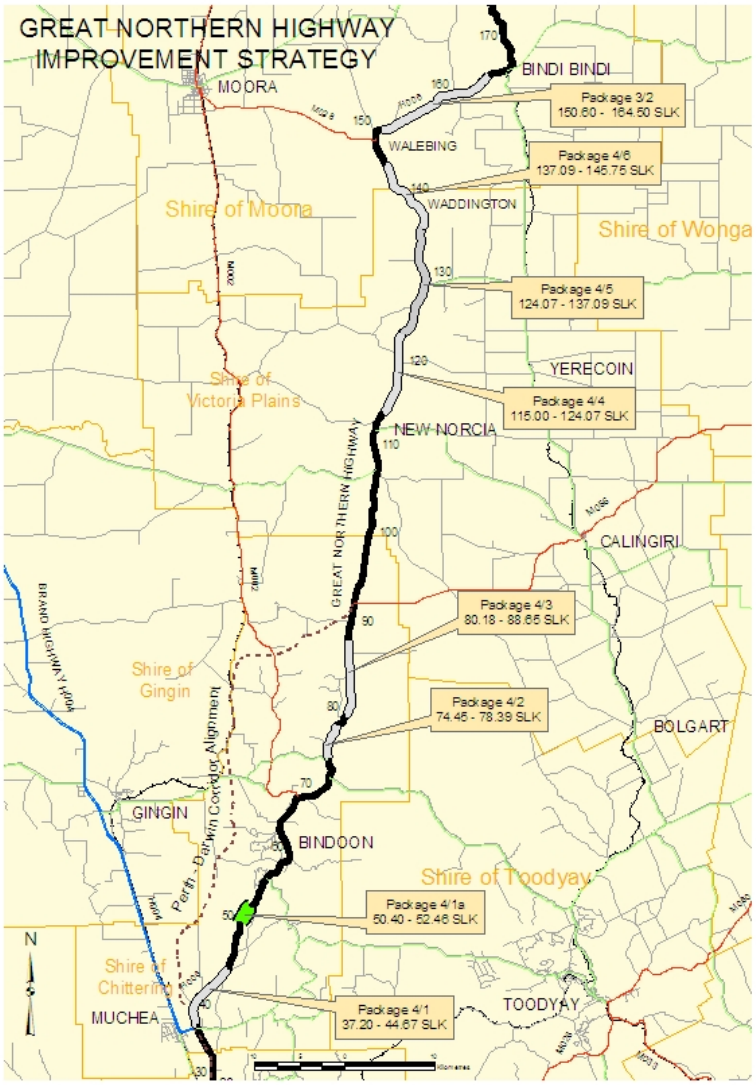
Great Northern Highway

Design Package 3A
Chittering Roadhouse - 50.40 to 52.48 SLK

Vegetation Rehabilitation Strategy



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1. PROJECT AREA

1.1 Project Location

The project is located north of Bullsbrook on the Great Northern Highway between 50.5-52.48 SLK which is 12km south of the town of Bindoon (see Figure 1) and approximately 60km north of Perth. These road works between 50.5-52.48 SLK are known as Design Package 3A (previously 4/1A).

1.2 Road History

The greater portion of this road was originally built in the late 1950's and sealed in the 1970's. Widening and resealing has occurred in the last 20 years and established the current road widths. Gradual and steady increases in traffic levels and the type of vehicles along Great Northern Highway have occurred as a result of ongoing development in the area and to the north. This has resulted in an increased volume of heavy vehicles accessing the North West regions of Western Australia that did not exist when the road was first designed and built. The alignment, width and general road geometry of the existing road is now substandard and unsuitable for the increased traffic meaning these works are required to improve the road amenity and general road safety attributes of this section of Great Northern Highway.

1.3 Proposed Roadworks

50.50-52.48 SLK Road Widening / Reconstruction / Realignment
The proposed upgrade works will consist of reconstruction and widening of the existing formation along with an acceleration land north from the Chittering Roadhouse. These works will improvement the vertical and horizontal geometry where necessary to achieve acceptable standards for a National Highway. The principal objective is to improve the level of service and safety for road users along with access to the Chittering Roadhouse.

