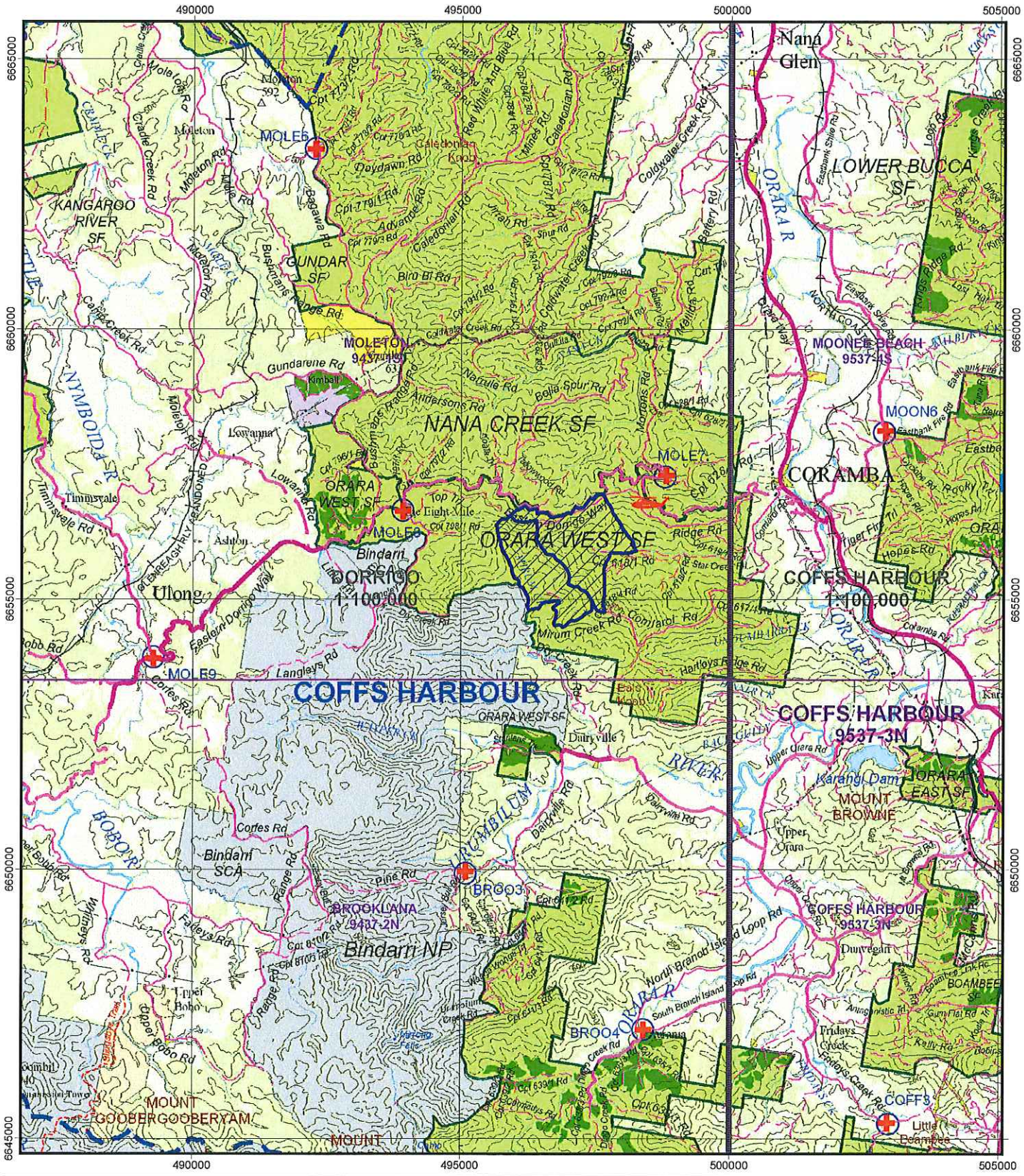
N

Map Sheets:
1:25,000 Molteon 9437-1S
1:100,000 Dorrigo 9437
Scale: 1:100,000

North East Region - Coffs Harbour MA
Locality Map
Compartments 614 & 620
Orara West State Forest



MAP FEATURES

- Subject Area
- Emergency Meeting Point (Safety Point)
- Helicopter Landing Point
- State Forest
- 1:25000 Map Sheet
- 1:100000 Map Sheet
- National Park Estate

0 0.5 1 2 3 4 5 Kilometers

GDA

Prepared by: Matt Howat
Date: 10/02/12

North East Region - Coffs Harbour MA
Harvest Plan Operational Map
Compartments 614 & 620
Orara West State Forest

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Forestry Corporation

Map Sheets
1:25,000 Moleton 9437-1S
1:100,000 Dorrigo 9437

Scale 1:10,000

96 97 98

57 56 55

621 628 619 798 620 614 799 618 715 617

Eastern Dorrigo Way
Ridge Road
Cpt 620/1 Rd
Cpt 620/1 Road
Cpt 618/1 Road
Star Creek Road
Mirum Creek Road
Cpt 618/4 Road
Comiaroi Road
Bindarri NP

Note: Wildlife Habitat Corridor (FMZ 2) 50m either side of Star Creek in addition to Ridge & Headwater Habitat

0 125 250 500 750 1,000 Meters

$^{66}55^{000m.}N$ $^{4}96^{000m.}E$

MAP FEATURES
- State Forest Boundary
- Compartment Boundary
- 1 Km Grid
- 10 / 100 m Contour
- State Forest
- National Park Estate
- Drainage Line
- Indicative Drainage Feature
- Underground Cable - Indicative location only

ROADS
- Sealed
- All Weather, Unsealed
- Dry Weather, Unsealed
- 4WD Track
- Non Haulage Roads

HARVESTING PRESCRIPTIONS
- General Management (FMZ 4)
- Areas for Further Assessment
- Special Prescription (FMZ 3B)
- Inaccessible
- Indicative Regolith Class 2 Soils - Harvesting restrictions apply

HARVESTING PROTECTION (TSCL, EPL & FL)
Riparian (IHL 3)
- Filter 10m either side
- Filter 20m either side
- Filter 30m either side
- Operational zone 10m either side

FOREST MANAGEMENT PROTECTION
- Special Management (FMZ 2)
- Harvesting Protection (FMZ 3A)
- High Conservation Value Old Growth
- Rainforest - Crafti + RN17
- Indicative Slopes > 30 degrees
- Indicative Slopes 25-30 degrees in Regolith 2 soils - No harvesting permitted

RIDGE & HEADWATER HABITAT
- 40m wide exclusion
- 80m wide exclusion

DUMPS & CROSSINGS
- Log Dump
- Approved Crossing
- Approved Crossing in C_617-619 Plan
- Approved IFOA exclusion crossing
- Other approved exclusion crossing

THREATENED SPECIES LOCATIONS
- Yellow-bellied Glider
- Pouched Frog
- Sphagnum Frog
- Niemeyera whitei

TSL PRESCRIPTIONS/ZONES
- Yellow-bellied Glider modified harvest area
- Sphagnum Frog 50m exclusion zone

