works. However, other diversion are only likely to be possible once construction has reached a certain point.
- 1.2.21 Services are either located above or below ground. For works above ground, posts, towers or pylons will have to be delivered to the site and constructed. This will involve transport of materials and some excavation and concrete works for foundations or footings. Plant likely to be involved will include:
- excavators;
  - dump trucks and lorries;
  - concrete wagons; and
  - cranes (for pylon construction).
- 1.2.22 For works below ground, excavation will be necessary to the ensure the services are placed in a trench at an appropriate level. Where the service apparatus will pass below the route, ducting and a concrete surround will be required to protect the diversion and will be delivered to the site. Plant likely to be involved will include:
- excavators;
  - dump trucks and lorries;
  - concrete wagons; and
  - hand operated compacting plant.

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**Topsoil Stripping and Storage**

- 1.2.23 Where appropriate, topsoil will be stripped off the full area occupied by the roads, cuttings, embankments and associated structures to depths defined for each particular location. The topsoil will be stockpiled in large mounds, outwith working areas, until such time as it is re-used on the exposed side slopes of embankments and cuttings. Otherwise, adjacent grassland areas are to be protected. Measures such as cut off ditches may be required around stockpiles to transfer any contaminated run-off to temporary settlement ponds.
- 1.2.24 The plant generally used for topsoil stripping includes rubber-tired motorised scrapers, for long haul; and crawler tractors with scrapers, when stockpiles are close to the excavations. More controlled procedures will be required in environmentally sensitive zones where smaller excavators would be used to load dump truck transporters. Limits will be imposed on the maximum distance from the zone of excavation to the point of deposition of the topsoil to control invasive plant species and ensure that topsoil is reused close to the location it was stripped. In addition, archaeologists may be required during the topsoil stripping process.

**Pre-Earthworks Drainage**

- 1.2.25 Pre-earthworks drainage comprises unlined or lined ditches, or filter drains constructed at the top of cutting slopes or toe of embankments where required by the design to prevent surface or ground water entering the works. When placed at the top of cuttings, surface water carried by the pre-earthworks drainage is clean and can be transferred directly to watercourses unless the rate of discharge has to be controlled. When placed at the toe of embankments, surface water carried by the pre-earthworks drainage will contain sediment from run-off from the embankments being constructed and will be required to discharge water to temporary settlement ponds prior to it being discharged to a watercourse.
- 1.2.26 Pre-earthworks drainage will involve excavation of a ditch or trench with the excavated material being transported to a tip or for reuse within the works. Plant likely to be involved will include:
- excavators; and
  - tracked vehicles, dump trucks, lorries.
- 1.2.27 It should be noted that some ditches will have to be lined depending on the nature of the subsoil to prevent ingress of sediment into the ditch. Other options in this instance would include use of filter drains. Plant likely to be involved will include:
- excavators;
  - tracked vehicles, dump trucks, lorries; and
  - concrete wagons.

**Earthworks (Cuttings and Embankments)**

- 1.2.28 The principal earthworks process involves layered excavations of soils in cuttings and transportation of the excavated soil to neighbouring zones where embankments are required. Deposition in the fill areas will be built up by depositing the material and using bulldozers to place it in layers which are compacted by rollers. This earthworks procedure continues until the ground elevation in cuttings is reduced, and embankments are built, to the road formation level. The road formation level is the plane between the soil layers and structural road pavement materials.
- 1.2.29 Generally, it is preferred to achieve a cut/fill balance and have short haul distances to minimise transport of earthworks materials along the site between cuttings where they are excavated and embankments where they are placed. The undulating topography of the site and alignment standards to be provided complicate achievement of an earthworks quantities balance and long hauls of material may be required. Excavations in cutting will include the removal of the top layers (generally around 2m deep) of material which are likely to be unacceptable for use in the main road

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embankments and transport of this material to stock piles to be reused as landscaping earthworks mitigation at a later date. The lower layers of the cuttings are likely to comprise material which is more acceptable for use in the main road embankments and this will be transported and compacted as described above.

