Swarkestone & Stanton-by Bridge Bypass Engineering Feasibility Study

April 2010

Derbyshire County Council Scheme Number

Scott Wilson Works Number **D130388**

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Revision Schedule

Swarkestone & Stanton-by Bridge Bypass Route Feasibility Study

April 2010

Rev	Date	Details	Prepared by	Reviewed by	Approved by
0	April 2010	Issue	**Naba Adhikari** Senior Engineer	**Edward Varley** Principal Engineer	**Edward Varley** Principal Engineer
1	July 2010	Issue	**Naba Adhikari** Senior Engineer	**Edward Varley** Principal Engineer	**Edward Varley** Principal Engineer
2	July 2010	Issue			**Edward Varley** Principal Engineer

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1 Introduction

This report has been prepared by Scott Wilson Ltd. on behalf of Derbyshire County Council under the Three Counties Alliance Partnership framework contract to examine possible options for alternative routes for highways to relieve traffic on the A514 as it passes over Swarkstone Causeway and through the village of Stanton by Bridge.

The site is located in South Derbyshire, 5 miles south of Derby. The National Grid Reference of the site centre is approximately 437000, 328000.

The A514 crosses the River Trent at Swarkstone via Swarkstone Bridge before travelling across the rivers flood plain using Swarkstone Causeway. The road then travels through Stanton- by-Bridge before separating into the B587 and A514 to the south of the village. The B587 forms the main route at this point

The Swarkstone Bridge dates from the 18th century and was for about three hundred years the Midlands main crossing of the River Trent. The Swarkstone Causeway is in total under a mile long and has seventeen arches, and is the longest stone bridge in England. It is listed as an Ancient Monument but is subject to modern day traffic loading and volumes. Attempts have been made by the Derbyshire County Council to protect the bridge by creating a 7.5 tones weight restriction and 40mph speed limit on this section of the road.

In addition it should be noted that the nearest alternative crossings of the River Trent without weight restrictions are at Burton Upon Trent, some 12 miles upstream, and the M1 motorway 8 miles downstream. Other alternative routes crossing the River Trent would require drivers to enter Long Eaton or Nottingham itself.

In order to address the above issues emerging in the context of the South Derbyshire Local Development Framework Core Strategy, both Derbyshire County Council and South Derbyshire District Councils have identified two prospective bypass routes to divert through traffic away from the scheduled ancient Swarkstone bridge/causeway, and village of Stanton-by-Bridge and Swarkstone.

Derbyshire County Council, together with South Derbyshire District Council has asked Scott Wilson Ltd to undertake a feasibility exercise into these routes and investigate other potential routes for this purpose.

Serious concerns have been raised locally, most notably about repeated damage to the Scheduled Ancient Monument and the poor availability of non-restricted access for Heavy Goods vehicles to South Derbyshire from the north.

The following problems have been cited in particular:

- Frequent damage to the historic structure itself through the volume and weight of vehicles using it;
- Highway safety arising from the narrow and convoluted nature of the Causeway itself;
- Traffic congestion and delays in this corridor;

- Constraints on the potential for tourism and economic development in South Derbyshire through poor, weight restricted, road access;
- Constraints on access to jobs and services in Derby City from South Derbyshire through poor, weight restricted, road access;
- Disturbance to the village of Stanton by Bridge and Swarkstone in particular caused by the volume and weight of through-traffic.

Based on the site visit and desk study a number of possible by-pass routes over River Trent and its flood plain have been examined in outline, analysed and detailed in this report.

1.1 Desired Output

It is accepted that information to enable a preliminary design to be undertaken is limited at present, and that this report shall form part of a more detailed study and route assessment. This report is therefore intended to provide guidance on the selection of possible routes, and to highlight potential areas where further consideration may be required in the detailed design.

The desired output comprises the following specific tasks:

- Review five alignments suggested by the local authorities, shown at Appendix B, against the Design Manual for Roads and Bridges TD9/93 Highway Link Design and horizontal and vertical alignment
- Examine the area of other additional alterative routes that may be identified at this stage, shown in Appendix B.
- Provide revised corridors consistent with TD 9/93, assuming a design speed of 85 KpH, carriageways width of 7.3 metres wide carriageway, 2.4 metre wide cycle/footways with 1 metre wide verges. No street lighting is envisaged.
- From the constraints plan Figure 1, provided by Derbyshire County Council, identify over-ground constraints likely to be encountered by each of the potential routes and describe the scale of mitigation required to address the concerns. Advice should be provided on the Environment Agency's likely requirements in terms of engineering design and flood risk management.
- From the Geology Plans Figures 3 and 4, provided by Derbyshire County Council, identify below-ground constraints likely to be encountered by each of the potential routes. Describe the scale of mitigation required to address the concerns. For example, construction in (likely) alluvial deposits will entail risks that need to be specified, together with likely engineering requirements such as piling or other ground treatments.
- Describe the earthworks and structures likely to be required.
- On the basis of the above, provide a preliminary estimate of the likely total cost of delivering each route option.

2 Existing Road Network

The study starts from the south of the roundabout on the A50 junction 3 and runs to the south across River Trent and its flood plain to A514 to the south of the Stanton- by- Bridge.

There is a five-arm roundabout forming a junction between the A50 and A514 Swarkestone Road to the northern limit of the study area. This is a busy at grade roundabout with slip roads to the grade separated A50 trunk road. The adjacent land use to the south of this junction is predominantly farmland with two farmhouses.

To the northwest of the study area, the A514 runs in a north south direction through Stanton-by-Bridge forming a junction with B587 just south to this village. This section of the A514 Swarkestone Road through the village is of substandard width and alignment when compared to current designs for this category of road. The existing vertical and horizontal alignments have not been analysed, but by inspection, the road width through Swarkestone Causeway and south to the village show narrow carriageways with restricted visibility and blind junctions.

A514 at its junction with Ward Lane and B587 does not comply with the requirement set out in TD9/93. The alignment would also appear to contain a number of substandard horizontal curves. The horizontal alignments leads to the existing stopping sight distance being restricted. From visual inspection of the existing route it appears that stopping sight distances are not achieved at a number of locations along this section of A514. Hence a by-pass route would not only prevent deterioration of an ancient Swarkestone Causeway but also improves the safety in this road section.

The land along the A514 Swarkestone Bridge Road is predominantly agricultural between bridge and Ward Lane, whereas between Ward Lane junction and at its junction with B587 the road is bordered mainly by residential properties.

Just to the south of the Swarkestone Bridge, there is a junction at A514, leading to the narrow countryside road that runs north south along the bank of the River Trent almost parallel to the Swarkestone Bridge Road. This road runs across the flood plain and meets Ingleby Road leading back to the A514 via. Church Lane and Wood End Lane.

In the far southern limit of the study area Wood End Lane forms junctions with A514 and B587. It has a speed limit of 30mph and width varies from 5 m to 6.5m.

3 Route Development

3.1 General Background

Route development has been undertaken by means of:

- Site visits to the area (restricted to visual inspection from existing public highways and footpaths
- Examination of aerial photographs in the public domain
- Examination of geotechnical information in the public domain

Proposed routes are illustrated in drawings

- D130388/AL/01 – Routes A to E and
- D130388/AL/01 – Routes F to G

Illustrative typical cross sections have been provided in drawing D130388/CS/01.

Details of proposed routes have not been discussed with the Environment Agency, but general guidance on the requirements of the Environment Agency has been obtained and measures included in the following proposals. Should the Council elect to pursue one or more of the proposed routes it is recommended that detailed discussions are entered into in advance of the development of the detailed design.

It should also be noted that the routes will have an impact upon conservation areas. It is recommended that discussions are entered into in advance of detailed design with the local conservation officers for the Council, and with English Heritage.

The current speed limit across the A514 varies within the study area. There is a speed limit of 40mph over the Swarkstone bridge and causeway area, whereas a speed limit of 30mph is in place in the vicinity of Stanton-by-Bridge.

It is anticipated that the design of proposed alignment with higher speed limit and standard width for the new bypass route would encourage motorist to travel along this new route. Hence, existing through traffic from the Swarkstone Bridge and Causeway and villages of Stanton-by-Bridge and Swarkstone would be diverted away.

3.2 Route A

For this option, at the northern end of the route, a new junction would be provided on the A514 just south of the Mersey canal bridge. It is currently envisaged that this junction would be a T-junction with a traffic signal control system.

At the southern end of the route a new roundabout would be provided on the A514, approximately 200m south of Stanton-by-Bridge at its junction with the B587. It is currently envisaged that this roundabout would be a three-arm mini roundabout.

Once a preliminary design has been produced, capacity and delays can be predicted for this mini-roundabout using suitable computer software, which incorporates models developed from the relationships in TRL Report 281. However, the final decision should be taken based on the traffic figures on each arm of the proposed roundabouts. The TD 54/07(DMRB vol. 6 section2 part 2) recommends a roundabout only if the 2 way AADT on any arm is higher than 500. It may be acceptable to introduce a four-arm mini-roundabout where the forecast traffic flow on one arm is less than 500 vehicles per day (2-way AADT) providing there is a strong expectation of the need to 'give way' on all approaches. This would be dependent upon the circulating movements at each junction.

Introducing a roundabout may lead to the reassignment of traffic to and from other routes. There is therefore a need to assess the surrounding network for the traffic and safety implications before considering introducing a new roundabout.

The design period and forecast of traffic growth should be subject to the requirements of the Derbyshire County Council and local transport policies.

Route A commences at the proposed by-pass junction on the A514 as described above and ends at the proposed new mini roundabout on the A514, south of the Stanton-by-Bridge. The entire route runs in a north south direction, predominantly through open farmlands.

At the beginning, the route passes parallel to the Trent and Mersey Canal at grade in a south-westerly direction before crossing the River Trent. Using a suitable bridge. The route then heads in a southerly direction on a low embankment across the flood plan.

A box culvert would be provided over the bridle path that connects the Kings Newton and Stanton-by-Bridge. It is envisaged that Route A would pass over the existing B587 road with a bridge. During the site visit, it appeared that the B587 at the proposed crossing runs in a north south direction along the narrow valley and as a result, it would appear unfeasible to drop the vertical alignment of the new route sufficiently within a short distance for it to cross the B587 at grade. This effectively removes the possibility for an at-grade crossing with a new junction at this location. Until an accurate survey of the topography at this location this option has not been considered for further assessment.

The proposed alignment would finally rejoin existing A514 at its proposed roundabout at chainage 3296, south of the Stanton-by-Bridge.

