APPENDIX J

External Route Study

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Client: Burrendong Wind Farm Pty Ltd

EXTERNAL ROUTE ASSESSMENT

Burrendong Wind Farm

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1 Introduction

Burrendong Wind Farm is a proposed wind farm development comprising 96 turbines, and is located some 30 km west of Mudgee, NSW.

The construction of the project will require many Over Size, Over Mass (OSOM) vehicle deliveries to the site, and hence it is critical that the route into the site is capable of accommodating these specialised vehicles.

This report will present the findings of a desktop assessment considering two possible routes to access Burrendong Wind Farm. The extent of the public roads included in the assessment are shown below in Figure 1. Both routes utilise Burrendong Dam Road (shown green) and Endacott Road (shown orange) just prior to accessing the project site, but it is before the intersection of Burrendong Dam Rd and Yarrabin Rd (shown yellow) where the two proposed routes vary. The arrows shown in Figure 1 indicate the direction that chainage (CH) was assigned for the purposes of Section 3, 4 and 5 of this report.

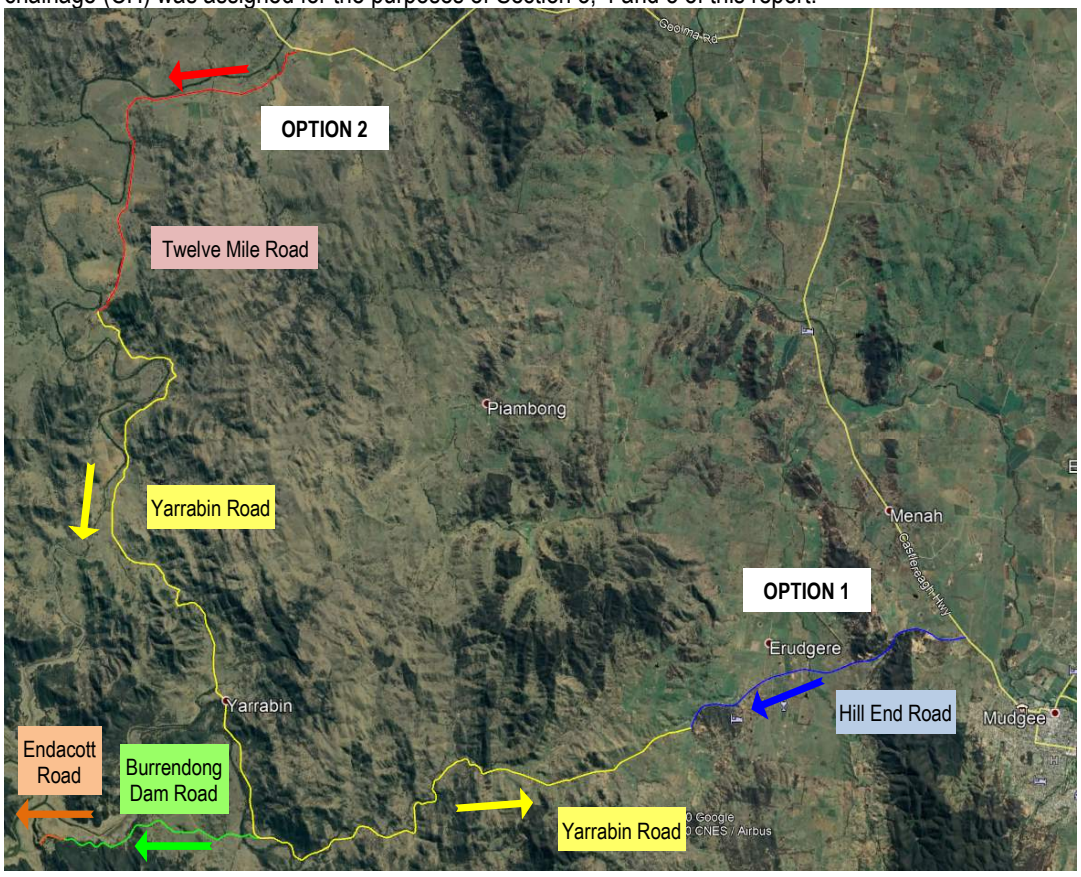

Figure 1 – Public roads involved in the Burrendong Wind Farm External Route Assessment

Route Option 1 extends from the intersection of Castlereagh Highway and Hill End Road (shown blue) through to Yarrabin Road and then Burrendong Dam Road. Option 2 extends from the intersection of Goolma Road and Twelve Mile Road (shown red) through to Yarrabin Road and then Burrendong Dam Road.

This report will identify potential issues and design challenges that will be encountered on both of the routes. Where appropriate, the report will present a typical example of a design that could be adopted in certain locations and comment on any potential challenges. The overall intent of this report is to discuss the advantages and challenges posed to each of the routes, and comment on which route in the opinion of icubed consulting is better suited for the project.

The desktop assessment has been conducted using AutoCAD's Vehicle Tracking software, to draw swept paths of the OSOM vehicles over AutoCAD Map's in-built aerial imagery. The swept paths in this report are shown without any buffer/offset.

In addition to the AutoCAD desktop analysis, both routes were video surveyed by car on 12th August 2020. Screenshots from the footage will be used for discussion in this report. It should be noted however that the end of Burrendong Dam Road (where Endacott Road begins) is the entrance to a gated holiday park, which could not be accessed. A directory link to these videos has been provided with this report. This report will identify existing vertical curves that may need to be upgraded but, without survey, it is difficult to accurately comment on the suitability of the curves.

Plan drawings of the public roads included in this assessment have been provided in Appendix D – Public Road Plan Drawings.

2 Design OSOM Vehicles and Adopted Typical Design

Three unique OSOM vehicles were used during this assessment. The chosen vehicles were a 90 m wind turbine blade truck and trailer, a transformer drake trailer, and a 6.5 m diameter tower segment truck and trailer. This section will describe the unique characteristics of the three OSOM vehicles and the challenges they introduce to the geometric design of the roads. Section 2.4 of this section will outline the typical design adopted for the assessment of these routes.

This assessment referred to the report '*RJA Route survey Newcastle Port to Lake Burrendong WF REV00'*, dated 20/12/19, for the routes. In the report, the Castlereagh Hwy & Hill End Road intersection (Option 1) is approached by all OSOM vehicles from the north. For Option 2, the Goolma Road & Twelve Mile Road is approached from the west by the blade transport, and from the east by the transformer and tower transports.

Initial impressions of the route in Option 1 indicate that a blade transport will be too difficult to drive and/or upgrade for. For this reason, the blade transport has not been assessed in Option 1.

2.1 90 m Wind Turbine Blade

This OSOM vehicle consists of a truck and trailer carrying a 90 m long blade. The total length of the truck and trailer body (sans blade) is almost 73 m long, but the blade extends a further 24 m past the trailer – bringing the total length of the transport to almost 97 m. The truck operates like a typical truck would, while the trailer is capable of axle steering, giving the driver more control over the position of the trailer.

The truck and trailer has a relatively narrow track width of 2.6 m when travelling in a straight line but this does increase slightly when travelling around bends. At its steering limits, the trailer can demand up to a 7 m track width – but designing for this scenario is unrealistic. The blade on the transport has a physical width of approximately 4.3 m when travelling in a straight line.

The challenges of transporting a vehicle of this length are inherently obvious – being the nearly 100 m clear distance needed at all times to move the vehicle. On a typical horizontal curve, the vehicle's body (and its load) between the truck and trailer will overhang the inner parts of a curve. Additionally, the 24 m of blade that extends past the trailer creates overhang along the outer parts of the bend. This inner and outer overhang either side of the road creates additional challenges that need to be considered in the design.

2.2 Transformer Drake Trailer

This OSOM vehicle consists of a substation transformer being transported on a drake trailer consisting of 16 axles, and is approximately 30 x 4.3 m in length and width. The total length of the vehicle is almost 43 m. The vehicle's 4.3 m of track width in a straight line is the widest of the three OSOM vehicles, and the track

width demand increases drastically around bends. For this reason, the transformer drake, more than the other OSOM vehicles, governs the trafficable width requirement of horizontal curves of the road.

2.3 6.5 m Diameter Tower Section

This OSOM vehicle consists of a 6.5 m diameter wind turbine tower section on a truck and trailer. The dimensions of the vehicle body extents used is 50 x 2.5 m, meaning it is neither the longest or widest of the OSOM vehicles. The challenge imposed by this vehicle is simply the size (width and height) of the load. Specifically, this vehicle will govern the height objects above the road (such as trees and overhead lines) are allowed to be, and the clearance either side of the road along straight sections. Compared to the blade truck and trailer, the driver has less control over the position of the trailer and relies more on the position of the truck (the front) to determine the position of the trailer (the back). Consequentially, s-bends are more challenging to drive.

2.4 Adopted Typical Design

Based off the OSOM vehicle characteristics and challenges discussed in Sections 2.1–3 above, a typical bend geometry was adopted to show what a possible design may look like at existing unsuitable locations. However, it should be noted that whilst the typical design will work in typical locations, more unique challenges will require/benefit from changes to the typical geometry.

The typical horizontal bend realignment adopted for this assessment was a 100 m radius and a 7 m track width. Unless noted otherwise, all possible / typical designs shown in this report adopt this bend radius and width.

The blade vehicle is capable of turning a 100 m bend relatively easily, but it is the body / load overhang that is more important. A typical 100 m bend can require up to almost 20 m clear space in total. More space (approximately double) is required on the outer part of the bend than the inner.

As mentioned in Section 2.2, the transformer drake governs the trafficable width requirement. On a 100 m radius bend, the drake has a wheel path demand of approximately 5.6 m, meaning the adopted 7 m is reasonably conservative.

The tower trailer is also capable of taking this turn relatively easily. Two consecutive 100 m bends in the form of an s-bend is also possible, albeit less comfortably. Refer section 4.2.13 for an example s-bend.

Screenshots of the AutoCAD assessment have been used in this report. The legend of the screenshots is shown below in Table 1, and an example screenshot shown in Figure 2. Some lines within screenshots of this report may be obscured by other lines, but all swept path have been drawn within the possible design extents. Some screenshots will overlay the swept path of all vehicles at once.

Table 1 – AutoCAD Legend

Description	Colour	Linetype
Existing road centreline	**Black / White**	Centreline
Existing overhead lines	**Red**	
Existing line poles	**Red**	Circle
Possible / typical design	**Dark blue**	Continuous and centreline
Vehicle Swept Paths:		
Vehicle load swept extents (tower and blade only)	**Magenta**	Continuous
Vehicle body extents	**Red**	Continuous
Vehicle wheel path	**Red**	Diagonal hatch

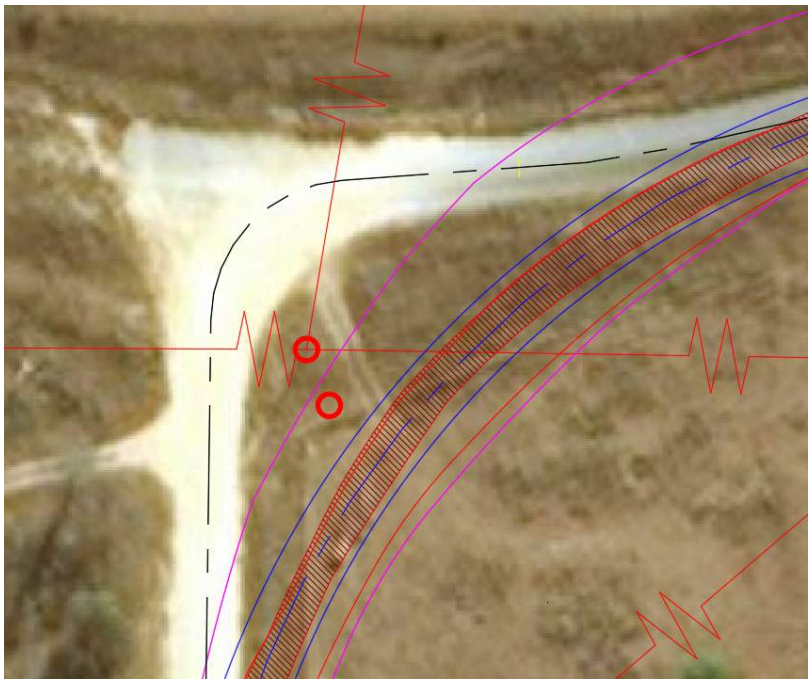

Figure 2 – Example screenshot from in AutoCAD assessment of tower blade

3 Castlereagh Hwy / Hill End Rd / Yarrabin Rd / Burrendong Dam Rd (Option 1)

This section will describe the characteristics and challenges specific to route Option 1.

3.1 Option 1 Route Description

The total distance specific to this option (from Castlereagh Hwy to the Yarrabin Rd & Burrendong Dam Rd intersection) is 26.7 km, all of which is sealed. Hill End Rd makes up the initial 9.8 km, before turning onto Yarrabin Rd, and is a well-maintained road with what appears to be adequate width for the OSOM vehicles. Hill End Rd doesn't appear to present any geometric challenges (in terms of horizontal and vertical curvature). The only minor challenges for Hill End Rd (excluding intersections with other roads) appear to be the tree trimming (in approximately 5 – 15 locations), and overhead lines. There are numerous culvert and waterway crossings along the route which haven't all been identified in this report.

Figure 3 – Example of tree overhang which may require trimming (Hill End Rd, approx. CH9300)

Road quality drops from Hill End Rd to Yarrabin Rd. Road width decreases slightly, which, while not an issue in straight sections, does pose concerns on bends. There are also more sharp bends that are not possible for the OSOM vehicles to take. Vegetation is tighter to the road than Hill End Rd, such that almost every instance of trees along the road is subject to trimming or removal.

Figure 4 – Example tower swept path through straight, vegetated section of Yarrabin Road.

3.2 Option 1 Geometric Challenges and Major Waterway Crossings

3.2.1 Hill End Road, CH 0, Intersection with Castlereagh Highway

The existing internal bend radius from Castlereagh Hwy turning onto Hill End Rd is approximately 10 m and will need to be upgraded. Castlereagh Hwy adopts an additional overtaking lane in both directions of travel, which makes the total trafficable width approximately 15 m. Due to this large width, the turn onto Hill End Rd can be completed with a relatively small radius.

The example below in Figure 5 shows the swept paths on a 15 m radius. There is a culvert across Hill End Rd with a headwall on the inside of the bend that will need to be accommodated in any widening work. There is also a road sign on the north side of Hill End Road that is within the tower's path.

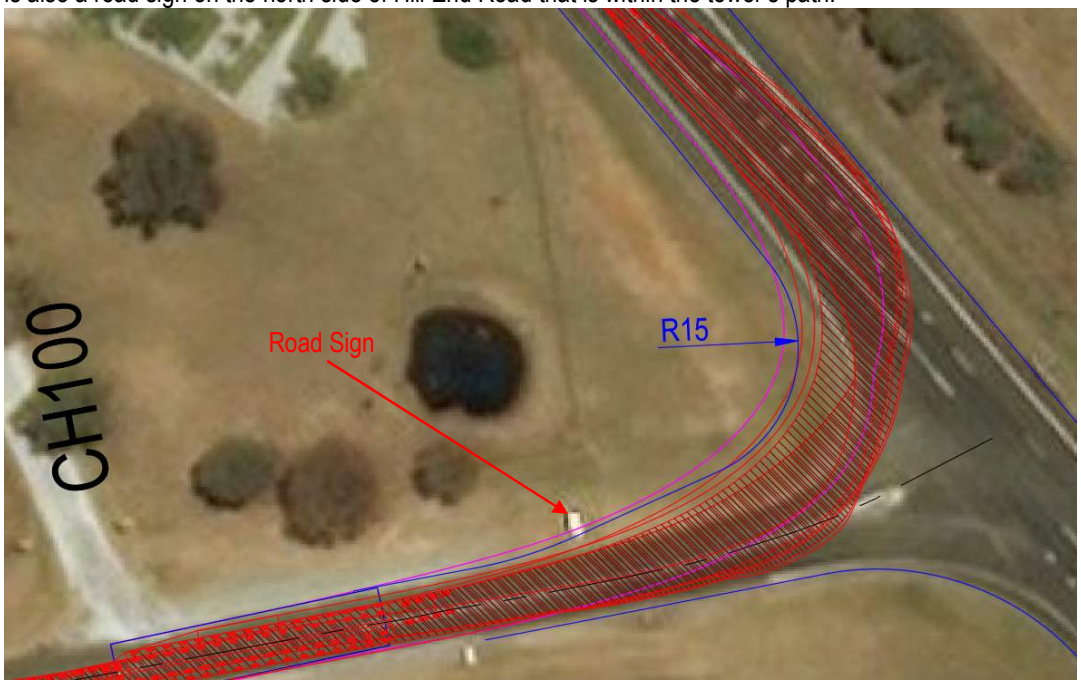

Figure 5 – Castlereagh Hwy & Hill End Road intersection.

Figure 6 – Google Street View of Castlereagh Hwy & Hill End Rd intersection (March 2018)

3.2.2 *Intersection of Hill End Road & Yarrabin Road and major waterway crossing*

Hill End Rd is approximately 10 m wide at this location due to a widened shoulder, but the internal bend radius of approximately 30 m is too small for the OSOM vehicles to traverse (see Figure 7). As shown below in Figure 8, the OSOM vehicles can take the turn with a 56.5 m radius

Figure 7 – Hill End Rd, with the turn onto Yarrabin Rd on the right.

