Appendix A19.5: Impact Assessment

1.1 Introduction

1.1.1 This appendix provides the detailed assessment of the potential impacts of the proposed scheme to support Section 19.4 (Potential Impacts and Effects) of Chapter 19 (Road Drainage and the Water Environment), which reports only those impacts with a significance of effect of 'Moderate' or above. Impacts are reported for the attributes 'Flood Risk', 'Hydromorphology', 'Surface Water Quality' and 'Surface Water Supply' for each of the identified surface water features as described in Section 19.3 (Baseline Conditions) of Chapter 19 (Road Drainage and the Water Environment) and in Appendix A19.1 (Baseline Conditions).

1.2 Construction and Operational Activities

1.2.1 The activities associated with each water feature are detailed in Table A19.5-1 below.

Table A19.5-1: Proposed construction and operational activities

Water Feature	Dualled Mainline (within 50m)	Side Road/ Access Track	New Bridge/ Bridge Extension	New Culvert/ Culvert Extension	Mainline SuDS Outfall	Pre-Earthwork Drain (PED)	Channel Re-grading / Realignment
WF06 (River Tay)	✓	✓	✓		✓		
WF01 (Birnam Burn)	✓			✓		✓	✓
WF02	✓					✓	
WF05	✓			✓		✓	✓
WF05A	✓	✓		✓	✓	✓	✓
WF07	✓	✓		✓		✓	✓
WF08 (Inchewan Burn)	✓	✓	✓		✓	✓	
WF09	✓	✓		✓		✓	✓
WF11 (River Braan)	✓	✓	✓		✓	✓	
WF12 (Mill Stream)	✓	✓			✓		
WF12A	✓					✓	

Water Feature	Dualled Mainline (within 50m)	Side Road/ Access Track	New Bridge/ Bridge Extension	New Culvert/ Culvert Extension	Mainline SuDS Outfall	Pre-Earthwork Drain (PED)	Channel Re-grading / Realignment
WF12B	✓	✓		✓		✓	✓
WF13	✓	✓		✓		✓	✓
WF14	✓	✓		✓		✓	✓
WF16	✓			✓		✓	✓
WF18	✓			✓			✓

1.3 Impact Assessment

1.3.1 This section reports on the assessment of the specific impacts affecting water features during both the construction and operational phase of the proposed scheme.

1.3.2 Pre-mitigation impacts include consideration of embedded mitigation, defined within DMRB LA 104 as *"design measures which are integrated into a project for the purpose of minimising environmental effects".* Embedded mitigation relevant to the water environment are summarised in Section 19.4 (Potential Impacts and Effects) of Chapter 19 (Road Drainage and the Water Environment), with further detail provided in Chapter 6 (Iterative Design Development).

1.3.3 Post-mitigation impacts include consideration of essential mitigation measures, as defined within DMRB LA 104 as those that are "*critical for the delivery of a project which can be acquired through statutory powers*". Within this assessment essential mitigation is defined under two categories (standard and specific). Essential Standard mitigation measures (as detailed in Table 19.19 of Chapter 19) are considered applicable to all receptors potentially impacted by the proposed scheme regardless of the significance of effect outlined within this appendix. Essential Specific mitigation measures (as detailed in Table 19.20 of Chapter 19) are typically receptor specific, and the corresponding Mitigation Item reference is provided in this appendix.

1.3.4 Tables A19.5-3 and A19.5-4 are colour coded by significance of effect, as shown in Table A19.5-2 below.

Table A19.5-2: Colour coding of significance of effect

Significance	Colour
Very Large	
Large	
Moderate	

Significance	Colour
Slight	
Neutral	
Beneficial (all significance levels)	

1.3.5 The significance of effect was determined as a function of the importance of the surface water feature and the magnitude of a predicted impact using the matrix contained within Table 19.8 of Chapter 19 (Road Drainage and the Water Environment). The matrix allows for the use of professional judgement to assign a significance rating in certain circumstances. The selection of a single significance from the two options available has been undertaken based on professional judgement and using the precautionary principle.

Table A19.5-3: Specific construction impacts

Water Feature	Potential Construction Impacts	Pre-Mitigation: Importance x Magnitude = Significance			Essential Specific Mitigation	Post-Mitigation: Importance x Magnitude = Significance		
		Flood Risk	Hydromorphology	Surface Water Quality		Flood Risk	Hydromorphology	Surface Water Quality
WF06 (River Tay)	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas. Loss of floodplain storage due to construction works within the floodplain may increase flood risk. Temporary structures for the construction of the new River Tay bridge crossing within close proximity to the watercourse/in-channel works may create constricted flow and/or a loss of floodplain storage due to works encroaching into the floodplain. **Hydromorphology:** Due to proposed construction activities adjacent to the channel on River Tay there is the potential to cause impacts to the hydromorphology of the watercourse, including; ▪ Potential fine sediment input from activities associated with the Proposed Scheme occurring within the River Tay flood plain and on tributaries which discharge into the River Tay. These activities include but are not limited to works in close proximity to, and along the banks of, the River Tay including construction of the new mainline, sideroads, access tracks, SuDS features, bridge extensions (and associated scour protection) and embankments. ▪ There may be a requirement to install scour protection in multiple locations along the River Tay, including at the estate access embankment around CH1820m and at the southern bridge pier of the proposed Tay Crossing. Construction of scour protection in these locations will involve working adjacent to and may involve working within the channel and therefore the River Tay SAC. The type and extent of scour protection in these locations has yet to be determined. ▪ Works (within 15m of the River Tay) along the bank top and/or bank face to construct the access track around mainline chainage CH4850 have the potential to create bank instability due to the tracking of plant and materials close to the banks of the River Tay. ▪ Works relating to the construction of outfalls may require removal of riparian vegetation and a length of natural bank and bed as a result of the new headwalls. Construction works at the outfall locations are assumed to take place channel banks and could lead to bank instability and increased erosion risk due the tracking of plant and potential removals of riparian vegetation. ▪ The above activities could also involve the removal of riparian vegetation, alter the bank/bed composition and bank angle leading to destabilisation of channel banks and increased sediment input which could lead to a change in morphological features and smothering of bed substrate. ▪ Two SuDS outfalls are located within the confines of a lateral bar upstream and downstream of the proposed Tay bridge crossing. Construction of the headwall and associated pipe work could disturb this morphological feature due to the requirement to excavate to bury the pipe and the tracking of plant to install the	very high x minor = Moderate	high x major = Very Large	very high x major = Very Large	**Hydromorphology:** P02-W20 P02-W21 **Surface Water Quality:** P02-W18 P02-W19	Very high x negligible = Slight	high x negligible = Slight	very high x negligible = Slight

	outfall head wall. The above activities could also alter the bank/bed composition and bank angle leading to destabilisation of channel banks and increased sediment input which could lead to an increased propensity for fines to settle leading to homogeneity and lack of diversity in sediment distribution. **Surface Water Quality:** Due to proposed construction activities on multiple tributaries of WF06 (River Tay) this has the potential to cause significant impacts on water quality, including cumulative impacts from tributaries. Potential impacts include: ▪ A major measurable (temporary) shift from baseline water quality from works in-channel and within the floodplain. ▪ Smothering of the riverbed from increased sediment laden runoff (upstream) due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). This may potentially impact the River Tay SAC. The above impacts, individually or in combination, may result in a temporary deterioration of WFD quality elements of the River Tay.							
WF01 (Birnam Burn)	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas. Construction of culvert extensions and channel realignment with in-channel works. Potential for localised flood risk upstream of A9. **Hydromorphology:** Due to proposed construction activities in-channel and adjacent to the channel on WF01 there is the potential to cause impacts to the hydromorphology of the watercourse, including; ▪ Potential fine sediment input from indirect construction activities associated with surrounding earthworks and construction activities. This could lead to changes of the morphological features present through an increased propensity for fines to settle leading to homogeneity and lack of diversity in sediment distribution. ▪ In-channel works would be required as part of culvert extensions and proposed upstream channel realignments. Construction works within the channel have the potential to damage or alter bank composition and stability, bed substrate and morphological features, including upstream step-pool sequences. There is also the potential to generate additional fine sediment input from in-channel works which could alter sediment dynamics and distribution within the impacted reach. ▪ Works within the vicinity of and along the banks of WF01, associated with the construction of a new mainline lay-by and embankment could remove riparian vegetation upstream of the road crossing, alter and destabilise channel banks due to the movement and tracking of plant, leading to increased erosion and sediment input into the watercourse. **Surface Water Quality:** Due to proposed construction activities in-channel and adjacent to the channel on WF01 (Birnam Burn) there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include:	low x minor = Slight	medium x minor = Slight	medium x major = Large	**Hydromorphology:** P02-W20 P02-W21 **Surface Water Quality:** P02-W18 P02-W19	low x negligible = Neutral	medium x negligible = Neutral	medium x negligible = Slight

	▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). This may potentially impact the downstream River Tay SAC.							
WF02	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas adjacent to watercourse. **Hydromorphology:** Due to proposed construction activities adjacent to the channel on WF02 there is the potential to cause impacts to the hydromorphology of the watercourse, including; ▪ Potential fine sediment input from indirect construction activities associated with surrounding earthworks. This could lead to changes of the morphological in channel features, through an increase in propensity for fines to settle leading to homogeneity and lack of diversity in sediment distribution. Increases in fine sediment could also lead to morphological changes to the surrounding floodplain. ▪ Works within the vicinity of and along the banks of WF02, associated with the construction of the new mainline and embankment could remove riparian corridor upstream of the road crossing, alter and destabilise channel banks due to the movement and tracking of plant, leading to increased erosion and sediment input into the watercourse. **Surface Water Quality:** Due to proposed construction activities adjacent to the channel on WF02 there is the potential to cause a measurable (temporary) shift from baseline water quality: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). This may potentially impact the downstream River Tay SAC. As there are no in-channel works, Essential Standard and Essential Specific measures would be considered sufficient to justify the selection of a residual significance of effect of Neutral.	low x minor = Slight	medium x minor = Slight	medium x moderate = Moderate	**Hydromorphology:** P02-W20 **Surface Water Quality**: P02-W18 P02-W19	low x negligible = Neutral	medium x negligible = Neutral	medium x negligible = Neutral
WF05	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas. Construction of culvert extension and channel realignment with in-channel works. Potential for localised flood risk upstream of A9. **Hydromorphology:** Due to proposed construction activities along the flow path of WF05 there is the potential to cause impacts to the hydromorphology of the watercourse, including;	low x minor = Slight	medium x minor = Slight	medium x major = Large	**Hydromorphology:** P02-W20 P02-W21 **Surface Water Quality**: P02-W18 P02-W19	low x negligible = Neutral	medium x negligible = Neutral	medium x negligible = Slight

	▪ Potential fine sediment input from works associated with construction of embankments within upstream and downstream reaches. Existing conditions indicate limited features both upstream and downstream of the existing A9 crossing and within the footprint encompassed by the proposed works. ▪ Works would consist of the construction of new sections/replacement culverts, any required channel formalisation, realignment or regrading to accommodate widening of the mainline and associated earthworks. The outlined activities have the potential to lead to changes in the existing sediment and flow dynamics. Extension of existing culverts would lead to loss of lengths of natural channel and bed substrate. **Surface Water Quality:** Due to proposed construction activities along the flow path of WF05 there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include: ▪ Increase in sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems; ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel).							
WF05A	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas. Construction of culvert extensions and channel realignment with in-channel works. **Hydromorphology:** Due to proposed construction activities in-channel and adjacent to the channel on WF05A there is the potential to cause impacts to the hydromorphology of the watercourse, including: ▪ Potential fine sediment input from works associated with construction of embankments within upstream and downstream reaches. Currently, there are limited morphological features both upstream and downstream of the existing A9 crossing and within the footprint encompassed by the proposed works. Fine sediment input from construction could lead to changes in existing sediment dynamics of the watercourse. Alteration of existing sediment dynamics and fine sediment inputs from construction may lead to an increased propensity for fines to settle leading to homogeneity and lack of diversity in sediment distribution. This could subsequently alter morphological features within the channel. ▪ Works within the vicinity and along the banks of WF05A associated with the construction of side roads, embankments and SuDS pond B(1) could lead to increased sediment input. The works would also require the tracking of plant within the vicinity of the water feature which could lead to bank destabilisation and changes in runoff pathways within the floodplain. Fine sediment input from construction and bank destabilisation could lead to changes in existing sediment dynamics of the watercourse, alteration of existing sediment dynamics and fine sediment inputs from construction may cause smothering of bed substrate and alteration to in channel morphological features. ▪ In-channel works would consist of the construction of new sections/replacement culverts, any required channel realignment or regrading to accommodate widening	low x minor = Slight	low x minor = Slight	medium x major = Large	**Hydromorphology:** P02-W20 P02-W21 **Surface Water Quality**: P02-W18 P02-W19	low x negligible = Neutral	low x negligible = Neutral	medium x negligible = Slight

	of the mainline, construction of the side road/junction and associated earthworks. Construction of an outfall associated with SuDS pond B(1) is also required. In-channel construction could disturb or lead to the loss of bed substrate, loss of channel footprint and mobilise fine sediment. This could lead to changes in morphological features, sediment availability and dynamics within the effected reach. **Surface Water Quality:** Due to proposed construction activities in-channel and adjacent to the channel on WF05A there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). ▪ Sewage inputs may impact surface water quality should an uncontrolled release from a damaged pipeline occur (a CSO runs parallel to the proposed scheme, for the construction of side roads, upstream of WF05A).							
WF07	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas. Construction of culvert extensions, deculverting and channel creation will result in in-channel works. **Hydromorphology:** Due to proposed construction activities within the catchment of WF07 and in-channel works there is the potential to cause impacts to the hydromorphology of the watercourse, including; ▪ Potential fine sediment input from works associated with the construction of mainline and side road embankments upstream of the proposed scheme. ▪ In-channel and works within the vicinity of the watercourse as part of channel creation has the potential to disrupt or lead to the generation of sediment. **Surface Water Quality:** Due to proposed construction activities along the flow path of WF07 there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel).	very high x minor = Moderate	low x minor = Slight	medium x major = Large	**Hydromorphology:** P02-W20 P02-W21 **Surface Water Quality**: P02-W18 P02-W19	very high x negligible = Slight	low x negligible = Neutral	medium x negligible = Slight
WF08 (Inchewan Burn)	**Flood Risk:** Potential for temporary increase in in surface water runoff rates from site areas. Construction works associated with the replacement of the Inchewan Burn (WF08) crossing and right bank access road.	very high x minor = Moderate	high x moderate = Moderate	medium x major = Large	**Hydromorphology:** P02-W20 P02-W21. **Surface Water Quality**:	very high x negligible = Slight	high x minor = Slight	medium x negligible = Slight