In terms of horizontal alignment, this route leaves the proposed junction at A514 with a straight section, running in a south-westerly direction followed by a right hand curve of about 786 m radius, before crossing the River Trent. From here, the alignment runs in a southerly direction with a straight stretch crossing the river at around chainage 1800. There is then another right hand bend with a 602m radius followed by a straight stretch to cross existing B587 with an under bridge at chainage 2900. This straight section runs to approximately chainage 3296 to form a proposed roundabout at A514. After crossing the River Trent this alignment runs in a south-westerly direction passing the B587 through a high voltage overhead electric transmission corridor which may limit horizontal and vertical alignments without alterations to the existing pylon systems.

This alignment has been designed for a design speed of 85kph, which is suitable for a speed limit of 50mph. According to TD9/93 Table 3, minimum radius of horizontal curve for this design speed should be 510m with 5% super elevation, which would be satisfied by the proposed horizontal curves radius as stated above.

The anticipated vertical alignment from proposed junction consists of a gentle down hill gradient of 0.5% for approximately 1200m. The gradient then changes to uphill slope of about 0.5% until chainage 1800. There is then a K20 sag curve followed by another K55 crest. The K20 sag curve is required to lift the alignment for crossing River Trent with a bridge. The alignment has been kept up over the River Trent to provide adequate flood height level under the proposed bridge.

Just after crossing the River Trent the route heads south-west on an embankment, passing over a box culvert carrying an underpass for Kings Newton bridle way, before moving into cutting up to 6 metres deep. The route then leaves on a down hill gradient of about 3% to cross the existing B587 by an under bridge.

In the original brief the County Council has suggested an at grade junction with the B587 at this location. At this point the B587 is approximately 9 metres below the level of the proposed route. To achieve the required level to meet the B587 it is believed that there will be two vertical curves at this location, K55 crest curve to lower the alignment before the followed by K20 sag curve to meet the alignment of the B587. Due to the steep vertical gradient required for the proposed route to climb the existing contours at this point, the route would form a cutting approximately 6 metres deep. In addition, should a roundabout be designed at this point additional land take would be required and the extent of any earthworks increased. It is not believed that this can be achieved before the route would rejoin the A514, and hence, the provision of a junction at this location was discarded.

It may be possible to raise the vertical alignments of the B587 and lower that of the A514 in this area to meet any proposed alignments, but this would have to be verified following a detailed topographical survey and assessment of the economic viability of the proposal. It should also be noted that, should the B587 be raised at this point the some form of culvert may be required for the stream that runs adjacent to the route at this point.

It has not been determined how private properties fronting the proposed corridor would access the new route. In order to improve the safety and efficiency of the route it would be necessary to control the number of accesses. This may result in the closing of existing access and provision of a parallel access road with a single point of access.

It is currently envisaged that the proposed alignment cross section will comply with TD27/05 requirements for a rural single carriageway all-purpose road (S2). From chainage 00 to 1200, the proposed route is in a shallow cutting followed by a low embankment to chainage 1800, before crossing the river. From chainage 1900 to 2200 vertical alignment will be in a shallow embankment across the River Trent floodplain. Then alignment enters into cutting in the vicinity of the B587 crossing. This route could accommodate overtaking sections and would allow the efficient movement of through traffic. It is believed that the corridor is sufficiently far enough away from the main areas of residential properties to provide significant benefits in terms of noise and air quality, and would be acceptable for conservation purposes as it can be masked from the causeway area by planting and earthworks.

3.3 Route B

This option was considered a variant to option Route A with the difference that the route commenced at the A50 junction 3 roundabout. The route shares a common alignment with Route A after Chainage 889, and the continuation of the route is not discussed.

The A50 roundabout will require works to accommodate a proposed sixth arm and may require widening to increase capacity. The existing footway/ cycleway facilities on the roundabout should be maintained and may provide a better link to the existing cycle route networks in the area. Uncontrolled pedestrian and cycle crossing facilities will need to be considered for inclusion in the roundabout's splitter islands if this design is adopted.

The anticipated horizontal alignment proceeds south for a distance of approximately 200m from the roundabout before crossing an existing railway line via a proposed under bridge. It then crosses the Trent and Mersey Canal at chainage 500 before joining with Route A around its chainage 850.

The anticipated vertical alignment commences with a 1.5% downhill gradient from the roundabout and runs on an embankment passing over a proposed box culvert to maintain an existing farm access. The alignment then continues to run on an embankment at sufficient level to provide headroom for proposed over bridge site crossing an existing railway line. The embankment would then continue to enable the route to cross the Trent and Mersey Canal with a proposed box culvert or bridge before meeting the alignment for Route A.

The difference between the Route options A & B in terms of journey times is considered, at this stage, to be negligible. The reasoning is that Option B has a complicated junction arrangement at the A50 junction 3 roundabout. As a result, the westbound traffic from A5132 and A514 wishing to join new proposed bypass route would need to negotiate the heavily trafficked roundabout at A50 junction 3. This will result in a modest extension to the journey time for these vehicles but it is believed that it will have no impact on traffic using the proposed junction on the A514 for Route A.

3.4 Route C

This route begins at the southern end of the existing Swarkestone Bridge and passes adjacent to the existing Swarkstone Causeway to the east and existing fishing pond to the west before rejoining the A514 at Ward Lane, just north of the Stanton-by-Bridge village. As a result, this road would not be able to provide a bypass for the through traffic away from narrow section of the A514 around this residential area.

This option was examined during the site visit and appeared to be unfeasible due to its proximity to the existing listed structure and limitations that could be placed upon construction by conservation issues. In addition, as the route does not address the problem stated in the project brief of reducing traffic through Swarkstone and Stanton by Bridge it is not considered that it would be acceptable as an alternative route.

3.5 Route D

This route commences at proposed new junction on A514 about 200m southwest from the Mersey Canal culvert. The route runs across the River Trent flood plain in a southerly direction across open farmland to rejoins the A514 at its junction with Ward Lane at Stanton-by Bridge.

According to the brief provided by DCC, the proposed bypass route would also need to address problems such as disturbance to the village of Stanton-by-Bridge caused by the volume and weight of the through traffic, highway safety and traffic congestion and delays. Given the proposed connection location with the A514 to the north of the village, this option would not be able to solve these problems. As a result, this option has not been proceeded for further analysis.

3.6 Route E

Once again, this route starts at the proposed junction on the A514 about 100m to the southwest of the Mersey Canal culvert. Commencing at the junction, the route runs in a southerly direction across the rear boundary of the existing Old Hall Farm and through an area of private land before crossing the River Trent, joining the A514 to the south of Stanton by Bridge. Predominantly the route passes through undeveloped pasture land.

In terms of horizontal alignment, from the beginning the route runs and long curve before straightening to cross the River Trent and the flood plain in a southerly direction before crossing Ward Lane. From here, the alignment curves to the south-westerly direction with a right hand bend radius of 508m crossing the existing B587 to join proposed roundabout on the A514 at chainage 2200.

In general, the vertical alignment would follow the existing grounds fall towards the River Trent, before running on low embankments until it crosses Ward Lane. At this point the alignment

would have to rise to cross the lane with a box culvert or bridge. From here before crossing the B587, the vertical alignment follows a downhill gradient of about 9% slope to cross the existing B587. There is then a K55 crest curve to lower the alignment at crossing of the B587 followed by K20 sag curve. After crossing the proposed bridge over B587 vertical alignment starts to climb reaching a maximum gradient of about 10%. At this location, a K20 sag curve is required to lift the vertical alignment. The alignment then finishes the deep cutting with a more flat uphill gradient of 2%, which continues to the proposed roundabout at A514.

Just after crossing the Ward Lane, this route crosses an existing escarpment at an oblique angle. This would lessen the visual impact, reduce gradients and improve the cut and fill balance, and is considered to be superior to Route A & B at the B587 crossing point.

The cut and fill balance varies across the proposed routes but, in the vicinity of the B587 crossing it results in a large quantity of surplus material. By keeping some of this material on site, in the form of landscaping and noise bunds, a significant reduction in cost can be achieved. However, the environmental effects of the bunds must also be considered as it will require significantly greater land take. Although this aspect can be managed by providing a gentle slope on the non-carriageway face so the land can be returned to agricultural use, this will not reduce the loss of habitats or existing hedgerows where present. However, this is balanced by a visual improvement compared to the route without the use of landscaping bunds.

The provision of direct vehicular access from individual properties onto a road of this standard is unacceptable under current design practice due to safety issues and the impact on capacity. It is therefore proposed that the existing Ward Lane adjacent to the properties is converted into an access way and a simple priority type junction will be provided at this junction as an access for Ward Lane. This would provide vehicular access to the properties with only a limited number of junctions onto the new road.

3.7 Route F

This is an additional option developed with the view of utilising the existing cycle route structures and following the disused railway alignment crossing the Trent and Mersey canal and River Trent as indicated in the study brief. This option was looked at during site visit to investigate its viability.

The new route commences at the A50 roundabout as described in Route B . It would cross and existing farm access and have to cross the existing railway line, before running parallel to the Trent and Mersey canal. It would also have to cross or replace the existing Swarkstone Road to Weston on Trent, and runs parallel to it before curving south along the National Cycle Route No.6 with a right hand bend of 450m radius to cross the Trent and Mersey canal and River Trent. The route leaves the bridge in a south-westerly direction on low embankment, across the flood plain for 600m.. The route then curves to the west to tie into the proposed roundabout on the A415 crossing B587 as it does, in a similar manner to that described in Route A.

In terms of the vertical profile, this route gently slopes downwards from north to southeast. After crossing the River Trent, the alignment runs on low embankment and turns quickly from

embankment into cutting. The bypass route drops down to cross the B587 with an under bridge that would carry existing B587 traffic under the new road. The alignment cuts into an upward gradient of 9%, before a K55 crest curve. From here, it drops down in a gentle slope until it meets proposed roundabout on the A515 at its current level.

This route attempts to follow the existing National Cycle Route as closely as possible. As a result, this route would be longer in terms of overall route length and journey time. It would require more land acquisition with compared to the other routes under consideration. This also results in low flexibility for cut fill balance.

Further more, the given obligatory points would dictate the horizontal alignment, i.e. National Cycle route and end connection location of the proposed bypass route. This would lead in assigning sharper horizontal curves and consequently lower design speed for the route.

Given the above facts it is felt that motorist may be reluctant to use this circuitous route and as a result, this alignment would not be fit for purpose.