1.4 Vegetation at 50.4-52.5 SLK

There were two vegetation types present on a regional scale in the immediate area (Shepherd et al. 2002); 3 - Medium forest: Jarrah and Marri and 4 - Medium woodland: Marri and Wandoo. The local scale mapping in the field identified five vegetation types, this vegetation has been grouped under one broad habitat type, Eucalyptus woodland (as listed in Australian Native Vegetation Assessment 2001).

The 5 vegetation types located within Design Package 3A identified during the 2005 survey are;
3 - Medium forest; jarrah-marri
950 - Medium woodland; Casuarina obesa
999 - Medium woodland; marri
1027 - Mosaic: Medium open woodland; jarrah & marri, with low woodland; banksia / Medium sparse woodland; jarrah & marri
1034 - Medium woodland; marri, wandoo & powderbark

These vegetation complexes have been recorded by SLK and GPS coordinates for Design Package 3A along with the condition of the vegetation, see Table 1 on the following page.

Table 1 – Vegetation Type and Condition GNH 50.4 to 52.5 SLK

SLK	Easting	Northing	Vegetation Type	Condition	% Pre European Remaining
49.25	409445	6516478	3	poor	70.0
49.30	409491	6516510	1034	good	63.7
49.53	409527	6516745	1034	good	63.7
49.57	409505	6516781	3	fair	70.0
49.58	409512	6516799	1034	good	63.7
49.70	409508	6516921	3	good	70.0
49.98	409432	6517188	3	fair	70.0
50.03	409413	6517235	3	fair	70.0
50.04	409449	6517250	950	fair	38.3
50.07	409407	6517285	0	Pine Trees	N/A
50.12	409472	6517326	1034	fair	63.7
50.15	409428	6517364	999	fair	13.1
50.38	409537	6517575	999	poor	13.1
50.38	409535	6517578	1003	good	41.5
50.39	409553	6517576	1027	good	55.5
50.46	409594	6517637	3	good	70.0
50.49	409569	6517677	3	excellent	70.0
50.52	409620	6517684	1003	good	41.5
50.54	409596	6517721	1027	good	55.5
50.60	409626	6517772	3	excellent	70.0
50.70	409705	6517847	999	fair	13.1
51.04	409867	6518150	1034	good	63.7
51.13	409910	6518222	1034	fair	63.7
51.15	409904	6518251	3	good	70.0
51.17	409927	6518261	1034	good	63.7
51.26	409972	6518334	3	good	70.0
51.35	410024	6518419	3	fair	70.0
51.54	410109	6518583	3	poor	70.0
51.69	410184	6518716	3	good	70.0
51.90	410262	6518907	0	Weeds only	N/A
52.17	410444	6519103	1034	good	63.7
52.31	410556	6519191	3	fair	70.0
52.35	410583	6519215	3	poor	70.0