	Hydromorphology: Due to proposed construction activities adjacent to the channel on WF08 (Inchewan Burn) there is the potential to cause impacts to the hydromorphology of the watercourse, including: ▪ Potential fine sediment input directly from construction activities or indirectly from works within the tributaries and surrounding earthworks and activities associated with the replacement of the Birnam Glen underbridge crossing and construction of a right bank footpath. Works associated with the bridge crossing and footpath replacement would take place 1m to 5m from the channel banks. Works could generate increased sediment which may lead to an increased propensity for fines to settle leading to homogeneity and lack of diversity in sediment distribution. This could subsequently alter morphological features within the channel. ▪ Works within the vicinity and along the banks of WF08 (Inchewan Burn), associated with the construction of the culvert and replacement bridge crossing and right bank footpath could remove riparian vegetation and alter and destabilise channel banks. There will also be loss of bed with the culvert as well as additional constraints to channel width, depth and interruption to channel connectivity, ▪ Construction works relating to outfall locations are likely to be associated with existing reinforced banks in this location. Impacts to the watercourse in terms of bank destabilisation are considered low if the bank integrity is maintained. **Surface Water Quality:** Due to proposed construction activities adjacent to the channel on WF08 (Inchewan Burn) there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). This may potentially impact the downstream River Tay SAC. Sewage inputs may impact surface water quality should an uncontrolled release from a damaged pipeline occur (a Combined Sewer Overflow (CSO) pipe crosses the proposed scheme and runs parallel to WF08).				P02-W18 P02-W19.			
WF09	**Flood Risk:** Potential for temporary increase in surface water runoff from site areas. Construction of replacement culvert and channel realignment with in-channel works may pose an increased risk to flooding locally. **Hydromorphology:** Due to proposed construction activities in-channel and adjacent to the channel there is the potential to cause impacts to the hydromorphology of the watercourse, including; ▪ Potential fine sediment input from direct construction activities within the channel associated with the replacement of culverts and surrounding earthworks. Although no morphological features were identified directly downstream of proposed construction activities, sediment generated from construction activities upstream could migrate to morphological features identified near the confluence with WF11	very high x minor = Moderate	medium x minor = Slight	medium x major = Large	**Hydromorphology:** P02-W20 P02-W21 **Surface Water Quality**: P02-W18 P02-W19.	very high x negligible = Slight	medium x negligible = Neutral	medium x negligible = Slight

	(River Braan). This could lead to changes of the morphological features present, including smothering of bed substrate and depositional features. ▪ In-channel works would consist of the construction of new sections/replacement culverts, and any channel realignments required and outfalls to accommodate the roundabout structure and associated earthworks. However, the channel downstream of the existing A9 is currently artificially straightened to follow property boundaries and displays no morphological features or coarse bed substrate therefore morphological impacts immediately downstream of the proposed scheme are likely to be minimal. ▪ Works within the floodplain and along the banks of WF09 including construction of the new mainline, sideroads, roundabout and associated embankments could remove riparian corridor, and alter and destabilise channel banks. Morphological impacts are most likely to affect recovering reaches downstream of the realigned and straightened channel cross section, towards the confluence with WF11 (River Braan). **Surface Water Quality:** Due to proposed construction activities in-channel and adjacent to the channel on WF09 there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). This may potentially impact the downstream River Tay SAC at the River Braan. Sewage inputs may impact surface water quality should an uncontrolled release from a damaged pipeline occur (a CSO runs parallel to and crosses the proposed scheme, for the construction of side roads and roundabout, and runs parallel to and crosses WF09).							
WF11 (River Braan)	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas. Construction works associated with the replacement of the River Braan (WF11) crossing, associated footbridge and left bank access track with near channel works may increase flood risk locally. **Hydromorphology:** Due to proposed construction activities adjacent to the channel on WF11 (River Braan) there is the potential to cause impacts to the hydromorphology of the watercourse, including; ▪ Potential fine sediment input from indirect construction activities within the floodplain including surrounding earthworks and construction activities associated with WF11 (River Braan) bridge replacement and left bank access track. Removal of the bridge pries and associated toe protection may involve working in-channel and has the potential to generated increases in sediment laden run off during the removal process, with the potential to directly disturb the existing bed substrate. ▪ Current design proposals indicate that the embankment associated with the left bank access track will be constructed at its closest around mainline CH4350	very high x moderate = Large	very high x moderate = Large	very high x major = Very Large	**Hydromorphology:** P02-W20 P02-W21 **Surface Water Quality**: P02-W18 P02-W19	very high x negligible = Slight	very high x minor negligible = Slight	very high x negligible = Slight

	approximately 5m from WF11 (River Braan) banks. This could lead to increased sediment input and morphological changes to the river during construction. ▪ Increased in sediment input could lead to an increased propensity for fines to settle leading to homogeneity and lack of diversity in sediment distribution which could subsequently alter the depositional features present, including the proximal bar immediately downstream of the embankment location. ▪ Construction of scour protection along the left-hand bank through and downstream of the proposed bridge crossing to protect the proposed left bank access track that runs below the bridge structure. This would involve working in and within the vicinity of the channel to construct the access track and embankment which has the potential to disturb or remove natural bed and bank material. Any works within this area has the potential to impact on the proximal bar immediately downstream of the embankment on. ▪ Works within the vicinity and along the banks of WF11 (River Braan) including construction of outfalls have the potential to remove riparian vegetation and alter and destabilise channel banks and bed locally. **Surface Water Quality:** Due to proposed construction activities adjacent to the channel on WF11 (River Braan) there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). This may potentially impact the downstream River Tay SAC. The above impacts, individually or in combination, may result in a temporary deterioration of WFD status of River Braan.							
WF12 (Mill Stream)	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas. Construction of retaining walls in vicinity of watercourse to support new carriageway embankment may increase flood risk. **Hydromorphology:** Due to proposed construction activities in-channel and adjacent to the channel on WF12 there is the potential to cause impacts to the hydromorphology of the watercourse, including; ▪ Potential fine sediment input from indirect construction activities within the floodplain including surrounding earthworks associated with proposed embankments, widening of the mainline, construction of the downstream side road/access track and construction of SuDS basin F. Fine sediment impacts are likely to be low within WF12 itself due to the limited morphological features observed, however increase sediment loadings from construction could impact on the River Tay downstream. ▪ In-channel works associated with the construction of new sections of the crossing required to accommodate the mainline and associated earthworks. In-channel construction could disturb or remove natural bed substrate and bank sediment. As	very high x minor = Moderate	low x minor = Slight	medium x major = Large	**Hydromorphology:** P02-W20, P02-W21 **Surface Water Quality**: P02-W18, P02-W19.	very high x negligible = Slight	low x negligible = Neutral	medium x negligible = Slight

	the bed at this location consists of masonry bed protection this would likely act as a sediment transfer zone and increased sediment loadings could result in increased sediment input to the River Tay downstream. ▪ Works within the vicinity of the watercourse and along the banks of WF12, including construction of the new mainline access track, and SuDS basin F. These works could remove riparian corridor and alter and destabilise channel banks. Tracking of plant could lead to disruption to runoff pathways within the floodplain. Destabilisation of channel banks could lead in increases of fine sediment input which could enter the River Tay downstream. ▪ Construction works relating to outfalls may require removal of riparian vegetation and alteration of lengths of existing bank and bed as a result of new headwalls. Construction works and removal of riparian vegetation at the outfall location will take place on the channel banks and could lead to bank instability and increased erosion risk. **Surface Water Quality:** Due to proposed construction activities in-channel and adjacent to the channel on WF12 (Mill Stream) there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). This may potentially impact the downstream River Tay SAC.							
WF12A	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas adjacent to the watercourse. **Hydromorphology:** Due to proposed construction activities adjacent to the channel on WF12A, there is the potential to cause impacts to the hydromorphology of the watercourse, including: ▪ Potential fine sediment input from construction activities within the floodplain including surrounding earthworks and construction activities associated with the widening of the mainline. The widening of the mainline will take place over an already culverted section of W12A, however the watercourse may still be within the working area and therefore the potential for increases in fine sediment exist. Increases in fine sediment input could lead to an alteration of existing sediment dynamics as a result of fines settling and dampening of morphological variability on the bed. **Surface Water Quality:** Due to proposed construction activities adjacent to the channel on WF12A there is the potential to cause impacts to surface water quality from works in the vicinity of the channel. Potential impacts include: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems.	low x minor = Slight	medium x negligible = Neutral	medium x negligible = Slight	**Hydromorphology:** P02-W20, P02-W21. **Surface Water Quality**: P02-W18, P02-W19.	low x negligible = Neutral	medium x negligible = Neutral	medium x negligible = Neutral

	▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). As there are no in-channel works, Essential Standard and Essential Specific measures would be considered sufficient to justify the selection of a residual significance of effect of Neutral.							
WF12B	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas. Works around culvert and channel realignment with in-channel works may lead to a temporary increase in flood risk locally. Potential for increased flood risk to the A9. **Hydromorphology:** Due to proposed construction activities in-channel, upstream and adjacent to the channel on WF12B there is potential to cause impacts to the hydromorphology of the watercourse, including: ▪ In-channel works associated with the construction of approximately 40m of new sections/replacement culvert and any channel realignments required to accommodate the proposed Dalguise Junction northbound diverge slip road, mainline and associated earthworks. In-channel works have the potential to disturb and remove bed substrate and bank sediment, thereby mobilising fine sediment. Increased sediment input could result in increased deposition of sediment downstream. The earthworks lie directly over the upstream channel and could disturb bed substrate and bank sediment, thereby mobilising fine sediment. Increased sediment load could result in increased deposition of sediment downstream of this watercourse. The current channel upstream of the A9 is displays a poorly defined cross section and ephemeral characteristics with no distinct morphological features, therefore the impacts are considered to be minor. **Surface Water Quality:** Due to proposed construction activities in-channel, upstream and adjacent to the channel on WF12B there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). This may potentially impact the downstream River Tay SAC.	very high x moderate = Large	low x minor = Slight	medium x major = Large	**Hydromorphology:** P02-W20, P02-W21, P02-W22. **Surface Water Quality**: P02-W18 P02-W19	very high x negligible = Slight	low x negligible = Neutral	medium x negligible = Slight
WF13	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas. Construction of culvert replacement and channel realignment with in-channel works, increase in flood risk locally. **Hydromorphology:** Due to proposed construction activities in-channel and adjacent to the channel on WF13 there is the potential to cause impacts to the hydromorphology of the watercourse, including: ▪ Potential fine sediment input to watercourse from indirect construction activities including surrounding earthworks and construction activities associated with the widening of the mainline, construction of Dalguise underpass/junction (both of which directly impinge on WF13), construction of SuDS basin H (which lies	low x moderate = Slight	high x major = Large	medium x major = Large	**Hydromorphology:** P02-W20 P02-W21 **Surface Water Quality**: P02-W18 P02-W19	low x negligible = Neutral	high x negligible = Slight	medium x negligible = Slight

	approximately 50m from the WF13 channel) and associated SuDS access track (which directly crosses the WF13 channel). This could lead to changes to morphological features, including smothering of bed substrate and depositional features. ▪ In-channel works to construct approximately 140m of additional culvert length and associated channel realignments are required upstream of the existing A9. In addition, a new culvert (approximately 10m in length) will be required downstream of the Highland Main Line railway to accommodate a SuDS access track. These works have the potential to remove natural bed substrate and morphological features, including step-pool sequences observed upstream. Works could also lead to bank instability due to tracking of plant and removal of riparian vegetation. ▪ Works within the vicinity and along the banks of WF13, including the construction of the Dalguise junction and underpass, has the potential to alter or destabilise channel banks and remove riparian corridor. Removal of riparian corridor and destabilisation of channel banks can lead to increases in sediment input to the receiving watercourse, Increases in fine sediment input could lead to an alteration of existing sediment dynamics and an increased propensity for fines to settle leading to homogeneity and lack of diversity in sediment distribution. This could subsequently alter morphological features within the channel. **Surface Water Quality:** Due to proposed construction activities in-channel, downstream and adjacent to the channel on WF13 there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). This may potentially impact the downstream River Tay SAC.							
WF14	**Flood Risk:** Potential for temporary increase in surface water runoff from site areas. Construction of the culvert replacement and minor channel regrading works may lead to a temporary increase in flood risk locally. **Hydromorphology:** Due to proposed construction activities in-channel and adjacent to the channel on WF14 there is the potential to cause impacts to the hydromorphology of the watercourse, including: ▪ Potential fine sediment input from indirect construction activities including earthworks within the floodplain, construction of the new River Tay Bridge crossing and realignment of the B898 side road. This could lead to changes to morphological features, including smothering of bed substrate and depositional features. ▪ In-channel works for construction of the replacement culvert and any required channel realignments associated with the realignment of the B898 have the potential to remove natural bed substrate and morphological features, including	low x minor = Slight	medium x minor = Slight	medium x major = Large	**Hydromorphology:** P02-W20 P02-W21 **Surface Water Quality**: P02-W18 P02-W19	low x negligible = Neutral	medium x negligible = Neutral	medium x negligible = Slight

	step-pool sequences observed upstream. Works could also lead to bank instability due to tracking of plant and removal of riparian vegetation. ▪ Works within the vicinity and along the banks of WF14, including the construction and realignment of the new side road and construction of the Tay bridge extension (bridge piers at their closest are located approximately 10m from the channel), has the potential to alter or destabilise channel banks and remove riparian corridor. This could result in increased bank erosionwithin the impacted reach. **Surface Water Quality:** Due to proposed construction activities in-channel and adjacent to the channel on WF14 there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). This may potentially impact the downstream River Tay SAC.							
WF16	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas. Construction of culvert replacement with in-channel works may lead to a temporary increase in flood risk locally. **Hydromorphology:** Due to proposed construction activities in-channel and adjacent to the channel on WF16 there is the potential to cause impacts to the hydromorphology of the watercourse, including: ▪ Potential fine sediment input from indirect construction activities including surrounding earthworks and construction activities associated with the widening of the mainline, construction of SuDS basin I and associated cutting (which lies within 5m of the WF16 channel) could lead to changes to morphological features, including smothering of bed substrate and depositional features. ▪ In-channel works for construction of replacement culverts and any required channel realignments to accommodate the mainline, associated earthworks and SuDS basin I have the potential to remove natural bed substrate and morphological features. Works could also lead to bank instability due to tracking of plant and removal of riparian vegetation. ▪ Works within the vicinity and along the banks of WF16, including the construction if SuDS basin I has the potential to alter or destabilise channel banks and remove riparian corridor. This could result in increased bank erosion and lateral migration of the watercourse. **Surface Water Quality:** Due to proposed construction activities in-channel and adjacent to the channel on WF16 there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems.	low x minor = Slight	medium x minor = Slight	medium x moderate = Moderate	**Hydromorphology:** P02-W20 P02-W21 **Surface Water Quality**: P02-W18 P02-W19	low x negligible = Neutral	medium x negligible = Neutral	medium x negligible =Neutral

	▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). This may potentially impact the downstream River Tay SAC.							
WF18	**Flood Risk:** Potential for temporary increase in surface water runoff rates from site areas. Construction of culvert replacement with in-channel works may lead to a temporary increase in flood risk locally. **Hydromorphology:** Due to proposed construction activities in-channel and adjacent to the channel on WF18 there is the potential to cause impacts to the hydromorphology of the watercourse, including: ▪ Potential fine sediment input from indirect construction activities including surrounding earthworks and construction activities associated with the widening of the mainline could lead to changes to morphological features, including smothering of bed substrate and depositional features. ▪ In-channel works for construction of replacement culverts and any required channel realignments to accommodate the mainline, associated earthworks have the potential to remove natural bed substrate and morphological features. Works could also lead to bank instability due to tracking of plant and removal of riparian vegetation. ▪ Works within the vicinity and along the banks of WF18, has the potential to alter or destabilise channel banks and remove riparian corridor. This could result in increased bank erosion within the impacted reach. **Surface Water Quality:** Due to proposed construction activities in-channel and adjacent to the channel on WF18 there is the potential to cause a major measurable (temporary) shift from baseline water quality. Potential impacts include: ▪ Smothering of the riverbed from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. ▪ A decline in pollutant removal capacity resulting from increased risk of chemical pollution resulting from accidental spillage of fuel, oils, cementitious material (or other polluting substances). ▪ A decline in river ecosystem health and loss of aquatic species from decline in water quality (e.g. chemical release or excessive sediment smothering of river channel). This may potentially impact the downstream River Tay SAC.	low x minor = Slight	medium x minor = Slight	low x moderate = Slight	**Hydromorphology:** P02-W20 P02-W21 **Surface Water Quality**: P02-W18 P02-W19	low x negligible = Neutral	medium x negligible = Neutral	low x negligible = Neutral

Surface Water Supply				
Description	**Potential Construction Impacts**	**Pre-Mitigation: Sensitivity x Magnitude = Significance**	**Essential Specific Mitigation**	**Post-Mitigation: Sensitivity x Magnitude = Significance**
Abstraction from River Tay for agricultural irrigation purposes	Due to proposed construction activities within the study area there is the potential to cause a measurable shift from baseline water quality, temporarily causing a deterioration in water supply. Causes of this deterioration could be sourced from increased sediment laden runoff due to exposed soil/earthworks and inadequate construction drainage systems. Additionally, a deterioration in the (quality of) water supply could be sourced from accidental spillage(s) of fuel, oils, cementitious material.	high x moderate = Large	**Surface Water Supply:** P02-W18, P02-W19.	high x negligible = Slight

(NGR NO 00449 44434)	These substances (or any other polluting substances) are likely to be utilised extensively during the construction phase of the proposed scheme, meaning there is an increased risk of chemical pollution occurring during this period and deteriorating identified water supply features.			