3.8 Route G

This route was explored as an additional option utilising the existing road network to the west of the Swarkestone Causeway. This road begins at its junction with A514 just south of the existing Swarkestone Bridge. This road runs across the flood plain in a north south direction along the bank of the River Trent replacing the existing Swarkstone Bridge Road. This route is likely to be flooded due to its low vertical alignment, unless it is raised on an embankment. If this occurs it will have a direct effect on the flood levels of the River Trent as it removes to opportunity for flood water to enter the flood plain in advance of the Swarkstone Bridge

The route then turns to the east up a steep uphill section along existing roads leading to the existing A514 to the south of the village.

During the site inspection, it appeared that it would be difficult to create appropriate links with existing road network to the southern end of the study area without the creation of a new alignment. It is recommended that consideration be given to the abandonment of the existing carriageway alignment and a new alignment be created that would minimise the visual impact of the new carriageway on the area.

The minimum level of the vertical alignment and its elements for this route along Swarkstone Bridge Road would be dictated by the predicted flood level for the River Trent. In order to raise the existing road level an embankment with 1:3 slopes would need to be constructed along the existing road above the flood level. Depending on the existing highway boundary, additional land take may be required. The existing route alignment would need to be realigned away from the river bank as the road is too close to the River bank and balancing ponds in places.

Upgrading of this existing access route across River Trent flood plain would need to comply with Planning Policy Statement 25. Careful consideration should be given to the maintenance of flood route and potential loss of floodplain storage as a result of embankment works. Compensatory flood storage may be required. If this outline proposals is taken forward to

detailed design the Environment Agency should be formally consulted to ensure that they are satisfied that the route would not exacerbate flooding mechanisms, and that the route is safe in terms of flood risk.

Given the above constraints, this route would not appear to offer an acceptable solution for a proposed Swarkestone bypass road.

4 Standards and Departures from Standard

4.1 General Background

The proposed alignments have been designed in accordance to the TD9/93 of the Design Manual for Roads and Bridges. Cross sections of the proposed alignments have been based on TD27/05. Where allowance has been made for ghost island junctions, these have been designed in accordance with TD42/95. Any roundabout on the scheme would have to be designed to TD16/93.

The proposed bypass routes do not require any departures from standard for the currently proposed alignments, except for Route F and G. They have utilised the permitted relaxations in some places. The alignments comply with the recommendation of TD9/93, for ;

- Provision of overtaking sections
- Provision of one step below desirable visibility in none overtaking section

TD9/93 recommends that 30% of the proposed road should be overtaking sections (Category 2 road, Table 7). This requirement has been achieved on proposed routes.

The full overtaking sight distance for a design speed of 85kph is 490m and 285m for a 70kph design speed. These requirements mean that the proposed alignments have no problem for overtaking sight distance. The desirable minimum stopping sight distance has been provided throughout the alignments. The alignments will require a significant amount of warning lining and possibly the use of hatching to discourage speeding.

TD9/93 recommends that in sections of none overtaking the k value on vertical crest curves should be one step below the desirable minimum value. This is to ensure that none overtaking section's forward visibility is restricted to clearly dissuade overtaking in these areas (TD9/93 para. 7.30). This requirement however conflicts with another requirement, which is to provide the full stopping sight distance in the vicinity of a junction (TD9/93 para. 1.26). The alignments have been designed to provide full stopping sight distance in the vicinity of junctions, which has required the use of the desirable minimum crest curves within none overtaking sections. This is particularly the case for the alignments close to the proposed roundabout on the A515 and junction on the A514.

The carriageway standard has been based on the expected traffic flows provided by the Derbyshire County Council. For flows in this region of 14,500 v/day, the choice of carriageway standard should be wide single two-lane (WS2), or dual two-lane (D2AP). The opening year flows would even exceed the maximum opening year AADT for S2, the client has, however, instructed Scott Wilson to only consider single carriageway options in this report.

Considering the environmental sensitivity of the area and the standard of the surrounding roads, it was considered that S2 was the most appropriate choice. However, due to the

gradients required at crossing over B587 section to negotiate the existing escarpment, climbing lanes have been included on the steepest gradients.

The viability of the carriageway standard will be considered as part of the economic assessment of the scheme. However, the final choice will be as a result of environmental, economic and operational considerations.

It is currently envisaged that the proposed alignment cross section will comply with TD27/05 requirements for a rural single carriageway all-purpose road (S2). The typical cross sections for the routes are shown in drawing D130388/CS/01.

The selection of junction type has been guide by Figure2/2 in TD42/95, which is shown below. This gives recommended junction types based on the predicted major road and minor road traffic flows.

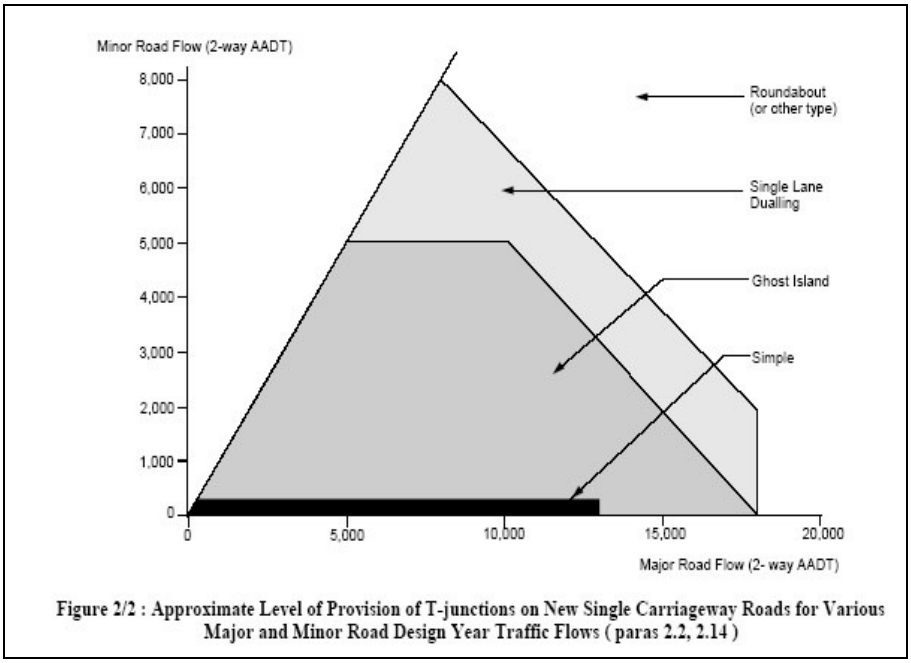


Figure 2/2 : Approximate Level of Provision of T-junctions on New Single Carriageway Roads for Various Major and Minor Road Design Year Traffic Flows (paras 2.2, 2.14)

Figure 2/2 from TD42/95

Using this graph the predicted main line traffic flows effectively preclude the use of any junction other than a roundabout (or other type). This however would appear to be an excessive requirement for very minor junctions, such as the junction with Ward lane. It is therefore proposed that the junctions onto the mainline are ghost island junctions.

The junctions at A50 junction 3 in the beginning of the bypass route for option B is envisaged to be a six arm roundabout, whereas at the end of the routes at A514 a mini roundabout would serve for options A, B, E and F. For all other routes commencing north of the River Trent from the A514 a priority junction would be provided.

For all the identified routes, the junction arrangements and overall strategies have been given careful consideration. The principal factors have been both adequate capacity for the anticipated traffic flows and the highest possible safety standards.

The proposed roundabout and junction have not been designed yet as this is beyond the scope for this study.

5 Drainage

5.1 General Background

The proposed alignments have been reviewed to identify possible means of discharging surface water run off from the proposed carriageway. No consultation has been carried out with the Environment Agency, Drainage Board or Water Company to see if they would agree to the proposed methods of outfall.

The drainage design shall be considered for a 1 in 100 year storm return period with a 20% uplift on volumes for global warming in line with current recommendations.

The ground water from the surrounding area will tend to move towards the more permeable sub base and fill material beneath the carriageway construction. In order to contain this it is anticipated that some form of filter or basal layer drainage system will be required beneath the highway construction to reduce the moisture content of the highways construction.

In addition some of the area forms part of the flood plain for the River Trent. Any works that decrease the flood storage volume available may require mitigation measures to provide additional storage to replace that lost. It is therefore preferable for any works to be restricted to existing ground level. If mitigation measures are required they are likely to be in the form of ponds or wetland areas.

In the absence of existing surface water sewers in the area it would seem that surface water drainage will have to be via existing streams and drainage ditches. In the absence of drainage studies for the area these must be assumed to be running at capacity downstream during peak discharges at present, and some form of retention reservoirs may be required to moderate peak flows.

Consultation should be undertaken with the local land drainage authority for the area to ensure that existing drainage paths are not affected by the proposals. The authority is believed to be Swarkestone District Council.

5.2 Route A

It is currently envisaged that the system would drain from the proposed junction at chainage 00 towards chainage 700. Storage facilities would have to be provided to attenuate the rate of outfall to the stream around chainage 700. A pollution control device will also be required to achieve the minimum legal requirements for the quality of discharging surface water, as set out by the Environment Agency. The system could then outfall into the adjacent watercourse at this location.

From chainage 700 onwards the system will drain to a low point at approximately chainage 1700. The system could then outfall into the River Trent at this location. Storage will need to be provided to attenuate the rate of outfall to the equivalent of a green field site. It is currently envisaged that a detention/balancing pond could be constructed in the land between the

proposed alignment and the Mersey Canal. A pipe culvert will be provided at chainage 700 to discharge drainage system to the watercourse.

The system will drain back from chainage 2400 to the proposed detention pond at around chainage 1900 and outfall into the River Trent with a pipe culvert. The surface water from chainage 2500 to proposed under bridge at B587 will outfall in to the adjacent stream at chainage 2900. Likewise the system will drain back from chainage 3100 to this stream location.

Due to lack of suitably close watercourse, the last section of this route from chainage 3150 would also require to drain into the existing highway drainage system of A514. In order to accommodate these additional flows, it is anticipated that the existing drainage system would require upgrading.

It is anticipated that around each outfall location some storage facilities would be required to attenuate the proposed flows, to the equivalent of a green field site. Pollution control measures would also be required.

5.3 Route B

Drainage system of the proposed Route B has been achieved through a combination of both outfalls into existing watercourses and into existing highway drainage. It is anticipated that flow attenuation measures will be required for this route including the use of balancing ponds at each outfall location, online storage ditches and oil interceptors at suitable locations along the routes.

In the beginning of the route at around the roundabout to chainage 800 drainage system would discharge into the existing highway drainage network system.