OTHER FAUNA EXCLUSION ZONES
- Pouched frog exclusion zone

Prepared By: Matt Howat
Date: 17/05/13

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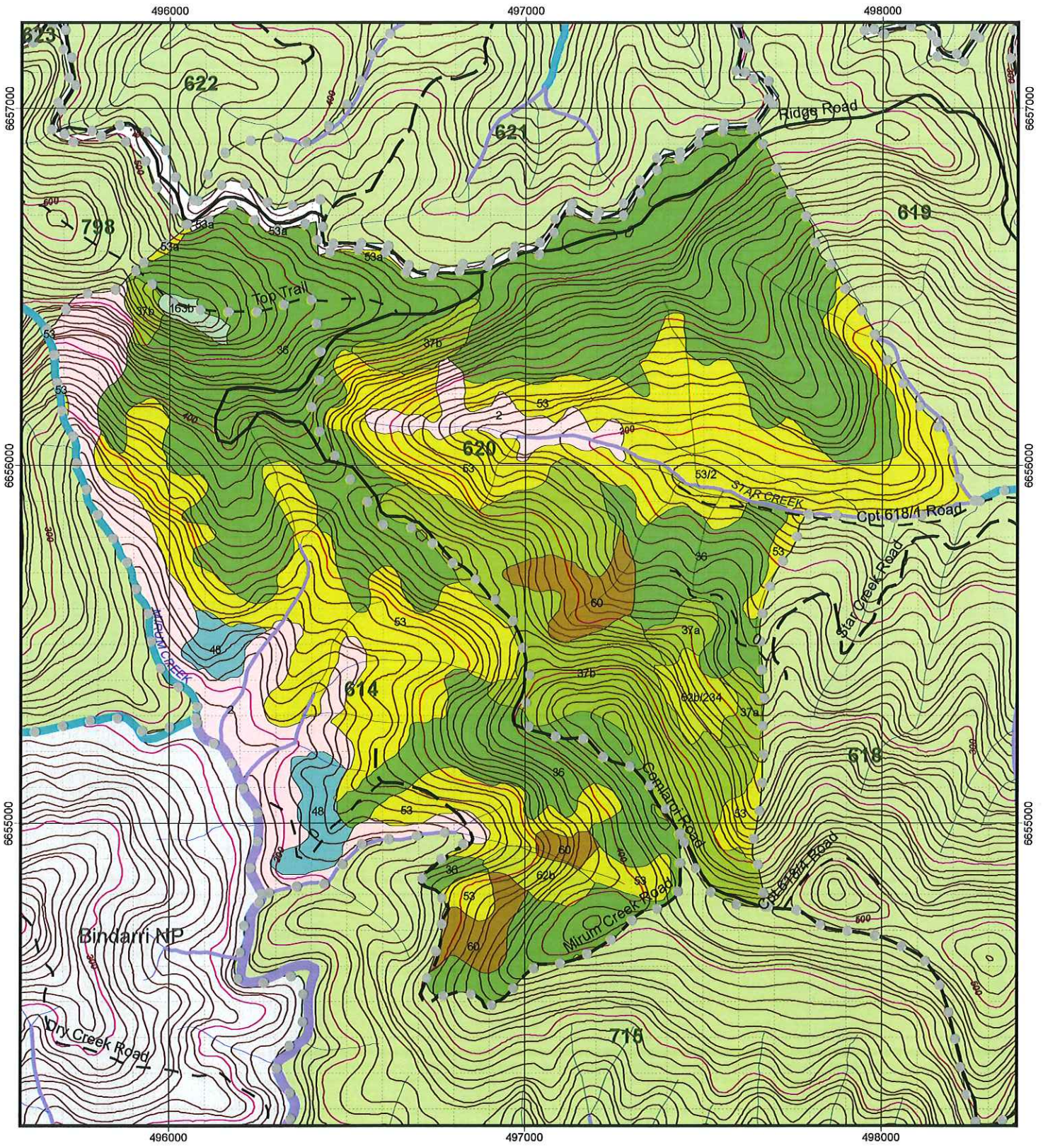
Map Sheets
1:25,000 Moleton 9437-1S
1:100,000 Dorrigo 9437

Scale 1:15,000

North East Region - Coffs Harbour MA
Forest Type Map
Compartments 614 & 620
Orara West State Forest



MAP FEATURES
- State Forest Boundary
- Compartment Boundary
- 1 Km Grid
- 10 / 100 m Contour
- State Forest
- National Park Estate

ROADS
- Sealed
- All Weather, Unsealed
- Dry Weather, Unsealed
- 4WD Track

DRAINAGE
- 1
- 2
- 3
- 4 PLUS

FOREST TYPES
- Type 2 Yellow Carabeen
- Type 36 Moist Blackbutt
- Type 37 Dry Blackbutt
- Type 48 Flooded Gum
- Type 53 Brush Box
- Type 60 Narrowleaved White Mahogany - Red Mahogany - Grey Ironbark - Grey Gum
- Type 62 Grey Gum - Grey Ironbark - White Mahogany
- Type 163 New England Blackbutt
- BNA_Exclusions