Table 2 – Species List GNH and Surrounding Area, ~ 40.0 to 60.0 SLK

Species Present	Present in DP3A	Common Name
Acacia acuminata		Jam
Acacia auronitens		
Acacia drewiana subsp. drewiana	✔	
Acacia drummondii	✔	Drummond's Wattle
Acacia drummondii subsp. affinis	✔	
Acacia lasiocarpa		Panjang
Acacia pulchella var. glaberrima		
Acacia pulchella var. reflexa	✔	(acuminate bracteole variant)
Acacia saligna		Orange Wattle
Acacia squamata	✔	
Acacia microbotrya		Manna gum or Manna wattle
Acacia meisneri		
Acacia willdenowiana	✔	Grass Wattle
Actinostrobus pyramidalis		Swamp Cypress
Adenanthos cygnorum subsp. cygnorum	✔	Common Woollybush
Allocasuarina campestris		Black tammar
Allocasuarina huegeliana	✔	Granite sheoak or Rock sheoak
Allocasuarina humilis		Dwarf sheoak
Allocasuarina microstachya		
Anarthria laevis		
Anigozanthos humilis		Catspaw
Anigozanthos manglesii	✔	Red & Green Kangaroo Paw
Astroloma macrocalyx	✔	Swan Berry
Astroloma pallidum	✔	Kick Bush
Austrodanthonia setacea	✔	
Banksia attenuata	✔	Slender Banksia
Banksia grandis	✔	Bull banksia
Banksia menziesii	✔	Firewood Banksia
Banksia sphaerocarpa var. sphaerocarpa	✔	Fox Banksia
Boronia ramosa	✔	
Bossiaea eriocarpa	✔	Common brown pea
Calothamnus quadrifidus	✔	One-sided bottlebrush
Calothamnus sanguineus		Silky-leaved Blood flower
Calytrix flavescens	✔	Summer Starflower
Calytrix sylvana	✔	
Casuarina obesa	✔	Swamp Sheoak
Caustis dioica		
Conospermum stoechadis ssp. sclerophyllum		
Conostephium pendulum	✔	Pearl Flower
Conostylis aculeata subsp. aculeata	✔	
Conostylis juncea	✔	
Conostylis setosa	✔	White Cottonhead
Dampiera alata	✔	Winged-stem Dampiera
Dampiera lavandulacea		
Dampiera lindleyi	✔	
Dampiera linearis	✔	Common Dampiera
Darwinia neildiana		Fringed Bell
Dasypogon bromeliifolius		Pineapple Bush
Daviesia angulata	✔	
Daviesia benthamii subsp. benthamii		
Daviesia debilior subsp. sinuans		
Daviesia decurrens	✔	Prickly bitter pea
Daviesia physodes		
Daviesia preissii	✔	

Desmocladus fasciculatus	✔	
Dianella revoluta		Blueberry lily or Spreading flax lily
Dillwynia laxiflora	✔	
Drosera erythrorhiza	✔	Red Ink Sundew
Dryandra nivea	✔	Honeypot dryandra
Dryandra nobilis		Giant dryandra
Dryandra polycephala		Many headed dryandra
Dryandra sessilis	✔	Parrot bush
Dryandra squarrosa		Pingle
Eremaea pauciflora var. pauciflora	✔	
Eucalyptus accedens	✔	Powderbark Wandoo
Eucalyptus calophylla	✔	Marri
Eucalyptus loxophleba		York gum
Eucalyptus marginata	✔	Jarrah
Eucalyptus todtiana	✔	Coastal Blackbutt
Eucalyptus wandoo subsp. wandoo	✔	Wandoo
Eucalyptus rudis		Flooded gum
Gastrolobium capitatum		
Gastrolobium villosum	✔	Crinkle-leaved poison
Glischrocaryon aureum	✔	Common Popflower
Gompholobium knightianum	✔	
Gompholobium shuttleworthii	✔	
Gompholobium tomentosum	✔	Hairy Yellow Pea
Goodenia coerulea		
Grevillea bipinnatifida		Grevillea bipinnatifida
Grevillea pilulifera		Woolly-flowered Grevillea
Grevillea synapheae subsp. synapheae		
Hakea candolleana		
Hakea incrassata		Marble hakea
Hakea lissocarpha	✔	Honey Bush
Hakea preissii		Christmas hakea or Needle bush
Hakea prostrata	✔	Harsh Hakea
Hakea stenocarpa	✔	Narrow-fruited Hakea
Hakea trifurcata		Two leaf hakea
Hakea undulata	✔	Wavy-leaved hakea
Hakea varia		Variable-leaved Hakea
Hardenbergia comptoniana	✔	Native Wisteria
Hemiandra linearis	✔	Speckled Snakebush
Hemiandra pungens	✔	Snakebush
Hibbertia commutata	✔	
Hibbertia montana		
Hibbertia hypericoides	✔	Yellow buttercups
Hibbertia lasiopus	✔	Large Hibbertia
Hovea trisperma		Common hovea
Hypolaena exsulca	✔	
Jacksonia floribunda	✔	Holly Pea
Jacksonia sternbergiana		Stinkwood
Kennedia coccinea	✔	Coral Vine
Kennedia prostrata	✔	Running postman / Scarlet runner
Kunzea micrantha subsp. micrantha		
Kunzea recurva	✔	
Labichea lanceolata subsp. lanceolata	✔	
Laxmannia squarrosa	✔	
Lechenaultia biloba	✔	Blue lechenaultia
Lechenaultia floribunda		Free-flowering Leschenaultia
Lepidosperma resinosum		