- 1.2.30 Some excavations may encounter rock and this is harder to excavate. In some instances, rock may be ripped using a bulldozer with a blade attached to the rear. Other options include using a hydraulic breaker (also known as a rock hammer or pecker) or blasting. Blasting is only likely to be used for the removal of large quantities of rock to expedite programme or for harder rock which cannot be ripped. Blasting involves drilling holes to the required depth in the rock, placing charges and detonators. Prior to blasting, the blast area is evacuated and controlled blasting occurs. The blasted rock is transferred to dump trucks or lorries and transferred for reuse as bulk rockfill in the works or to a crusher to process the rock into aggregate for use as drainage bedding and filter material, pavement materials, concrete aggregates etc.
- 1.2.31 The main items of plant required for the earthworks activities will include but is not limited to:
- rubber-tired motorised scrapers and crawler tractors with scrapers for cut / fill operations;
  - bulldozers to grade banks in cuttings;
  - front loading bucket excavators and dump trucks in cuttings;
  - bulldozers with ripping blades or tracked excavators with a hydraulic breaker for rock excavations;
  - road wagons for off-site disposal of unsuitable and surplus;
  - bulldozers to layer and grade soil deposited in embankments;
  - smooth or vibrating rollers to compact the fill in layers;
  - motor graders to plane and trim the formation; and
  - rock crushers.

**Environmental Bunds and Landscaping**

- 1.2.32 Construction of environmental bunds for landscaping or noise attenuation purposes is part of the overall earthworks operation. As indicated above, the material used to form these bunds is likely to be excavated from the top of cuttings and stockpiled prior to use.
- 1.2.33 The material will be loaded from the stockpile and transported along the haul road to the location of the earthworks mitigation where it is deposited, placed and compacted.

**Drainage, Service Ducts and Chambers**

- 1.2.34 Construction of carriageway drainage will involve laying filter drains, carrier drains and outfalls to transport surface water run-off from side slopes, carriageways and other paved areas. Drainage products will include pipes, gully pots, cover gratings, graded gravel to bed, gravel filter material, and other stone pieces for balancing ponds and open channels. Manholes and chambers will be built with in-situ concrete bases, precast concrete ring or brickwork walls and iron cover on precast concrete caps. Drainage products and construction materials will be delivered to site by road.
- 1.2.35 Construction of carriageway drainage will involve excavation of the drain with material being deposited adjacent to the drain in the road verge or transported for reuse or disposal. Gravel bedding and filter material (crushed rock) is delivered to the works. This may be from a local quarry or may be excavated and processed on site. The bedding material is placed at the bottom of the excavated trench and the drainage pipes, are placed on top. The filter material is then placed on top. Some filter drains have a geotextile surround to prevent sediment ingress into the filter material. If this is required it will be placed in the trench prior to depositing the pipe bedding

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and will wrap around approximately the bottom two thirds of the filter material. If the drainage pipe crosses the road carriageway, it will have a concrete surround which will be transported to the site and placed around the pipe in the trench. Following concreting, the pipe trench will be backfilled with acceptable earthworks material.

- 1.2.36 Catchpits and manholes will be constructed as described previously for pre-earthworks drainage.
- 1.2.37 As described previously, the permanent treatment and attenuation facilities will be constructed in a similar manner as the temporary ponds described previously or by cleaning and maintaining the temporary ponds constructed previously.
- 1.2.38 An outflow from the will be constructed from the carriageway drainage network to the permanent ponds and from the permanent ponds to the receiving watercourse. This will be in the form of a pipe or ditch and will involve trench or ditch excavation as described previously for pre-earthworks drainage. If a piped outfall is proposed, a headwall will be required at the point it discharges to the receiving watercourse. Headwalls are likely to be insitu concrete although they may have a stone facing or other finish applied following the main headwall works. Headwall construction will involve excavation to form the base of the headwall, steel fixing, shuttering, concreting and backfilling operations. During this operation, temporary diversion or damming of the watercourse may be required.
- 1.2.39 Service ducts and chambers are constructed in a similar manner as carriageway drainage and catchpits/manholes. Service chambers may, however, be brick built involving transport of materials and on site manufacture and use of mortar.
- 1.2.40 Plant likely to be involved in the construction of the drainage system will include:
- excavators;
  - tracked vehicles, dump trucks, lorries; and
  - concrete wagons.

**Topsoil Spreading, Seeding and Turfing**

- 1.2.41 Topsoiling and seeding will be undertaken as soon as possible after earthworks construction is completed. This will enable the subsoil to be sealed preventing sediment run-off. As described previously, topsoil will have been stripped and stored adjacent to the works. The topsoil will be transported from the topsoil storage locations to the works and will be placed by a tracked excavator. Grass seeding may be by hand or by machine spreading, undertaken in the relevant areas specified in the landscape design.