0 125 250 500 750 1,000 Meters

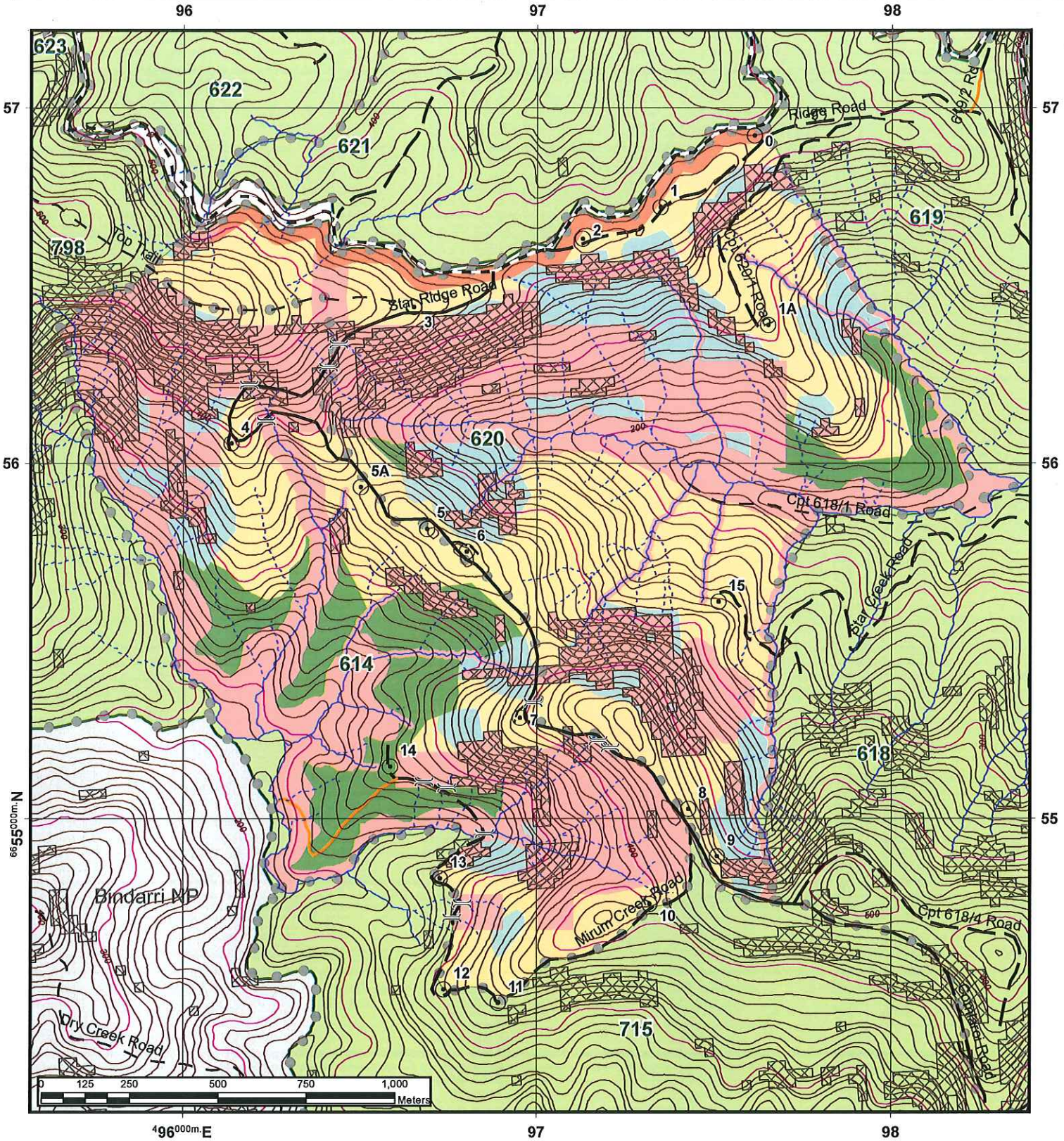
Prepared by: Matt Howat
Date:11/05/12

N Map Sheets
1:25,000 Moleton 9437-1S
1:100,000 Dorrigo 9437

Scale: 15,000

North East Region - Coffs Harbour MA
Indicative Silviculture Map
Compartments 614 & 620
Orara West State Forest

Forestry Corporation GDA



MAP FEATURES
- State Forest Boundary
- Compartment Boundary
- 1 Km Grid
- 10 / 100 m Contour
- State Forest
- National Park Estate
- Drainage Line
- Indicative Drainage Feature

ROADS
- Sealed
- All Weather, Unsealed
- Dry Weather, Unsealed
- 4WD Track
- Non Haulage Roads

DUMPS & CROSSINGS
- Log Dump
- Approved Crossing

INDICATIVE SILVICULTURE
- Wet Forest Types - Flooded Gum, Brush Box
- Dry & Moist Forest Types - Blackbutt, Mahogany, Ironbark
- Steep/Inaccessible Areas
- FMZ 3B
- Harvesting Exclusion Zones

Prepared By: Matt Howat
Date: 20/05/13

FORESTS NEW SOUTH WALES – NORTH EAST REGION

HARVESTING PLAN No. 10395

Orara West State Forest – Compartments 614 & 620

1. Certification

This plan has been prepared in accordance with the Integrated Forestry Operations Approval (IFOA) issued under the Forestry and National Park Estate Act 1998 and addresses significant aspects and impacts in the planning process. The Standard Harvest Plan Conditions for Native Forest Operations in North East Region (NER) apply to this operation.

Prepared by:

Harvest Planner Matt Howat		Date: 21/05/13

Endorsed by:

Harvest Planning Team Leader Steve Pickering		Date:

Endorsed by:

A/ Planning Manager ~~Dean Kearney~~ M. HOWAT		Date: 21/05/13

Approved by:

Regional Manager Craig Busby		Date: 26/7/13

Note: Approval includes the Harvest Plan Operational Map (HPOM).

2. Description of Proposal

Selective harvesting of regrowth native forest stands, using Single Tree Selection (STS).

Other proposed works:

	Proposed	*Details*
Roading	Yes	Road Works Plan attached.
Post-harvest Burning	Yes	Plan to be prepared separately.
Rehabilitation	No	Not applicable.

3. Area Identification and Yield Estimates

Region	North East Region
Management Area	Coffs Harbour
State Forest	Orara West
State Forest No.	535
Pricing Area	Coffs Harbour
Other Tenure Details	State Forest only

Compartment Number	614	620	*Total*
Gross Area (ha)	162	204	366
Net Harvest Area (ha)*	70	122	192
Estimated Yield (m^3/ha)	42	36	38
Volume (m^3) All Products	2919	4345	7264

*Excludes steep areas, likely inaccessible areas and other exclusions.

Products	*Total (m^3)*
High Quality Large	2485
High Quality Small	789
Low Quality	3093
Veneer	287
Poles/Piles	480
Girders	130
Total	7264

4. Forest Description

4.1 Forest Type (See Forest Type map)

- The dominant forest type within these compartments is Moist Blackbutt Type 36, with Dry Blackbutt, mahogany and Ironbark on north facing slopes and along ridges.
- Wet forests Type 53 Brush Box and Type 48 Flooded Gum are present in gullies and on some south facing slopes.

4.2 Harvest History

- The compartments have been regularly harvested since the early 1900s. The present timber stand is a result of harvesting events and past timber stand improvement operations.
- Harvesting in these compartments in the early to mid 1980s concentrated on ridge tops and other Blackbutt areas.
- The most recent harvesting event in the early to mid 1990s removed quota and salvage sawlogs using STS silviculture.

4.3 Stand Description

- Mixed-age regrowth with some mature trees remaining from previous harvesting operations.
- DBHOB range of commercial trees from 25-80cm.

4.4 Site Quality

- Stands are of varying quality
- Variable quality across the site mainly depending on aspect with a range of growth stages from young regrowth to mature trees present and canopy heights mostly in the range of 25-45m.

4.5 Stand Health

- Very good with few old defective trees and healthy regrowth present across the stand.

5. Silviculture and Harvesting Prescriptions

Notwithstanding the prescriptions detailed below, all conditions of the IFOA, including General and Species Specific conditions of the Threatened Species Licence (TSL) and the Environment Protection Licence (EPL) are to be applied, where they are described in this plan or in the respective licences.

5.1 Objectives

- Maximise the recovery of merchantable timber from the mature age/size cohort within the constraints of the harvest plan.
- Create suitable conditions for a regeneration event.
- The table below gives proposed silvicultural treatments for the forest types within the harvest area:

Stand Description	Mixed-age dry and moist Blackbutt, Mahogany and Ironbark.	Wet Flooded Gum and Brush Box Forest.	Blackbutt forest – FMZ 3B.	Mixed Aged, Mixed Species Forest
Proposed Silviculture	Heavy STS	Heavy STS	Light STS - Regional manager approval required before harvesting to determine appropriate management for visual amenity.	Nil – steep areas, likely inaccessible areas and other exclusions.
Est. % of NHA	65%	15%	5%	15%
Expected BA Removal (%)	45%	60%	15%	0%
Future Ops 15-20 years	STS	STS	STS	None

5.2 Single Tree Selection

- This operation will be managed with the object of harvesting trees that have reached their maximum economic end use, and removing poorer quality and less vigorous trees to allow the remaining high-quality trees to grow on.
- Tree removal and ground disturbance must also maximise regeneration opportunities.
- STS must remove no more than 40% of the basal area across the net harvest area.
- BA removal is permitted to exceed 40% in some localised areas, but will be balanced by tree retention across the tract and zero basal area removal in steep areas and inaccessible areas.
- Trees with dbhob <20cm must not be selected for harvesting under STS (1.5.10 IFOA).