Lepidosperma squamatum	✔	
Leucopogon oxycedrus	✔	
Lobelia alata		Angled Lobelia
Lyginia imberbis		
Marianthus bicolor	✔	Painted Marianthus
Melaleuca lateritia		Robin redbreast bush
Melaleuca preissiana		Moonah
Melaleuca radula		Graceful honey-myrtle
Melaleuca seriata		
Melaleuca trichophylla		
Melaleuca uncinata		Broom Bush
Mesomelaena pseudostygia		
Mesomelaena tetragona	✔	Semaphore Sedge
Mirbelia spinosa		
Nuytsia floribunda	✔	Christmas Tree
Olearia paucidentata	✔	Autumn Scrub Daisy
Opercularia vaginata	✔	Dog weed
Patersonia juncea	✔	Rush Leaved Patersonia
Patersonia occidentalis	✔	Purple Flag
Patersonia rudis	✔	Hairy Flag
Pericalymma ellipticum		Swamp Teatree
Petrophile linearis	✔	Pixie Mops
Petrophile striata	✔	
Phlebocarya ciliata	✔	
Phlebocarya filifolia		
Phyllanthus calycinus	✔	False boronia
Pimelea imbricata var. piligera	✔	
Pimelea suaveolens	✔	Scented Banjine
Ptilotus drummondii		Narrowleaf Mulla Mulla
Ptilotus manglesii	✔	Pom Poms
Ptilotus polystachyus var. polystachyus		Prince of Wales Feather
Scaevola glandulifera	✔	Viscid Hand-flower
Scaevola repens var. repens		
Scholtzia involucrata		Spiked Scholtzia
Sphaerolobium medium	✔	
Stackhousia monogyna	✔	
Stirlingia latifolia	✔	Blueboy
Stylidium dichotomum		Pins-and-needles
Stylidium miniatum	✔	Pink Butterfly Triggerplant
Stypandra glauca	✔	Blind Grass
Synaphea spinulosa subsp. spinulosa	✔	
Tetratheca hirsuta	✔	Black Eyed Susan
Tetratheca nuda	✔	
Thysanotus dichotomus		Branching fringe lily
Thysanotus manglesianus		Fringed lily
Thysanotus multiflorus		Many-flowered fringe lily
Tricoryne elatior		Yellow Autumn Lily
Tripterococcus brunonis	✔	Winged Stackhousia
Trymalium angustifolium	✔	
Verreauxia reinwardtii		Common Verreauxia
Verticordia densiflora		Compacted Featherflower
Verticordia lindleyi subsp. lindleyi		
Viminaria juncea		Swishbush
Xanthorrhoea preissii	✔	Black boy
Xanthosia candida	✔	
Xanthosia huegelii	✔	

2. REHABILITATION OF THE ROAD RESERVE

The revegetation along this section of highway will be contained within the recently widened road reserve and comprise a mix of direct seeding and plantings with locally occurring indigenous species. The majority of the work will be on the western side of the road between 50.1 -52.0 SLK where a 10m strip of land has been acquired from the adjacent two landowners. The total area of this section is 1.9ha however with a vegetation setback of 2m from the property boundary approximately 1.5ha is to be revegetated. In addition to this area, a minimum of 1.8ha will be revegetated within the current road reserve. This figure is based on a 10m clear zone from the travelling edge line and a 2m setback from property boundaries, equating to 0.56ha on the east side of the road and 1.24ha on the west. The total area of revegetation for DP03A is 3.3ha.