**Pavement Construction**

- 1.2.42 Pavement construction involves building the pavement up in layers.
- 1.2.43 The bottom layer (sub-base) is a crushed rock aggregate which will be delivered to the site from local quarries or crushed and graded on site from excavated rock, as described previously. The material is deposited and then pushed into place and compacted. Plant likely to be involved in pavement construction will include:
- bulldozers;
  - motorised graders;
  - sprayers;
  - lorries;
  - crawler spreaders;

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- dump trucks;
- rollers;
- gas heaters; and
- pneumatic spades and other hand tools.

1.2.44 The upper pavement layers can be a cement bound material, concrete or bituminous material. All of these will involve transport of material to the site either from local sources or from a batching plant on site. On large projects, it is not uncommon for on site batching plants to be constructed, depending on the availability of suitable materials on site to manufacture the pavement material.

**Roadworks Finishes including Safety Barriers, Signs, Road Markings, Lighting**

1.2.45 Following pavement construction, safety barriers will be installed. Posts and barriers are delivered to the site and safety barrier installation then involves driving steel posts into the ground or excavating small footings and placing concrete into which the posts are set. The barriers are bolted to the posts and fixed to small concrete anchorages either end.

1.2.46 Sign installation will involve excavation for the foundations which are concrete and setting the posts. The sign faces are then fixed to the sign posts. Some signs may be lit and will require cabling to be passed through the service ducts installed as described previously.

1.2.47 Road markings will be sprayed onto the road surface using specialist lorry mounted equipment.

1.2.48 Lighting columns are installed in a similar manner as traffic sign posts.

1.2.49 Plant likely to be involved in road finishes construction will include:

- rubber tyred excavators;
- vans and lorries; and
- concrete wagons and cement mixers.

**Accommodation Works**

1.2.50 Accommodation works may be bridges, access roads, fences and walls or other ancillary items agreed with landowners. Construction methods will be similar to those described for these items in this outline methodology.

**1.3 Structures**

**Bridge and Underpass Construction**

1.3.1 Typical construction methods for bridges are described below. These apply in general to most of the bridges on the AWPR. The sequence bridges are constructed in can be significantly affected by the location of the structure: for example if it is on the line of an existing road the need to keep traffic flowing can result in complex construction phasing at bridges.

**Overbridges**

1.3.2 An overbridge carries a road over the AWPR and incorporates a deck, supported on piers and abutments which are supported by foundations. Abutments are formed to support the ends of the bridge deck; piers are formed in the central reserve or verge to support the inner parts of the deck. The main bridge elements can be steel or concrete or combinations of these. Concrete can be cast on site (in situ) or the bridge can include precast units which are transported to the site. The exact form and materials used on each bridge is specific to individual locations depending on the

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nature of the bridge, the alignment of road it carries, the distances between the piers and between the piers and abutments (spans).

- 1.3.3 The road surface on the bridge deck is normally a bituminous bound pavement laid on a waterproofing coat. Bridge deck waterproofing can either be a spray applied or sheet membrane system. The spray applied system comprises a solvent free methyl methacrylate resin spray and a polymer modified bituminous based hot melt adhesive tack coat. The sheet membrane system comprises a non-woven polyester reinforced, styrene-butadene-styrene (SBS) polymer modified bitumen sheet with a solvent-based bituminous primer and blown (oxidised) bitumen bonding. A steel parapet is also fixed to the bridge deck.

Bridge Construction Sequence

- 1.3.4 Construction of overbridges will commence when the earthworks embankments on the adjacent sections of road are at abutment level. Typical bridge construction procedures may be summarised as follows:

Bridge Foundations

- 1.3.5 Foundations are required for the abutments and piers. Foundations can be either concrete pad or piled.