5.3 Other Conditions

- The Silviculture Map shows indicative areas for each silvicultural treatment outlined above. The boundaries of these areas are not fixed – areas for application of silvicultural regimes should be determined by the SFO in conjunction with the Harvesting FA. Significant variation from this intent requires approval from the Harvesting Team Leader.
- The SFO must monitor basal area retention under STS.
- The actual harvest areas must be recorded/mapped and retained with this plan.

6. Special Conditions

6.1 EPL Licensing

- This operation is licensed under the EPL.
- The Harvesting Manager is responsible for sending a Commencement of Operations form to the Office of Environment and Heritage (OEH) within 14 days of commencement of operations authorised under this plan.
- A Cessation of Operations form is to be forwarded to OEH within 14 days of cessation of operations authorised under this plan.
- The SFO must notify the Harvesting Manager when operations have commenced and ceased.

6.2 Seasonal Roading, Harvesting and Burning Restrictions

- Seasonal roading, harvesting and burning restrictions apply to operations conducted under this plan.
- For slopes greater than or equal to 20 degrees, forestry activities are not permitted during the period 1 December to 30 April inclusive. Harvesting supervisors should assess slopes in the field to determine areas where restrictions apply
- Condition 37 of Schedule 4 of the EPL applies seasonal restrictions to post-harvest burning. Burning carried out during the months of January or February must use a ground burning (top disposal) method only.

6.3 Leases, Permits & Plots

Type	*Present*	*Details*	*Conditions*
Crown Leases	No		NA
Occupation Permits (Grazing)	No		NA
Occupations Permits (Apiary)	No	No recorded set down locations or permits within harvest area. However, within compartment 620 on Ridge Road between dumps 1 and 2 there are a number of old hives that appear to have been abandoned.	Only move or disturb hives if they are constraining the harvesting operation.
Occupation Permits (Other)	No		NA
Permanent Growth Plots (PGP)	No		NA
Research Plots	No		NA
Plus Trees	No		NA
Special Purpose Permits	No		NA

6.4 Critical Boundaries

6.4.1 National Park

- Bindarri NP adjoins compartment 614 to the south-west. The harvest boundary is offset from this by rainforest protection areas. Access is possible to the national park from state forest via a 4wd track that runs west from dump 14. On completion of operations this track must be blocked at the harvest boundary by earth/log barrier or similar to prevent illegal access to the national park.

6.4.2 Other critical boundaries

- A Wildlife Habitat Corridor (Special Management Zone FMZ 2) 100m runs along Star Creek and north through the compartments. This is in addition to Ridge & Headwater Habitat in the same area.
- If there is any doubt about the location of a critical boundary, the Harvesting Team Leader must be consulted about requirements to adequately determine the boundary location.

6.5 Underground Cables

- There is an underground Telstra cable that runs through the compartments adjacent to Top Trail and Star Ridge Road. Approximate location as per HPOM.

- Site plans for the cable are held in the Harvest Plan Folder.
- Dial before you dig procedure must be followed prior any excavation or road maintenance works in this area to determine cable locations.

6.6 Haulage Considerations

- Additional signage should be used on where Star Ridge Road joins Eastern Dorrigo Way to notify traffic of turning trucks.

6.7 IFOA Required Approval of Forestry Activities

- Approvals have been obtained for the following activities. Locations as shown on the HPOM.

Activity	*Crossing/Location*	*Feature Type*	*Conditions*
Snigging along existing track.	IFOA crossing A, compartment 620.	Wildlife Habitat Corridor Riparian Habitat, Ridge & Headwater Habitat Protection Zones.	Minimise size of snig track, remove debris outside filter strip and drain to EPL standard on completion of use. This crossing is not permitted to be used if it is determined that it passes through an Endangered Ecological Community (EEC) and removal of species that constitute this EEC along the track prism is required.
Snigging along existing track.	Exclusion Zone Crossing B, Top Trail, compartment 620.	Wildlife Habitat Corridor.	Minimise size of snig track and drain to EPL standard on completion of use.

- Any additional crossings of Rainforest, HCVOG and Riparian Protection Zones require prior Regional Manager (or the Office of Environment & Heritage (OEH)) approval before they can be implemented.
- It is the responsibility of the SFO to identify any additional areas that need to be crossed, the proposed location of any such crossings, and to contact the Planning Unit via the Harvesting Team Leader to obtain the necessary approval.

6.8 Rainforest & EECs

- Unmapped rainforest is to be identified and marked for retention in accordance with Forest Practices Circular 2005/02.
- Endangered Ecological Community (EEC) 'Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions' is potentially present within these compartments outside the mapped rainforest extent. Areas of this forest community should be identified as described in the FNSW EEC Identification Guide, and if present within the operation area, excluded from harvesting.

6.9 Compartment 620 Harvesting Access

- Two areas of compartment 620 will have more suitable access from adjoining compartments to the east, and should be harvested in conjunction with operations in those compartments.
- The ridge in the eastern section north of Star Creek bounded by areas with slopes greater than 30 degrees. Cpt 620/1 Road will provide access to this ridge from dump 1A. The road and crossings will be maintained under the Roadworks Plan for compartments 617, 618 & 619.
- The eastern section south of Star Creek bounded by areas with slopes greater than 30 degrees, FMZ 3A and a class 1 watercourse. This area will be serviced by dump 15, which will be accessed via Star Creek Road through compartment 618 to the east. The road and crossings will be maintained under the Roadworks Plan for compartments 617, 618 & 619.

6.10 Log Dumps

- Log dumps 9, 10 and 12 are permitted to be located within adjoining compartment 715 provided they comply with any exclusions zones and other prescriptions detailed in the harvest plan for compartments 616 & 715.
- Log dumps 9, 10, 11, 12 & 13 are permitted to be used during operations conducted under the harvest plan for compartments 616 & 715.

6.11 Weeds

- Parts of the operational area are heavily infested with Lantana. Machinery operators are to conduct visual inspections and clean machinery if required when moved from weeded to non-weeded areas.

6.12 LiDAR Corrected Drainage

- The locations of drainage lines shown on the HPOM have been altered using information available from LiDAR. This should more accurately reflect the location of mapped drainage lines.
- Also shown are Indicative Drainage Features - these may be drainage lines, drainage depressions, or neither. The location of these features is indicative only and their status should be confirmed in the field before the appropriate prescriptions (if any) are applied.

7. Forest Management Zoning Conditions

The following Forest Management Zones and conditions apply:

FMZ	*Type*	*Notes*
Zone 2	Special Management	FMZ wildlife corridors 50m either side of Star Creek and Mirum Creek, plus area north of Star Creek headwater that includes some High Conservation Old Growth (HCVOG). These areas must be protected as marked on the map.
Zone 3A	Harvesting Protection	HCVOG, Rainforest, and an area in compartment 614 east of Star Ridge Road that includes Forest Types 62b/234 (Grey Gum-Grey Ironbark-White Mahogany/Rock) which is marked as Harvesting Protection FMZ 3A. Also pockets of forest isolated due to other protection zones. These areas must be protected as marked on the map.
Zone 3B	Special Prescription	Visual protection zone along Eastern Dorrigo Way. Harvesting operations within this area must aim at retaining the visual amenity of the forest by one or more of the following options, or an appropriate alternative: - Minimise snig tracks within visible forest areas. - Snig tracks to run perpendicular to the road where practical. - Retain understorey vegetation where practical to provide visual screening. - Limit tree removals to maximum 50 percent of canopy. Log dumps are permitted within the visual protection zone. Regional manager approval required before harvesting 3B zone to determine appropriate management for visual amenity.
Zone 4	General Management	Available for harvesting in accordance with the conditions of this harvest plan.
Zone 8	Further Assessment	These areas are to be rezoned FMZ 4 with management by prescription (Standard Harvest Plan Conditions for Native Forest Operations in North East Region apply). These areas may include - Mapped drainage features – identify in the field and apply EPL and TSL conditions based on actual field location. - Modelled drainage features – modelled streams are to be inspected by the SFO. Appropriate prescriptions (Schedule 4 of the EPL) are to be applied if required and noted on the HPOM. - Modelled Inherent Hazard Class (IHC) 4 areas – assess actual slope in the field and exclude areas >30 degrees in accordance with condition 3 of schedule 4 of the EPL.