There is a sudden, decline down off Hill End Rd (best seen in Figure 7) which raises vertical geometry concerns.

Figure 8 – Hill End Rd & Yarrabin Rd intersection, swept paths shown.

Additionally, the initial width of Yarrabin Rd is too narrow at the intersection, and will not accommodate the width demands of the transformer. This is consistent with a major waterway bridge / culvert that is shown below in Figure 9. This waterway crossing will need to be upgraded.

Figure 9 – Major waterway crossing on Yarrabin Rd at intersection with Hill End Rd

3.2.3 *Yarrabin Road (CH 35,850), bend and major waterway crossing*

This location has a bend that is too sharp, a road width that is too narrow, and a reasonable concrete waterway crossing – shown below in Figure 10. To meet the demands of the OSOM vehicles, the road alignment will likely need to shift north (to the right in Figure 10). This will result in the reconstruction of the waterway, tree removal, and reinstatement of the pavement and seal.

Figure 10 – Major waterway crossing on Yarrabin Rd at CH 35,850

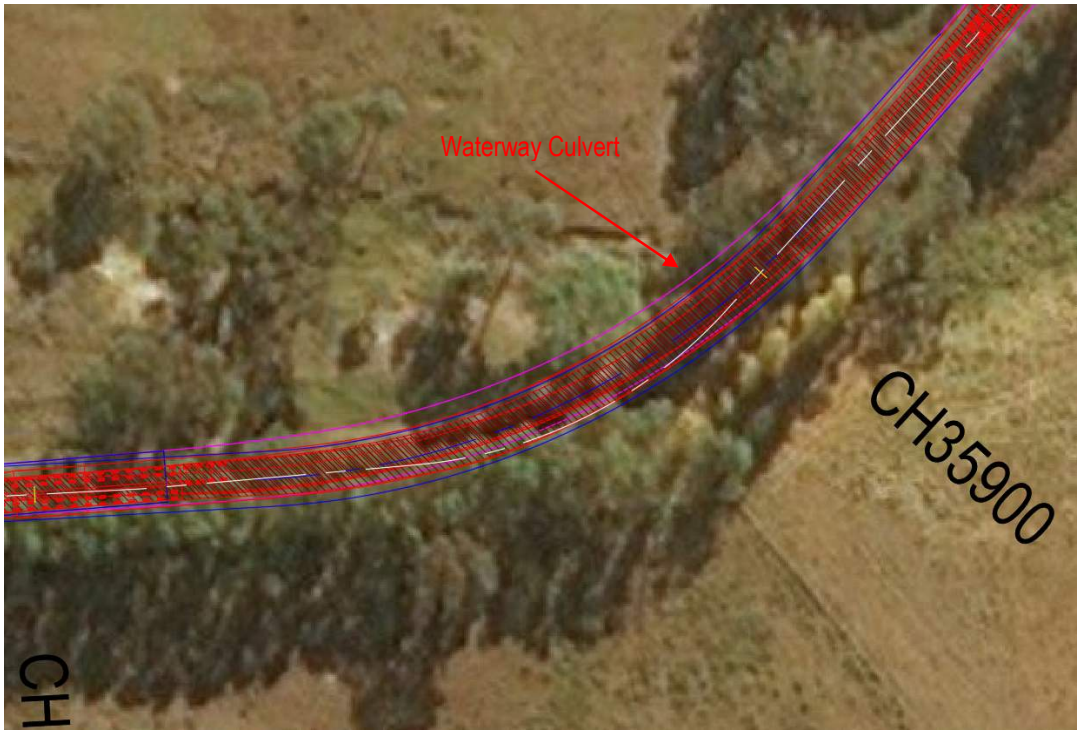

Figure 11 – Yarrabin CH 35,850 possible realignment and swept paths.

3.2.4 *Yarrabin Road (CH 34,400), S Bend, vertical curve and floodway*

This location has an S-bend comprised of two approximately 100 m horizontal curves. The main concern of this location, however, is the vertical geometry of the road and a sag localised to the floodway. Survey should be sought to determine if OSOM vehicles are capable of traversing.

Figure 12 – Yarrabin Road CH 34,450 floodway and vertical curve.

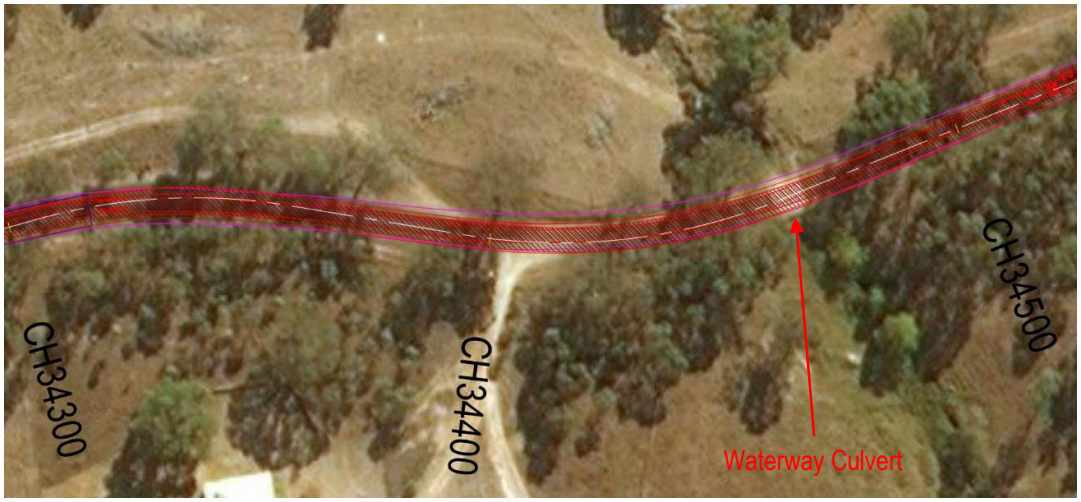

Figure 13 – Yarrabin Road CH 34,440 S Bend.

3.2.5 Yarrabin Road (CH 31,650), tight bend

The road at this location has a 50 m radius bend with dense vegetation either side. The typical road realignment is shown below in Figure 14. To achieve this, the trees on the side of the road (shown Figure 15) will need to be cleared. The existing road formation is reasonably proud of the natural surface, and hence significant fill material will be required to realign the road. The western portion of the bend begins to climb a hill, and so there are vertical geometry considerations at this location.

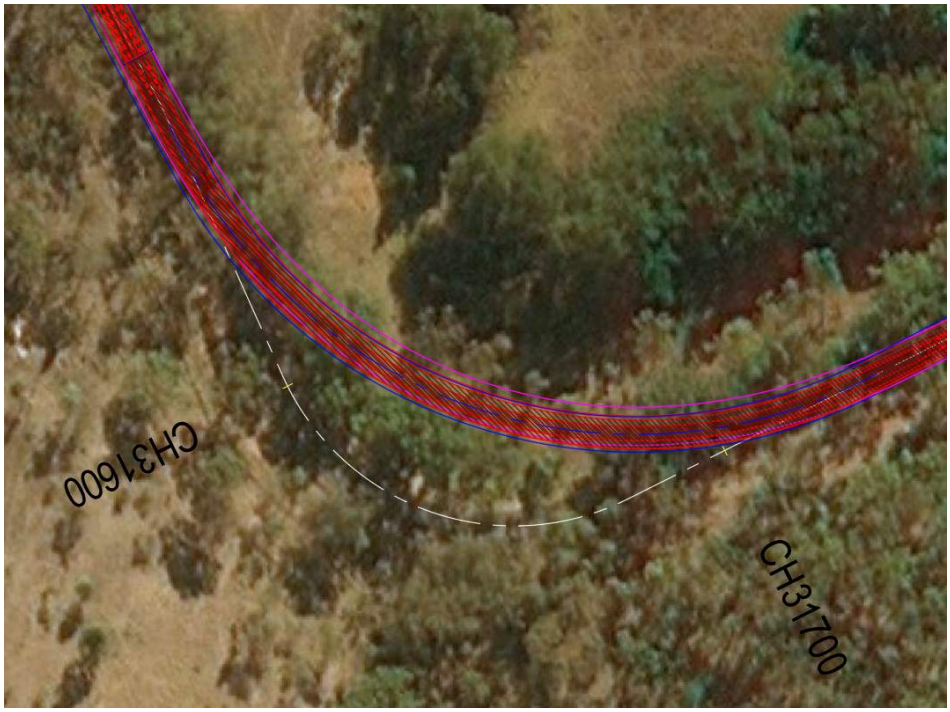

Figure 14 – Yarrabin Road CH 31,650 tight bend

Figure 15 – Yarrabin Road CH 31,650 tight bend and dense vegetation

3.2.6 *Yarrabin Road (CH 31,100), tight bend*

This location has a 30 m radius bend that will need to be upgraded. The area is moderately vegetated and reasonably flat. There is a slight vertical sag that doesn't appear to be challenging.

Figure 16 – Yarrabin Road CH 31,100 tight bend

Figure 17 – Yarrabin Road CH 31,100 tight bend

3.2.7 Yarrabin Road (CH 30,650 – 30,950), tight bend and rock wall

The existing alignment in this location consists of two approximately 80 m radius bends. The typical bend alignment is shown below in Figure 18, consisting of one 100 m radius. A snippet taken just after the first 80 m bend is shown in Figure 19.

Figure 18 – Yarrabin Road CH 30,650 – 30,950

Figure 19 – Yarrabin Road CH 30,900, just after first 80 m bend.

Without survey, it is not clear if the width through this location is sufficient, meaning a major concern for this location is the constraints either side of the road. The southern side of the road from approximately CH 30,650 – 30,750 is a steep rock face. Conversely, the northern side involves a steep drop off. Consequentially, any widening through this location will be challenging. These constraints are shown below in Figure 20.

Figure 20 – Yarrabin Road CH 30,750. Rock wall and sharp drop off.

3.2.8 Yarrabin Road (CH 29,650), bend

This location has approximately a 70 m bend radius. The typical 100 m radius design is shown below in Figure 21. This bend will likely be more suitable for shoulder widening, rather than a track realignment. The north side of the road has a sharp drop off from the shoulder, meaning any widening will be better suited to the south side. Both widening, or road realignment will result in significant tree clearing.

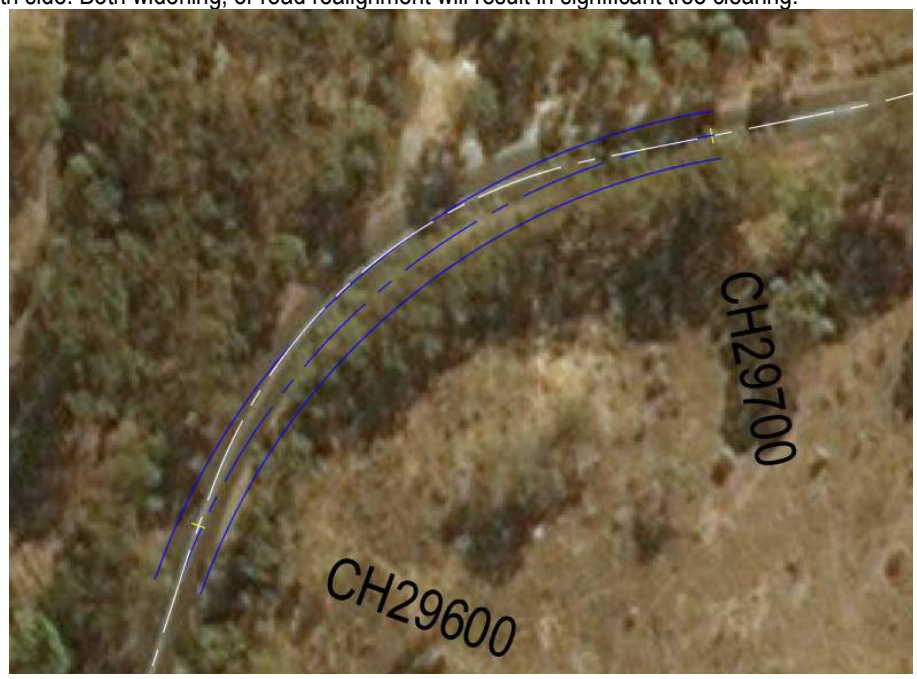

Figure 21 – Yarrabin Road CH 29,650, possible design

Figure 22 – Yarrabin Road CH 29,650

3.2.9 Yarrabin Road (CH 29,350), bend

This location has approximately a 70 m bend radius. The typical 100 m radius design is shown below in Figure 23. This bend will likely be more suitable for shoulder widening, rather than a track realignment. The west side of the road has a sharp drop off from the shoulder into a gully, and the east side has a steep, vegetated batter (see Figure 24 below). Both widening, or road realignment will result in significant tree clearing and significant cut or fill.

Figure 23 – Yarrabin Road CH 29,350 bend, possible design

Figure 24 – Yarrabin Road CH 29,350 bend

3.2.10 Yarrabin Road (CH 28,400), bend

The existing bend at this location has approximately a 70 m radius. The typical possible alignment is shown below in Figure 25, but this location may be better suited to shoulder widening. The southern side of the road has a steep rock wall at the start of the bend, whilst the northern side has a steep drop off from the shoulder into a gully (refer Figure 26).

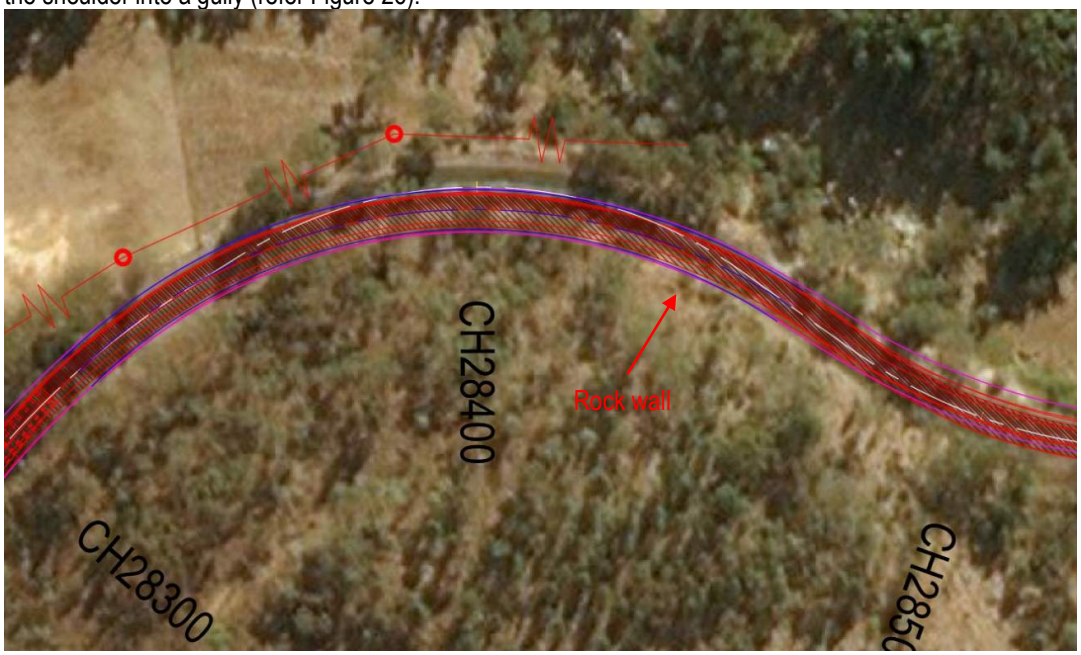

Figure 25 – Yarrabin Road CH 28,400 bend.

Figure 26 – Yarrabin Road CH 28,400. Rock wall at start of the bend, and drop off on right side of photo.

3.2.11 Yarrabin Road (CH 27,400), tight bend and major waterway crossing

The existing bend at this location has approximately a 55 m radius. The typical design is below in Figure 27, which shows a significant deviation from the existing alignment. There is also a major culvert crossing that will need to be duplicated in any new alignment through this location. The existing crossing is shown below in Figure 29.

Figure 27 – Yarrabin Road CH 27,400

Figure 28 – Yarrabin Road CH 27,550 start of bend.

Figure 29 – Yarrabin Road CH 27,350 culvert

3.2.12 Yarrabin Road (CH 26,400), crest

There is a crest at CH 26,400 which may not be suitable for the OSOM vehicles.

Figure 30 – Yarrabin Road CH 26,400 crest

3.2.13 Yarrabin Road (CH 24,325), waterway bridge

This major waterway crossing appears to be of suitable width for the OSOM vehicles. An assessment should be made to determine if the bridge has suitable structural capacity for the OSOM vehicles.

Figure 31 – Yarrabin Road CH 24,325 waterway

3.2.14 Yarrabin Road (CH 23,700), crest

There is a crest at CH 26,400 which may not be suitable for the OSOM vehicles.

Figure 32 – Yarrabin Road CH 23,700 crest

3.2.15 Yarrabin Road (CH 23,350), bend and steep grade

The existing bend at this location has approximately a 75 m radius. The bend also features a steep grade (see Figure 33) that may be too steep for OSOM vehicles. The typical possible design is also shown below in Figure 34. There is a steep drop off from the southern side of the road whilst the north side has a highly vegetated and somewhat rocky slope.