As mentioned in section 3.3 above, Route B follows the same alignment as Route A after chainage 800. This means that the drainage system would drain in a similar manner to Rote A after this point.

5.4 Route C

As explained in route description under section 3.4 above this route has not been considered for further analysis, hence no drainage system has been analysed for this option. However, as the route crosses the River Trent flood plain any drainage system would have to provide storage facilities to attenuate the rate of outfall and a pollution control device to achieve the minimum legal requirements for the quality of discharging surface water, as set out by the Environment Agency. It is believed that this would have to be incorporated in the form of an extended ditch between the causeway and the new alignment as there is insufficient fall over the length of the causeway in the possible road alignment to allow positive drainage to one point.

5.5 Route D

It is assumed that the surface water drainage from the proposed junction at A514, chainage 00 will drain to the River Trent at around chainage 400.

The drainage system from the end point of the route from chainage 1300 would also drain back to the River Trent. As for the previous options A & B, some storage facilities and pollution control measures are likely to be required as this route runs across the flood plain of the River Trent.

Storage will need to be provided to attenuate the rate of outfall to the equivalent of a green field site.

5.6 Route E

The drainage system for the proposed route will also be a combination of both outfalls into existing watercourses and into existing highway drainage systems if sufficient capacity exists.

Once again, this alignment starts at A514, just north to the River Trent. Hence, the drainage system from the beginning would be discharged into River Trent with corresponding storage and pollution control measures.

From chainage 1300 also the system would drain back to the River Trent at around chainage 800 across the flood plain.

Given the nature of the topography of the proposed alignment, it is expected that from this point onwards, before crossing the B587, drainage will be discharged either into existing watercourses, soak away systems or into the existing highways drainage network system adjacent to the B587. The drainage system after crossing the B587 would also drain back to the existing drainage system of B587 which we believe discharges into the adjacent stream. After this point the system will drain into the existing drainage ditch adjacent to the A514, south of the Stanton-by-Bridge village. The existing drainage ditch is likely to be required some offsite upgrading works to accommodate the additional flows.

5.7 Route F

It is envisaged that, from chainage 00 to the River Trent, the system would drain to an existing watercourse, as this route starts at existing junction 3 on the A50 roundabout and runs along the Mersey Canal, before crossing River Trent. As in the previous routes pollution control measures are likely to be required.

After crossing the River Trent, the drainage system would run to an existing highways drainage ditch around B587. The reminder of the alignment would also drain to the existing system adjacent to the A514.

5.8 Route G

This option is an on-line improvement of the existing road as described in the route description under section 3.8 above. The route runs across the flood plain along the bank of the River Trent and alongside an existing pond. The drainage design would have to consider the most beneficial method to accommodate excess storm water discharge, as discharge into the adjacent ground water table will be impractical due to high water levels in the surrounding area.

In addition additional storage may be required to compensate for the volume of water displaced by the carriageway in flood events. It is not believed that there is sufficient land that is not itself subject to flooding available adjacent to the route at this point to provide this storage volume.

Drainage along the remainder of this route has not been considered as it is believed that it will be influenced by decisions on the actual route to be adopted. (refer to section 3.8 above)

6 Existing Ground Conditions

The information currently available or referred to for the preparation of the feasibility study and accompanying report is listed in Appendix A – Background Information. Where definitive information is not available any design is to be based upon best practice using nationally recognised standards, but assuming the probable worst case scenario.

6.1 Site Topography

From the north (chainage zero) all the proposed routes considered for further analysis extend from the A514 in a southerly direction and cross the River Trent and its flood plain and agricultural fields for approximately 1700 m before crossing the existing B587. At around chainage 2900 existing B587 runs in a north south direction, perpendicular to the proposed alignments along the deep narrow valley. At this location, due to the nature of the existing topography, all proposed routes would require an under bridge over the B587. At both ends of the crossing, all alignments move into cut, reaching maximum depth of 9m. After crossing the B587, the routes run in a shallow cutting to tie into proposed roundabout on the A514, south of the Stanton-by-Bridge

Without a topographical survey, it will be impossible to provide an accurate earthworks design or quantities for the works. We shall provide a best estimate of the factors affecting the vertical alignment based upon the contour levels available and upon visual survey. This will provide an estimate of cutting and embankment areas (also see 3.3 below).

To the west of the B587 an extensive drainage ditch exists that appears to form a large part of the local land drainage system. Alteration of this ditch would be costly and may affect the hydrology of the area. As a result it is recommended that no alteration is undertaken north of the A516 Derby Road.

6.2 Geotechnical Issues

The major geological issue with the proposed routes are unknown. This would need to be addressed in any future ground investigation study, but is likely to be a risk throughout the design and construction of all the options.

From the visual ground investigations carried out and desk studies of the adjacent area it appears that the ground conditions are predominantly alluvial deposition in nature. It could therefore be assumed that, with the noted high water tables requiring surface drainage ditches to aid land drainage, that the moisture content of the soil will be correspondingly high. However, in areas adjacent to the drainage ditches the drawdown of the ground water table caused by the ditch will result in a marked reduction of moisture content.

In addition, given the alluvial nature of the surrounding area, it can be assumed that soil conditions could vary throughout the length of the route, with the possibility of localised areas or 'lenses' of varying material. These lenses may be sands, gravels or clays.

In view of this it can be assumed that the bearing capacity of the in the area will be poor in the base of the valley, with varying soil strengths anticipated to be encountered within the alluvial areas.

Preliminary design will therefore take the worst possible case for the soil bearing capacity, and provide additional surface water drainage paths in an effort to reduce the moisture content of the soil beneath the highway construction.

6.2.1 Introduction

This note summarises the ground conditions expected to be encountered and possible ground treatment required for the proposed route corridors, divided into the following areas according to their topography: . Refer to Figure X.

Northern Area – This covers the rising ground from River Trent floodplain generally to the northeast of the Trent & Mersey Canal, Swarkstone Road, and railway. This area covers both Route Corridors Rev A and Rev B.

Central Area – This comprises the River Trent floodplain, from the Trent & Mersey Canal in the north to the ridge at Ward's Lane in the south. This area is split by a change in underlying bedrock at a point 200-400m north of the river crossing and covers Route Corridor Rev B.

Southern Area – This covers the area to the southwest of Ward's Lane. This area covers Route Corridor Rev B.

6.2.2 Geology

The following section summarises the bedrock and superficial geology and likely hydrology with comment on mining related issues. The interpreted geology and ground conditions are based on available archival data including the following:

BGS Technical Report WA/96/30 (1996) Gypsum: Geology, Quarrying, Mining and Geological Hazards in the Chellaston and Aston-on Trent areas. 1:10,000 sheets SK33SE, SK32NE, SK43SW and SK42NW.

BGS 1:50,000 Series Map, Sheet No. 141, Loughborough, Solid and Drift.

Report No. 563/72/SD, May 1975. Report on a soil survey at M42 Birmingham-Nottingham Motorway: Castle Donnington Section IIA, Volume 1, Part A. Prepared by Cementation Ground Engineering for DoE.

BGS 6" County Series Geological Map, Derby 55SW (1916).

BGS 6" County Series Geological Map, Derby 58NW (1916).

British Geological Survey (2002) Engineering geology of British rocks and soils: Mudstones of the Mercia Mudstone Group. Research Report RR/01/02.

6.2.2.1 Bedrock Geology

The bedrock geological strata (Figure 3) along both of the proposed route corridors comprise two major units divided by the west-northwest to east-southeast trending River Trent Fault:

Permo-Triassic strata comprising Sherwood Sandstone Group and Mercia Mudstone Group transitional Unit A. These strata are generally located to the north and north east of the River Trent, approximately conjectured at 290m north, and proved 400m north, of the proposed crossing.

Carboniferous Strata of Namurian age Millstone Grit Group. The Millstone Grit strata are generally located to the south and south west of the River Trent, and extend to the immediate north of the river at the proposed crossing.

The Permo-Triassic strata that forms the transition between the Sherwood Sandstone Group and the overlying Mercia Mudstone Group, is the transitional Unit A. The general description taken from BGS Report RR/01/02 corroborates the material described from the borehole logs observed and comprising of:

interbedded brown mudstones, siltstones, with paler grey-brown sandstones in approximately equal proportions. Sulfates (Gypsum) is present in small veins and nodules but generally not as abundant as in higher units. In the Eastern England Shelf, the base of the unit is unconformable and is marked by patchily distributed basal conglomerates up to 1m thick with strong calcareous cement.

The mapping and borehole records indicate that the bedrock comprises of arenacous (sandstone) strata to the south of the Trent & Mersey Canal, becoming a silty mudstone to the north of the canal. Previous investigations have revealed that the strata variably consist of coarse sandstone referred to as 'Keuper Sandstone' with conglomerate proved at a depth of approximately 9m bgl adjacent to the canal on the south side, overlying a destructured sandstone of the Millstone Grit horizon, and overlain by interbedded very stiff clay and siltstone generally proved as fine grained fissile mudstone and interbedded with silty clay and siltstone and increasing depth to conglomerate progressing northwards to approximately 70m north of the railway.

Approximately 100m north of the railway an east west fault is conjectured between the sandstone strata of the SSG and mudstones of the MMG. Therefore it was concluded that the features of the MMG sandstone strata in the south, and MMG mudstone strata in the north are generally similar with the mudstone generally showing an increase in clay content.

6.2.2.2 Superficial Deposits

Where the bedrock strata are covered by superficial deposits (Figure 4), these comprise of Glacial Till in the north, Sand & Gravel and Alluvial deposits within the River Trent floodplain

and minor Head / Fluvio-Glacial deposits and alluvial deposits to the south. Alluvial deposits comprise silty organic clay overlying sandy gravel deposits with peat inclusions to a depth of up to 7.5m bgl.

6.2.3 Ground Conditions

The general ground conditions are described over pertinent sections of the proposed route corridors in more detail covering the various sections grouped according to their topography as follows.

6.2.3.1 Northern Area

Route Corridor Rev B:

Route Corridor Rev B extends to Chellaston roundabout on the A50. A cover of cohesive Glacial Till is indicated on the mapping, which is underlain by MMG strata likely to comprise of very stiff clay interbedded with siltstone becoming silty mudstone with depth.

It is anticipated that cuttings will be made in, and embankments and structures will be founded on partially weathered MMG bedrock and Glacial Till. Conventional earthworks and bridge foundations are anticipated. Control of groundwater is likely to be required.