8. Cultural Heritage Conditions

8.1 Aboriginal Cultural Heritage

- No special conditions apply.

8.2 Non Aboriginal Cultural Heritage

- No special conditions apply.

9. Flora and Fauna Conditions

Refer to Technical Guidance Note 2005-3A March 2005 for conditions (TSL Booklet).

9.1 Mark-up Conditions

The SFO must search for threatened species and mark-up the block as per Conditions 5.1 (General) and 5.2 (Koala) of the TSL. The Tree Marking code is shown in the Standard Harvest Plan Conditions for Native Forest Operations in North East Region.

9.2 Applicable Tree Retention Conditions

Prescription	*TSL Conditions*
Hollow Bearing and Recruit Trees	Regrowth Zone – 5.6c & d.
Is Greater Glider density >1 per ha	No – 6.9d does not apply.
Stag Retention	5.6e
Significant Food Resources	5.6f
Protection of Retained Trees	5.6g

9.3 Species Known or Likely to Occur

Recent and reliable records exist within, or within close proximity of the compartments for the following threatened species. These species require species-specific or site-specific prescriptions if further records or habitat features are identified during mark-up.

Species Group	*Common Name*	*Scientific Name*
Amphibians	Pouched Frog	*Assa darlingtoni*
	Stuttering Frog	*Mixophyes balbus*
	Giant Barred Frog	*Mixophyes iteratus*
	Sphagnum Frog	*Philoria sphagnicola*
Mammals	Grey-headed Flying Fox	*Pteropus poliocephalus*
	Koala	*Phascolarctos cinereus*
	Yellow-bellied Glider	*Petaurus australis*
Birds	Masked Owl	*Tyto novaehollandiae*
	Powerful Owl	*Ninox strenua*
	Glossy-black Cockatoo	*Calyptorhynchus lathami*
Flora	Rusty Plum	*Niemeyera whitei*
	Orara Boronia	*Boronia umbellata*
	Milky Silkpod	*Parsonsia dorrigoensis*

9.4 Site-Specific Conditions, Exclusion Zones & Modified Harvest Areas

Table 1: General Prescriptions

TSL Condition	*Condition No.*	*Record Details*	*Prescription Summary*
Koala Mark-up Searches	5.2.2	Nil records – continue search.	These compartments contain preferred forest types, marking-up must be conducted at least 300m in advance of harvesting operations. In the event that a koala or scats (as noted in 5.2.2(i)) are found, a koala star search will be conducted to determine koala use area/s.
Tree Retention	5.6 (f),(g)	Nil records – continue search.	Retain and protect glossy black cockatoo feed trees. Retain all yellow-bellied glider and squirrel glider sap feed trees.
Burning	5.16	Threatened species have been recorded in these compartments.	The habitat requirement of threatened species must be taken into account when instigating hazard reduction burns to promote and maintain an understorey mosaic, significant areas of dense understorey vegetation and to minimise impact on large fallen logs.
Ground Habitat Protection	5.17 (a)	Nil records – continue search.	To the greatest extent practical, protect ground habitat from SFA. Ground habitat includes understorey vegetation, ground cover vegetation, leaf litter and fallen timber.
	5.17 (b)	CWRV and small mammals, reptiles.	Commercial Firewood collection is not permitted.
	5.17 (d)	Larger CWRV.	Firewood licences state that timber with hollows and/or over 40cm diameter must not be collected or damaged.

Table 2: Species Specific Prescriptions (Record and Survey Based)

TSL Condition	*Condition No.*	*Record Details*	*Prescription Summary*
Pouched Frog *(Assa darlingtoni)*	6.1 (Apply Dorrigo MA condition)	15 ASS DAR records in and within 50m of compartment boundaries.	Exclusion zone of 50m on all records as mapped. This is not a TSL prescription outside of the Dorrigo Management Area, therefore standard approvals required for forestry activities in these areas do not apply. Snigging along existing roads through Pouched Frog exclusion zones is permitted.
Sphagnum frog *(Philoria sphagnicolus)*	6.4	2 PHIL SPHA records in and within 50m of compartment boundaries.	Exclusion zone of 50m on all records as mapped.
Powerful Owl *(Ninox strenua)*	6.9	1 POWL record within 2km of compartment boundaries.	Landscape approach as specified in 6.9.2 will be used. Condition 5.13 may be applicable to protect any roosts or nests found.
Masked Owl *(Tyto novaehollandiae)*		2 MOWL records within 2km of compartment boundaries.	Search gully lines and heads of gullies for roost and nest sites.
Yellow-bellied Glider	6.17	1 YEBG call detection record.	Exclusion of 50m on dens. Retention of all sap feed trees. Within 100m of dens, sap

(Petaurus australis)		1 YEBG observation record within 50m of compartment C_620.	feed trees and observation records, 15 mature / late mature feed trees must be retained. Within 200m of call detection site, 15 feed trees must be retained. Retained trees must be of same species as tree with den, feed marks or observation or should be species that shed their bark in long strips.
Niemeyera whitei	6.27	20 NIEM WHIT records in compartments C_614, 620. 2 NIEM WHIT records within 50m of compartment C_620.	Harvesting is permitted in populated areas. This species is managed under a threatened flora monitoring program. No burning in areas with records.

Table 3: Other Ecological Considerations

Issue, Feature or Record	*Presence*	*Assessment & Management Recommendations*
EEC: Lowland Rainforest in the NSW North Coast and Sydney bioregion.	Present - continue search within NLA.	Identify and mark in field to exclude specified forestry activities. Contact FNSW ecology unit for guidance if required.

In addition to Forest Management Zone Exclusions, the following exclusion zones occur within the operation area and are shown on the operational map:

- Riparian Protection (TSL Condition 5.7)
- Ridge and Headwater Habitat (TSL Condition 5.8)

Boundary marking conditions for each exclusion zone are described on the HPOM and in the tree marking code (see Standard Harvest Plan Conditions for Native Forest Harvesting in North East Region).

9.5 Other Fauna Exclusion Zones

An exclusion zone is indicated on the HPOM for the Pouched Frog to protect known record locations and suitable habitat for this species. This area will be treated as per standard prescriptions for Forest Management Exclusion Zones.

10. Fisheries Licence Conditions

Refer to Technical Guidance Note 2005-02 March 2005 (Fisheries Licence Booklet).

Class 1 Aquatic Habitat has been identified as occurring within these compartments. Conditions of the Fisheries Licence apply.