Figure 33 – Yarrabin Road CH 23,350 bend and steep crest

Figure 34 – Yarrabin Road CH 23,350 bend

3.3 Option 1 Overhead Line Crossings

Twenty-one overhead line crossings were identified during the video drive-through, which have been listed in Table 2. None of the overhead lines could be safely assumed to meet the height clearance needed by the 6.5 m tower transport. The overhead lines and their respective poles have been traced into AutoCAD, and screenshots shown in

Appendix A – Overhead Line Screenshots, Option 1. The position of the lines are indicative and a best-guess. Survey should be sought to determine the actual location and number of crossings along the route.

Table 2 – List of Overhead Line Locations, Option 1

Item Number	Road	Chainage	Notes
1	Hill End Road	500	
2	Hill End Road	1,300	Double poles
3	Hill End Road	1,750	
4	Hill End Road	3,200	
5	Hill End Road	3,250	
6	Hill End Road	3,675	
7	Hill End Road	4,750	
8	Hill End Road	5,450	
9	Hill End Road	5,975	
10	Hill End Road	6,400	One pole with 4 lines, 3 of which cross road
11	Hill End Road	6,525	
12	Hill End Road	7,125	
13	Hill End Road	9,700	
14	Yarrabin Road	38,250	
15	Yarrabin Road	38,075	
16	Yarrabin Road	37,650	
17	Yarrabin Road	37,425	
18	Yarrabin Road	30,450	
19	Yarrabin Road	28,125	
20	Yarrabin Road	24,250	
21	Burrendong Dam Road	75	

Figure 35 – Example Hill End Road overhead line crossings. Left: CH 1,300. Right: CH 6,400.

4 Goolma Rd / Twelve Mile Rd / Yarrabin Rd / Burrendong Dam Rd (Option 2)

This section will describe the characteristics and challenges specific to route Option 2.

4.1 Option 2 Route Description

The total distance specific to this option (from Goolma Rd Hwy to the Yarrabin Rd & Burrendong Dam Rd intersection) is 34.5 km. Twelve Mile Rd makes up the initial 12.85 km before turning onto Yarrabin Rd. Only the initial 400 m of Twelve Mile Rd is sealed. Unlike route Option 1, this route has 18 cattle grids which have been identified in Section 4.4 of this report. The road quality and width is variable, and the wearing course will likely need to be upgraded to accommodate the OSOM vehicles. There are numerous culvert and waterway crossings along the route which have not all been identified in this report. Many overhead lines have also been identified and shown in Section 4.3.

4.2 Option 2 Geometric Challenges and Major Waterway Crossings

This section will display the challenges identified during the assessment for Option 2.

4.2.1 Twelve Mile Road (CH 0), intersection with Goolma Rd

This existing intersection is currently not suitable and will need upgrading. An example intersection is shown below in Figure 36, which is a 9 m wide road with 40 m radii to accommodate the OSOM vehicles from their respective directions. The example design assumes that turning lanes will be required to be installed along Goolma Rd for the project.

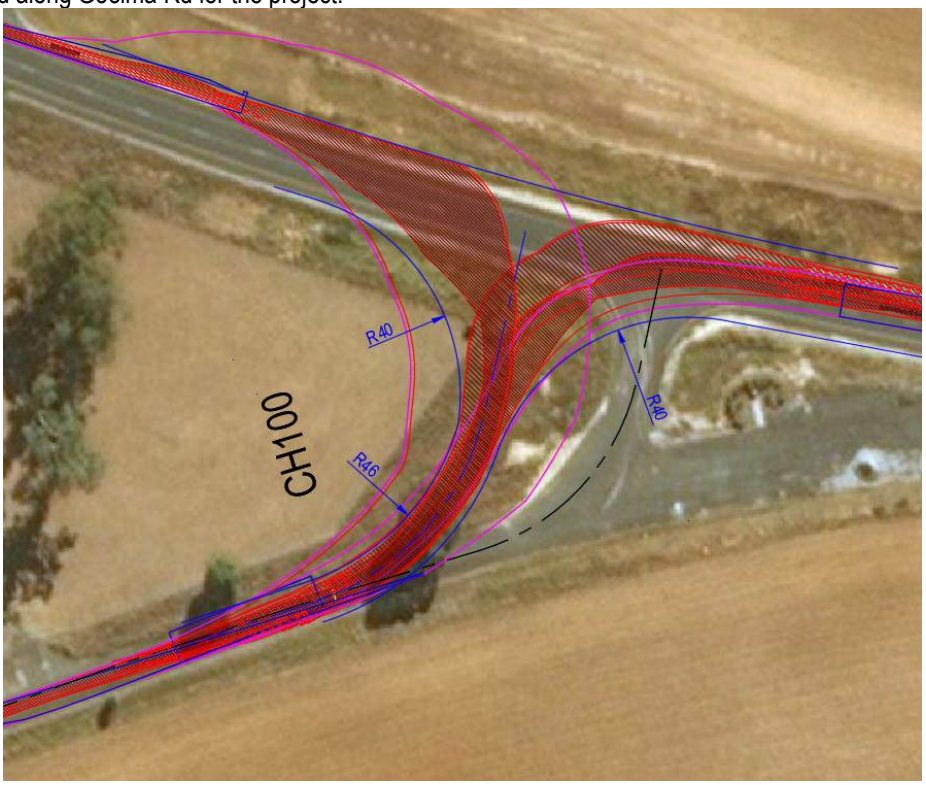

Figure 36 – Goolma Rd & Twelve Mile Rd intersection swept paths

Figure 37 – Goolma Rd & Twelve Mile Rd existing intersection

4.2.2 *Twelve Mile Road (CH 400), tight bend*

The existing bend in this location has approximately a 15 m radius. There are two poles on the inside of the bend but only one has overhead lines connected to it. It is not clear if the other is being used. The typical design is shown below in Figure 38. The swept path of the blade dodges the pole with overhead lines but not the other (see Figure 39 for an image of these poles).

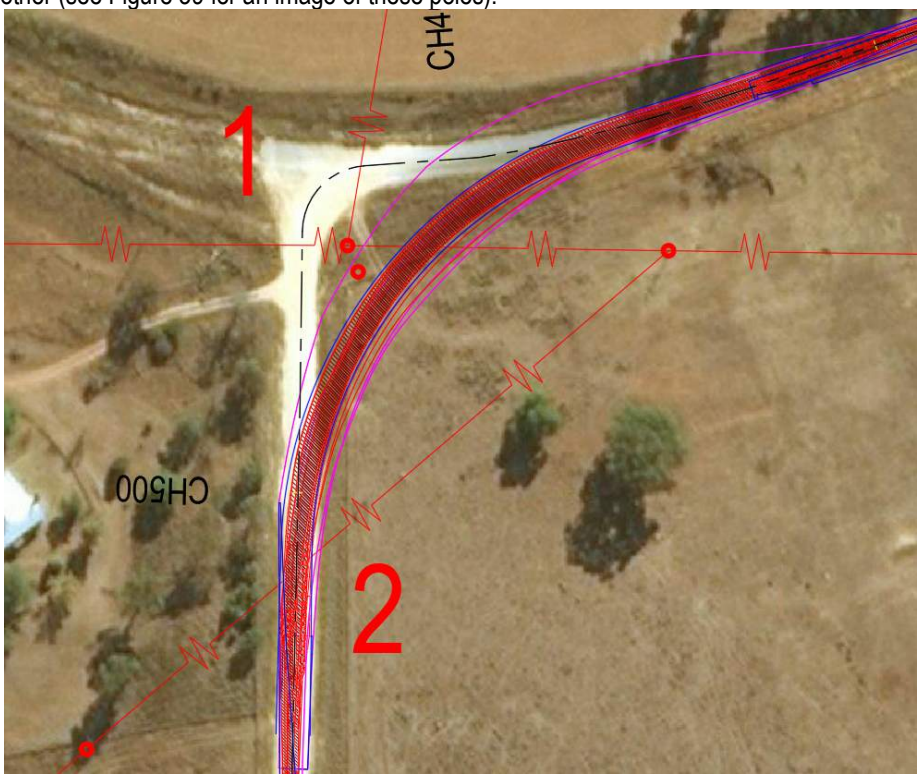

Figure 38 – Twelve Mile Rd (CH 400) typical design bend

Figure 39 – Twelve Mile Rd (CH 400) bend

4.2.3 *Twelve Mile Road (CH 1,000), tight bend*

The existing radius in this location is approximately 40 m. The typical design is below in Figure 40, which shows an isolated tree which will likely require removing. The typical design cuts through a fence on the inside of the bend.

Figure 40 – Twelve Mile Rd (CH 1,000) bend swept paths

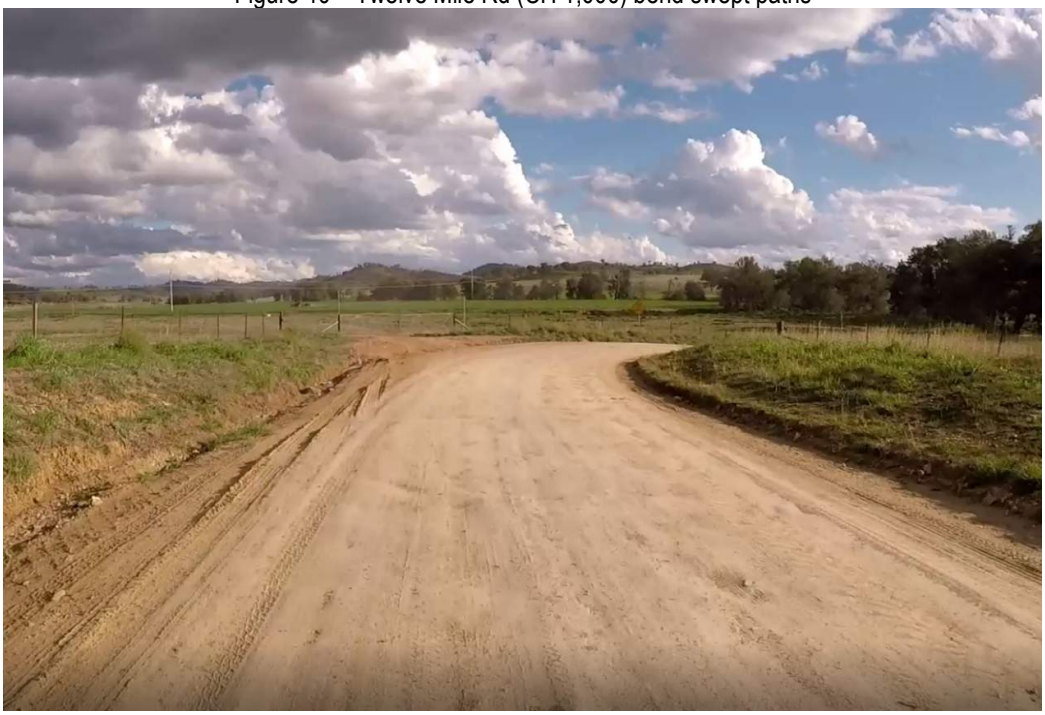

Figure 41 – Twelve Mile Rd (CH 1,000) bend

4.2.4 *Twelve Mile Road (CH 1,150), bend and waterway*

This location has a tight bend with a vertical curve, and a waterway that is unsuitable for the OSOM vehicles. The waterway will need to be upgraded to support the width demands of the OSOM vehicles and the track should be realigned to take the bend. The vertical geometry may need to be changed to accommodate the OSOM vehicles.

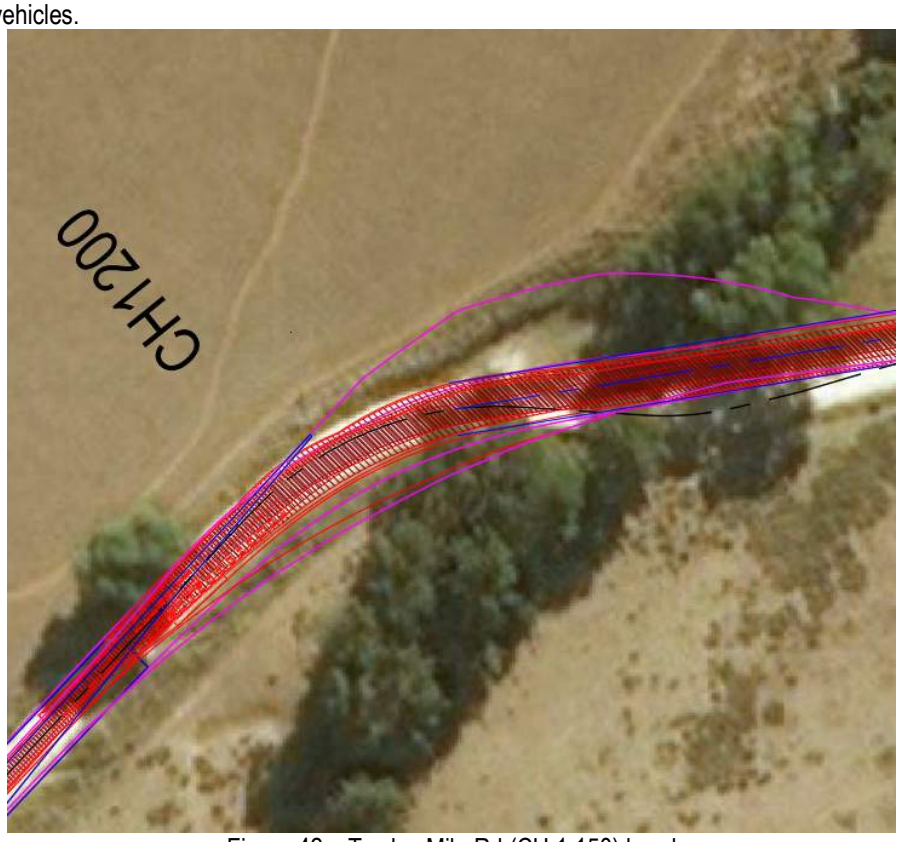

Figure 42 – Twelve Mile Rd (CH 1,150) bend

Figure 43 – Twelve Mile Rd (CH 1,150) bend

4.2.5 Twelve Mile Road (CH 12,600), bend

The existing bend radius at this location is approximately 60 m. At the start of the bend there is a cattle grid and moderate amount of vegetation. Figure 44 below shows the typical design with only the blade swept path to show potential vegetation clearing.

Figure 44 – Twelve Mile Rd (CH 12,600) bend swept path, only blade path shown

Figure 45 – Twelve Mile Rd (CH 12,600) bend, vegetation and cattle grid

4.2.6 *Yarrabin Road (CH 750), bend*

The existing bend radius at this location is approximately 80 m. There appears to be a waterway across the road at this location but culverts could not be identified during the video drive.

Figure 46 – Yarrabin Rd (CH 750), bend swept paths

Figure 47 – Yarrabin Rd (CH 750), bend

4.2.7 *Yarrabin Road (CH 1,000), bend*

The existing bend radius at this location is approximately 25 m and will require a significant realignment. The typical design is shown below in Figure 48. The typical design cuts through a property fence (that is shown in Figure 49 below) but the existing topography is not overly challenging.

Figure 48 – Yarrabin Rd (CH 1,000), bend swept paths

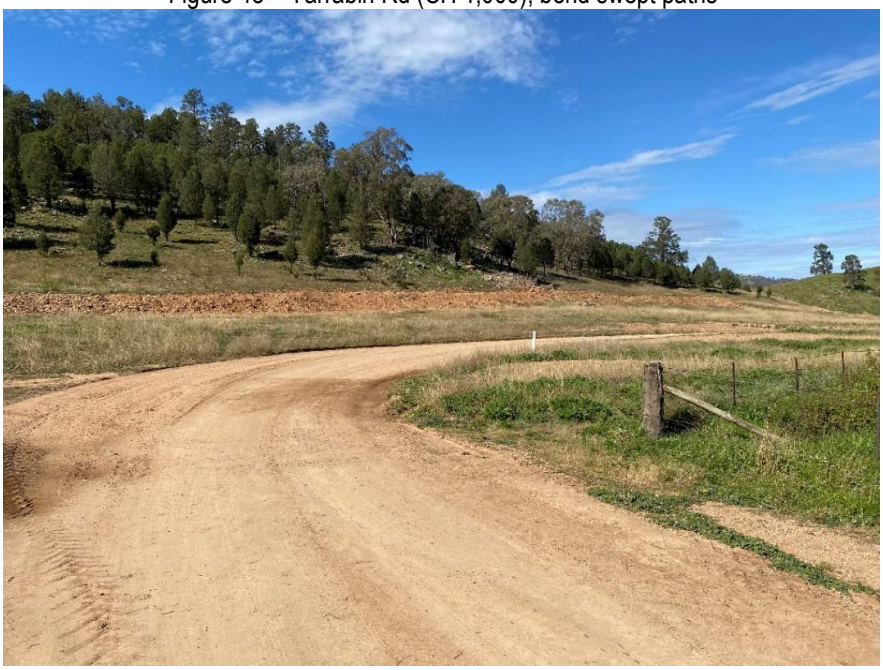

Figure 49 – Yarrabin Rd (CH 1,000), bend and fence

4.2.8 Yarrabin Road (CH 1,950), bend

The existing bend radius at this location is approximately 75 m, and will not require a major realignment.