- 1.3.6 Pad footings are generally constructed as follows:

- excavation to a depth of approximately 2.5 metres below formation level to a suitable founding soil strata;
- laying a concrete layer, approximately 75 mm thick, at foundation formation level over the full extent of the rectangular foundation to produce a clean, flat plain surface, capable of containing the wet structural foundation concrete. The concrete layer is transported to the site in a concrete wagon;
- fabricating cages of steel reinforcement, which is done on site, with bars protruding vertically for subsequent concrete pours;
- placing formwork for the foundation slab. Formwork will be comprised of wooden or metal sheets supported by wooden stakes or other props.
- transporting concrete to the site and pouring and compacting the concrete, by vibration, to required level, in formwork;
- leaving the concrete for a period of time to enable it to cure before stripping the formwork to from foundation base;
- steel reinforcement is fixed for the pier followed by shutters for the pier;
- placing concrete for the pier, including vibration and finish to exposed top of concrete; and
- curing fresh concrete, stripping shutters, treating concrete surface and backfilling over excavations with acceptable material and compacting using a small machine operated compactor.

- 1.3.7 Piled foundations are generally constructed as follows:

- carry out preliminary excavations at foundation positions;
- install foundation piles to a suitable load bearing soil strata - this can either be by driving preconstructed concrete or steel piles to the required depth with a pile driver, or by using a boring machine to create the void for the pile, placing a casing in the void followed by lowering steel reinforcement and pouring concrete to form the pile;
- complete excavations to the appropriate formation level;



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- trim projecting piles to required level using mechanical saws or cutting equipment; and
- construction of a reinforcement pile cap upon which piers and abutments will be constructed follows in a similar manner as the construction of the pad footing.

Bridge Piers

1.3.8 Bridge piers are generally concrete columns and are constructed as follows:

- fixing a grillage of steel reinforcement for piers to the starter bars;
- erecting vertical formwork for piers with shores and bracing;
- placing and vibrating concrete into formwork for piers; and
- stripping shutters and curing concrete.

Abutments

1.3.9 Abutments are concrete seats upon which the bridge beams can be supported at each end of the bridge. Construction of abutments is generally undertaken as follows:

- fixing a grillage of steel reinforcement for abutment walls;
- erecting vertical formwork for abutment walls;
- placing concrete in wall formwork and compacting by vibration;
- removing shutters, curing concrete, treating exposed surfaces and applying waterproof membrane to faces retaining soil fill – the waterproof membrane can typically be a bitumen coating applied by brush or spray;
- drain is laid behind the abutments comprising a small pipe with a granular surround;
- placing and compacting granular fill, behind abutments and wing walls, to road formation level; and
- preparation of seatings for bridge beams.

Bridge Deck

1.3.10 Bridge decks can be several different forms, as follows:

- concrete deck cast on site (in situ deck); and
- beam and slab, with beams being precast concrete or steel, and the deck being concrete cast in situ.

1.3.11 In situ decks are generally constructed as follows:

- erecting formwork on staging to support the wet concrete forming the deck;
- erecting a steel reinforcement cage within the formwork;
- pumping concrete into the formwork and compacting by vibration;
- preparing a finish to the top surface of the wet concrete by smoothing the concrete with a float; and
- leaving the concrete for a period of time to enable it to cure before removing the staging.

1.3.12 Decks supported by beams are constructed as follows:

- taking delivery of precast / prestressed concrete or steel bridge beams and erecting in position over temporary props at pier positions and abutments using cranes;

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- erecting soffit formwork, between and along outer edges of bridge beams, and side forms for edge parapet beam and diaphragms / transverse beams;
- fixing inserts for services and additional structural elements;
- fixing grillage of steel reinforcement for in-situ concrete deck and parapet beamf
- placing concrete for bridge deck and in-situ edge beams. This is normally done as a staged process. The first stage involves the concrete pour of the main deck sections, followed by the diaphragms / transverse beams and finally the edge beams;
- curing deck concrete, stripping formwork, treating exposed surfaces;
- waterproofing top of structural deck; and
- completing services.

1.3.13 The deck is completed with construction of the verges/footways, and placement of the deck waterproofing system as described above. The final stages of bridge construction include erecting metal parapet elements and applying pavement markings.

**Underbridges**

1.3.14 Underbridges accommodate roads or watercourses which pass below the AWPR. They can be open structures, similar in appearance to overbridges or underpasses which are more box shaped. Both underbridges and underpasses are constructed in a similar manner as overbridges, comprising:

- foundation construction;
- abutment, pier and wall construction;
- deck construction; and
- finishes.

1.3.15 Plant likely to be involved in bridge construction includes:

- excavators;
- dump trucks and lorries;
- piling rigs;
- mobile cranes;
- concrete wagons and pumps;
- hand compactors; and
- paving machines and smooth rollers.