The species list for the revegetation (see Table 3) is very extensive and it is possible not all of these species will be available at the time of seeding/planting. It is anticipated this may be the case with several of the understorey species and if this occurs more of the species which are available will be added to the mix to compensate. To provide food plants for any Carnaby's Black Cockatoos in the area Allocasuarina, Banksia, Calothamnus, Dryandra, Eucalyptus and Hakea species must make up part of the revegetation species list.

2.1 Weed Control

The revegetation site will be sprayed with a residual herbicide (e.g. Simazine) if there is sufficient time before the planting season (greater than 6 months). This will reduce the amount of weeds present, however if direct seeding is to take place immediately no residual herbicide will be sprayed as this will stop any native seedlings emerging.

Once the annual grasses emerge weeds will be sprayed with herbicide (e.g. Glyphosate) several weeks before planting. Roundup Bi-Active will be used in the areas closer to waterways and as the majority of the revegetation will be on already cleared land herbicide be applied from a boom spray unit where accessible and hand sprayed in other areas.

2.2 Hygiene Management

The project area falls within a rainfall zone in which dieback may occur (nearest weather station, Pearce RAAF - 694mm). Hygiene measures will be in place to reduce any possible spread if the disease is present, which include:

- All machinery, plant and equipment shall be free of soil and vegetative matter prior to entering the road reserve and when leaving the site.
- No entry will be permitted to vegetated areas outside of the road reserve boundary.
- The movement of soil in wet conditions will be avoided or kept to an absolute minimum where the work is essential.
- Soil or mulch brought from offsite into the revegetation area must be from a dieback free location.

2.3 Machinery

- Fuel storage areas will not be required and no oil changes will be permitted on site.
- Any soil contaminated by oil or fuel will be removed from site and disposed of at an approved location.
- All machinery to be fitted with fire extinguishers.

2.4 Site Preparation

The site will be ripped along the contour at 1-metre intervals and to a minimum depth of 300mm before seeding. This ripping will break up the compacted ground, create niches for the seed to lodge and encourage root development as well as catching surface water and preventing erosion. Any large boulders and wood debris brought to the surface during ripping will be left for future fauna habitats.

Weed free topsoil and mulched vegetation where available from the road works will also be respread across the revegetation site to a minimum depth of 50mm and not more than 75mm thick.

Road batter slopes will not be ripped but will be priority sites for available weed free topsoil and mulch.

2.5 Revegetation

Direct seeding will take place at an appropriate time for maximum germination once the road works are complete. Mixed seed will be spread at an approximate rate of 3kg/hectare and bulked up with vermiculite and/or sawdust in order to improve evenness of spread. At this rate **6kg** of seed will be required to cover the direct seeding zones.

Planting will occur during winter in the resumed farmland and existing road reserve at approximately 2,500 stems per hectare (1 plant per 4 m^2). Seedlings are to be 'hardened off' before planting and at this rate **8,000 stems** will be required to cover the nominated planting zones. Tree bags may be placed over seedlings however due to the large number of seedlings to be planted it won't be practical to bag each one.

Fertiliser for direct seeding and planting won't be used as the majority of the land to be revegetated is old farmland which has been subjected to high fertiliser use over many years. If however it is felt that fertiliser would benefit the revegetation prior to seeding, fertiliser with a high nitrogen content and phosphorous content lower than 3% (e.g. Agras No. 1) may be applied at a maximum rate of 120kg/hectare. Seedlings could possibly be fertilised with slow release tablets placed 100mm from the roots and 100-150mm below the surface (eg Baileys 'Apex Native').

Species diversity has been chosen based on a breakdown of roughly 20% upper storey, 30% middle storey and 50% understorey, ground covers and climbers. This means that if 50 species are being used 10 would be larger trees, 15 smaller trees and shrubs and 25 lower understorey plants.