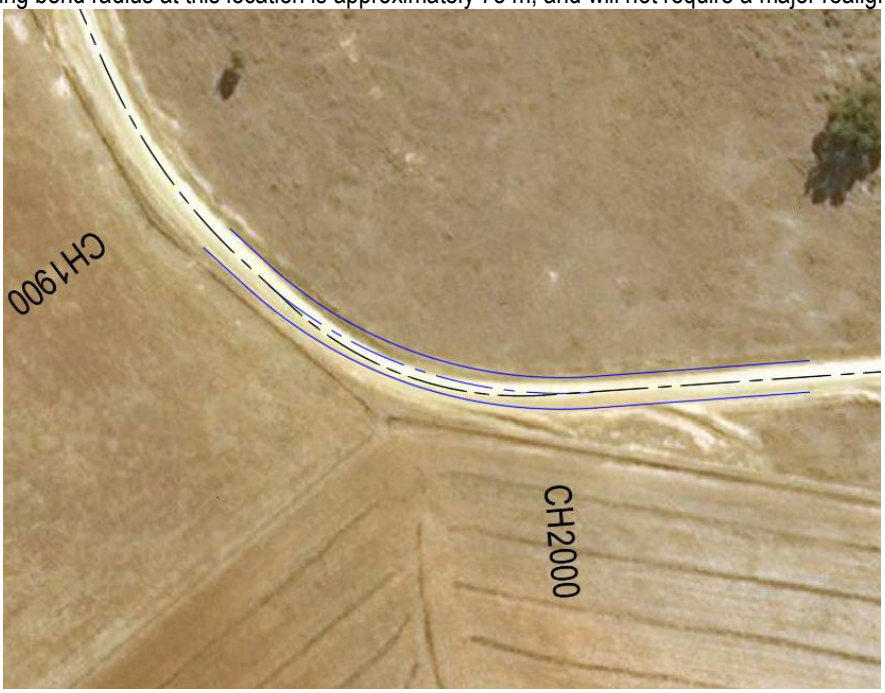

Figure 50 – Yarrabin Rd (CH 1,950), bend

4.2.9 Yarrabin Road (CH 2,400), bend

The existing bend radius at this location is approximately 65 m, and will not require a major realignment.

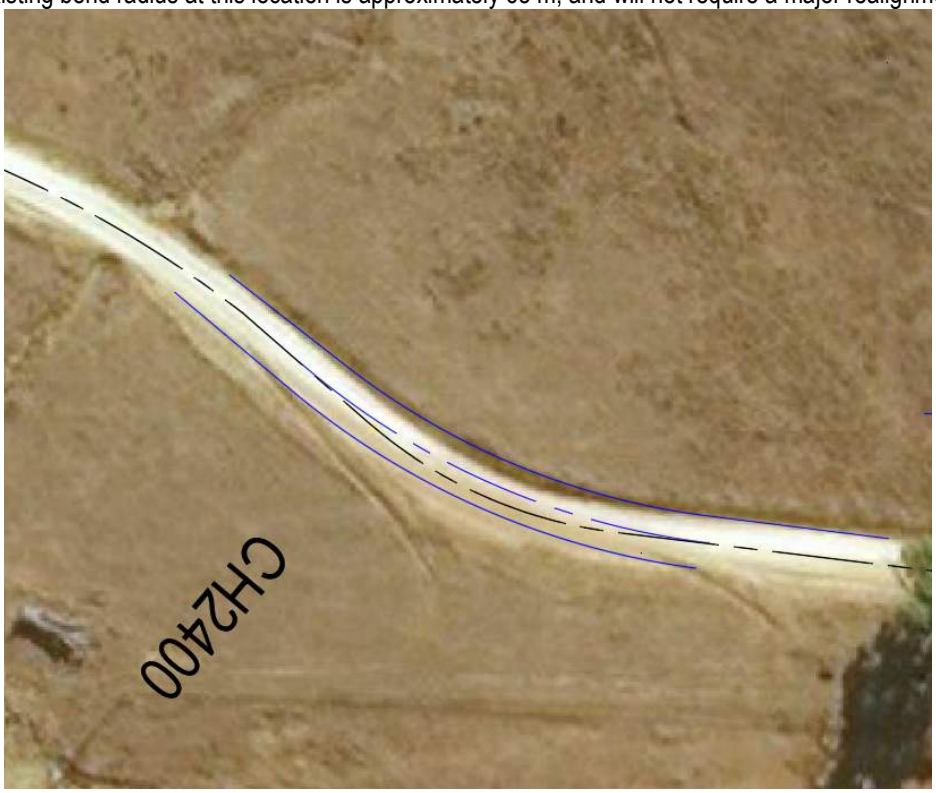

Figure 51 – Yarrabin Rd (CH 2,400), bend

4.2.10 Yarrabin Road (CH 3,100 – 3,500), two s-bends

This length of road consists of two S-bends that currently will not accommodate the OSOM vehicles. There is a cattle grid on the first bend (CH 3,200) and a small culvert on the third bend (which is the tightest at 30 m radius) located at CH 3,400. The fourth bend also has a high grade that will likely need to be vertically realigned, in addition to being horizontally realigned (see Figure 53).

Figure 52 – Yarrabin Rd (CH 3,100 – 3,500), possible realignment

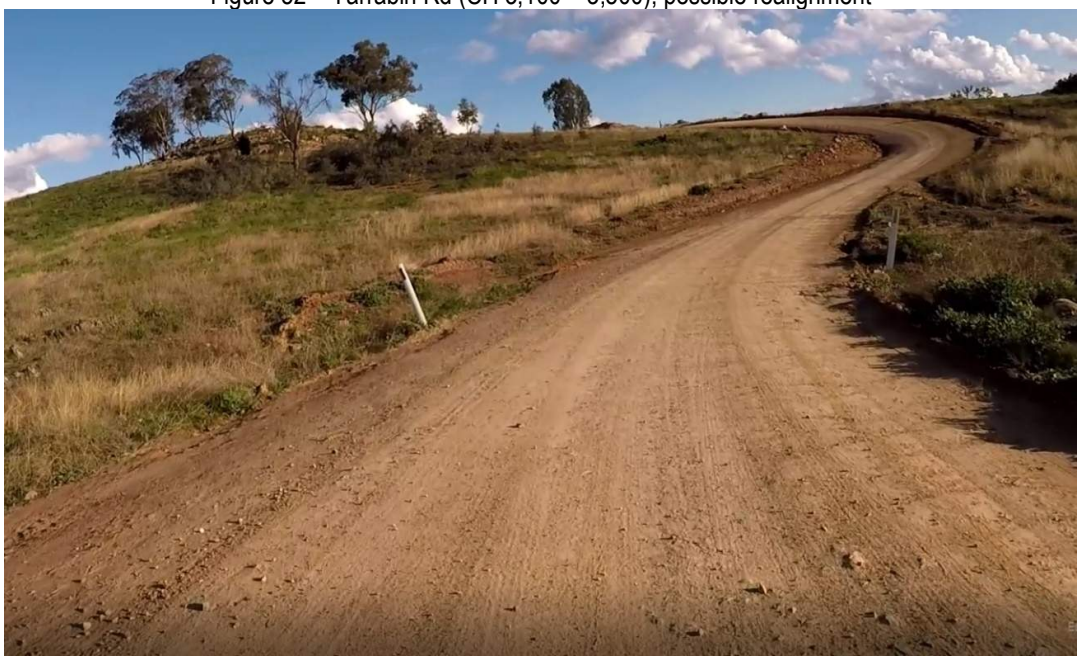

Figure 53 – Yarrabin Rd (CH 3,400), bend with hill

4.2.11 Yarrabin Road (CH 3,750), tight bend

The existing bend radius at this location is approximately 40 m, and there is a small culvert within the bend. The realignment of this location (shown Figure 54) will need to install an equivalent culvert.

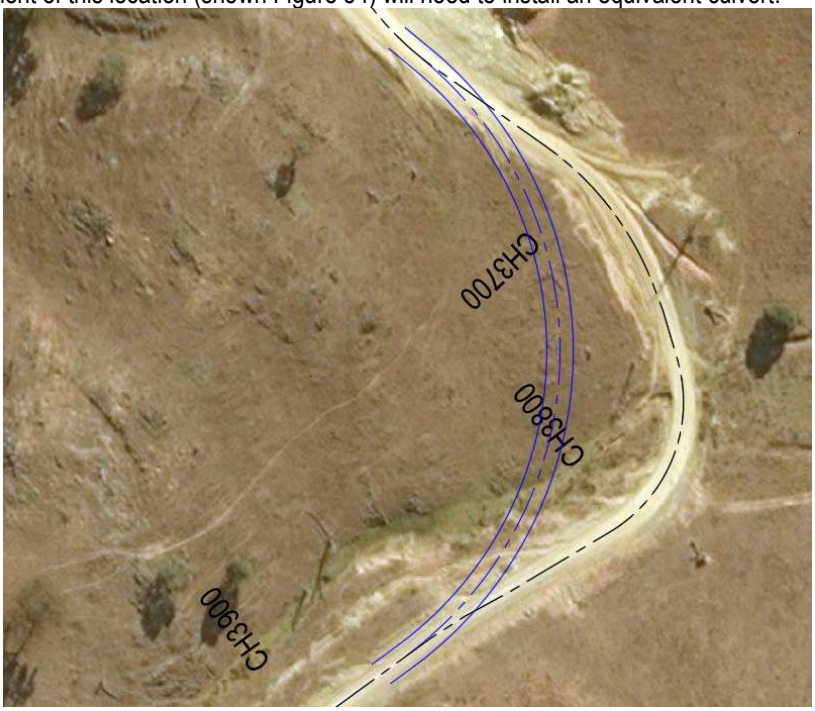

Figure 54 – Yarrabin Rd (CH 3,750), bend

Figure 55 – Yarrabin Rd (CH 3,750), bend and culvert crossing

4.2.12 Yarrabin Road (CH 4,600), bend

The existing bend radius at this location is approximately 80 m, and will not require a major realignment. There is a moderately sized culvert at the start of the bend that may need to be upgraded.

Figure 56 – Yarrabin Rd (CH 4,600), bend

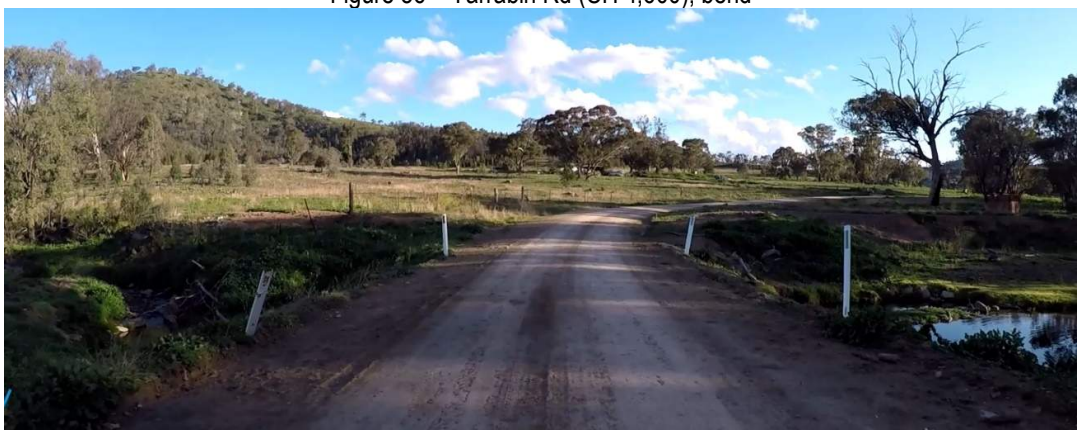

Figure 57 – Yarrabin Rd (CH 4,550), culvert

4.2.13 Yarrabin Road (CH 5,400), s-bend

The existing bend radii of this s-bend are approximately 40 m and 70 m, and there is a cattle grid located in the first bend (see Figure 58). The typical design, consisting of two 100 m bends is shown below Figure 59, while an alternate possible design is shown in Figure 60.

Figure 58 – Yarrabin Rd (CH 5,400), cattle grid and s-bend

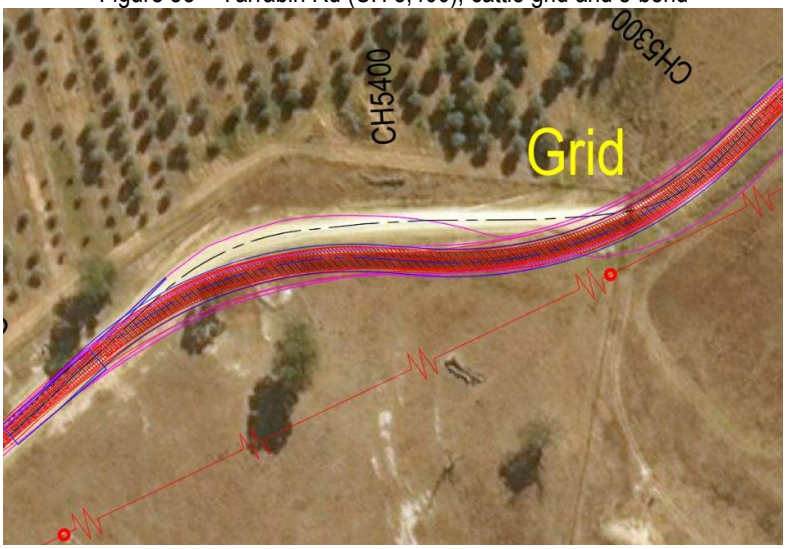

Figure 59 – Yarrabin Rd (CH 5,400), s-bend swept paths

Figure 60 – Yarrabin Rd (CH 5,400), s-bend alternate possible design

4.2.14 Yarrabin Road (CH 7,400), bend

The existing bend radius at this location is approximately 80 m, and will require only a minor realignment. There are a few trees in this area that will likely need to be removed to accommodate an upgrade. Figure 61 below shows the blade swept path through this area to give a sense of the vegetation disturbance.

Figure 61 – Yarrabin Rd (CH 7,400), bend, just blade swept path shown

Figure 62 – Yarrabin Rd (CH 7,400), bend

4.2.15 Yarrabin Road (CH 7,925), major floodway

There is a major concrete floodway at this location that will likely need to be upgraded. The floodway sits in a sag that may be too tight for the OSOM vehicles.

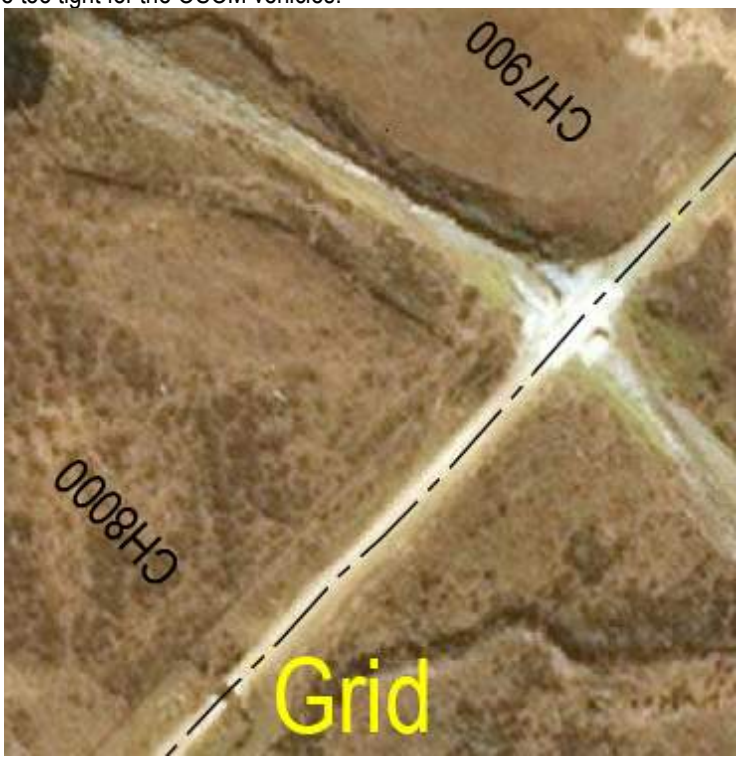

Figure 63 – Yarrabin Rd (CH 7,925), floodway

Figure 64 – Yarrabin Rd (CH 7,925), floodway and vertical curve

4.2.16 Yarrabin Road (CH 10,900), vertical curve

There is a vertical curve, shown in Figure 65 that is likely unsuitable for the OSOM vehicles.