Route Corridor Rev A:

Route Corridor Rev A extends to Cuttle Bridge on the A514. Glacial Till deposits are indicated to the immediate north of this section. To the south of Swarkstone Road extending to south of the canal and including the area of raised ground, alluvial deposits cover the majority of this section and previous investigations indicate that these could typically comprise of up to 1.5m of alluvial clay.

There is potential for poor founding conditions through this section. Earthworks constructed on this material may require foundation treatment such as localised excavation and replacement of soft / unsuitable material, and starter layers combined with surcharging, pause periods and monitoring. Control of groundwater is likely to be required.

Gypsum:

Gypsum strata of economic worth are present and have historically been worked in the area between Chellaston, Weston-on-Trent and Aston-on-Trent. These are located at a significant distance to the north east of the proposed route corridors, but there is a likelihood of discrete gypsum as veins or nodules to be present. Significant solution features are unlikely, therefore it is considered that conventional earthworks and structure foundations will be required.

6.2.3.2 Central Area

The central area traverses the River Trent floodplain and is divided at approximately 200-400m north of the river crossing by a change in underlying bedrock, namely Permo-Triassic to the north and Millstone Grit to the south.

North:

This area is underlain by sandstone and mudstone strata of Permo-Triassic age, with a thinner cover of superficial material.

The gravel alluvium horizon extends to depths of up to 5m bgl.

These bedrock strata were found to comprise of a shallow weathered layer of very stiff gravelly clay of up to a few metres thickness, typically <2m to 4m, becoming intact interbedded sandstone, siltstone and mudstone. SPT blow count values (generally extrapolated values) were typically greater than 180 for the sandstones.

There is potential for poor founding conditions through this section in areas of cohesive alluvium. Long term settlement is likely where pockets of peat or fine alluvium are present. Earthworks constructed on this material may require foundation treatment such as localised excavation and replacement of soft / unsuitable material, and starter layers combined with surcharging, pause periods and monitoring. Control of groundwater and flood protection is likely to be required.

South:

This section crosses the river in an area of ox-bow meander to the east of Stanton Barn. The ground investigation records across the area of flood plain show a significant cover of superficial deposits underlain by Millstone Grit strata.

The superficial alluvial deposits extend to a depth of 7.5m bgl, comprising

Topsoil up to 0.7m thick, overlying;

Cohesive alluvium comprising firm sandy organic clay with gravel and carbonaceous debris and peat pockets extending to depths of between 0.5m and 1.2m bgl, overlying;

Medium dense rounded gravel with sand and cobbles, with occasional carbonaceous debris and peat pockets, extending to depths of between 5m and 7.5m bgl.

Groundwater strikes were generally recorded at depths of between 2m and 3m bgl.

The Millstone Grit strata typically comprise of highly weathered and fractured, revealed as stiff gravelly clay, fissile mudstone interbedded with siltstone and sandstone, often weathered to sand. Previous investigation indentified two faults immediately north of the river and heavy weathering on the north and south sides of the river extending to depths in excess of 10m bgl.

It is likely that there are poor founding conditions through this section and excavation into the alluvial material is likely to be problematic due to shallow groundwater levels. Earthworks constructed on this material are likely to require foundation treatment and flood protection.

Localised excavation and replacement of soft / unsuitable material may be required where possible. Basal reinforcement may be required to guard against instability where soft alluvial material is left in-situ. Starter layers including geotextile separators may be required to provide a suitable embankment construction platform on soft alluvial material, combined with surcharging, pause periods and monitoring to reduce differential settlement due to the compression of organic silt and peat horizons. This is particularly important for the river crossing approach earthworks to reduce long term differential settlement with the structure. Where there is a significant thickness of cohesive alluvium (or horizons of peat or fine alluvium) this may be mitigated against by stone columns or vertical drains where extended pause periods are not feasible.

In the area of the river crossing structure, the cohesive (organic) and granular alluvial material is underlain by the faulted, highly weathered and fractured Millstone Grit strata. It is likely that bored cast-in-situ piled foundations will be required and will need to account for high groundwater levels and the possibility of negative skin friction due to settlement of the alluvium. Rock sockets into the competent Millstone Grit strata are likely to be required, with a possible founding depth of between 10m and 20m bgl, dependant on the magnitude of ground disturbance due to faulting. Consideration for river bank erosion protection measures will be necessary for the construction.

6.2.3.3 Southern Area

The edge of the River Trent floodplain is generally demarked between Stanton Barns and Kings Newton Fields. The southern section of the route corridor is located to the southwest of Wards Lane, crossing the B587 and Wood End Lane. Superficial deposits are relatively shallow, underlain by Millstone Grit strata.

Superficial deposits are relatively shallow, with a similar sequence and description as described above extending with a cover of river gravel to depths of about 2.5m bgl. Deposits of fluvio-glacial origin were described extending from below topsoil to depths of 2.1m bgl comprising firm very sandy clay with occasional gravel. Head deposits indicated may be of similar nature.

Sandstone and mudstone bedrock of the Millstone Grit series was generally encountered at depths of less than 2.5m bgl.

It is anticipated that cuttings will be made in, and embankments and structures will be founded on weathered Millstone Grit and Fluvio Glacial deposits. Conventional earthworks and bridge foundations are anticipated. Earthworks constructed on alluvial material may require foundation treatment such as localised excavation and replacement of soft / unsuitable material, and starter layers combined with surcharging, pause periods and monitoring. Control of groundwater is likely to be required.

6.2.4 Ground Investigation

There are significant sections of the route corridors that do not currently have ground investigation and risks to both earthwork and structure construction have been identified. It is recommended that a more detailed geotechnical survey to determine the exact nature of the ground conditions is undertaken when the final alignment is agreed.

This should include assessment of depth to competent rock-head in the area of the river crossing; monitoring to establish the shallow groundwater regime; confirm consistency of the alluvial deposits and identify the presence of significant pockets of peat. The descriptions presented on historical records do not allude to the presence of aggressive ground conditions, although the data are very limited and Millstone Grit is potentially more aggressive than alluded to. The design standards and assessment procedures of aggressivity have changed, therefore this should be confirmed for the purpose of concrete and steel design.

6.3 Flora and Fauna

A separate environmental assessment of the area would be essential as all routes cross areas designated as nature reserves. However, from visual survey on the 22nd March 2010 it was noted that the proposed routes would result in the removal of a number of mature species of trees that currently form part of the field boundary system outside these areas.

Should these trees (or other forms of flora or fauna) endanger the development of the route it may be possible to minimise the risk by using route E, running parallel to existing field boundaries and minimising the number of tress affected. This could also result in the remaining trees forming a visual barrier for the route from the village of Stanton-by-Bridge.

In addition, the area is crossed by a number of small streams and contains wet areas and ponds. It is likely that these areas may contain amphibians, and it is therefore recommended that any investigation pay attention to this possibility, and that the final design seeks to minimise disturbance to any pond or wet area. Should the removal of such an area be needed it is likely that the Environment Agency shall seek a replacement area as part of the works

6.4 Existing Buildings

From the visual survey, there are no buildings or structure affected by the proposed routes.

6.5 Existing Services

A search for statutory undertaker's services has not been undertaken in this study. However, it is recommended that detailed information be made once the potential route is finalised.

High voltage overhead electricity cables were noted running east / west in the vicinity of the existing B587, which may affect the proposed alignments.

6.6 Historic Monuments

All routes will cross areas designated as 'Of Historic Significance' and works will result in the disturbance of those areas.

7 Proposed Design

The final road alignment has yet to be confirmed by Derbyshire County Council, therefore, for the purposes of this report an approximate alignment is to be designed, with assumed chainages commencing in the north at A514. It is assumed from the general site topography that the route will be approximately at grade with low embankment and no significant structures, or cuttings

The information currently available or referred to for the preparation of the preliminary design and accompanying report is listed in Appendix A – Background Information. Where definitive information is not available any design is to be based upon best practice using nationally recognised standards, but assuming the probable worst case scenario.

7.1 Proposed Widths

The proposed carriageway width has been specified by Derbyshire County Council as 7.30 metres wide. A 2.40 metre wide footway/cycleway is also provided, which with 1 metre wide verges would result in a minimum width of 11.7. As a result, the proposed width of the route will be in the order of 11.7 metres wide without drainage facilities. With drainage facilities such as road side ditches a width of approximately 17.7 metres is envisaged.

Should some form of landscape mitigation be required to shield the new bypass road from surrounding areas any additional width required will have to be specified as part of a landscape mitigation package.

7.2 Pavement Design Subgrade and Capping

Pavement design should be carried out in accordance with Highways Agency requirements as given in DMRB HD26/06 (Ref 6). Given the anticipated variation of ground conditions across the site it may be assumed that the thickness of capping layer and sub grade required will vary and will be dependant upon the type ground encountered and methods of ground treatment adopted.

It can be assumed that, in order to facilitate the movement of ground water beneath the carriageway construction in flood events, that some form of basal layer will be installed (see 3.8 below). This is normally created by sandwiching a layer of free drainage material between two geotextile membranes. This basal layer may also form part of the ground improvement work required for poor soil conditions and result in a reduction of the thickness of sub-grade and capping layers.

7.2.1 Subgrade and Capping

In the absence of a geotechnical report or investigation and the possibility of varying soil conditions aligned with high moisture content the worst case scenario has been considered and a CBR of less that 2% assumed.

According to DMRB vol7, section.2, HD 25/94 figure 3.1, for the pavement foundation with less than 2% CBR, a sub base thickness of 150mm on top of 600mm capping has been adopted. The capping layer is assumed to comprise of free draining material which will also form the basal drainage layer.

7.2.2 Flexible pavement

According to DMRB vol.7 section 2 HD 26/06, figure 2.1,for the class 2 foundation with stiffness > 100MPa the combined design thickness of the flexible pavement will be 200mm.

As per HD 36/06, the permitted options are considered as follow.

40mm Thin wearing course surfacing system

60 mm Dense Bituminouis Macadam (DBM) 50 binder cousre

100mm Dense Bituminous Macadam DBM 50 base course

Maximum AAV for aggregate for TWCS - 16

Minimum PSV required for TWCS - 55

least 2.0m above water levels, (about 1m above existing ground levels) and that the road will have to rise from ground level to those points, increasing the verge width to provide an embankment for the culvert headwalls.

7.3 Earthworks

It is important to note that, due to the topography of the area, the earthworks balance of each bypass route is poor.

It is envisaged that the proposed routes are assumed to have two major bridges to cross the River Trent and existing B587 Road. Consideration should be given to the foundation design of these structures considering the local ground conditions following confirmation of the road alignment.