This ratio split of 20:30:50 also applies to the breakdown of seed and stem quantities. For 3kg/ha of seed 0.6kg is for upper storey, 0.9kg for middle storey and 1.5kg for understorey and with 2,000 stems/ha 400 are upper storey, 600 middle storey and 1,000 would be understorey species.

2.6 Monitoring/Follow up Planting

Monitoring of the revegetation effort will determine if follow up plantings will be required. The revegetation site will be inspected 12 weeks after planting/seeding and during the

following autumn to assess if winter plantings are required. One year after revegetation there should be 1,500 stems per hectare and no less than 5 species present per 1000m^2.

If required follow up herbicide applications will occur on problem weeds for up to three years after planting/seeding. This herbicide will be spot sprayed on the weeds by hand to avoid overspray onto native plants and will allow these plants to develop without competing with weeds. During these weed inspections for three years after planting/seeding the health and quantity of the revegetation will also be monitored. This monitoring may result in further plantings if species density or diversity has diminished.

Table 3 - Species List for Revegetation ~ 3.3ha

Species	Stem Quantity / ha	Seed Quantity / ha	Seed Cost / Kg
Acacia acuminata	✔	✔	$250.00
Acacia drummondii	✔	✔	$800.00
Acacia lasiocarpa	✔	✔	$350.00
Acacia microbotrya	✔	✔	$150.00
Acacia pulchella	✔	✔	$250.00
Allocasuarina huegeliana	✔	✔	$400.00
Allocasuarina humilis	✔	✔	$450.00
Anigozanthos manglesii		✔	$1,200.00
Banksia attenuata	✔		$100.00 (1,000 seeds)
Banksia grandis	✔		$100.00 (1,000 seeds)
Banksia menziesii	✔		$150.00 (1,000 seeds)
Banksia sphaerocarpa var. sphaerocarpa	✔		$150.00 (1,000 seeds)
Bossiaea eriocarpa		✔	$1,800.00
Calothamnus quadrifidus	✔	✔	$350.00
Calothamnus sanguineus	✔		$1,500.00
Calytrix flavescens		✔	$1,100.00
Casuarina obesa	✔	✔	$300.00
Daviesia decurrens		✔	$5,000.00
Daviesia preissii		✔	$5,500.00
Dianella revoluta		✔	$3,000.00
Dryandra nivea	✔	✔	$175.00 (1,000 seeds)
Dryandra nobilis	✔	✔	$125.00 (1,000 seeds)
Dryandra polycephala	✔	✔	$125.00 (1,000 seeds)
Dryandra sessilis	✔	✔	$100.00 (1,000 seeds)
Eremaea pauciflora		✔	$4,000.00
Eucalyptus accedens	✔		$325.00
Eucalyptus calophylla	✔		$250.00
Eucalyptus marginata	✔		$250.00
Eucalyptus wandoo	✔		$350.00
Gastrolobium villosum		✔	$1,400.00
Glischrocaryon aureum		✔	$1,200.00
Gompholobium tomentosum		✔	$2,500.00
Grevillea vestita		✔	$3,700.00
Hakea incrassata	✔		$3,100.00
Hakea lissocarpha	✔		$4,000.00
Hakea prostrata	✔		$3,200.00
Hakea undulata	✔		$3,500.00
Hardenbergia comptoniana		✔	$300.00
Hibbertia commutata		✔	$3,500.00
Hovea trisperma		✔	$4,000.00
Kennedia coccinea		✔	$400.00
Kennedia prostrata		✔	$300.00
Kunzea recurva	✔		$800.00
Marianthus bicolor		✔	$2,000.00
Melaleuca lateritia	✔		$700.00
Melaleuca radula	✔		$1,100.00
Nuytsia floribunda	✔	✔	$500.00
Patersonia occidentalis		✔	$500.00
Phyllanthus calycinus		✔	$600.00
Stirlingia latifolia		✔	$200.00
Xanthorrhoea preissii		✔	$250.00
Total	2,500 stems	3kgs	

FIGURE 1 ROADWORKS LOCATION OF DP3A.