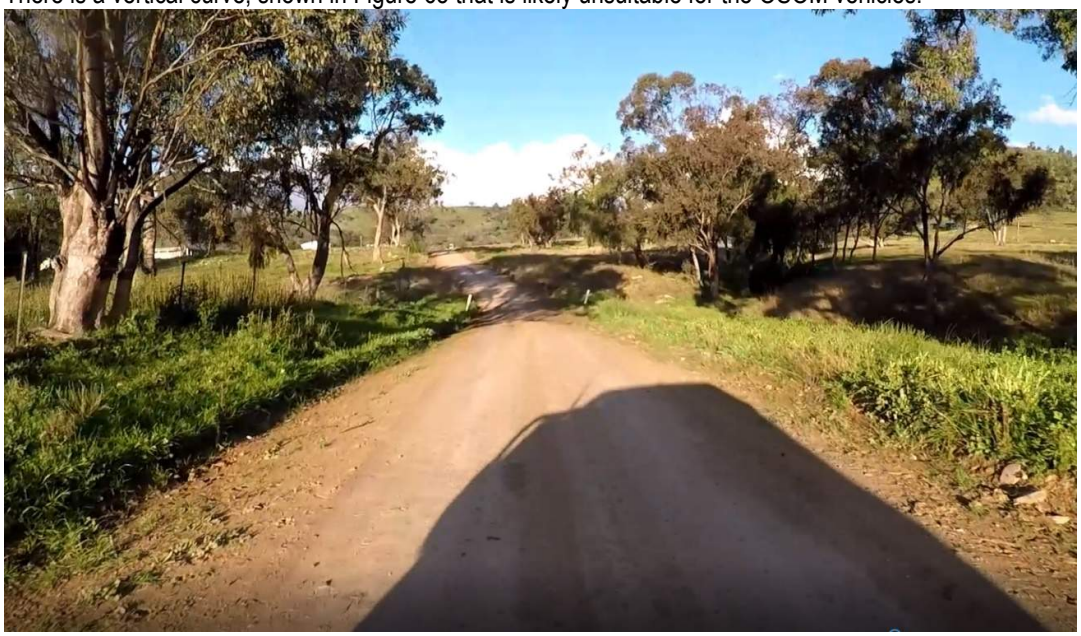

Figure 65 – Yarrabin Rd (CH 10,900), vertical curve

4.2.17 Yarrabin Road (CH 12,500 – 13,300), several tight bends

There are a series of tight bends throughout this section of road that are unsuitable for the OSOM vehicles. A challenge through this area is the creek running parallel to the road, the batters of which can be quite steep and best avoided. The initial bend has approximately a 35 m radius. The realignment, shown in Figure 66, will need to install a culvert where the road crosses the waterway.

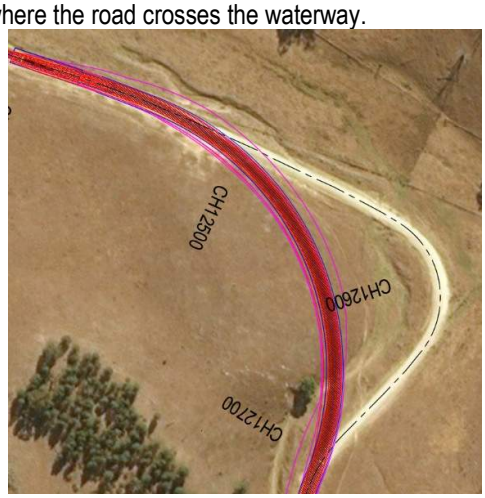

Figure 66 – Yarrabin Rd (CH 12,600), tight bend

The next part of the possible design (shown in Figure 67) aims to avoid the gully as much as possible. To do this, the bends at CH 12,950 and 13,150 cannot be realigned on the inside (east and north sides respectively) of their existing locations. The west side of the road extends up a hill which will be more practical to build on (see Figure 68 looking south from CH 13,000).

Figure 67 – Yarrabin Rd (CH 12,800 – 13,400), possible realignment

Figure 68 – Yarrabin Rd (CH 13,000), gully to avoid on left, hill on the right

4.2.18 Yarrabin Road (CH 14,250), tight s-bend

This location is constrained by a steep incline on the east of the road and a steep drop off on the west (see Figure 69). An example of a possible alignment is shown below in Figure 70 with the blade swept path shown. This alignment avoids the steep drop off which will require extensive amounts of fill, however the cut through the hill is also challenging. A location like this may benefit from localised road widening rather than a full realignment.

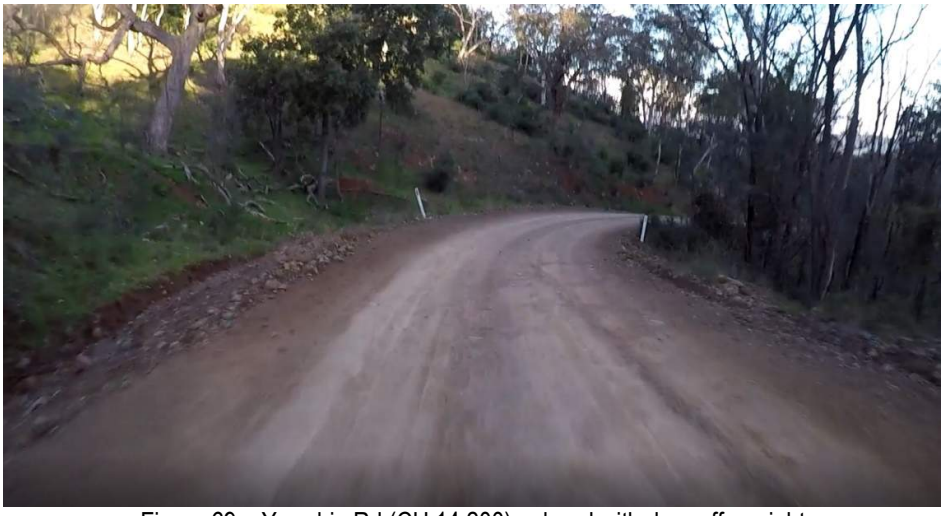

Figure 69 – Yarrabin Rd (CH 14,200), s-bend with drop off on right

Figure 70 – Yarrabin Rd (CH 14,250), s-bend, blade swept path shown

4.2.19 Yarrabin Road (CH 16,500), concrete floodway

There is a long concrete floodway at this location that may need to be upgraded. The transition on and off the floodway does not appear to be smooth / flat enough for the OSOM vehicles to traverse safely.

Figure 71 – Yarrabin Rd (CH 16,500), concrete floodway

4.2.20 Yarrabin Road (CH 18,000 – 18,500), heavily vegetated corridor

This area is heavily vegetated and will likely require a lot of tree trimming and possibly some tree removal.

Figure 72 – Yarrabin Rd (CH 18,250), heavily vegetated corridor

Figure 73 – Yarrabin Rd (CH 18,000 – 18,400), heavily vegetated corridor, tower swept path shown

4.2.21 Yarrabin Road (CH 21,600), intersection with Burrendong Dam Rd

The intersection with Burrendong Dam Rd will need to be upgraded. Two possible options have been presented below in Figure 74. The option on the left adopts a 60 m radius and a track width of 7 m for the OSOM vehicles to turn, whilst the option on the right adopts a 40 m radius with an 8.5 m track width. Both options aim to avoid the pole on the north side of Burrendong Dam Rd but this pole will likely need to be upgraded for height clearance anyway. Both options result in significant overhang on the north-east side of Yarrabin Rd, but due to the sloping topography of this location, this isn't expected to be an issue. There is less work involved in the right option, which is why it is preferable at this stage.

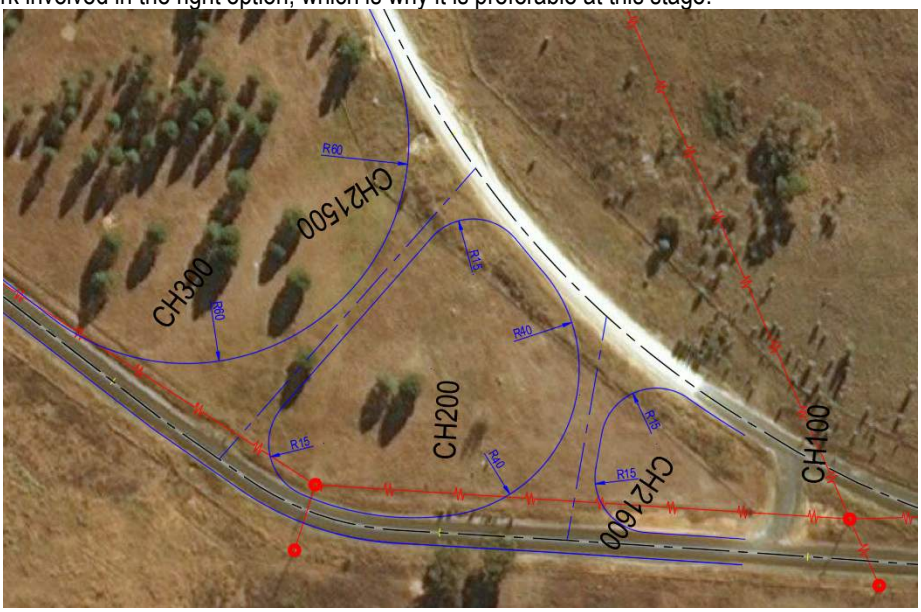

Figure 74 – Yarrabin Rd & Burrendong Dam Rd intersection possible upgrades

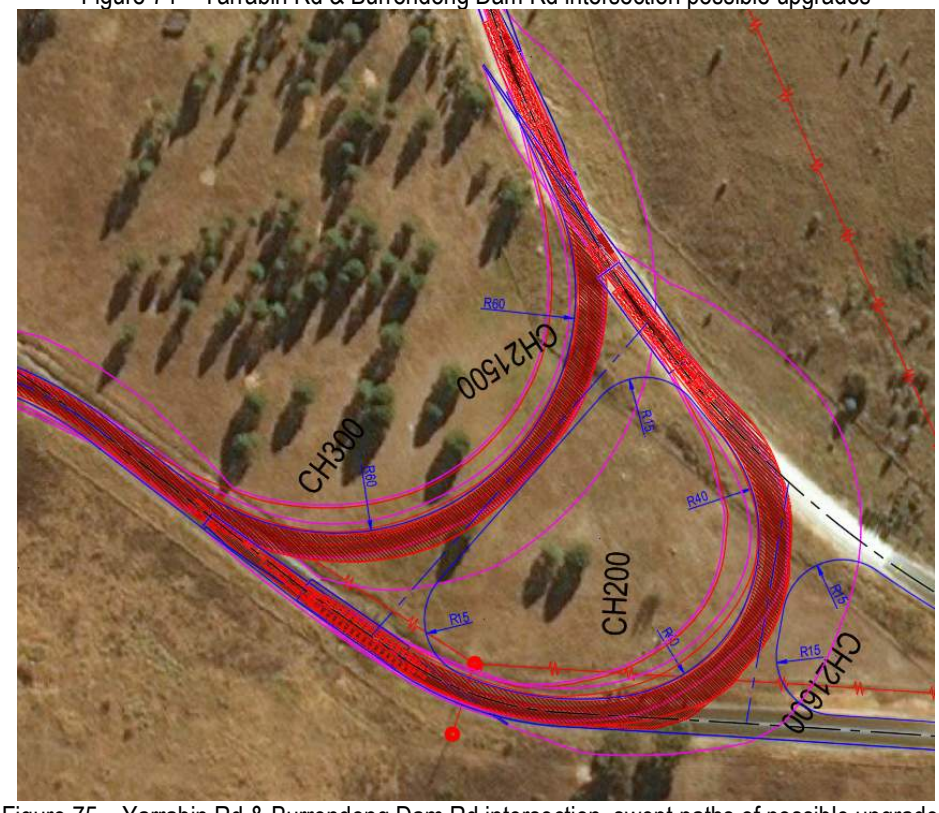

Figure 75 – Yarrabin Rd & Burrendong Dam Rd intersection, swept paths of possible upgrades

Figure 76 – Yarrabin Rd & Burrendong Dam Rd intersection

4.3 Option 2 Overhead Line Crossings

Nineteen overhead line crossings were identified during the video drive-through, which have been listed in Table 3. None of the overhead lines could be safely assumed to meet the height clearance needed by the 6.5 m tower transport. The overhead lines and their respective poles have been traced into AutoCAD, and screenshots shown in Appendix B – Overhead Line Screenshots, Option 2. The position of the lines are indicative and a best-guess. Survey should be sought to determine the actual location and number of crossings along the route.

Table 3 – List of Overhead Line Locations, Option 2

Number	Road	Chainage	Notes
1	Twelve Mile Rd	425	2 crossings.
2	Twelve Mile Rd	525	
3	Twelve Mile Rd	3,025	
4	Twelve Mile Rd	3,900	
5	Twelve Mile Rd	6,050	
6	Twelve Mile Rd	12,100	2 lines crossing. 1 pole adjacent to road branching out 4 ways.
7	Twelve Mile Rd	12,750	
8	Yarrabin Rd	0	
9	Yarrabin Rd	125	
10	Yarrabin Rd	5,625	
11	Yarrabin Rd	7,300	
12	Yarrabin Rd	7,575	
13	Yarrabin Rd	8,825	
14	Yarrabin Rd	9,450	
15	Yarrabin Rd	9,800	
16	Yarrabin Rd	11,125	
17	Yarrabin Rd	16,750	
18	Yarrabin Rd	19,625	
19	Yarrabin Rd	21,600	Running parallel to Burrendong Dam Rd

4.4 Option 2 Cattle Grids

Eighteen cattle grids were identified during the video survey of this route. The condition of the grids was typically poor – okay, and all widths were unsuitable for the OSOM vehicles. An example grid has been shown below in Figure 77 – Yarrabin Rd cattle grid. It should be assumed that all grids will need to be replaced.

Figure 77 – Yarrabin Rd cattle grid (CH 5,350)

A list of the cattle grids and their locations are shown below in Table 4.

Table 4 – List of Cattle Grid Locations – Option 2 Route

Number	Road	Chainage	Notes
1	Twelve Mile Road	12,575	
2	Yarrabin	400	
3	Yarrabin	1,000	
4	Yarrabin	2,500	
5	Yarrabin	3,200	
6	Yarrabin	4,000	
7	Yarrabin	5,000	
8	Yarrabin	5,325	
9	Yarrabin	6,775	
10	Yarrabin	7,150	
11	Yarrabin	8,000	
12	Yarrabin	8,950	
13	Yarrabin	10,175	
14	Yarrabin	11,150	
15	Yarrabin	13,375	
16	Yarrabin	13,800	
17	Yarrabin	14,975	
18	Yarrabin	15,900	

5 Yarrabin Rd / Burrendong Dam Rd / Endacott Rd (Option 1 and 2)

This section will describe the characteristics and challenges specific to Burrendong Dam Rd and Endacott Rd, which are both included in route Option 1 & 2.

5.1 Burrendong Dam Rd / Endacott Rd Route Description

This route extends from the intersection of Yarrabin Rd & Burrendong Dam Rd through to Endacott Rd and finally an unnamed track. The location of the unnamed track in relation to Endacott Rd is shown below in Figure 78. The total distance of this route is 8 km.

Figure 78 – End of Endacott Rd

Burrendong Dam Rd makes up the initial 7 km before becoming Endacott Rd. Only the initial 700 m of Burrendong Dam Rd is sealed, with two lanes totalling approximately 5 – 6 m width. The last 3 km is densely vegetated (as shown in Figure 79 below), such that tree trimming along this section of the road should be anticipated.

Figure 79 – Road vegetation typical of the last 3 km of Burrendong Dam Rd

5.2 Burrendong Dam Rd / Endacott Rd Geometric Challenges and Major Waterway Crossings

5.2.1 Burrendong Dam Road (CH 400), bend

The existing bend radius at this location is approximately 60 m. The blade swept path through the typical design is shown below in Figure 80. Other concerns at this location is the overhead line which briefly runs parallel over the road at the start of the bend, and the trees that will likely need to be removed on the inside of the curve (shown Figure 81).

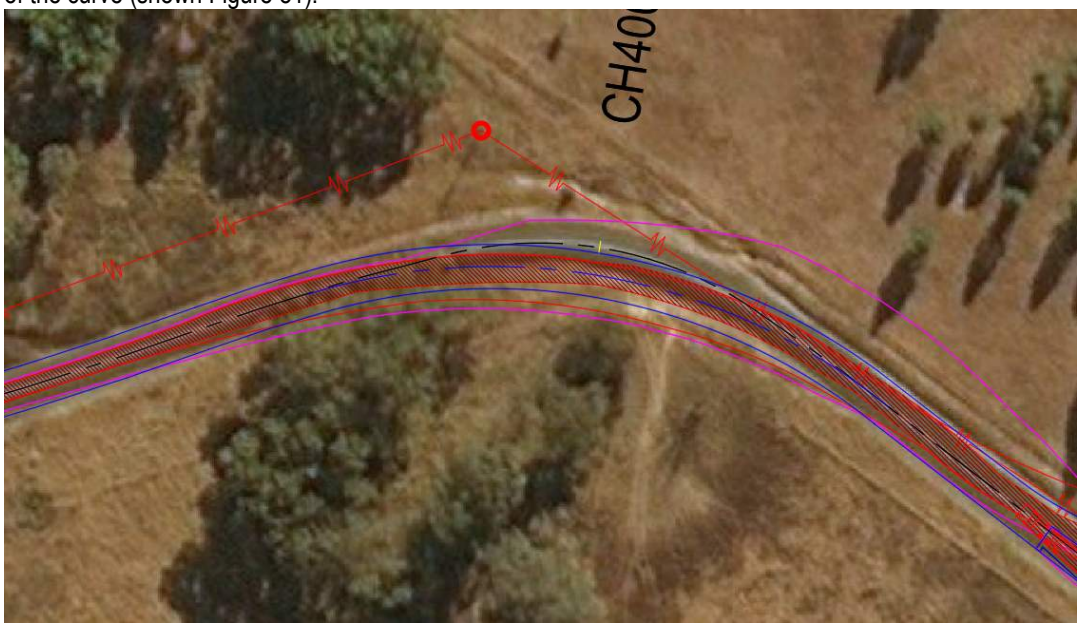

Figure 80 – Burrendong Dam Rd (CH 400), bend

The typical design also cuts through an existing fence line on the inside of the curve, and so the track may be better realigned towards the space on the left in Figure 81.