No major strengthened earthworks are likely to be required along the routes apart from the works on Routes. It is anticipated that some small structures are likely to be required at the stream crossing points. The structures are most likely to be precast concrete box culverts whose design will enable their dead load and the applied load from the road construction to be spread over their base area, reducing the ground pressure loading on the made up ground.

The soil strength results in the alluvial soil are expected to be quite low and include local variations in soil conditions crating soft spots. Without treatment, improvement or removal the

soft spot areas are unlikely to provide a suitable foundation for the proposed road, due to its low strength and variable nature.

This would normally also require the increase in depth of capping and sub-base layers to compensate for the low ground strength by distributing the load over a greater area.

A 'standard' road pavement construction is therefore likely to result in an undulating road surface over time as the road subsides over the weaker areas and the stronger layers remain unchanged. This is likely to result in serviceability and maintenance problems to the road and drainage as cracks, low spots and steps form.

Cuttings or embankments should be formed at a shallow angle; an assumed slope of 1:2 has been taken for design purposes. This may require some form of retention or slope stabilisation in the initial stages before root growth from landscape planting can establish to help to stabilise any new slopes.

Cuttings or embankments should be formed at a shallow angle; an assumed slope of 1:2 has been taken for design purposes. This may require some form of retention or slope stabilisation in the initial stages before root growth from landscape planting can establish to help to stabilise any new slopes.

7.4 Safety Fencing / Boundary Fencing

As the route will form part of the Derbyshire County Council highways networks there is no requirement under TD 19/06 'Requirement for Road Restraint Systems' for the provision of safety fencing along the route.

However, given the possibility of heavy vehicles reaching high speeds along the route and the presence of adjacent water features such as the Mersey Canal, River Trent and drainage ditches, it is recommended that the final design consider the requirements of the Technical Directive for the protection of such features.

Where features such as large culverts or water features have been identified as a possibility from the preliminary design costs for safety fencing have been included in the estimate of costs.

Agricultural boundary fencing shall be required along the route, the exact nature depending upon accommodation works agreements. In addition it is likely that hedge planting shall be required by the landowners. It is advised that the ownership of the fence and hedge line is transferred back to the land owners at the expiration of the normal construction maintenance period. Additional land take will be required to accommodate any hedge planting required, although this area of land would be transferred back to the original landowner with the hedge line maintenance responsibility.

7.5 Structures and Culverts

A number of the routes require the construction of structures across various features such as railway lines, canals and the River Trent. These bridges have been taken as being constructed with plied foundations supporting a bearing shelf, with precast concrete beams. It is considered that this type of bridge would be the most suitable for the predominantly alluvial soils that would be encountered adjacent to the River Trent.

An alternative option for the bridge abutment design that could be considered given the soil conditions that could be reasonably anticipated would be that of reinforced earthworks. This would utilise existing sandy or alluvial soils from the area, but would be dependant upon the bearing strength of the underlying strata to be economic. The earthworks involved would also have to be suitable to resist potential flooding from the River Trent.

It should also be noted that the new crossing of the River Trent will be a major structure in the area, and the first new structure of its type since the construction of the M1 motorway. Given the location adjacent to the Grade 1 listed Swarkstone Causeway, and the stone arch Swarkstone Bridge, it is likely that the design of the new bridge may attract attention. In similar instances new bridges have been designed by specialist engineering/architectural teams, possibly following a study or competition to determine the most acceptable form for the new bridge. If this course of action is taken then costs estimates for the bridge should be adjusted accordingly to take into account the additional costs to meet aesthetic requirements.

The span will have to be of sufficient clearance over the river to allow the free passage of any river craft. Definitive guidance of this clearance has not been sought from The Environment Agency at this time.

Structures for minor road crossings, farm access tracks and streams have been classed as box culverts. It is considered that these would be more economical to construct than piled bridge abutments.

7.6 Anticipated Construction Costs

7.6.1 Highways Construction

Highway construction costs are based upon the construction of a 7.30 metre wide carriageway with 2.4 metre wide footway/cycleway and metre wide verge strips on a minor embankment up to 2m high in difference from existing ground level. Given the area is alluvial ground it can also be assumed that the ground bearing strength may be poor in general and that additional costs for ground improvement shall be required.

An exercise has been carried out to cost roadworks per 100 metres at today's prices using rates obtained from the Highways Agency Framework 2 Contract. The approximate cost has been found to be in the order of £150,000 per 100m length purely for carriageway construction.

Comparable costs from the A6192 Markham Lane (let in 2004) are £1,100 per metre, for a 7.3m wide carriageway without footway or cycleway, or remediation works for soil conditions. Given inflation at today's rates and the additional cycleway/ footway width, this would equate to £1,600 per metre for the highway construction when taken in isolation.

Additional side road or junction alteration construction costs may increase the rate locally up to £3,500 per metre. This would typically take place at the junction of the A514 and new roundabout on the A514 south of the village of Stanton-by-Bridge.

7.6.2 Structures Construction

Two bridges shall be needed at the crossing of the River Trent and at the B587 under bridge respectively for routes A, B, E and F.

7.6.3 Anticipated Construction Costs

Given the factors listed previously an estimate of construction costs for those routes considered to be feasible:

Route A

3296 m length @ £1,600 per metre =	5,273,600
Bridge over River Trent	4,500,000
Bridge over B587	1,500,000
Box culverts for stream crossing 3 no. @£200,000	600,000
New Junction construction at A514 north =	300,000.
New roundabout construction at A514 south =	500,000
Ground mitigation works (estimated see 7.5.2 below)	209,296
Total	£12,888,896

Route B

3500m length @ £1,600 per metre =	5,600,000
Bridge over River Trent	4,500,000

Bridge over Railway Line	2,000,000
Bridge over Unclassified Road (taken as enlarged box culvert)	500,000
Bridge over canal	1,500,000
Bridge over B587	1,500,000
Box culverts for stream crossing 3 no. @£200,000	600,000
New Junction construction at A514 north =	300,000.
New roundabout construction at A514 south =	500,000
Ground mitigation works (estimated see 7.5.2 below)	222,250
Total	£17,222,250

Route C

Not considered feasible at this stage

Route D

Not considered feasible.

Route E

2200 m length @ £1,600 per metre =	3,520,000
Bridge over River Trent	4,500,000
Bridge over B587	1,500,000
Box culverts for stream crossing 3 no. @£200,000	600,000
New Junction construction at A514 north =	300,000.
New roundabout construction at A514 south =	500,000
Ground mitigation works (estimated see 7.5.2 below)	139,700
Total	£11,059,700

Route F

Not considered feasible

Route G

Not considered feasible.

7.6.4 Geotechnical Costs

The additional costs of ground mitigation works will vary depending upon the type of work undertaken and the scale of those works at each particular location. Given the possibility of varying ground conditions within the site, and the lack of accurate data from site to identify specific ground conditions, any estimate of costs associated with geotechnical works has been taken for the worst case scenario, based upon previous experience of such sites.

It is anticipated that the entire site shall use geotextile membranes of some form, either for soil strengthening or for separation of the new construction from existing contaminated ground to prevent leachate. From recent works at Staveley Northern Loop Road an estimated cost of this work would be between £520,000 and £600,000 at 2006/07 rates.

Ground mitigation works are taken as the provision of a drainage / capping layer between two layers of geotextile membrane, estimated at £5/m2. This is extended 1.0 metres beyond the edge of the construction area.

It may be possible to reduce the cost of ground mitigation works following geotechnical investigations in the area, but at present the worst case scenario has been taken for costing purposes.

7.6.5 Anticipated Statutory Undertakers Costs

Taken from section 3.6 above it may be reasonable to assume that additional costs will be incurred for the movement and/or replacement of existing services. Without a preliminary design study being completed it is impossible to identify the full extent of these works or services affected by the highway alignment, but it is believed that alterations to services will be limited to adjustment of existing agricultural water and electrical supplies, overhead power supplies and British telecom ducts.

Existing pumped combined sewers can normally be sleeved or protected by suitable reinforced slabs as they are usually sited at sufficient depth in agricultural fields to avoid damage by farming operations. This should be verified by further investigation with the appropriate statutory undertaker.

It is difficult to quantify these works at present, but given the rural nature with the availability of land adjacent to the proposed alignments, it is anticipated that additional costs will be limited and could be carried out in advance of any construction works.

The works may have to be undertaken by the service supply firms themselves, and additional costs attached to the works for their specialist attendance and supervision. For that reason we believe that a sum in the region of between £300,000 to £400,000 should be put aside for these works.

7.6.6 Anticipated Total Costs

Given the anticipated costs for highways construction and ground mitigation works it is believed that the total costs for the scheme (excluding land acquisition and accommodation works) shall be in the region of

Option A - £15.30 million,

Option B - £20.10 million and

Option E - £12.00 million, respectively at current (March 2010) rates.

In addition, in accordance with current guidance from the Highways Agency, an Optimism Bias of 20% should be added to the project at this stage. This is to allow for items that have not been identified in the initials feasibility study, or which may need to be investigated in more detail.

Following decisions on the preferred option it is believed that these costs may be reduced by further ground investigation works reducing the ground mitigation works, and liaison with the statutory undertakers affected by the works.

Land acquisition costs have not been included in the above prices, and should be considered once the route option has been decided.

8 Conclusion

The purpose of this report is not to recommend a particular route, as the assessment of a route needs to be done based on wider issues.

Each of the Options A, B& E that have been developed can be designed and constructed in accordance with the current standards. Routes C, D, F & G are not considered viable due to the problems with environments, safety and proximity to the river respectively.

There are some significant risks with all the options, which cannot be fully identified or quantified at present, these are;

Public Utility Diversion Works

Unknown Geology

Soil Contamination

Flood plain accommodation works

Ecological and conservation works

All routes will pass across the River Trent flood plain and liable to flooding. Careful consideration should be given during detailed design stage. However, the current road network through village of Stanton-by-Bridge over Swarkestone Causeway, which this route will replace, is below current standards, and the disruption that the provision of the bypass must be weighed against the benefit to the village as a whole, and to the protection of ancient listed structures.