Table A19.5-4: Specific operation impacts

Water Feature	Potential Operation Impacts	Pre-Mitigation: Importance x Magnitude = Significance			Specific Mitigation	Post-Mitigation: Importance x Magnitude = Significance		
		Flood Risk	Hydromorphology	Surface Water Quality		Flood Risk	Hydromorphology	Surface Water Quality
WF06 (River Tay)	**Flood Risk:** The proposed scheme results in a loss of floodplain storage due to the requirement for new infrastructure (widened carriageway, SuDS basin and junction) within the River Tay (WF06) floodplain (i.e. the 0.5% AEP (200-year) plus CC event flood extent). However, although there is a loss of floodplain storage, there is almost no resultant increase in flood depths on sensitive receptors in both the pre-mitigation and with mitigation scenarios (Tay House, Eastwood House, Royal School of Dunkeld, Little Dunkeld Kirk, STW at Dunkeld and properties on High Street, Athol Street, Cathedral Street, Water Wynd, Willowbank, Burnmouth Road, Torlee Road (+1mm pre-mitigation and +2mm post mitigation), throughout Dunkeld, Little Dunkeld and Birnam and Cottages along East Bank of River Tay in Little Dunkeld) of <2mm is considered to be negligible. With the exception of Torlee Road, all receptors are either neutral (0mm change) or display slightly shallower depths (-1 to-2mm) than the baseline. There is a decrease in fluvial flood depth from the River Tay (WF06) of 54mm at the Sewage Treatment Plant close to Dunkeld House Hotel pre-mitigation resulting in a moderate beneficial impact. This reduces to -17mm with proposed mitigation and a minor beneficial impact. There are very small areas of minor adverse impact on the left bank of the River Tay directly opposite the River Braan confluence. The areas are small (circa 600m^2) with maximum depths of circa 28mm above the baseline in an area of riparian woodland and not close to any sensitive receptors. No mitigation is proposed for this impact. The banks of the River Tay upstream of the Braan confluence display areas of minor to major beneficial impact but are found to be some distance from sensitive receptors. There is a small area of flooding to the proposed A9 north of the Tay Crossing (ch 8300-8400) close to the tie-in with the Tay Crossing to Ballinluig section. This section has been designed and consented to a 0.5%AEP (200-year) plus 20%CC uplift and is therefore impractical to alter the road geometry. An Emergency Response Plan will be developed (P02-W41) which will facilitate the short-term closure of the A9 at Dunkeld roundabout with local access via Dalguise Junction. Overall, the significance of effect is considered to be Neutral both pre-and post mitigation. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including; ▪ Abutments associated with the proposed crossing may require the permanent removal of riparian vegetation.	very high x negligible = Neutral	high x moderate = Large	very high x negligible = Slight	**Flood Risk:** P02-W41 **Hydromorphology:** P02-W23 P02-W31 P02-W36 **Surface Water Quality:** P02-W24 P02-W28 P02-W29	very high x negligible = Neutral	high x minor = Slight	very high x negligible = Slight

	▪ If abutments are not out with the design flood event, they could throttle flows during high flow events leading to increased erosion (through a backwater effect) upstream and downstream of the structure (as flows are released from confinement). ▪ There may also be a requirement to install scour protection to protect the proposed southern bridge pier of the Tay crossing from fluvial scour. The southern bridge pier lies within 1m of the River Tay channel at the Tay bridge crossing (CH 7300 -7500). The type and extent of scour protection is still to be confirmed. Scour protection in this location could permanently alter the form of the watercourse as it occurs within an existing eddy and area of scour. This has the potential to deflect fluvial energy downstream from this location, causing potential scour downstream of the bridge crossing. ▪ The proposed estate access track around CH1820m is located within 25m of the outside bend of a meander where the river has historically shown measurable bank retreat. There exists the potential for accelerated natural erosion processes due to the removal of riparian vegetation to facilitate the access track and therefore there may be a requirement for scour protection in this location. The extent and nature of scour protection has yet to determined. However, scour protection in this location could permanently alter the form of the watercourse as it occurs within an existing area of active erosion. There is also potential that scour protection in this location would deflect fluvial energy downstream causing potential erosion issues and changes to sediment flow processes. ▪ The five outfalls from SuDS basins at various location along the River Tay would require the permanent removal of a length of natural bank and bed and could lead to localised changes to flow patterns with the potential to alter sediment transport processes. If outfalls are installed and placed incorrectly, outfall discharge may not always be directly into the River Tay, but instead flow over depositional features downstream of the outfall locations, for example around the depositional bar located proximal to the outfall at mainline chainage 800. This could lead to alteration to channel morphology, flow and/or sediment processes which could result in changes to the current channel characteristics and in-channel physical habitat features. These changes may also impact on the function and habitat value of the River Tay SAC. **Surface Water Quality:** Operational discharges from mainline drainage (outfall A, B(2), G and H, I). HEWRAT 'Pass' for soluble pollutants, and pass against EQS compliance (Cu and Zn), pre mitigation and post mitigation. Alert for sediment bound pollutants. Risk of pollution from spillage <0.5%.							
WF01 (Birnam Burn)	**Flood Risk:** Potential alterations to flood risk due to extended culvert and any associated channel realignment. Flows are out of bank with a >100mm headwater level increase compared to the baseline and therefore there is a major adverse increase in flood risk to the woodland. The proposed scheme is not at increased risk of flooding from WF01 as there is 5.67m of freeboard between the anticipated upstream headwater level and the proposed A9 road level. There is no increase in pass forward flow due to the proposed scheme. Increased impervious surfaces due to carriageway near watercourse. As the woodland is the only receptor at risk of increased flood risk, significance of effect is considered to be Slight. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including; ▪ Operation of culvert extensions. It is likely a culvert extension would extend for approximately 5.95m upstream and would remove a length of steeper step-pool channel	low x major = Slight	medium x minor = Slight	n/a	**Hydromorphology:** P02-W32 P02-W33	low x major = Slight	medium x negligible = Neutral	n/a