Figure 81 – Burrendong Dam Rd (CH 400), bend, looking north-east

5.2.2 *Burrendong Dam Road (CH 600), major waterway, tight bend, vertical curves*

The waterway at this location is likely not wide enough to support the width demands of the transformer drake. Additionally, the horizontal and vertical bend on the western side is inaquate for the OSOM vehicles and will need to be realigned.

Figure 82 – Burrendong Dam Rd (CH 600) waterway bridge and insufficient curve in background

An example horizontal realignment is shown in Figure 83 below with the transformer swept path to compare it to the width of the bridge. There is an overhead line which, due to the vertical curve, may have sufficent clearance. There is also a fence line which the realignment avoids, but this will not prevent the removal of trees on the southen side due to blade overhang.

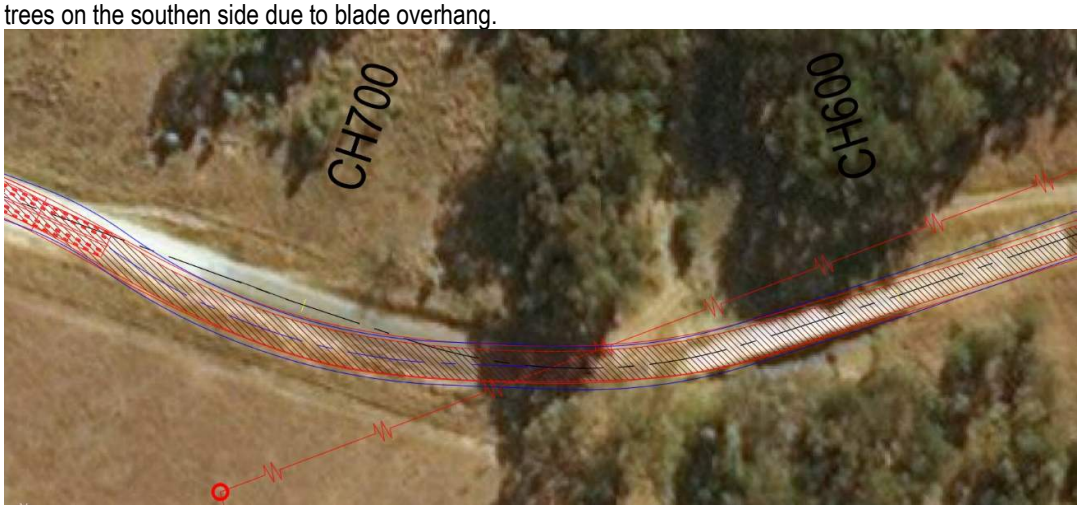

Figure 83 – Burrendong Dam Rd (CH 600), bend typical alignment with transformer swept path

5.2.3 Burrendong Dam Road (CH 1,450), bend

The existing bend radius at this location is approximately 45 m, and will need to be upgraded. There are trees and a fence line that will interfere with the realignment.

Figure 84 – Burrendong Dam Rd (CH 1,450), bend with typical realignment

Figure 85 – Burrendong Dam Rd (CH 1,450), bend

5.2.4 *Burrendong Dam Road (CH 4,200 – 6,900), dense vegetation*

This stretch of road is very windy and densely vegetated. All horizontal curves appear to be adequate (roughly 100 m radius) for the OSOM vehicle but vegetation will need to be cleared on every bend due to the blade's overhang. The following screenshots will present the swept path of the blade though this area. The blue line in the screenshots gives a rough indication of the edge of the road.

Figure 86 – Burrendong Dam Rd (CH 4,200), bend, blade swept path

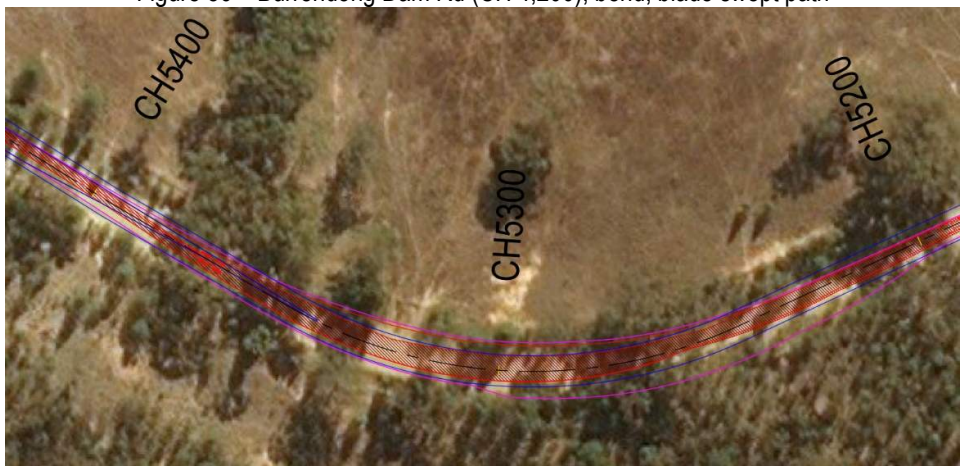

Figure 87 – Burrendong Dam Rd (CH 5,300), bend, blade swept path

Figure 88 – Burrendong Dam Rd (CH 5,600), bend, blade swept path

Figure 89 – Burrendong Dam Rd (CH 5,850), bend, blade swept path

Figure 90 – Burrendong Dam Rd (CH 6,100), bend, blade swept path

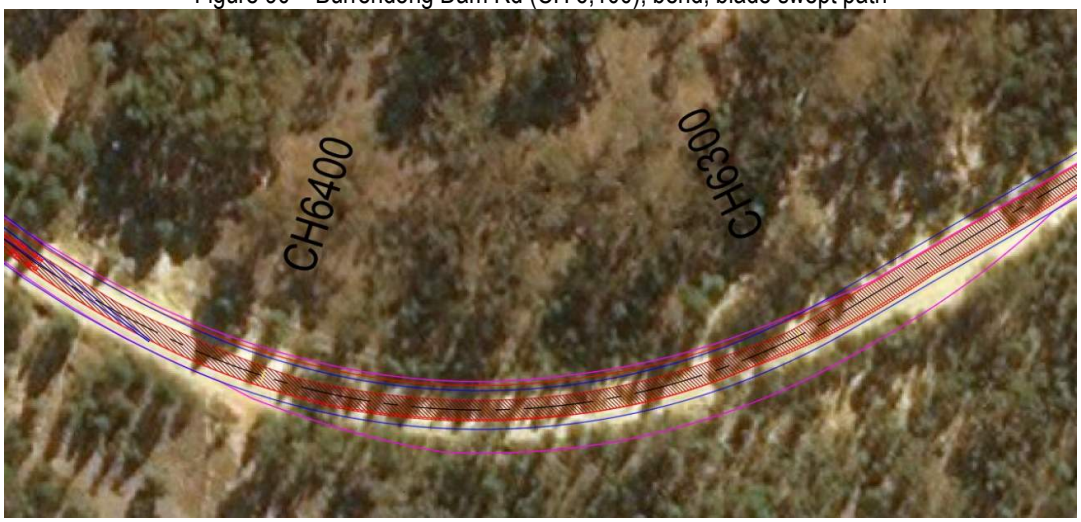

Figure 91 – Burrendong Dam Rd (CH 6,350), bend, blade swept path

Figure 92 – Burrendong Dam Rd (CH 6,700), bend, blade swept path

5.2.5 *Endacott Rd (CH 50), tight bend and structure interference*

The first bend within the holiday park has a radius of approximately 90 m. The main concern with this bend is the proximity of a building and fence which the swept path of the blade comes too close to. The bend will need to be realigned with a very large radius to ensure the blade does not come too close to the structures. The example shown in Figure 93 below adopts a 300 m radius which gives a 6 m buffer to the building. To do so, the realignment cuts though a vegetated hill, which is shown in Figure 94 below.

Figure 93 – Endacott Rd (CH 50), bend realignment, blade swept path

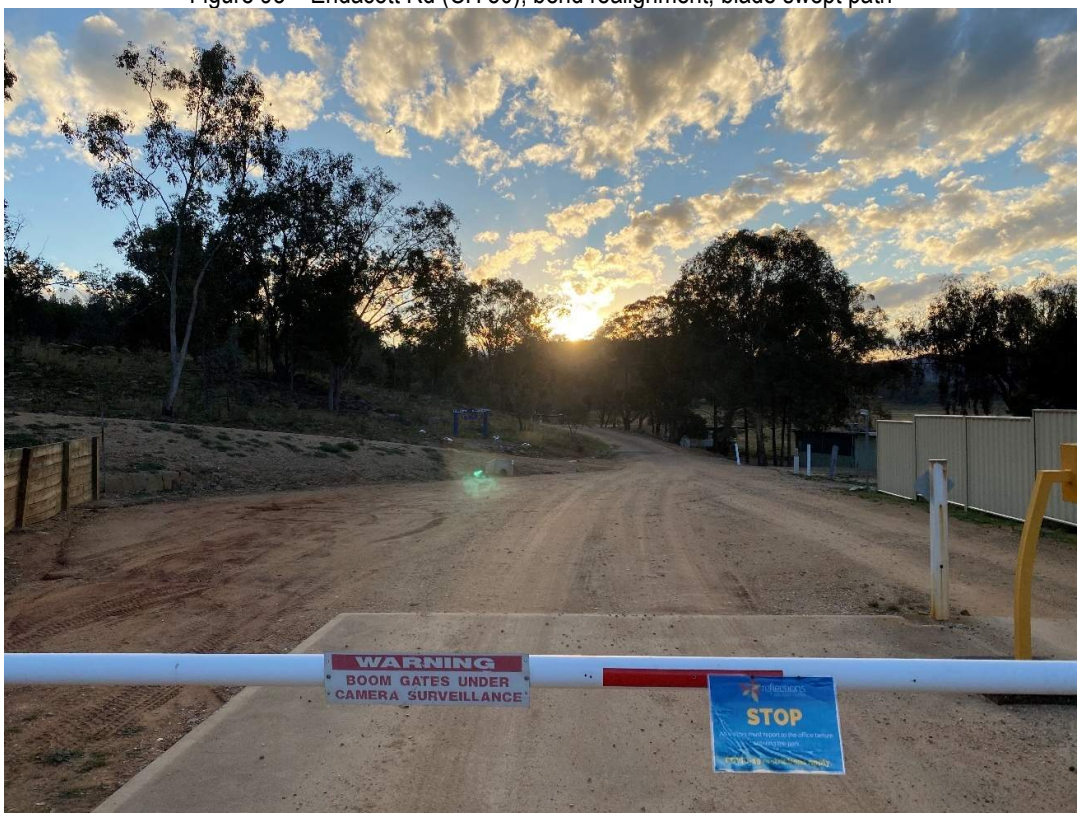

Figure 94 – Burrendong Dam Rd (CH 6,950), fence to avoid on right, vegetated hill in background

5.2.6 *Endacott Rd (CH 550), blade overhang example*

This bend has a roughly 100 m radius and may be able to keep its current alignment. Trees in this location however appear to be interfering with the blade's swept path and will likely need to be removed.

Figure 95 – Endacott Rd (CH 550), bend

5.2.7 *Endacott Rd / unnamed track (CH 800), tight bend and structure interference*

The bend at this location has approximately a 25 m radius and will need upgrading. Another concern at this location is the proximity of the building at CH 700 which is close to the blade's overhang. The typical realignment and blade swept path in Figure 96 shows the blade with a 3.5 m offset from the building, but this appears to be easily improved by increasing the radius of the bend.

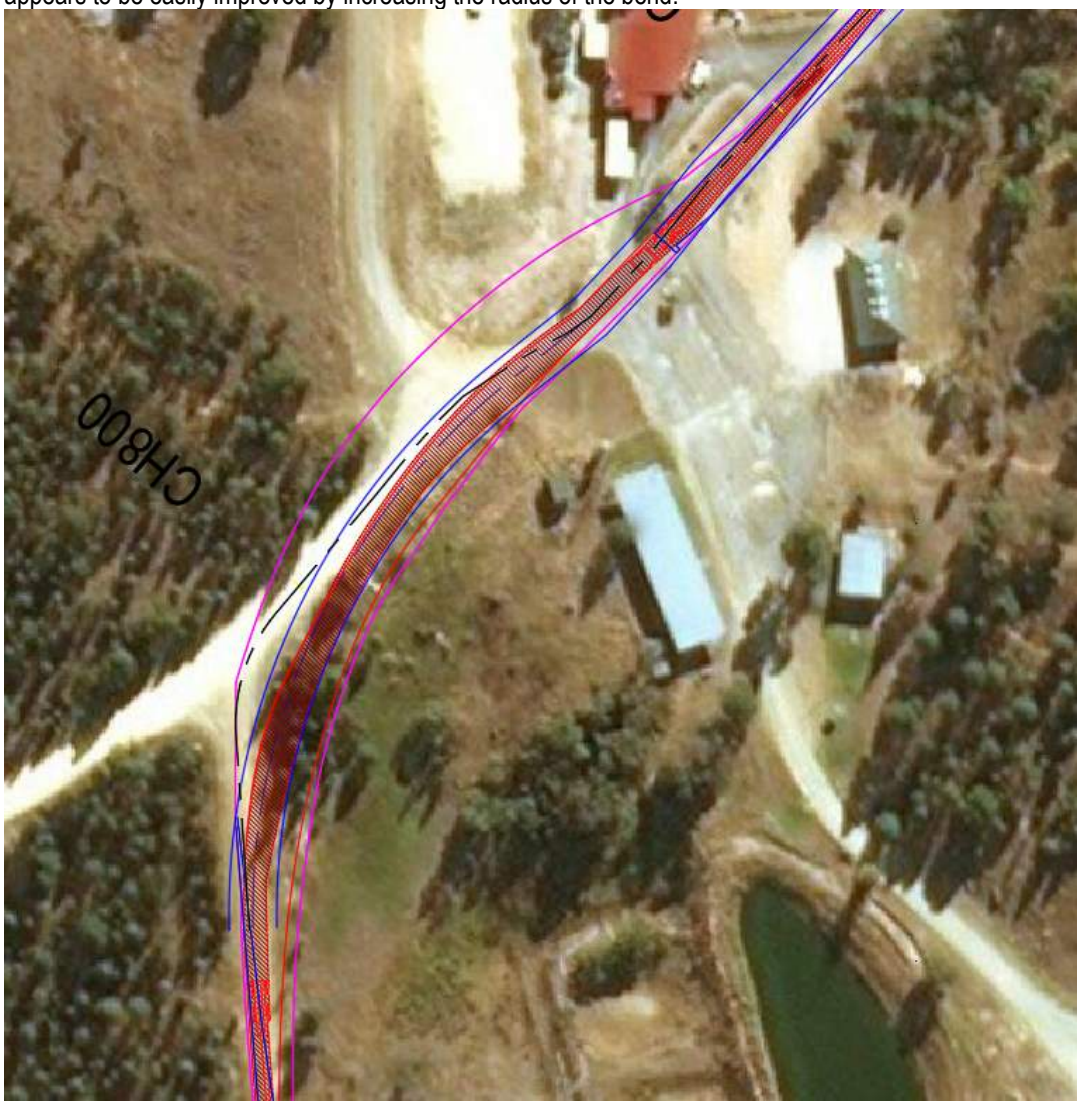

Figure 96 – Endacott Rd / unnamed track (CH 800), bend realignment and blade swept path

5.3 Burrendong Dam Rd / Endacott Rd Overhead Line Crossings

Three overhead line crossings were identified during the video drive-through, which have been listed in Table 5. None of the overhead lines could be safely assumed to meet the height clearance needed by the 6.5 m tower transport. The overhead lines and their respective poles have been traced into AutoCAD, and screenshots shown in Appendix C – Overhead Line Screenshots, Burrendong Dam Rd (Option 1 & 2). The position of the lines are indicative and a best-guess. Survey should be sought to determine the actual location and number of crossings along the route. Endacott Rd could not be video surveyed and therefore overhead lines could not be identified along this road during this assessment.

Table 5 – List of Overhead Line Locations, Burrendong Dam Rd

Number	Road	Chainage	Notes
1	Burrendong Dam Rd	350	
2	Burrendong Dam Rd	650	Likely will have enough clearance due to existing curve.
3	Burrendong Dam Rd	2,950	

6 Discussion and Recommendations

This section will summarise and compare the differences between the two route options. Since the route after the intersection of Yarrabin Rd and Burrendong Dam Rd is consistent with both options, this section will not discuss the route after that point.

This report shows that there are challenging upgrades along both Option 1 and 2. Option 2 is the longer of the two, with a total distance of 34.5 km to the Yarrabin Rd / Burrendong Dam Rd intersection compared to the 27 km of Option 1. The road pavement quality of Option 1 is superior to that of Option 2, which will likely require a pavement upgrade along the entire route. Option 1 is expected to have more vegetation clearing since there are more trees along the side of the road than Option 2. The number of upgrades to overhead lines is considered practically equal between both routes, assuming all observed overhead lines need to be upgraded.

It is anticipated that there is less upgrade works in total along Option 1, but, Option 2 is considered to have less very-challenging upgrades. Examples of these very-challenging upgrades include significant waterways and tight horizontal and/or vertical curves requiring significant amounts of cut/fill through densely vegetated areas.