- Condition 7 (General Aquatic Habitat Protection Conditions) of the Fisheries Licence applies.
- The boundary of any exclusion zone or buffer zone is to be marked in the field before a specified activity is commenced where the activity will come within 50m of that boundary.
- Condition 7.9 of the Fisheries Licence applies to snig track crossings of mapped and unmapped drainage lines.
- Crossings must be approved and marked in the field prior to use.
- Crossings may only be used where it is not reasonably practicable to use another route or site.
- Conditions 8.3 and 8.4 of the Fisheries Licence apply to crossings.
- A pre-logging aquatic habitat assessment of the site of each proposed crossing where in-stream maintenance is required must be completed prior to use. Consultation with the harvest planner is required prior to construction and use of such crossings.

11. Soils and Water Protection Conditions

Refer to Technical Guidance Note 2005 - 1B (Environment Protection Licence Conditions booklet) and Standard Harvest Plan Conditions for Native Forest Harvesting in North East Region.

Site-specific EPL conditions:

Elements	*Conditions*
Unmapped Drainage Lines	EPL applies - unmapped drainage line harvesting not permitted.
Drainage Feature Protection	See HPOM for widths.
Inherent Hazard Level	Level 3 - Harvesting is not permitted on slopes greater than or equal to 25 degrees on regolith class 2 soils types at any time of the year. See HPOM for indicative areas of regolith class 2 soils.
Dispersible Soils	No conditions required.
Mass Movement	No conditions required.
Log Dumps	Refer relevant conditions for IHL, Schedule 4 Section F of EPL booklet.
Snig Tracks	Yes – Refer to specific conditions below.
Roads	See Schedule 5 (p. 18-26) of EPL booklet.
Non-Haulage Roads	May be used for extraction, EPL applies. Remove debris and reshape road to trafficable state on completion of operations.

11.1 Site Specific Conditions for Snig Tracks

Use of snig tracks with a grade of greater than 25 degrees is permitted with the following conditions:

- Use of previous snig track locations is preferred.
- Side-cutting of new snig tracks is not permitted.
- These snig tracks are used to take advantage of favourable terrain, such as a stable ridgeline.

12. Legal Conditions

This operation must comply with:

- Standard Harvest Plan Conditions for Native Forest Operations in North East Region.
- Licence Conditions issued by Forests NSW under the Forestry Act (1916).
- State Forests of NSW Forest Practices Code - Part 2 Timber Harvesting in Native Forests (February 1999) and Forest Practices Code Part 4 Forest Roads and Fire Trails (February 1999).
- Integrated Forestry Operations Approval issued under part 4 of the Forestry and National Parks Estate Act 1998 including the associated licences:
  - Threatened Species Conservation Licence issued under the Threatened Species Conservation Act (1995).
  - Fisheries Licence issued under section 220ZW of the Fisheries Management Act 1994.
  - Environment Protection Licence No. 4017 (Upper North East) issued under section 55 of the Protection of the Environment Operations Act 1997 – applicable to harvesting operations and roading operations within native forest only.

13. Attachments

- Attachment 1: Locality map.
- Attachment 2: Harvest Plan Operational Map.
- Attachment 3: Forest Type Map.
- Attachment 4: Silviculture Map.
- Attachment 5: Site Safety Plan describes the safety requirements and Medical Emergency Evacuation Plan for this harvesting operation.
- Attachment 6: Roading plan prescribes roading requirements for this harvesting operation.

FORESTS NEW SOUTH WALES – NORTH EAST REGION

ROAD WORKS PLAN

Orara West State Forest - Compartments 614 & 620

1. Certification

Prepared by:

Harvest Planner Matt Howat		Date: 21/05/13

Approved by:

Regional Manager Craig Busby		Date: 26/7/13

2. Objectives

- Roadworks are required to service native forest harvesting operations within the above compartments. These compartments are scheduled for harvest in April 2014. Adjacent compartments 616 & 715 will be harvested concurrently. Compartments 617, 618 & 619 are also scheduled for harvesting. The access route for these compartments will include the sections of Star Ridge Road and Ridge Road to be maintained under this plan.
- The harvest plan operational map shows the location of the proposed works.
- The financial analysis spreadsheet gives full details of costs, benefits, material & plant requirements.
- Attachments:
  - Harvest Plan Operational Map.
  - Road maintenance and crossing assessment forms.
  - Crossing E design details from Forest Engineering Services.
  - Financial Analysis Spreadsheet.

3. Specifications and Legal Conditions

This operation must comply with:

- Standard Harvest Plan Conditions for Native Forest Operations in North East Region.
- Licence Conditions issued by Forests NSW under the Forestry Act (1916).
- State Forests of NSW Forest Practices Code - Part 2 Timber Harvesting in Native Forests February 1999 and Forest Practices Code Part 4 Forest Roads and Fire Trails (February 1999).
- Integrated Forestry Operations Approval issued under part 4 of the Forestry and National Parks Estate Act 1998 as amended May 2003 including the associated licences:
  - Threatened Species Conservation Licence issued under the Threatened Species Conservation Act (1995).
  - Licence issued under section 220ZW of the Fisheries Management Act 1994.

- Environment Protection Licence No. 4017 (Upper North East) issued under section 55 of the Protection of the Environment Operations Act 1997 – applicable to harvesting operations and roading operations within native forest only.

- Technical Guidance Notes for Roadworks.

4. Special Conditions

Feature	*Conditions*
Threatened Species	See harvesting plan and HPOM for conditions. Minimise disturbance within protection zones.
Seasonality	Seasonal roading, harvesting and burning restrictions apply to operations conducted under this plan. For slopes greater than or equal to 20 degrees, forestry activities are not permitted during the period 1 December to 30 April inclusive. Harvesting supervisors should assess slopes in the field to determine areas where restrictions apply.
Engineering Design	See specific prescriptions for Crossing E prepared by Forest Engineering Services.
Underground/Overhead Utilities	There is an underground Telstra cable that runs through the compartments adjacent to Top Trail and Star Ridge Road. Approximate location as per operational map. Site plans for the cable are held in the Harvest Plan Folder. Dial before you dig procedure must be followed prior any excavation or road maintenance works in this area to determine cable locations.
Safety Issues (includes hazards, public use of roads)	See Hazard Assessment in the Site Safety Pack.
Weeds	Parts of the operational area are heavily infested with Lantana. Machinery operators are to conduct visual inspections and clean machinery if required when moved from weeded to non-weeded areas.

4.1 EPL Licencing

This operation is licensed under the EPL.

The Harvesting Manager is responsible for forwarding a Commencement of Operations form to the Office of Environment and Heritage within 14 days of commencement of operations authorised under this plan.

A cessation of Operations form is to be forwarded to the Office of Environment and Heritage within 14 days of cessation of operations authorised under this plan.

The Supervising Forest Officer must notify the Harvesting Manager when operations have commenced and ceased.

5. Scheduled Works

See attached road maintenance and crossing assessment forms for details.