**River Dee Crossing**

1.3.16 The River Dee crossing is proposed to be an arch type structure with a concrete/steel arch constructed over the river with steel hangers carrying a steel/concrete deck. The arch is supported at either end by concrete abutments which are constructed to the north and south of the river. A culvert is also included to the north of the river which is positioned opposite the existing culvert under the B979. The culvert will be a reinforced concrete box culvert constructed, constructed as described below. Construction of the main crossing will include some of the main elements described previously and will follow the overall process detailed below:

- foundation construction;
- abutment construction;

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- deck construction; and
  - finishes.
- 1.3.17 Access to the River Dee Crossing will be taken from the B9077 South Deeside Road to the construction areas to the south of the river and from the B979 to the construction areas to the north of the river.
- 1.3.18 Temporary works, such as silt/sediment fences and other temporary arrangements to control surface water run-off will be required to mitigate the risk of pollution of the river during construction. No works are permitted within the River Dee Special Area of Conservation (SAC).
- 1.3.19 The foundations will be bored pile foundations constructed following the process as described previously. The B9077 South Deeside Road underbridge will also be constructed at this stage following the process described above for underbridge construction. The culvert to the north of the River Dee will also be constructed at this stage following the process described below for reinforced concrete box culvert construction.
- 1.3.20 Abutment and pier construction will be similar to that described previously. Following construction of the abutments, the embankments between the B9077 and south abutment and the River Dee floodplain and the north abutment will be constructed. Embankment construction will follow the process described for earthworks described previously.
- 1.3.21 The main difference between other bridges and the Dee Crossing will be in bridge deck construction. The bridge deck is anticipated to be a post-tensioned concrete box with the concrete box sections, either cast in-situ or installed as pre-cast segments. The construction of the river span is envisaged to be the balanced cantilever method and is described below, which would ensure that no temporary supports are required within the river:
- balance cantilever deck construction would be undertaken progressively from the piers out towards midspan of each span. The deck is supported by travelling formwork which is fixed initially to the piers and then moves progressively along the previously constructed deck to support the current section of deck being constructed. Construction progresses simultaneously away from the piers until a full span is complete. Once complete the final pre-stressing tendons are installed and stressed to create a fully continuous structure. All of these works will entail steel-fixing, post-tensioning, shuttering, concrete placement and compaction.
- 1.3.22 For the sections over the floodplain the deck can be constructed in a number of ways, including by balanced cantilever, as described above, or on supports, as described below:
- deck construction could be supported on temporary staging which be similar to a framework of scaffolding that would be designed to support the deck during construction works. Once each span is complete, the final pre-stressing tendons would be installed as described previously. Once the deck is complete the temporary staging would be removed.
- 1.3.23 Complete construction of the deck as a balanced cantilever would minimise the construction activities on the floodplain although the movement of plant, machinery and the workforce will be required at floodplain level during construction.
- 1.3.24 Following completion of the deck, the bridge finishes will be completed as described previously.
- 1.3.25 Areas will be included within the CPO to the north and south of the river which are essential to facilitate construction of the River Dee crossing. These areas will be used for the storage of materials and for any compounds required specifically for construction of the bridge.

**River Don Crossing**

- 1.3.26 The River Don crossing is proposed to be a concrete viaduct style structure. Construction will include the main elements described previously, comprising:

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- foundation construction;
  - abutment, pier and wall construction;
  - deck construction; and
  - finishes.
- 1.3.27 Temporary works, such as silt/sediment fences and other temporary arrangements to control surface water run-off will be required to mitigate the risk of pollution of the river during construction.
- 1.3.28 Foundation, abutment and pier construction will be similar to that described previously. The main difference will be in bridge deck construction. The bridge deck is anticipated to be a post-tensioned concrete box with the concrete box sections, either cast in-situ or installed as pre-cast segments. The construction of the river span is envisaged to be the balanced cantilever method and is described below, which would ensure that no temporary supports are required within the river:
- balance cantilever deck construction would be undertaken progressively from the piers out towards midspan of each span. The deck is supported by travelling formwork which is fixed initially to the piers and then moves progressively along the previously constructed deck to support the current section of deck being constructed. Construction progresses simultaneously away from the piers until a full span is complete. Once complete the final pre-stressing tendons are installed and stressed to create a fully continuous structure. All of these works will entail steel-fixing, post-tensioning, shuttering, concrete placement and compaction.
- 1.3.29 For the sections over the floodplain the deck can be constructed in a number of ways, including by balanced cantilever, as described above, or on supports, as described below:
- deck construction could be supported on temporary staging which be similar to a framework of scaffolding that would be designed to support the deck during construction works. Once each span is complete, the final pre-stressing tendons would be installed as described previously. Once the deck is complete the temporary staging would be removed.
- 1.3.30 Complete construction of the deck as a balanced cantilever would minimise the construction activities on the floodplain although the movement of plant, machinery and the workforce will be required at floodplain level during construction.
- 1.3.31 Following completion of the deck, the bridge finishes will be completed as described previously.
- 1.3.32 Two parcels of land are included included in the CPO which are essential to facilitate construction of the River Don crossing. These areas lie to the west of the river on the south side of the proposed AWPR and to the east of the river on the north side of the proposed AWPR and will be used for the storage of materials and for any compounds required specifically for construction of the bridge.