Option 2's inferior existing road quality somewhat works in its favour, as an average upgrade will be easier than an average Option 1 upgrade. Council may require that any road realignment along Option 1 adopt the existing road's design standards, including pavement seal.

Furthermore, icubed consulting consider upgrading Option 1 for the blade transport to be highly impractical, such that it was not considered during this assessment. This assessment, in icubed's opinion, has also shown that it is not worth upgrading route Option 1 for only the tower and transformer transports, when Option 2 is practical for all three OSOM vehicles assessed in this report.

For the above reasons, icubed consulting consider Option 2 to be the preferred route for the project.

7 Conclusion

This report has reviewed two possible external routes for OSOM vehicles to cater for the proposed Burrendong Wind Farm project. A desktop assessment of three unique OSOM vehicles was undertaken using AutoCAD's Vehicle Tracking software to give an indication of the construction challenges that exist along each route, and then comment on which route, in icubed's opinion, is more practical. This was supported by a video drive-through assessment of the two routes, undertaken on 12th August 2020. In

icubed's opinion, whilst there is more construction work to undertake along route Option 2, the upgrades along this route are generally far-easier than Option 1. For this reason, icubed recommend utilising route Option 2 from the Goolma Rd & Twelve Mile Rd intersection through to the Yarrabin Rd & Burrendong Dam Rd intersection.

Appendix A – Overhead Line Screenshots, Option 1

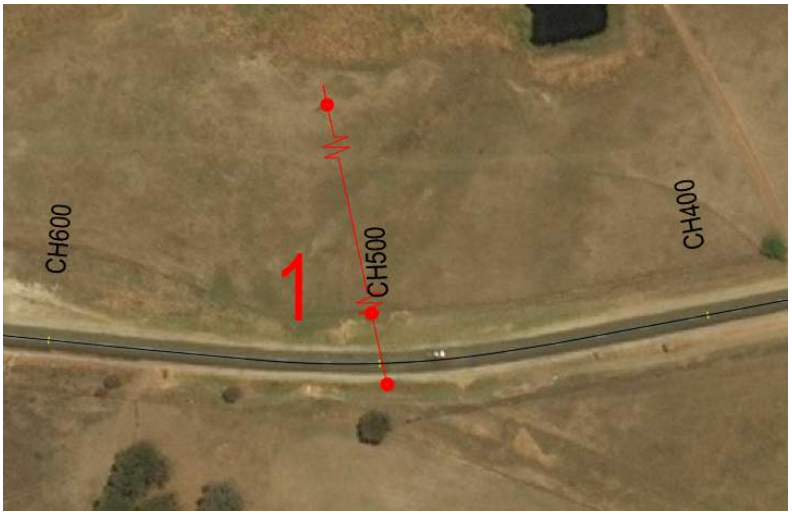

Figure A1 – Hill End Rd, Overhead Crossing

Figure A2 – Hill End Rd, Overhead Crossings

Figure A3 – Hill End Rd, Overhead Crossings

Figure A4 – Hill End Rd, Overhead Crossing

Figure A5 – Hill End Rd, Overhead Crossings

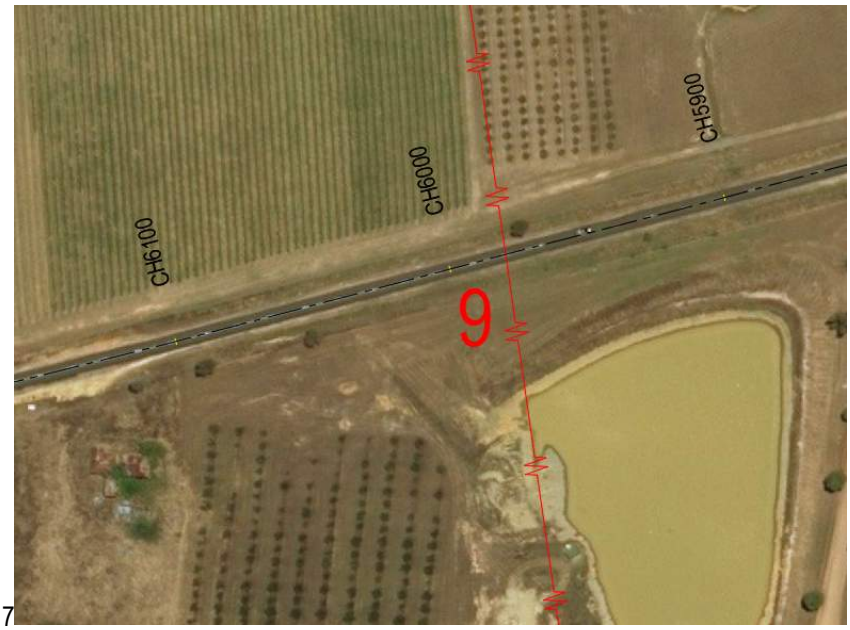

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Figure A6 – Hill End Rd, Overhead Crossing