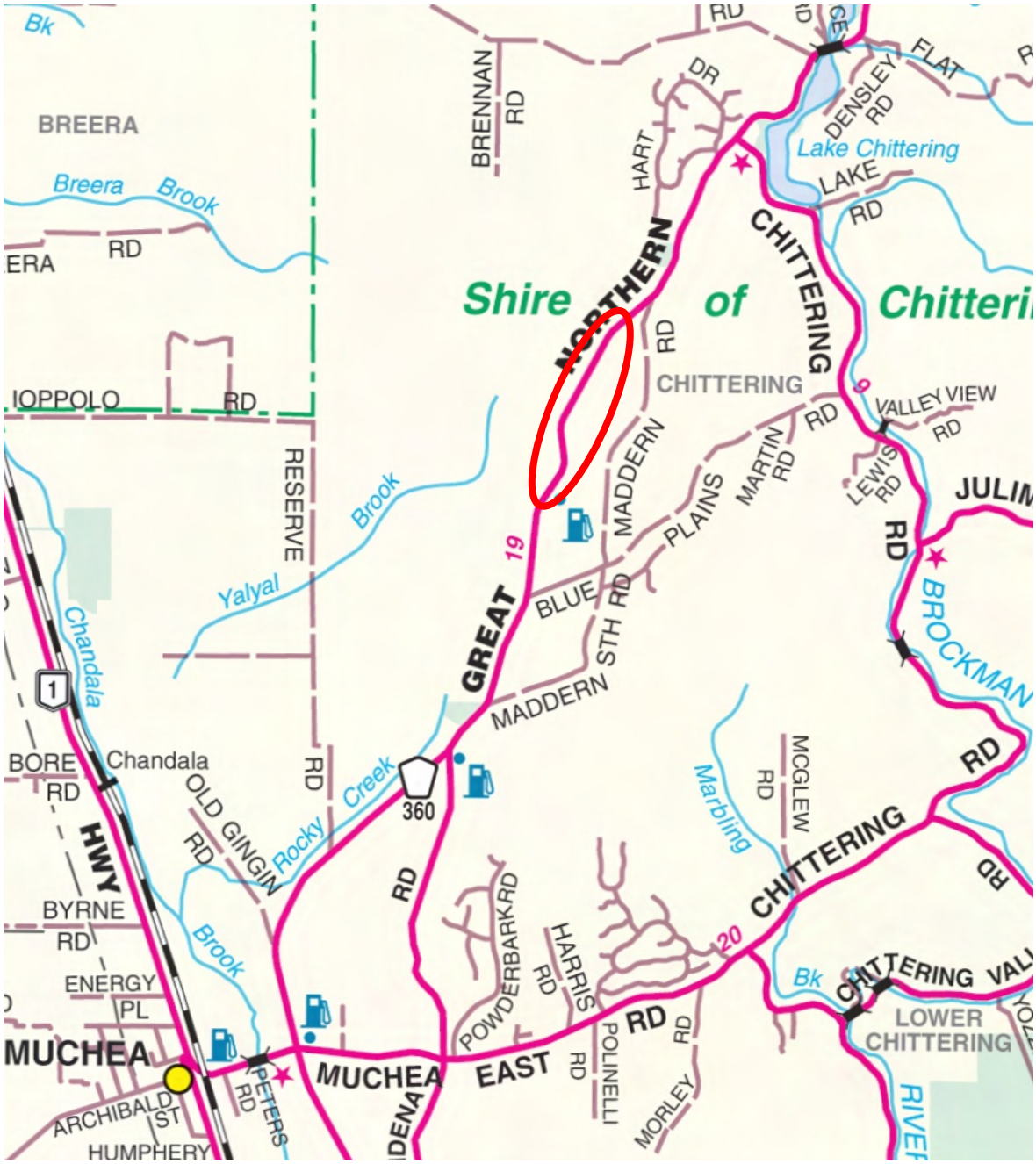

FIGURE 2 AERIAL PHOTO WITH OVERLAY OF DP3A DESIGN.