Road Maintainence/Upgrade

Road Name Star Ridge Road **Category** PERMANENT

Location Eastern Dorrigo Way to dump 9 **Length (m)** 3350

	WORKS		YES	INSTRUCTIONS/SITE SPECIFIC CONDITIONS
Site Info	Works >30 Slopes		☐	
	Mass Movement		☐	
	Dispersible		☐	
Pavement	Upgrade	Widening	☐	Location Upgrade Length (m) Formation Width (m) Upgrade Spoil Curve Widening
		Grade Lowering	☐	
		Realignment	☐	
		Reopening	☐	
	Maintenance	Clear veg/debris	☑	All Maintenance Length (m) 3350
		Repair surface	☐	
		Crown/Crossfall	☑	
		Gravel	☑	10% patch gravel Gravel Length (m) 330
Roadside/Batters	Remove trees >20 cm		☑	Remove Dangerous trees/stags only
	Remove trees <20 cm		☑	Clearing outside the road prism: NIL IDENTIFIED
	Batter Repair/Upgrade		☐	
Drainage	Culverts		☑	Numerous Size: VARIOUS Sets: NUMEROUS
	Mitres		☑	
	ROD/Spoon		☐	Sets: 0
	Belts/Channels		☑	Sets: 15
	Drop Downs		☐	Sets:
	Silt Trapping		☐	
	Comments:			

Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

Date	Event	Initial

Road Name Mirum Creek Road Category HAULAGE

Location Star Ridge Road to dump 14 Length (m) 2020

			WORKS	YES	INSTRUCTIONS/SITE SPECIFIC CONDITIONS
Site Info			Works >30 Slopes	☐	
			Mass Movement	☐	
			Dispersible	☐	
Pavement	Upgrade		Widening	☐	Location Upgrade Length (m) Formation Width (m) Upgrade Spoil Curve Widening
			Grade Lowering	☐	
			Realignment	☐	
			Reopening	☐	
	Maintenance		Clear veg/debris	☑	All Maintenance Length (m) 2020
			Repair surface	☐	
			Crown/Crossfall	☐	
			Gravel	☑	20% patch gravel Gravel Length (m) 400
Roadside/Batters			Remove trees >20 cm	☑	**Remove Dangerous trees/stags only**
			Remove trees <20 cm	☑	Clearing outside the road prism: NIL IDENTIFIED
			Batter Repair/Upgrade	☐	
Drainage			Culverts	☑	Numerous **Size:** VARIOUS **Sets:** NUMEROUS
			Mitres	☑	
			ROD/Spoon	☐	**Sets:** 0
			Belts/Channels	☑	**Sets:** 14
			Drop Downs	☐	**Sets:**
			Silt Trapping	☐	
			Comments:		

Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

Date	Event	Initial

Road Name Ridge Road | Category PERMANENT

Location Eastern Dorrigo Way to dump 1 | Length (m) 390

			YES	INSTRUCTIONS/SITE SPECIFIC CONDITIONS
Site Info		Works >30 Slopes	☐	
		Mass Movement	☐	
		Dispersible	☐	
Pavement	Upgrade	Widening	☐	Location Upgrade Length (m) Formation Width (m) Upgrade Spoil Curve Widening
		Grade Lowering	☐	
		Realignment	☐	
		Reopening	☐	
	Maintenance	Clear veg/debris	☑	All Maintenance Length (m) 390
		Repair surface	☐	
		Crown/Crossfall	☑	All
		Gravel	☐	Gravel Length (m)
Roadside/Batters		Remove trees >20 cm	☑	Remove Dangerous trees/stags only
		Remove trees <20 cm	☑	Clearing outside the road prism: NIL IDENTIFIED
		Batter Repair/Upgrade	☐	
Drainage		Culverts	☐	Size: Sets:
		Mitres	☑	
		ROD/Spoon	☑	Sets: 2
		Belts/Channels	☐	Sets:
		Drop Downs	☐	Sets:
		Silt Trapping	☐	
		Comments:		

Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

Date	Event	Initial

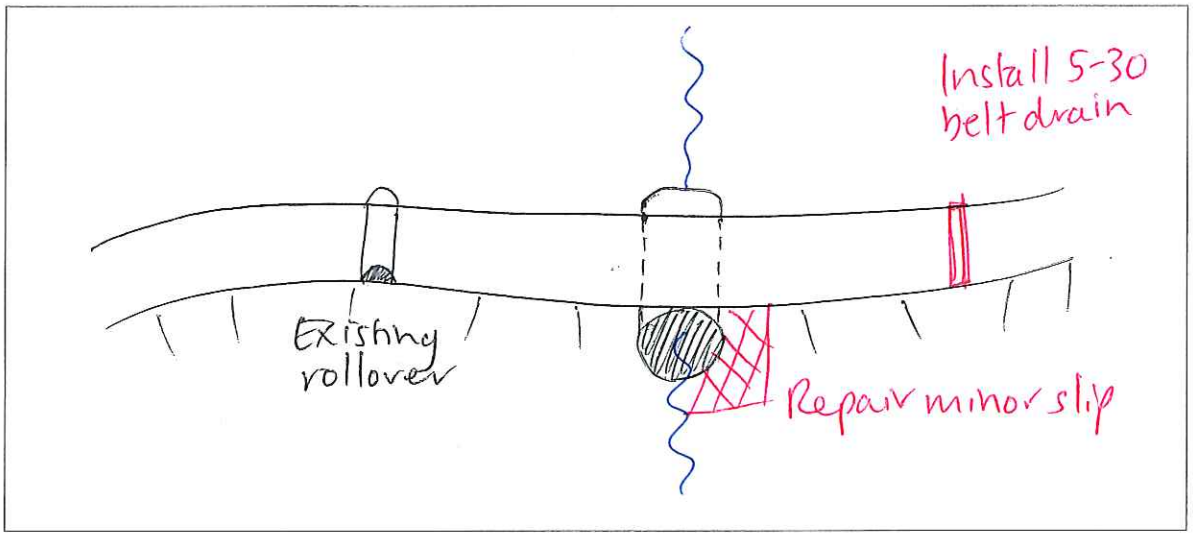
Crossing Works

Crossing Name A **Road Name** Star Ridge Rd **Location** 496442E 6656334N

Drainage Feature UDL **Stream Permanency** n

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
Culvert	450mm	stable	Existing	na	Permanent

Crossing Works		Approaches and Road Drainage	
Pavement/Structure	Existing natural surface.	**Approaches**	Good, install 5-30m drain.
Reshape Bed/banks	N	**Temporary Drainage**	na
Disposal of Spoil	na	**5-30m Upstream Left**	existing rollover/crest
Inlet	ok	**5-30m Upstream Right**	belt required
Outlet	minor slip in gully next to outlet	**Practices where no 5-30**	na
Stabilisation	water reaching surface below culvert o	**OutletControl**	Natural vegetation
ErosionControl	Natural vegetation	**TableDrain**	ok