Figure A7 – Hill End Rd, Overhead Crossings

Figure A8 – Hill End Rd, Overhead Crossing

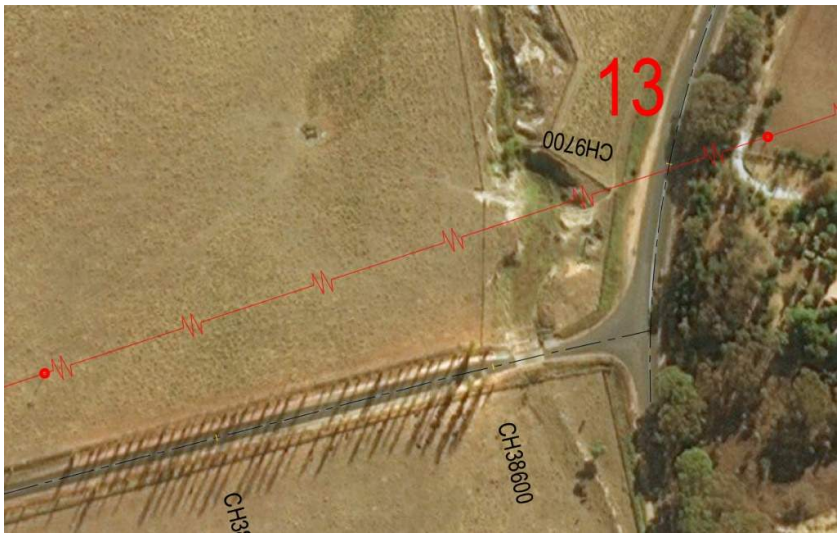

Figure A9 – Hill End Rd, Overhead Crossing

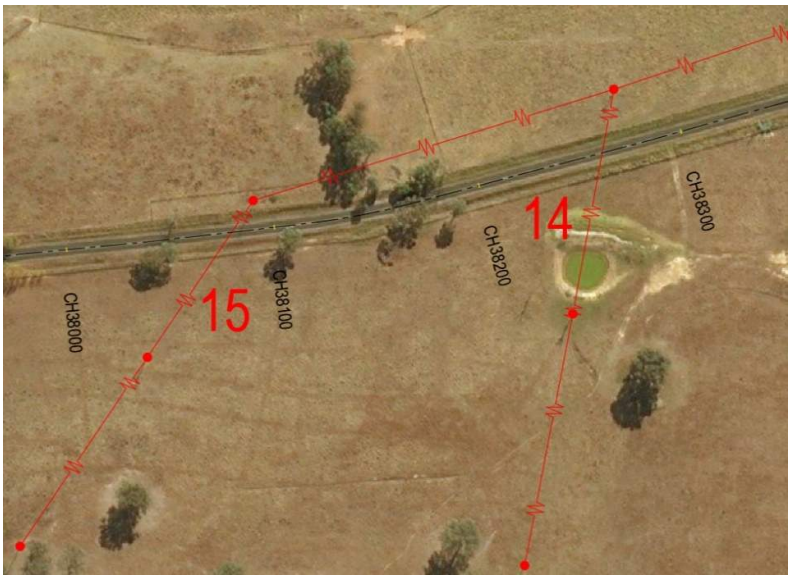

Figure A10 – Yarrabin Rd, Overhead Crossings

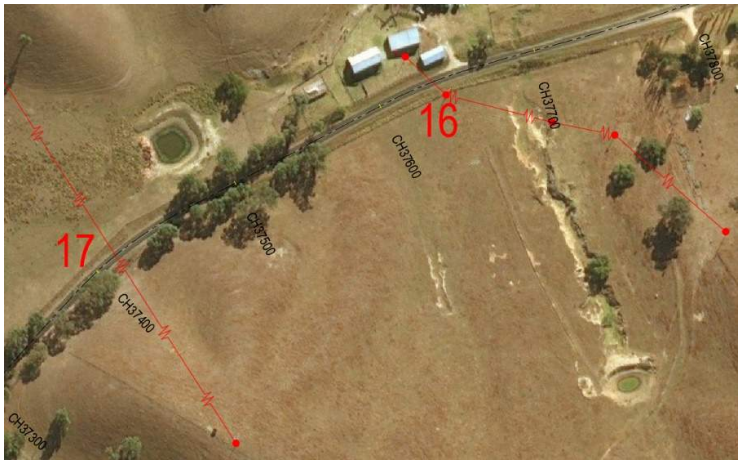

Figure A11 – Yarrabin Rd, Overhead Crossings

Figure A12 – Yarrabin Rd, Overhead Crossings

Figure A13 – Yarrabin Rd, Overhead Crossing

Figure A14 – Yarrabin Rd, Overhead Crossing

Figure A15 – Yarrabin Rd, Overhead Crossing

Appendix B – Overhead Line Screenshots, Option 2

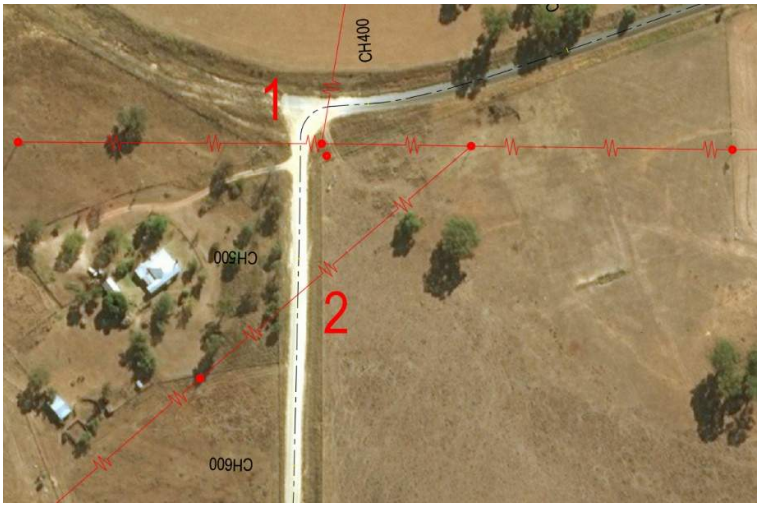

Figure B1 – Twelve Mile Rd, Overhead Crossing

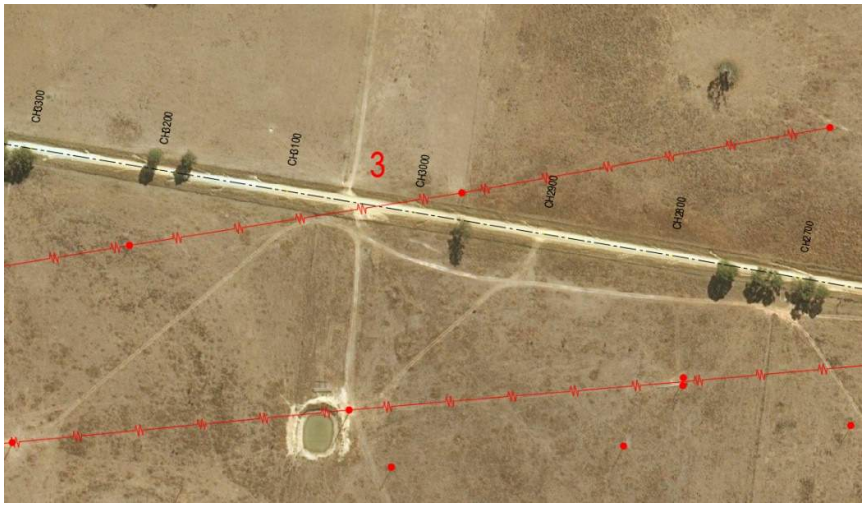

Figure B2 – Twelve Mile Rd, Overhead Crossing

Figure B3 – Twelve Mile Rd, Overhead Crossing

Figure B4 – Twelve Mile Rd, Overhead Crossing

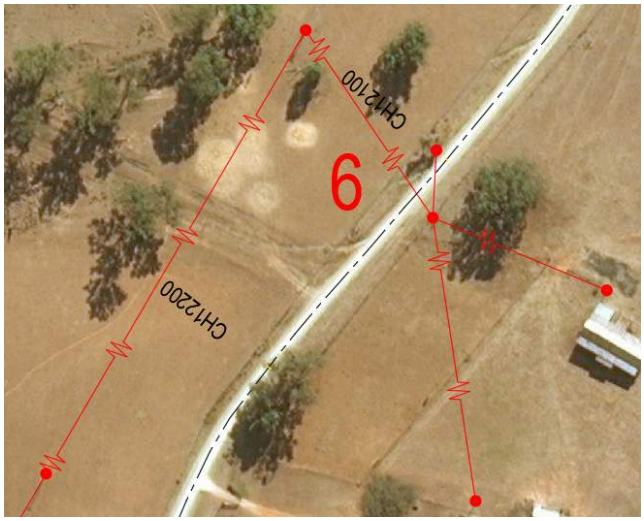

Figure B5 – Twelve Mile Rd, Overhead Crossings

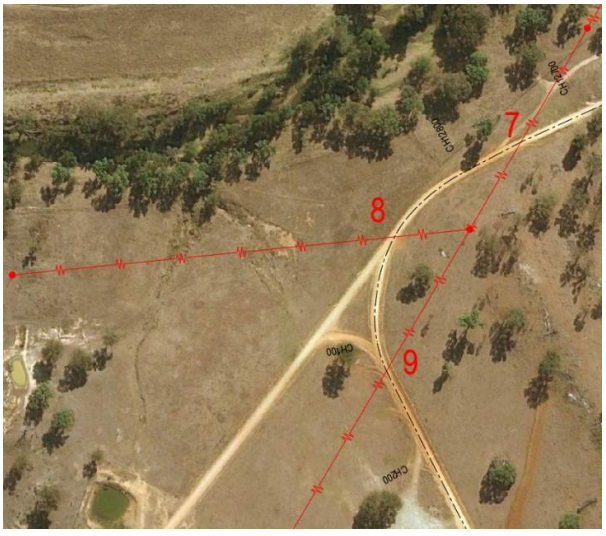

Figure B6 – Twelve Mile and Yarrabin Rd, Overhead Crossings

Figure B7 – Yarrabin Rd, Overhead Crossing

Figure B8 – Yarrabin Rd, Overhead Crossing

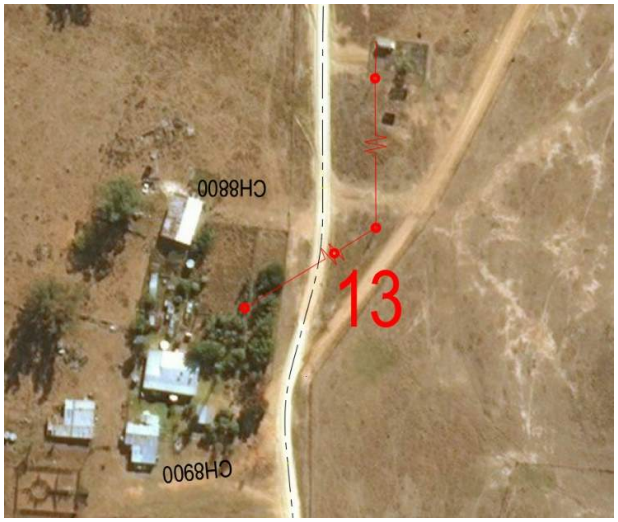

Figure B9 – Yarrabin Rd, Overhead Crossing

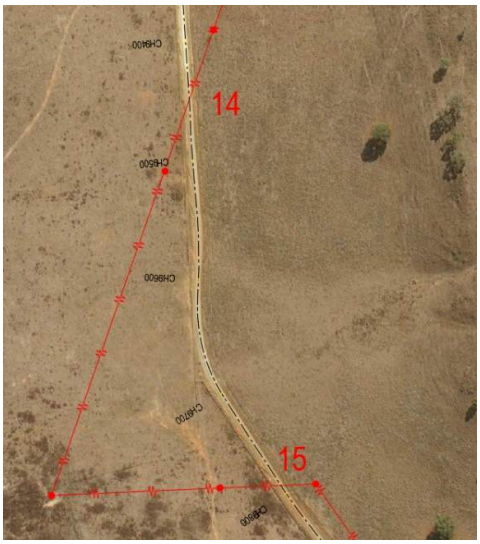

Figure B10 – Yarrabin Rd, Overhead Crossings

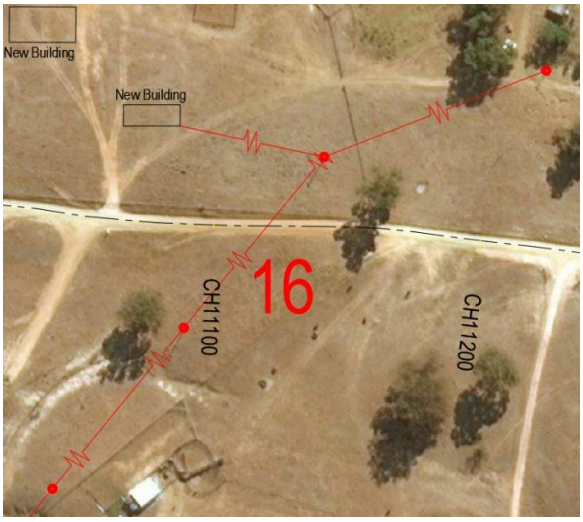

Figure B11 – Yarrabin Rd, Overhead Crossing

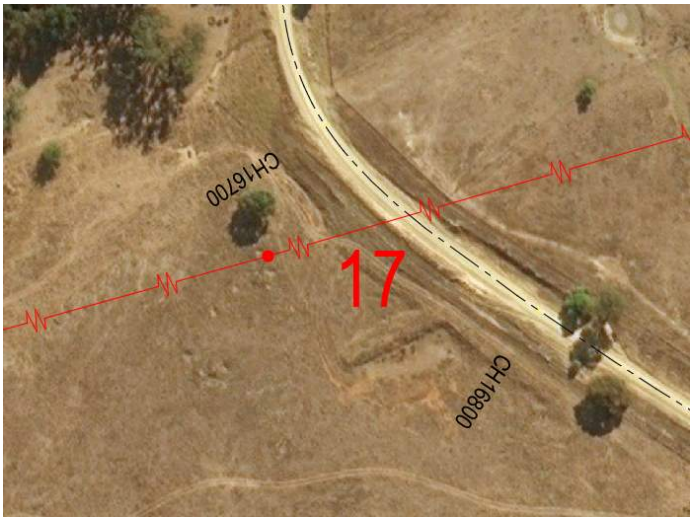

Figure B12 – Yarrabin Rd, Overhead Crossing

Figure B13 – Yarrabin Rd, Overhead Crossing

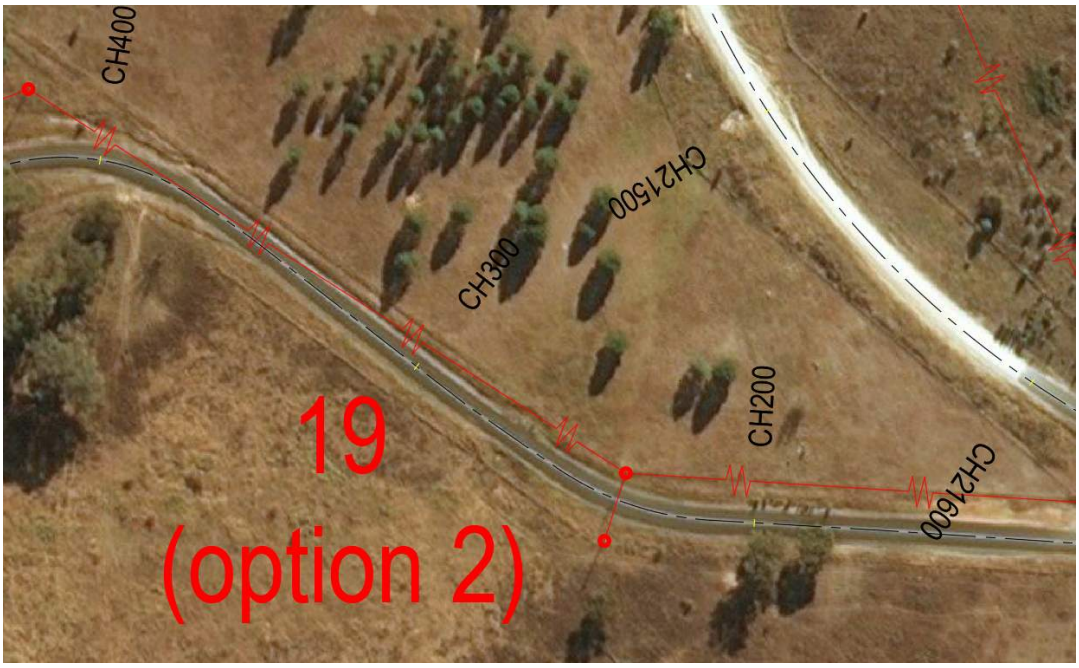

Figure B14 – Yarrabin Rd, Overhead Crossing

Appendix C – Overhead Line Screenshots, Burrendong Dam Rd (Option 1 & 2)

Figure C1 – Burrendong Dam Rd, Overhead Crossings

Figure C2 – Burrendong Dam Rd, Overhead Crossing

Appendix D – Public Road Plan Drawings

Plans shown overleaf

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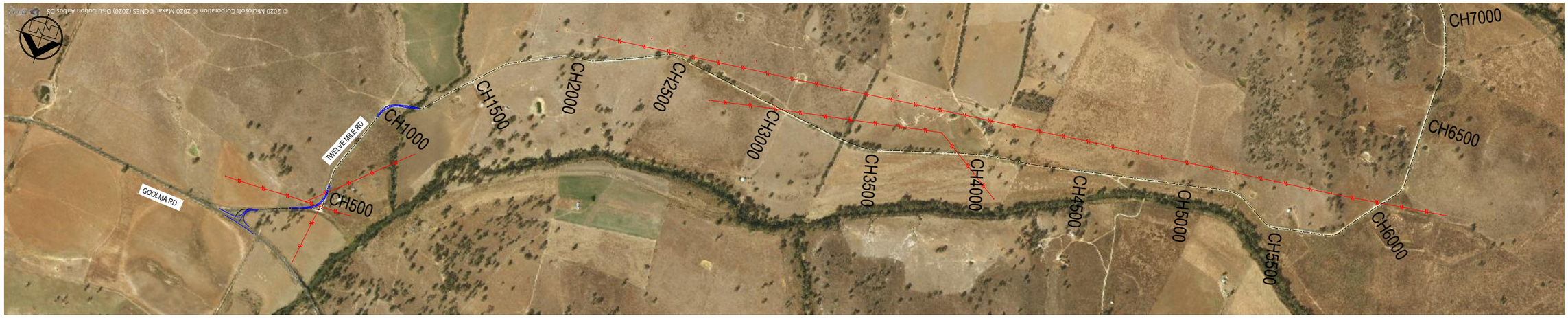

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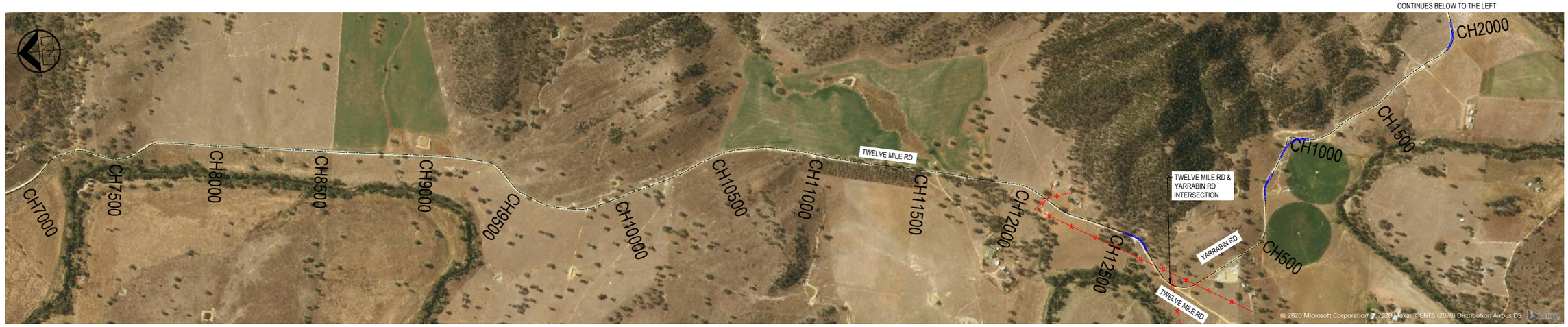

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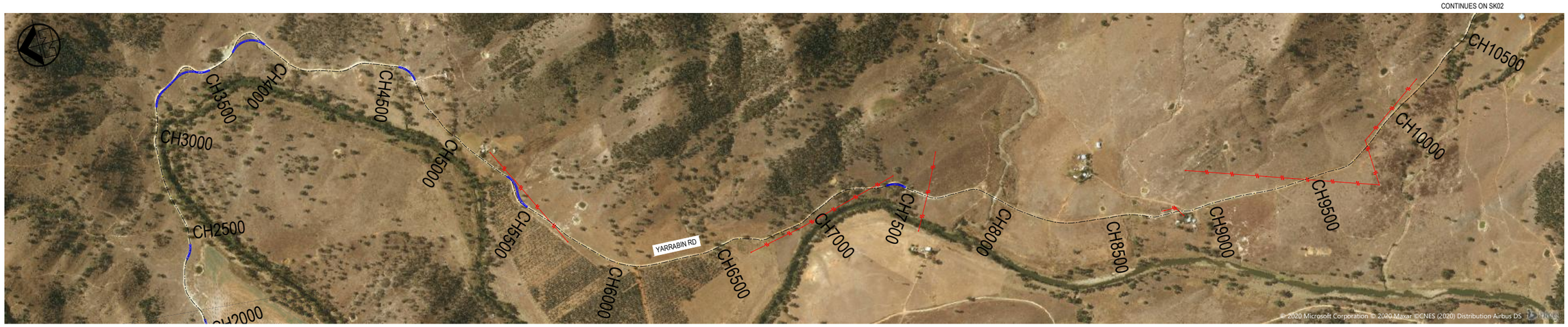

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TWELVE MILE ROAD & YARRABIN ROAD - PLAN

SCALE 1:20,000

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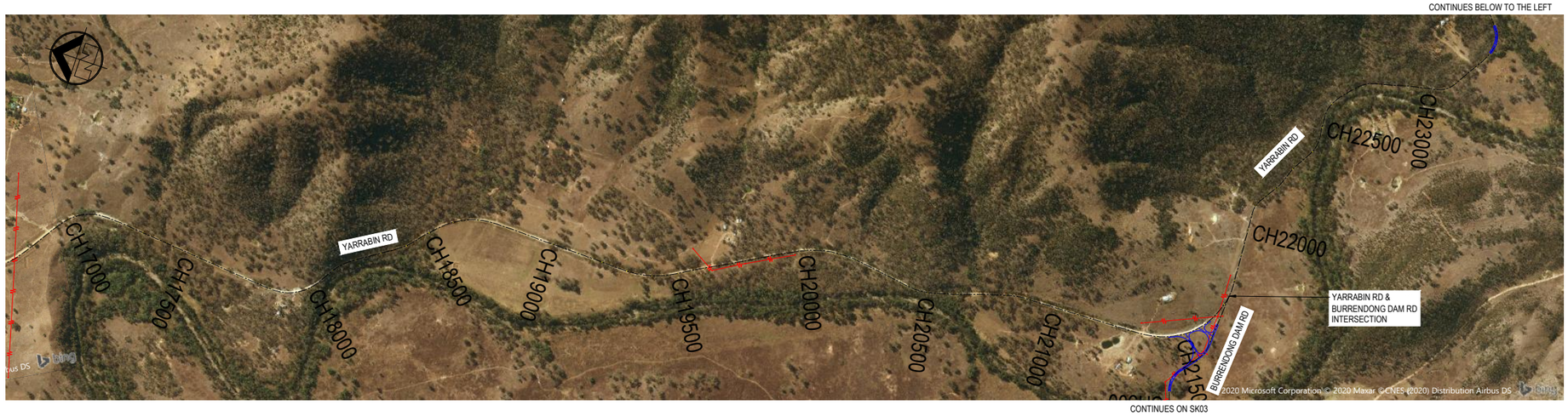
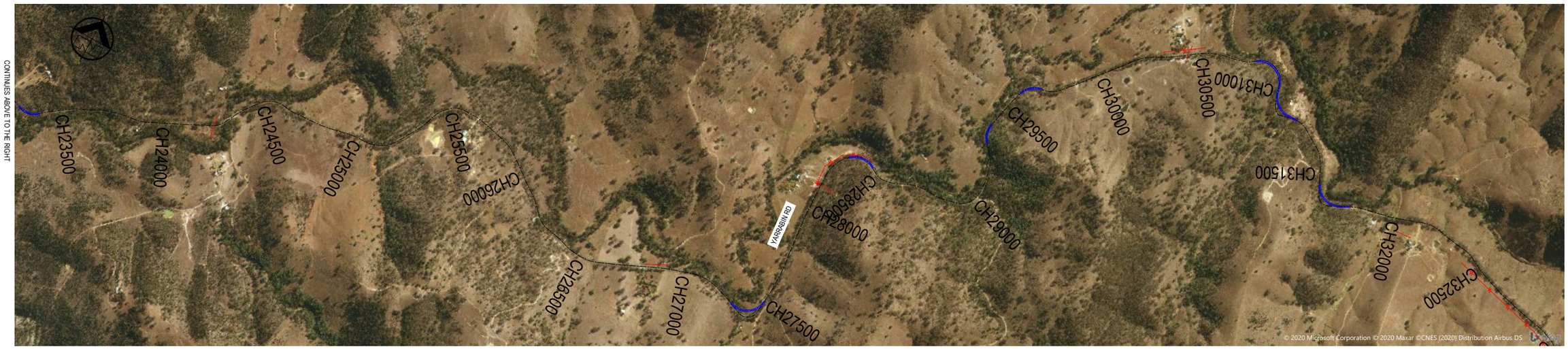
TWELVE MILE RD & YARRABIN ROAD
SK01 OF 03 - 1st DECEMBER 2020 - DK





YARRABIN RD - PLAN

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YARRABIN RD
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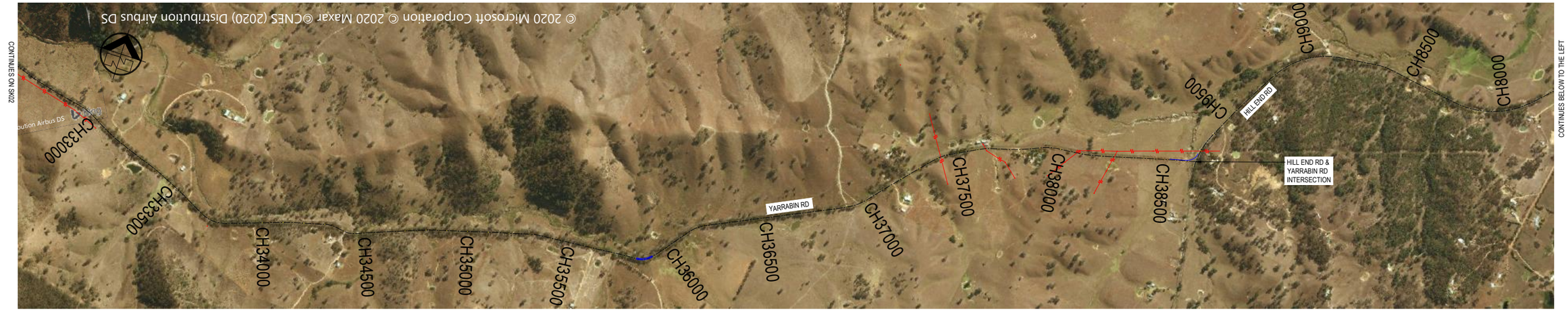
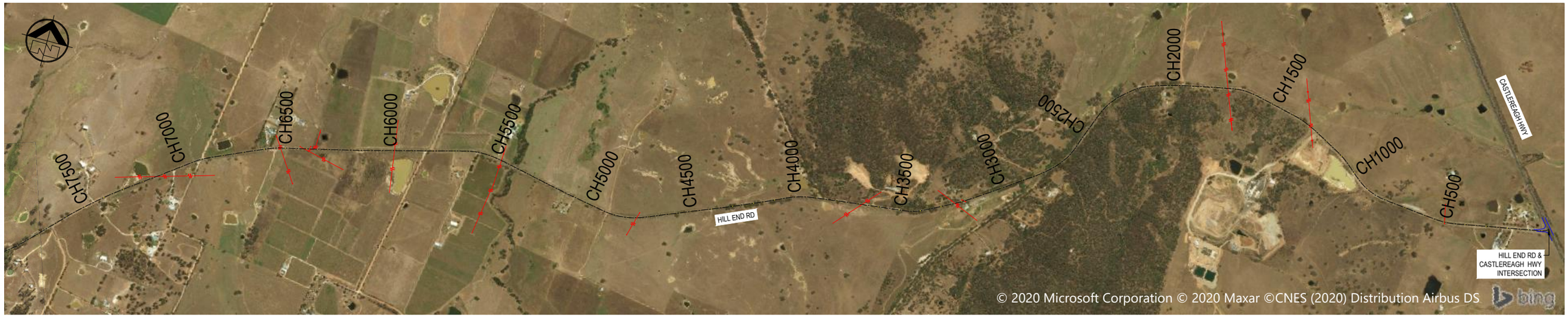


YARRABIN RD & HILL END RD - PLAN

SCALE 1:20,000



HILL END RD - PLAN

SCALE 1:20,000

BURRENDONG DAM RD & ENDACOTT ROAD - PLAN

SCALE 1:20,000

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YARRABIN RD, HILL END RD & BD RD
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