	including bed, banks and vegetated riparian corridor. This would impact flows, sediment regime and the lateral and longitudinal connectivity of the watercourse. The extension would reduce the existing channel gradient and lead to potential natural channel adjustment downstream as the watercourse establishes a new equilibrium. ▪ The culvert extension may also lead to deposition within culverts during low flows due to reductions in the channel gradient. Increased flow velocities and decreased roughness from culverts could further alter the sediment dynamics within the channel. ▪ The need for channel regrading upstream of WF01 has the potential to change flow regimes and sediment processes by alteration of channel gradients. This could lead to increased runoff from impervious surfaces and create areas of erosion and could alter the morphology of the channel. ▪ The regrading of WF01 would have potential to either reduce or increase the length of the channel, directly altering the gradient and changing sediment transport processes and channel form. Regrading could provide a beneficial impact with opportunity for improved transportation of sediment and encouragement of natural fluvial processes, especially downstream on this watercourse where there is currently an engineered concrete cascade. **Surface Water Quality:** No impacts anticipated.							
WF02	**Flood Risk:** Culvert proposed to be retained. Therefore, although flows remain out of bank, there is no increase in upstream headwater level and therefore no change in flood risk to the proposed scheme and woodland. There is no increase in pass forward flow due to the proposed scheme. Increased impervious surfaces due to carriageway near watercourse may cause additional surface runoff to WF02 when the capacity of the proposed drainage system is exceeded. **Hydromorphology:** No impacts anticipated. **Surface Water Quality:** No impacts anticipated.	low x negligible = Neutral	n/a	n/a	n/a	low x negligible = Neutral	n/a	n/a
WF05	**Flood Risk:** Potential alterations to flood risk due to extended culvert and any associated channel realignment. Flows remain out of bank with a >100mm headwater level increase compared to the baseline and therefore there is a major adverse increase in flood risk to woodland. The proposed scheme is not at risk of flooding from WF05 as there is 5.57m of freeboard between the anticipated upstream head water level and the proposed A9 road level. There is no increase in pass forward flow due to the proposed scheme. As the woodland is the only receptor at risk of increased flood risk, significance of effect is considered to be Slight. **Hydromorphology:** Channel regrading to tie-in with the extended culvert would help create a more-defined channel planform where it is currently lacking. **Surface Water Quality:** No impacts anticipated.	low x major = Slight	medium x minor beneficial = Slight beneficial	n/a	**Hydromorphology:** P02-W32 P02-W33 P02-W34	low x major = Slight	medium x minor beneficial = Slight beneficial	n/a
WF05A	**Flood Risk:** Potential alterations to flood risk due to extended culverts and any associated channel realignment. Flows remain out of bank with a >100mm headwater level increase compared to the baseline and therefore there is a major adverse increase in flood risk to woodland. The proposed scheme is not at risk of flooding from WF05A as there is 9.72m of freeboard between the anticipated upstream headwater level and the proposed A9 road level, this is an increased freeboard compared to baseline. Upstream of the proposed scheme, flows remain out of bank with no increase in headwater level and therefore there is no change in flood risk to the B876 road, Highland Main Line railway and woodland. There is no increase in pass forward flow due to the proposed scheme. Increased impervious surfaces due to	low x major = Slight	low x minor = Slight	medium x major = Large	**Hydromorphology:** P02-W23 P02-W32 P02-W33 P02-W34 **Surface Water Quality:**	low x major = Slight	low x negligible = Neutral	medium x minor = Slight

	carriageway near watercourse. As the woodland is the only receptor at risk of increased flood risk, the significance of effect is considered to be Slight. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including: ▪ Alteration of existing fluvial processes and loss of existing channel upstream and downstream by increasing culverted length by approximately 30m upstream and 20m downstream of the existing A9 to accommodate the widening of the mainline, construction of associated sideroad and embankments. No morphological features currently exist upstream. Removal of the downstream ponded area and replacement with approximately 20m of culvert could impact lateral floodplain connectivity and vegetated riparian corridor due to extended culvert lengths. ▪ Any channel realignments required for WF05A could have potential to either reduce or increase the length of the channel, directly altering the gradient and changing exiting flow and sediment dynamics. However, as the watercourse upstream of the existing A9 is ephemeral, realignment could provide a beneficial impact with opportunity for improved transportation of sediment and encouragement of natural fluvial processes leading to an improvement in overall channel form and behaviour. ▪ Bank protection requirements could result in the transfer of erosion downstream resulting in bank retreat and/or channel incision. Hard reinforcement could also impact on lateral connectivity and marginal habitat. ▪ Outfalls from SuDS basin B(1), which lies approximately 75m from WF05A, would discharge into WF05A. This carries the potential for localised changes to flow dynamics. The channel is poorly defined in this location displaying no morphological features and a lack of coarse sediment supply. Therefore, the impact of the outfall changing sediment dynamics is low. In addition, outfall rates are likely to be restricted in order for the SuDS to attenuate the 0.5% AEP (200-year) plus Climate Change event. Therefore, the impact of outfall flows on WF05A is likely to be low. **Surface Water Quality:** Operational discharges from mainline drainage (outfall B(1)). HEWRAT results show a fail for soluble pollutants (Cu and Zn), and failure against EQS compliance (Cu), pre-mitigation. Fail for soluble Zn RST24, pass for all Cu aspects and EQS compliance for both Cu and Zn post mitigation. Alert for sediment bound pollutants. Risk of pollution from spillage <0.5%.				P02-W25			
WF07	**Flood Risk:** The existing culvert size and position has not been determined and it is likely that it is undersized for the design flow. A new culvert is proposed with an outfall to an open channel section that conveys flows to the River Tay. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including ▪ Any proposed new culverts required to reconnect WF07 to the River Tay downstream of the proposed scheme could provide beneficial impacts as the culverts will facilitate longitudinal connectivity of the watercourse. ▪ Reconnection of the water course to the River Tay via the formation of a new channel and new culverts could have the potential for increased sedimentation downstream should gradients reduce significantly. ▪ Any realignments required for WF07 would increase the channel length downstream from the proposed scheme. This would alter the overall channel gradient and may affect	very high x negligible = Slight	low x minor = Slight	n/a	**Hydromorphology:** P02-W32 P02-W33 P02-W34	very high x negligible = Slight	low x negligible = Neutral	n/a

	sediment transport processes that are currently in operation during periods of sustained rainfall. As the watercourse upstream of the current A9 is ephemeral and shows no hydrological connection to the existing scheme, formation of a new channel downstream to reconnect WF07 to the River Tay could provide a beneficial impact with opportunity for improved transportation of sediment, encouragement of natural fluvial processes and creation of fluvial habitats. **Surface Water Quality:** No impacts anticipated.							
WF08 (Inchewan Burn)	**Flood Risk:** In the vicinity of the proposed scheme, modelled flows from Inchewan Burn (WF08) remain in-bank and therefore there is no increase in flood risk resulting from the proposed scheme. Further downstream, near to the confluence of Inchewan Burn (WF08) and the River Tay (WF06) the modelled flows of the two watercourses coincide. The proposed scheme results in a loss of floodplain storage due to the requirement for new infrastructure (widened carriageway, SuDS basin and junction) within the River Tay floodplain and the with-scheme modelling shows a subsequent change to flood depths where the two floodplains interact. However, the resultant increase in flood depths on sensitive receptors (Royal School of Dunkeld, Little Dunkeld Kirk and properties on Willowbank, and Burnmouth Road) of 1-3mm is considered to be negligible. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including; ▪ Removal of riparian vegetation to construct proposed bridge crossing which could lead to an increase in bank instability and fine sediment input which may lead to an increased propensity for fines to settle leading to homogeneity and lack of diversity in sediment distribution with subsequent changes to morphological features. ▪ WF08 (Inchewan Burn) crossing abutments and bridge piers could impact floodplain connectivity if they are not set back far enough from the channel margins. They could also throttle flows during flood events, leading to potential erosion issues upstream and downstream of the proposed crossing location ▪ Outfalls from geocellular storage would discharge into WF08 and would potentially require modifications to existing bank reinforcement. Impacts to the watercourse are considered minor if the integrity of the existing reinforcement and banks are maintained. **Surface Water Quality:** Operational discharges from mainline drainage (outfall C(1) and C(2)). HEWRAT 'Pass' for soluble pollutants, and pass against EQS compliance (Cu and Zn), pre mitigation and post mitigation. Alert for sediment bound pollutants. Risk of pollution from spillage <0.5%.	very high x negligible = Slight	high x minor = Moderate	medium x negligible = Slight	**Hydromorphology:** P02-W23 P02-W31 **Surface Water Quality:** P02-W26 P02-W27	very high x negligible = Slight	high x negligible = Slight	medium x negligible = Slight
WF09	**Flood Risk:** Flooding of the A9 and downstream receptors is predicted and works to the channel and culvert are not considered to be feasible to prevent this. This would lead to flooding of the A9 with a retained culvert size of 600mm. Specific Mitigation is required through provision of a flood relief culvert has been included from the roundabout outlet to the River Braan to manage the excess flow during the design event. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including; ▪ Removal of the existing 56m long culvert and replacing with a realigned open channel will lead to localised benefit to the watercourse reintroducing natural features and therefore promoting natural processes along the channel.	very high x major = Very Large	medium x moderate = Moderate	n/a	**Flood Risk:** P02-W40 **Hydromorphology:** P02-W32 P02-W33	very high x major beneficial = Beneficial	medium x minor = Slight	n/a