9 Appendices

9.1 Appendix A – Background Information Referred To

- Design Manual for Roads and Bridges - Currently available at the Highways Agency web site

  http://www.standardsforhighways.co.uk/dmrb/index.htm

- Proposed Alignment Design in accordance to the TD9/93

  http://www.standardsforhighways.co.uk/dmrb/vol6/section1/td993.pdf

- Cross section of the proposed alignment Design in accordance to the TD27/93

  http://www.standardsforhighways.co.uk/dmrb/vol6/section1/td2705.pdf

- Any Roundabout Design to be in accordance to the TD16/93

  http://www.standardsforhighways.co.uk/dmrb/vol6/section2/td1607.pdf

- County Specific Requirements from Derbyshire County Council Development Control - Currently available at the Leicestershire County Council web site

  http://www.leics.gov.uk/index/highways/road_pathway_maintenance/htd.htm

9.2 Appendix B - Drawing List

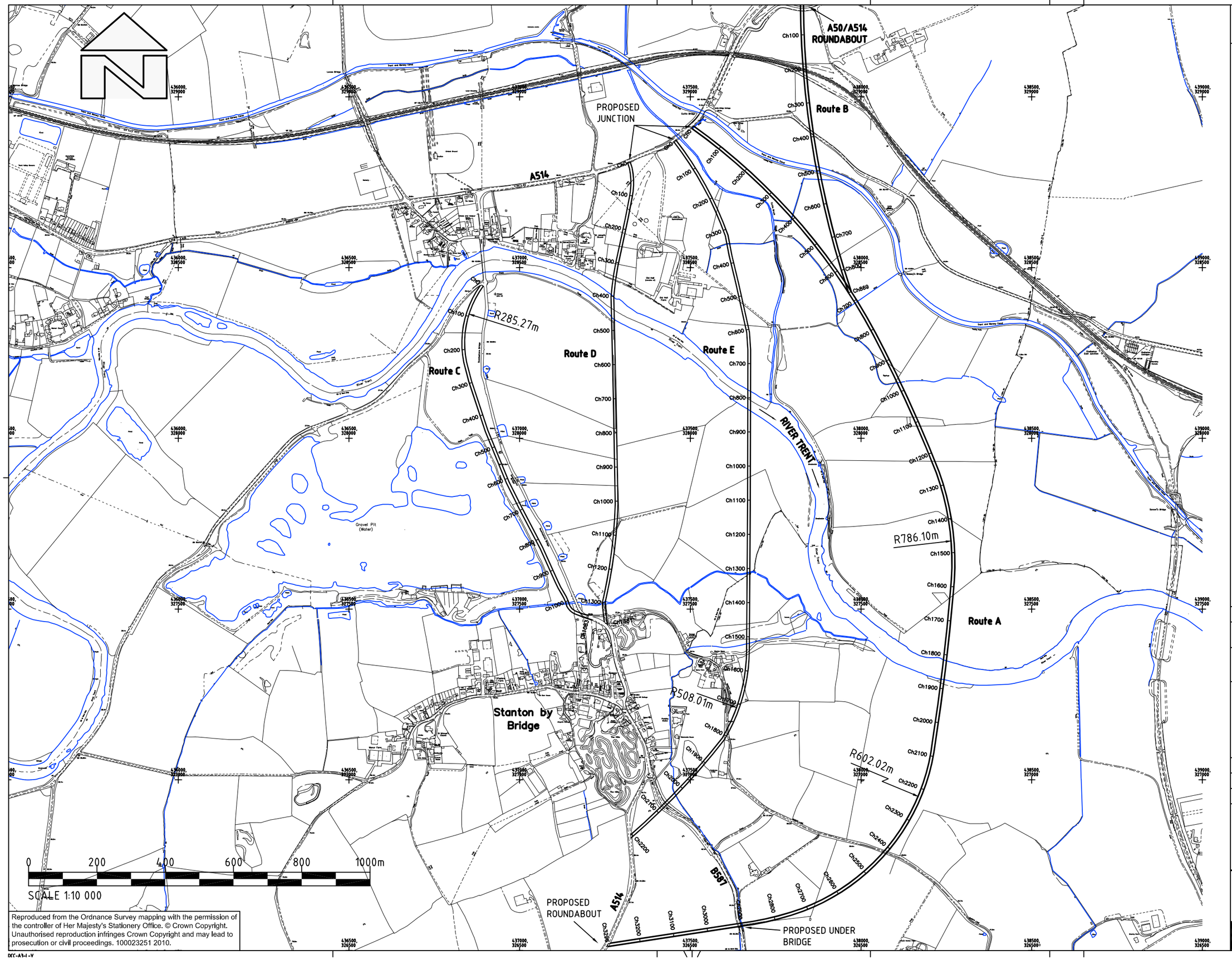
D130388 / AL/01 Swarkestone & Stanton-by-Bridge – Route Development Route A, B, C, D, E

D130388 / AL/02 Swarkestone & Stanton-by-Bridge – Route Development Route F & G

D130388 / CS/01 Swarkestone & Stanton-by-Bridge – Typical Cross section

D130388 / Rdbt/01 Swarkestone & Stanton-by-Bridge – Proposed Roundabout at A514

Sketch – Figure X – Possible Route Corridors



NOTES

Revision Details	By / Check	Date	Suffix

Drawing Status

Job Title
SWARKSTONE & STANTON-BY BRIDGE DIVERSION FEASIBILITY

Drawing Title
ROUTE DEVELOPMENT

Scale at A3
1:10000

Drawn	Approved
SA	

Stage 1 check	Stage 2 check	Originated	Date

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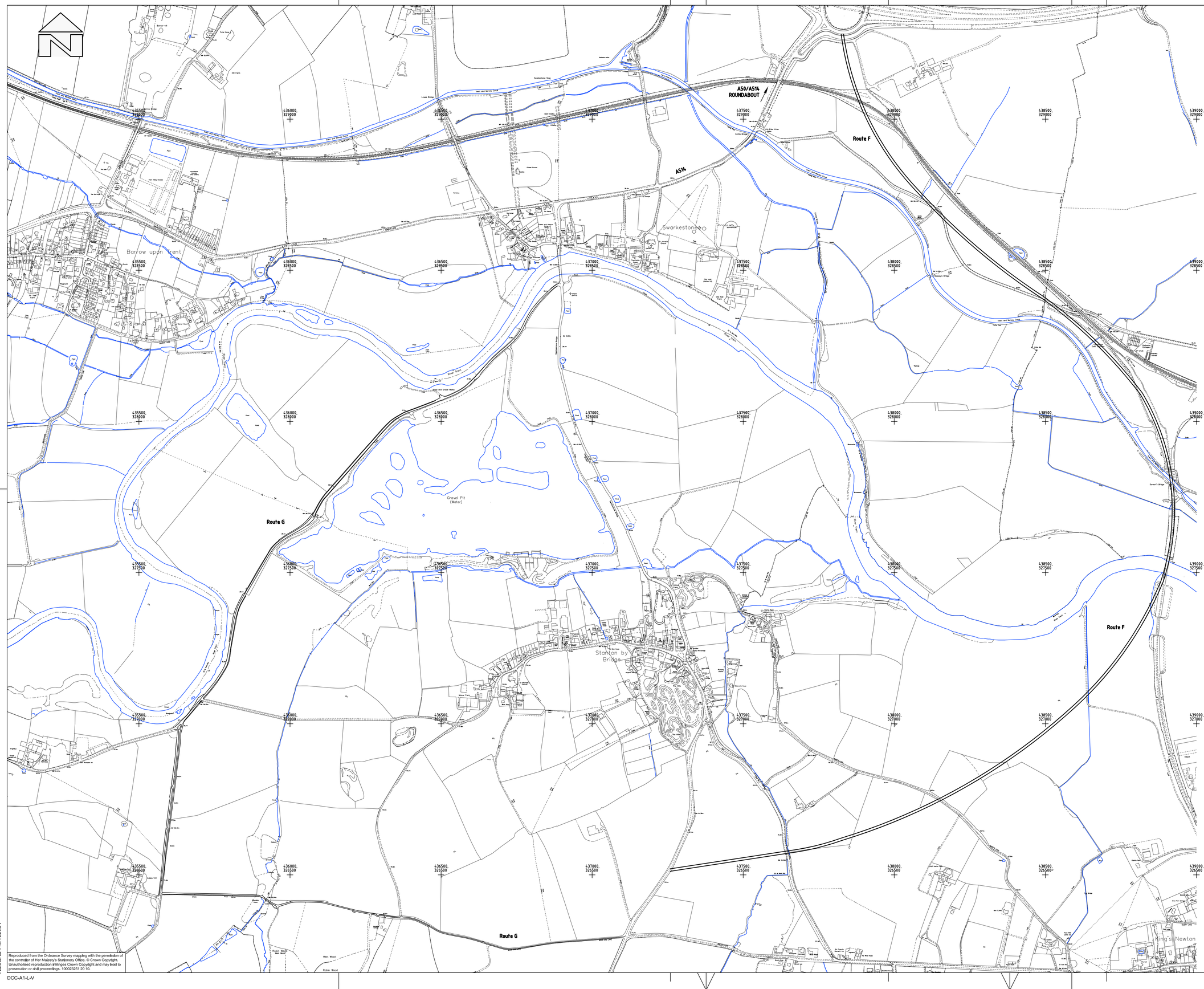
Drawing Number
D130388/AL/01

Rev

DCC-A3-L-V



NOTES

Revision Details	By / Check	Date	Suffix

Drawing Status

DERBYSHIRE COUNTY COUNCIL

HIGHWAYS & TRANSPORTATION CONSULTANCY SERVICES

Job Title

SWARKSTONE & STANTON-BY-BRIDGE DIVERSION FEASIBILITY

Drawing Title

ROUTE DEVELOPEMENT ROUTES F & G

Scale at A1
N.T.S.