**Culverts**

- 1.3.33 Culvert works will commence when the earthworks operation progresses far enough. Temporary culverts may be used to facilitate completion of haul roads. This will require approval from SEPA. The permanent culvert works will involve either temporary diversion and culverting for the watercourse, or constructing a temporary dam upstream of the works and pumping the water to the downstream side of the works. This will depend on the sensitivity of the watercourse and will be agreed with SEPA. Various types of culverts may be used:
- circular piped culverts;
  - precast box culverts;
  - in-situ box culverts;
  - corrugated steel pipes; and

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- bridges.

1.3.34 Circular piped culverts and precast box culverts are constructed in a similar manner:

- material, including gravel for bedding and culvert surrounds, and precast concrete culvert sections, will be delivered to the site taking access from the permitted roads and haul road through the works. The line of the culvert will be excavated to bedding level with material taken away by dump truck or wagon for reuse or disposal. The gravel bedding material will be placed followed by the culvert sections. Culvert sections will be treated with a waterproof membrane to faces retaining soil fill – the waterproof membrane will typically be a bitumen coating applied by brush or spray. Following this, the gravel culvert surround will be placed and compacted;
- insitu box culverts will commence with excavation as above. A thin layer of blinding concrete will be placed to provide an even and clean surface on which to construct the culvert. Construction of the box sections will involve steel fixing, shuttering, transport of concrete to the works and placing concrete within the shuttering. Following the completion of the concrete works, shuttering will be removed, the concrete will receive waterproofing and the culvert backfilled with gravel; and
- corrugated steel pipes are constructed from sections of pipe which are bolted together. Excavation and bedding works will be undertaken as described for the precast culverts. The pipe sections, having been delivered to the site, will be joined together to form the culvert. Following completion of the steelwork, the culvert will be backfilled with gravel and suitable earthworks material.

1.3.35 The above culvert types will also require construction of a headwall which will be constructed in a similar manner to that described previously for drainage outfall works. Headwalls are likely to be insitu concrete although they may have a stone facing or other finish applied following the main headwall works. Headwall construction will involve excavation, steel fixing, shuttering, concreting and backfilling operations.

1.3.36 Environmental measures such as otter ledges will be constructed following the main culvert works and are likely to be cast from insitu concrete transported to the site and pumped into the culvert.

1.3.37 Construction of a bridge will mean that the existing watercourse bed, banks and part of the riparian zone may be retained. The exact construction sequence will depend on the form of structure, for example whether it has piers or is a box shape, with construction methods similar to those described previously for bridges and underpasses.

1.3.38 Plant likely to be involved in culvert construction includes:

- excavators;
- tracked vehicles, dump trucks, lorries;
- concrete wagons;
- compacting plant; and
- cement mixers.

### **Retaining Walls**

1.3.39 Retaining walls can be different types as follows:

- contiguous bored pile walls;
- reinforced concrete cantilever walls; and
- reinforced earth walls.