	▪ The existing watercourse will be replaced by two culverts to allow the channel to flow beneath a proposed roundabout. ▪ The combined length of the two proposed culverts is approximately 73.28m, approximately 2m longer than the existing culvert arrangements. This would mean there would be an increase in the length of natural bed and bank being replaced by artificial material. However, culverts do remain a fragmentary feature along the channel. **Surface Water Quality:** No impacts anticipated.							
WF11 (River Braan)	**Flood Risk:** The proposed scheme results in a loss of floodplain storage due to the requirement for new infrastructure (widened carriageway,) within the River Braan (WF11) floodplain (i.e. the 0.5% AEP (200-year) plus CC event flood extent). The area of Inver between the right bank of the Tay and the left bank of the Braan (Approximately from chainage 4370 to 5000) is split by the existing A9. In the proposed scheme the A9 will have a higher vertical alignment and this has the effect of preventing flooding from the River Braan overtopping towards the River Tay. The areas of beneficial impact on the right-bank of the River Tay upstream of the Braan confluence, reflect this reduction in flow via this overtopping mechanism. Conversely, due to the increased impoundment, there are large areas of minor and moderate adverse impact on the River Braan floodplain as the overtopping flood mechanism is prevented. This area of adverse impact extends upstream on the River Braan to Inver Bridge and extends along the Mill Lade pre-mitigation. Specific mitigation has been provided in the form of 3no. flood relief culverts at the Mill Lade and 14no. flood relief culverts in the embankment of the proposed Scheme and a Compensatory Flood Storage area at the confluence with the River Tay. This reduces the post mitigation impacts to Neutral. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including; ▪ Abutments and bridge piers associated with the proposed bridge crossing are set (Approx. 10m) back in the floodplain, with some potential minor alterations to lateral floodplain connectivity and may require the permanent removal of riparian vegetation. A proposed right bank footpath has the potential to alter additional lateral floodplain connectivity further. As abutments are not outwith the design flood event, they could throttle flows during high flow events leading to increased erosion upstream and downstream of the structure. ▪ Current design proposals indicate that the embankment associated with the left bank access track will be constructed at its closest around mainline CH4350 approximately 5m from WF11 (River Braan) banks. Due to the proximity of the embankment there may be a need for additional permeant scour protection in this location. This has the potential for the removal of riparian vegetation in this location. Permeant scour protection also has the potential to locally alter flows and channel form which may have a detrimental effect on the proximal bar deposit immediately downstream of the proposed embankment location. ▪ Outfalls from SuDS basin D (located at its closest approximately 30m from the banks of WF11 (River Braan) would discharge directly into WF11 (River Braan). This has the potential to create localised changes to flow dynamics and alterations in sediment transport processes. SuDS outfalls are likely to be discharged at greenfield runoff rates which are slower than the velocity of WF11 (River Braan) at this location. Additionally, this reach of WF11 (River Braan) currently has extensive erosion protection relating to the existing bridge	very high x moderate = Very Large	very high x moderate = Large	very high x negligible = Slight	**Flood Risk** P02-W37 P02-W38 P02-W39 **Hydromorphology:** P02-W23 P02-W31 P02-W36 **Water Quality:** P02-W24	very high x negligible = Neutral	very high x minor = Moderate	very high x negligible = Slight

	Impacts to the watercourse banks are considered low if the integrity of the existing reinforcement and banks are maintained. ▪ Alteration to channel morphology, flow and/or sediment transport processes from the above could cause changes to the current channel characteristics and in-channel physical habitat features which provide ecological resilience for water-dependent flora and fauna. These changes may also impact on the function and habitat value of the River Tay SAC. **Surface Water Quality:** Operational discharges from mainline drainage (outfall D). HEWRAT 'Pass' for soluble pollutants, and pass against EQS compliance (Cu and Zn), pre mitigation and post mitigation. Alert for sediment bound pollutants. Risk of pollution from spillage <0.5%.							
WF12 (Mill Stream)	**Flood Risk:** Mill Stream (WF12) is within the River Braan (WF11) and River Tay (WF06) floodplain, and so is impacted by the flood depths of both watercourses. The proposed scheme results in a loss of floodplain storage due to the requirement for new infrastructure (widened carriageway, SuDS basin and junction) within the Mill Stream (WF12), River Braan (WF11) and the River Tay (WF06) floodplain (i.e. the 0.5% AEP (200-year) plus CC event flood extent).The Mill Stream (WF12) floodplain is impacted by the lost floodplain volume, resulting in small areas of minor adverse impact and Large significance. 3no. flood relief culverts have been included as specific mitigation for this impact to decrease the fluvial flood depth from the River Braan (WF11), within the Mill Stream (WF12) floodplain, resulting in a beneficial impact. There are negligible changes in fluvial flood depths at Inver Mill Farm and Inver Mill Caravan Park. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including: ▪ Potential for alteration of existing fluvial processes and loss of existing channel downstream by increasing culverted length. No morphological features currently exist upstream. ▪ Potential for changes in flow regime and sediment processes caused by channel realignments, increased runoff from impervious surfaces and areas of erosion and replaced culvert could cause increased sedimentation downstream. ▪ Any realignments required for WF12 would have potential to alter the gradient of the watercourse and thereby change sediment and flow processes. However, as the watercourse upstream of the existing A9 is already heavily modified, realignment could provide a beneficial impact with opportunity for improved transportation of sediment and encouragement of natural fluvial processes. ▪ Bank protection requirements at the culvert outlet could result in the transfer of erosion downstream into the Tay resulting in bank retreat and possible channel incision on WF12. ▪ Outfalls from SuDS basin F would discharge into WF12 and would require permanent removal of a length of natural bank and bed. This has the potential to cause localised changes to flow dynamics. Increased discharge into WF12 (Mill Stream) from outfalls has the potential to locally alter sediment regime (e.g. increased flow velocity could remove a layer of fine sediment from the channel substrate). **Surface Water Quality:** Operational discharges from mainline drainage (outfall F). HEWRAT 'Fail' for soluble pollutants (Zn), but passes for EQS compliance (Cu and Zn), and fails for sediment bound pollutants pre mitigation. HEWRAT 'Pass' for soluble pollutants, and pass against EQS compliance (Cu and Zn), post mitigation. Alert for sediment bound pollutants. Risk of pollution from spillage <0.5%.	very high x minor = Large	low x minor = Slight	medium x moderate = Moderate	**Flood Risk** P02-W38 **Hydromorphology:** P02-W23 P02-W32 P02-W33 **Surface Water Quality:** P02-W24	very high x minor beneficial = Moderate	low x negligible = Neutral	medium x negligible = Slight
WF12A	**Flood Risk:** No alterations to flood risk are expected.	low x negligible =	n/a	n/a	n/a	low x negligibl	n/a	n/a