Drawn	Approved		
SA			
Stage 1 check	Stage 2 check	Originated	Date
		15/02/10	

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Drawing Number D130388/AL/02 Rev

Plot Date :
AutoCAD File Name :

DCC-A1-L-V

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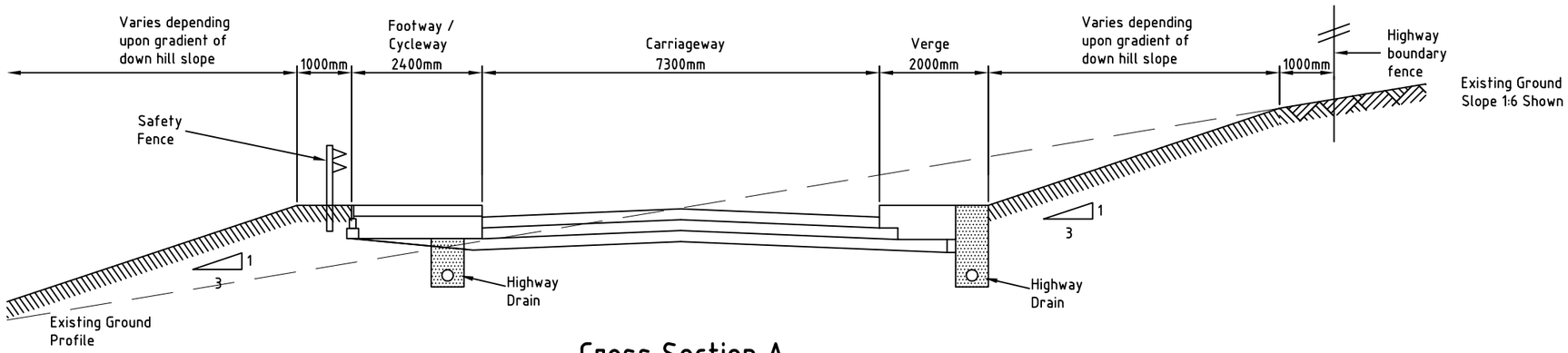

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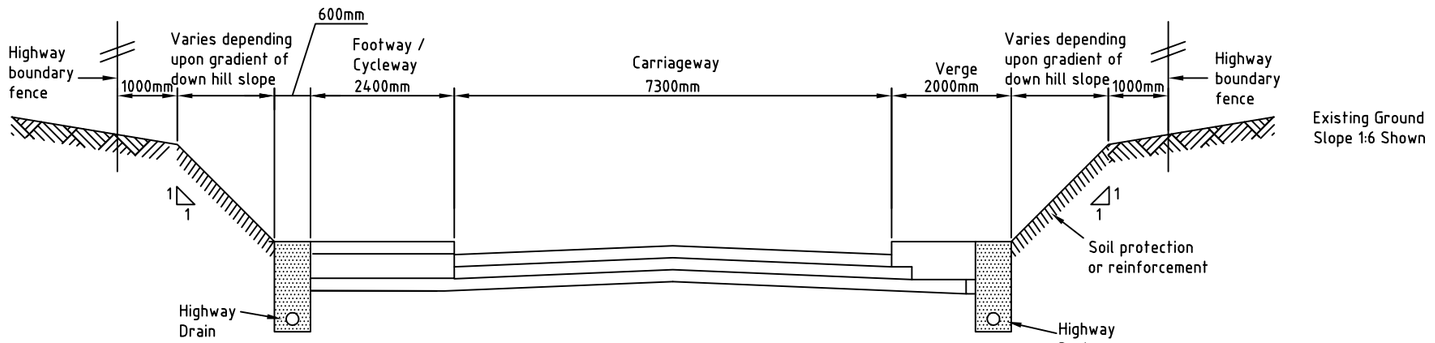
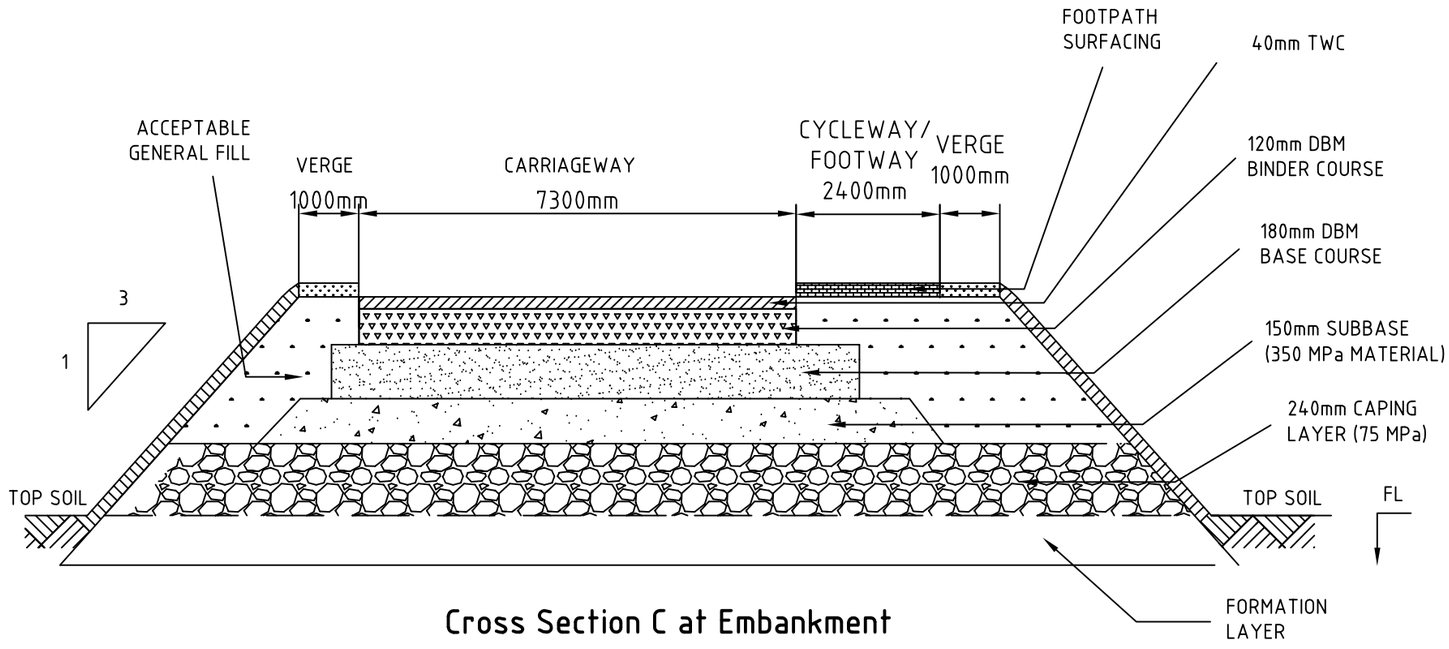


Cross Section B at Cutting



Cross Section C at Embankment

Revision Details	By / Check	Date	Suffix

Drawing Status

Job Title
SWARKSTONE & STANTON-BY BRIDGE DIVERSION FEASIBILITY

Drawing Title
TYPICAL CROSS SECTIONS

Scale at A3
1:10000

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Drawing Number
D130388/CS/01

Rev

Plot Date:
AutoCAD File Name:
DCC-A3-L-V

NOTES

Revision Details	By / Check	Date	Suffix

Drawing Status

Job Title
SWARKSTONE & STANTON-BY BRIDGE DIVERSION FEASIBILITY

Drawing Title
A514 ROUNDABOUT

Scale at A3
N.T.S.

Drawn		Approved	
SA			
Stage 1 check	Stage 2 check	Originated	Date

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Drawing Number: D130388/Rdbt/01 Rev

Plot Date :
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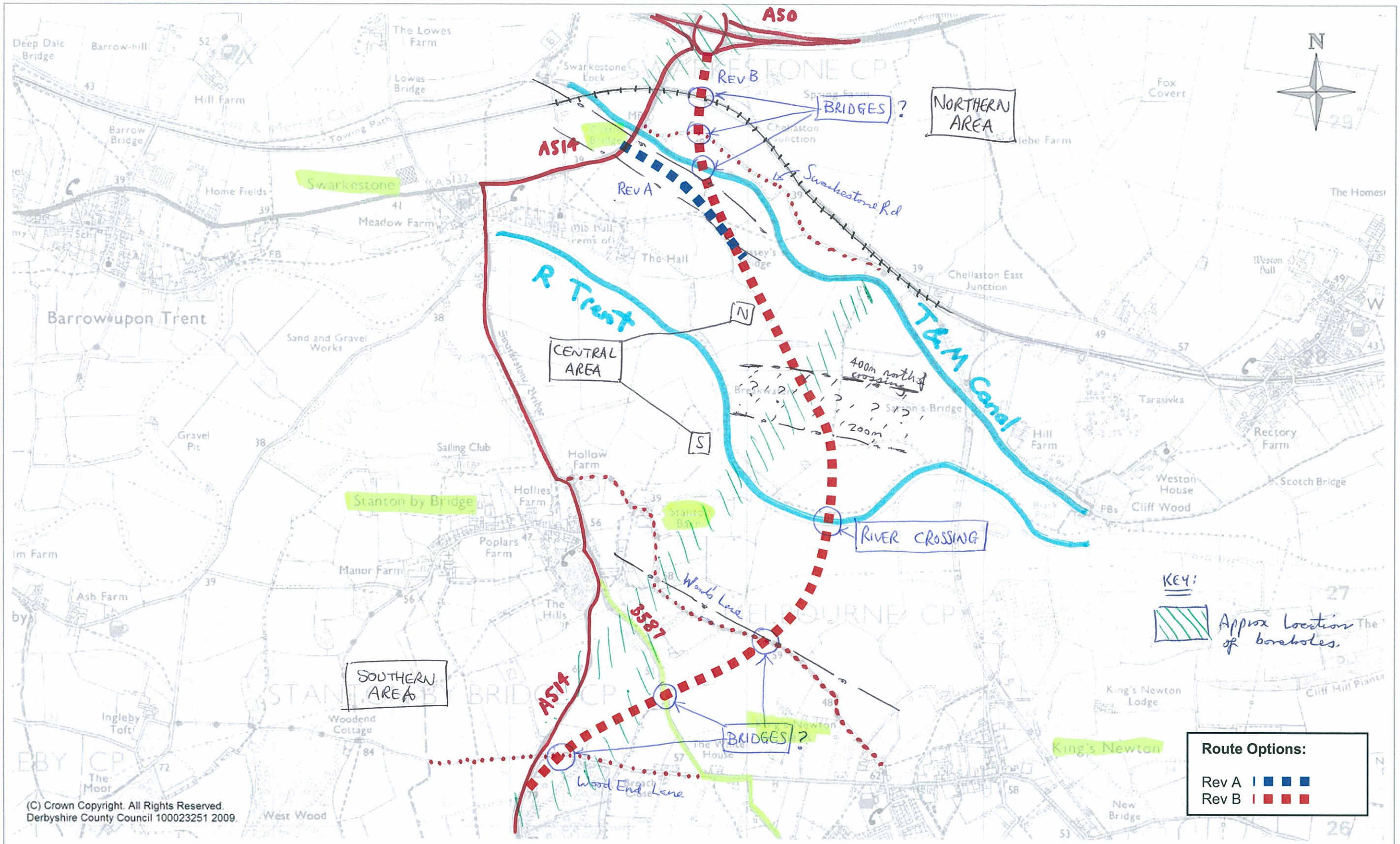

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Project	Title	Date	Scale
Swarkestone Causeway	Possible Route Corridors	Nov 2009	N.T.S.

Drawing No.

Figure 3 X