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- 1.3.40 The piled walls involve construction of piles similar to that described for piled foundations for bridges, although the piles are closely spaced (contiguous) to form a complete wall rather than being spaced apart. These are generally constructed by forming the piles and then excavating the material in front of the piles to reveal the face of the piles. A facing can be applied to the piles to provide the finished exposed surface.
- 1.3.41 Reinforced concrete walls are formed in a similar manner to the major concrete works described previously, with excavation for the wall being undertaken initially, followed by concreting works for the base (similar to foundation construction), and further concreting works for the main part of the wall (similar to abutment wall). At each stage, formwork is in place to contain the wet concrete and form the shape and finish to the wall. As with culvert headwalls, a facing can be applied which can be brick, stone or some other finish that may be specified by the architectural adviser or landscape architect.
- 1.3.42 Reinforced earth walls are formed by placing and compacting layers of gravel between which a plastic or metal reinforcing mesh or strips are placed.
- 1.3.43 Plant during wall construction is likely to be similar to that required for bridge construction.

## **1.4 Environmental Mitigation**

### **Earthworks Mitigation**

- 1.4.1 Earthworks mitigation comprises graded out slopes and bunds and is described previously in this outline methodology.

### **Landscape and Ecological Mitigation Planting**

- 1.4.2 Planting works are seasonally dependent and are generally undertaken in Autumn or Spring. Planting works are undertaken manually with plants delivered to the site and planted.

### **Noise Barriers**

- 1.4.3 Noise barrier construction is similar to fence construction as described previously.

### **Ecological Mitigation**

- 1.4.4 Specific mitigation required for ecological purposes may include fencing, bridges, enhancements for culverts, and construction as previously described.
- 1.4.5 Details of the specific mitigation measures identified in the ES are summarised in Chapter 55, Overall Schedule of Environmental Commitments.

## **1.5 Temporary Works**

- 1.5.1 Temporary works are generally described previously under the relevant construction element. In addition, temporary traffic management will in place during construction at works close to or on existing roads, and at site access and egress points. Such measures may include:
- traffic cones;
  - traffic signals;
  - temporary signs;
  - temporary lighting;
  - temporary speed restrictions;
  - temporary diversions;

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- narrow lanes;
- lane closures;
- partial or full road closures (to be agreed with the relevant authority) with appropriate diversion signing in place;
- contraflows; and
- rolling closures.

- 1.5.2 Temporary works involving traffic management can be disruptive to the local road network if not managed properly. The Contract for the scheme will contain specific restrictions regarding traffic management and routing of vehicles to and from the site. The contractor will prepare his own programme for the construction of the works, which will require approval by the Scottish Executive's representative on site. This programme will take into account the traffic management requirements of the contract for works affecting all existing roads. It is unlikely that any lane closures of the main trunk or A class roads will be permitted during peak hours except under exceptional circumstances and as a consequence it is anticipated that much of the off line works will be completed without affecting the trunk road traffic directly. However, impacts due to additional construction and delivery vehicles using these routes will occur
- 1.5.3 During construction of tie-ins with the existing road network or at locations where the proposed route is close to existing roads, narrow lanes may be used by the Contractor to facilitate construction. It is also possible that sections of temporary carriageway may be required to enable the flow of traffic to be maintained. During all traffic management works, the appropriate standards will be adhered to including those specifying geometric standards and pavement construction standards necessary to minimise disruption to road users
- 1.5.4 If contraflows are required overnight, temporary lighting will be required. Temporary lighting will also be required where structures are constructed over live traffic during night time periods. A typical example would be lifting bridge deck beams over the existing roads at the key junctions. This may have to be undertaken during night time road closures to ensure the safety of traffic is maintained and disruption is minimised. Road closures will be kept to a minimum and will involve adequate signing of appropriate diversion routes.

## **1.6 Maintenance**

- 1.6.1 Inspection works and maintenance will be required for the scheme. Routine maintenance could include works such as pavement rehabilitation, drainage works, safety barrier works, structural inspections and repairs. All of these may require traffic management measures to be implemented to ensure the safety of the workforce and road users during the works.
- 1.6.2 Winter maintenance will involve gritting and snow clearing to ensure the road surface is safe to drive on.
- 1.6.3 Landscape maintenance will involve grass cutting, weeding and general plant maintenance and this may also require temporary traffic management measures.
- 1.6.4 Due to the method of procurement for the scheme, as a Design, Build, Finance and Operate style contract, a private company will have responsibility for the design and construction of the scheme and they would continue to operate the completed trunk road for an extended concession period of the order of 30 years. Following expiry of the concession period, responsibility for operating and maintaining the trunk road will return to the Scottish Executive. Responsibility for the maintenance of the side roads will lie with Aberdeenshire or Aberdeen City Councils.