	Hydromorphology: No impacts anticipated. **Surface Water Quality:** No impacts anticipated.	Neutral				e = Neutral		
WF12B	**Flood Risk:** Potential alterations to flood risk due to extended culvert and any associated channel realignment. Flows are out of bank with a >100mm headwater level increase, but there is now a >600mm freeboard to the A9. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including; ▪ Removal of an approximately 40m section of open poorly defined ephemeral channel upstream to accommodate sideroad. Potential for alteration of existing fluvial processes and loss of existing channel features downstream by increasing culverted length. **Surface Water Quality:** No impacts anticipated.	very high x negligible = Slight	low x minor = Slight	n/a	**Hydromorphology:** P02-W32 P02-W33 P02-W35	very high x negligible = Slight	low x negligible = Neutral	n/a
WF13	**Flood Risk:** Potential alterations to flood risk due to replaced culvert and associated channel realignment. Replacement culvert would result in a small increase in flood risk downstream of the proposed scheme due to an increase in pass forward flows towards the Highland Main Line railway. Flows remain out of bank with a >100mm upstream headwater level increase and therefore there is a major adverse increase in flood risk to the surrounding agricultural land and woodland. The proposed scheme is not at risk of flooding from WF13 as there >600mm of freeboard from the anticipated headwater level and the proposed A9 road level. Increased impervious surfaces due to carriageway and Dalguise Junction near watercourse. As the woodland and agricultural land are the only receptors at risk of increased flood risk, significance is assigned Slight. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including; ▪ Culverting of approximately 140m of currently open natural channel under the Dalguise junction and SuDS access road. This would involve permanent removal of natural bed, banks and morphological features including step-pool sequences with a substantial increase of artificial bed and bank material associated with replaced culvert. Extension of existing culvert lengths and construction of new culvert would also result in a decrease in lateral connectivity of the watercourse and would remove riparian vegetation over the length. ▪ Changes in the gradient of WF13 by straightening through a culvert, potentially altering flow processes downstream of the existing A9. Potential changes in gradient within the culvert to accommodate the underpass in this location could create sediment management issues during operation. ▪ The realignment of WF13 could have potential to either reduce or increase the length of the channel, directly altering the gradient and changing sediment processes. Which may result in a change to channel morphology and flow processes as a result of the realignment. ▪ There is an existing knickpoint (area of instability) located downstream of the Highland Main Line railway where bed protection has failed. Potential for natural channel adjustment post construction as the watercourse establishes a new equilibrium. ▪ Bank protection requirements could result in the transfer/deflection of erosion downstream resulting in bank retreat and/or channel incision. Hard or raised reinforcement could also impact on lateral connectivity and marginal habitat. **Surface Water Quality:** No impacts anticipated.	low x major = Slight	high x major = Large	n/a	**Hydromorphology:** P02-W32 P02-W33	low x major = Slight	high x moderate = Moderate	n/a
WF14	**Flood Risk:** Potential alterations to flood risk due to extended culvert and any associated	low x major	medium x	n/a	**Hydromorphology**	low x	medium x	n/a

	channel realignment. Flows remain out of bank with >100mm headwater level increase and therefore there is a major adverse increase in flood risk to woodland. The proposed scheme (realigned B898) is not at risk of flooding from WF14 due to the 1.95m of freeboard from the anticipated headwater level and the proposed road level of the realigned B898. Increased impervious surfaces due to carriageway near watercourse. As the woodland is the only receptor at risk of increased flood risk, the significance of effect is considered to be Slight. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including; ▪ Removal of an equivalent length of steps and pools upstream of the side road, natural bed and banks and vegetated riparian corridor to facilitate culvert extensions. Lateral and longitudinal connectivity could be impacted within the immediate location of culvert. The culvert extension would reduce the existing channel gradient and could lead to channel adjustment downstream as the watercourse establishes a new equilibrium. ▪ The culvert extensions could lower the culvert gradient over an extended length which could lead to deposition within the culvert particularly during low flows. Increased flow velocities and decreased roughness from culverts would further alter the sediment transport processes. ▪ Bank protection requirements could result in the transfer/deflection of erosion downstream resulting in bank retreat and/or channel incision. Hard reinforcement could also impact on lateral connectivity and marginal habitat. ▪ The realignment of WF14 would further have the potential to either reduce or increase the length of the channel, directly altering the gradient sediment transport processes. Realignment if designed appropriately could provide a beneficial impact with opportunity for improved transportation of sediment and encouragement of natural fluvial processes. **Surface Water Quality:** No impacts anticipated.	= Slight	minor = Slight		: P02-W32 P02-W33	major = Slight	negligible = Neutral	
WF16	**Flood Risk:** Potential alterations to flood risk due to replaced culvert and channel realignment, and proximity of SuDS basin I. The replacement culvert would result in a small increase in flood risk downstream of the proposed scheme due to an increase in pass forward flows. There are no sensitive receptors downstream of the proposed scheme to the confluence with the River Tay. Flows remain in bank with a >100mm headwater level decrease compared to baseline and therefore there is a major beneficial magnitude of impact to the proposed scheme and woodland. Potential loss of floodplain area, including from SuDS basin I, but any impacts are anticipated to be minimal. Increased impervious surfaces due to carriageway near watercourse. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including: ▪ Removal of natural bed and banks and vegetated riparian corridor to facilitate culvert extensions. Lateral and longitudinal connectivity would be impacted within the immediate location of culvert. The culvert replacement would reduce the existing channel gradient and could lead to channel adjustment downstream as the watercourse establishes a new equilibrium. ▪ The culvert extensions would lower the culvert gradient over an extended length which could lead to deposition within the culvert particularly during low flows. Increased flow velocities and decreased roughness from culverts would further alter the sediment transport processes.	low x major beneficial = beneficial	medium x minor = Slight	n/a	**Hydromorphology:** P02-W32 P02-W33	low x major beneficial = beneficial	medium x negligible = Neutral	n/a

	▪ Bank protection requirements could result in the transfer/deflection of erosion downstream resulting in bank retreat and/or channel incision. Hard reinforcement could also impact on lateral connectivity and marginal habitat. Lateral connectivity of the downstream left-hand side of the watercourse is likely to be impacted by the proposed SuDS basin. ▪ The realignment of WF16 would further have the potential to either reduce or increase the length of the channel, directly altering the gradient sediment transport processes. Realignment if designed appropriately could provide a beneficial impact with opportunity for improved transportation of sediment and encouragement of natural fluvial processes. **Surface Water Quality:** No impacts anticipated.							
WF18	**Flood Risk:** Potential alterations to flood risk due to replaced culvert and any associated channel realignment. Replaced culvert would result in a small increase in flood risk downstream of the proposed scheme due to an increase in pass forward flows. There are no sensitive receptors downstream of the proposed scheme to the confluence with the River Tay. Flows remain in bank with a >100mm headwater level decrease and therefore there is a major beneficial magnitude of impact to the proposed scheme and woodland. Increased impervious surfaces due to carriageway near watercourse. **Hydromorphology:** Due to new infrastructure as part of the proposed scheme there is the potential to cause operational impacts to the hydromorphology of the watercourse, including: ▪ Removal of natural bed and banks and vegetated riparian corridor to facilitate culvert replacements. Lateral and longitudinal connectivity would be impacted within the immediate location of culvert. The culvert replacement would reduce the existing channel gradient and could lead to channel adjustment downstream as the watercourse establishes a new equilibrium. ▪ The culvert extensions would lower the culvert gradient over an extended length which could lead to deposition within the culvert particularly during low flows. Increased flow velocities and decreased roughness from culverts would further alter the sediment transport processes. ▪ Bank protection requirements could result in the transfer/deflection of erosion downstream resulting in bank retreat and/or channel incision. Hard reinforcement could also impact on lateral connectivity and marginal habitat. ▪ The realignment of WF18would further have the potential to either reduce or increase the length of the channel, directly altering the gradient sediment transport processes. Realignment if designed appropriately could provide a beneficial impact with opportunity for improved transportation of sediment and encouragement of natural fluvial processes. **Surface Water Quality:** No impacts anticipated.	low x major beneficial = beneficial	medium x minor = Slight	n/a	**Hydromorphology:** P02-W32 P02-W33	low x major beneficial = beneficial	medium x negligible = Neutral	n/a
Surface Water Supply								
Surface Water Supply feature	**Potential Operational Impacts**	**Pre-Mitigation: Sensitivity x Magnitude = Significance**			**Specific Mitigation**	**Post-Mitigation: Sensitivity x Magnitude = Significance**		
Abstraction from River Tay for agricultural	**No impacts on Surface Water Supplies are anticipated during the operational phase**	n/a			n/a	n/a		

irrigation purposes. NGR NO 00449 44434				