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

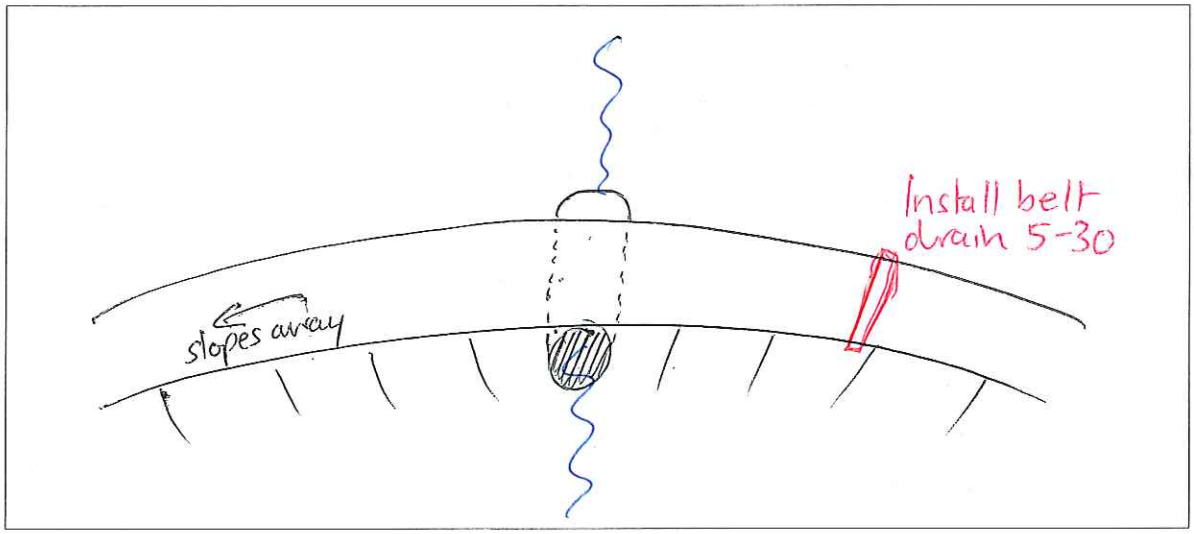
Date	Event	Initial

Crossing Name B **Road Name** Star Ridge Rd **Location** 496413E 6656270N

Drainage Feature UDL **Stream Permanency** n

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
Culvert	450mm	stable	Existing	na	Permanent

Crossing Works		Approaches and Road Drainage	
Pavement/Structure	Existing natural surface.	Approaches	Install 5-30m drain.
Reshape Bed/banks	n	Temporary Drainage	na
Disposal of Spoil	na	5-30m Upstream Left	NA-DOWNHILL
Inlet	ok	5-30m Upstream Right	BELT REQUIRED
Outlet	ok	Practices where no 5-30	na
Stabilisation	na	OutletControl	Natural vegetation
ErosionControl	Natural vegetation	TableDrain	ok



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

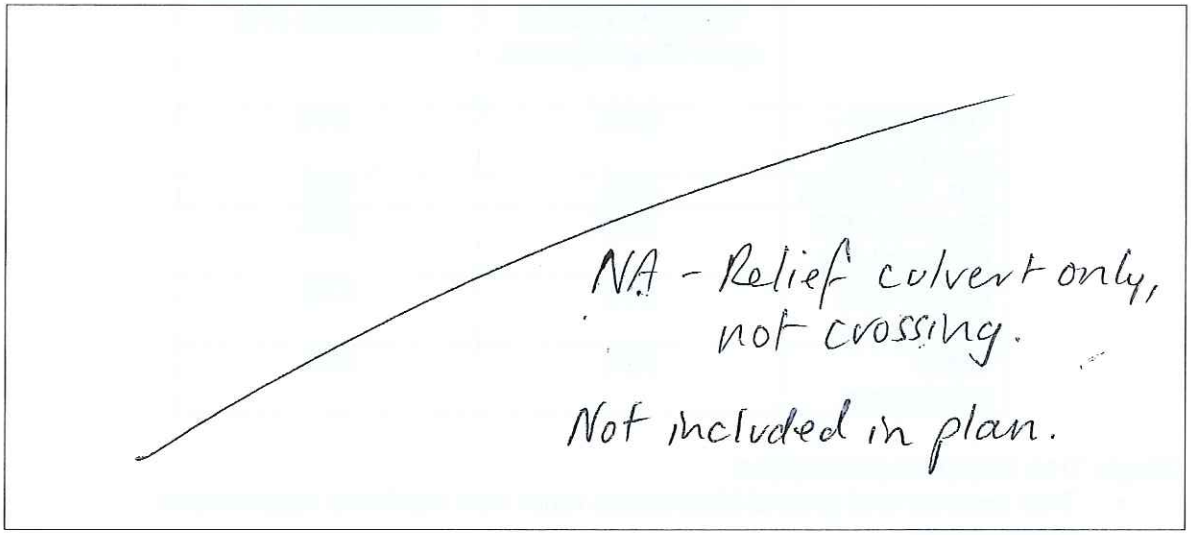
Date	Event	Initial

Crossing Name C **Road Name** Star Ridge Rd **Location** 496278E 6656189N

Drainage Feature **Stream Permanency**

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
not crossing only relief cu					

Crossing Works		Approaches and Road Drainage	
Pavement/Structure		Approaches	
Reshape Bed/banks		Temporary Drainage	
Disposal of Spoil		5-30m Upstream Left	
Inlet		5-30m Upstream Right	
Outlet		Practices where no 5-30	
Stabilisation		OutletControl	
ErosionControl		TableDrain	



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

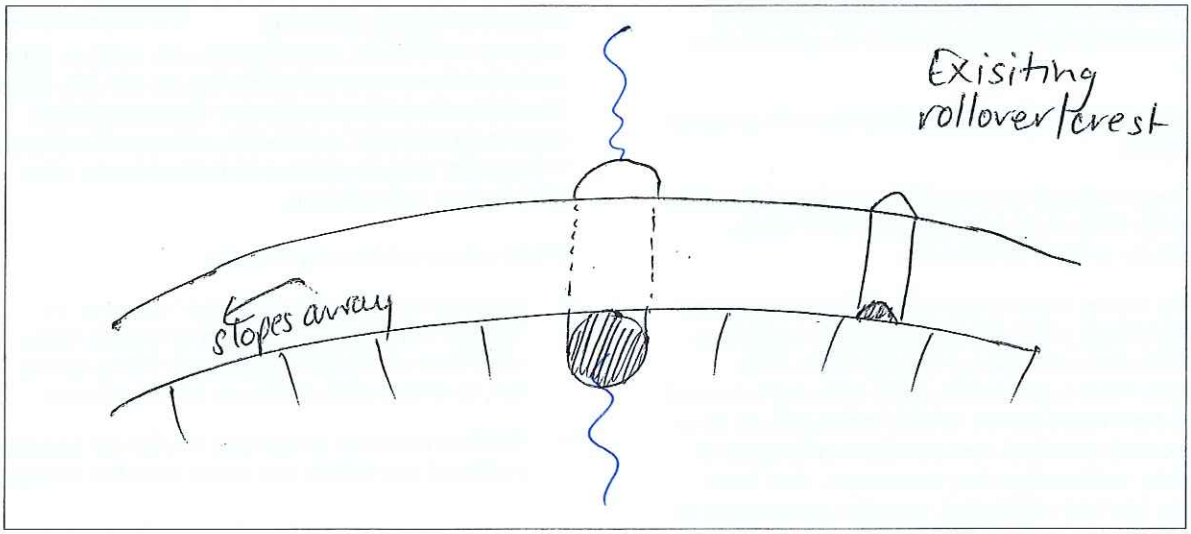
Date	Event	Initial

Crossing Name D **Road Name** Star Ridge Rd **Location** 466188E 6656220N

Drainage Feature Udl **Stream Permanency** n

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
Culvert	450mm	stable	Existing	na	Permanent

Crossing Works		Approaches and Road Drainage	
Pavement/Structure	Existing natural surface.	Approaches	Good.
Reshape Bed/banks	n	Temporary Drainage	na
Disposal of Spoil	na	5-30m Upstream Left	crest
Inlet	ok	5-30m Upstream Right	na - down hill
Outlet	ok	Practices where no 5-30	na
Stabilisation	na	OutletControl	Natural vegetation
ErosionControl	Natural vegetation	TableDrain	ok



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

Date	Event	Initial

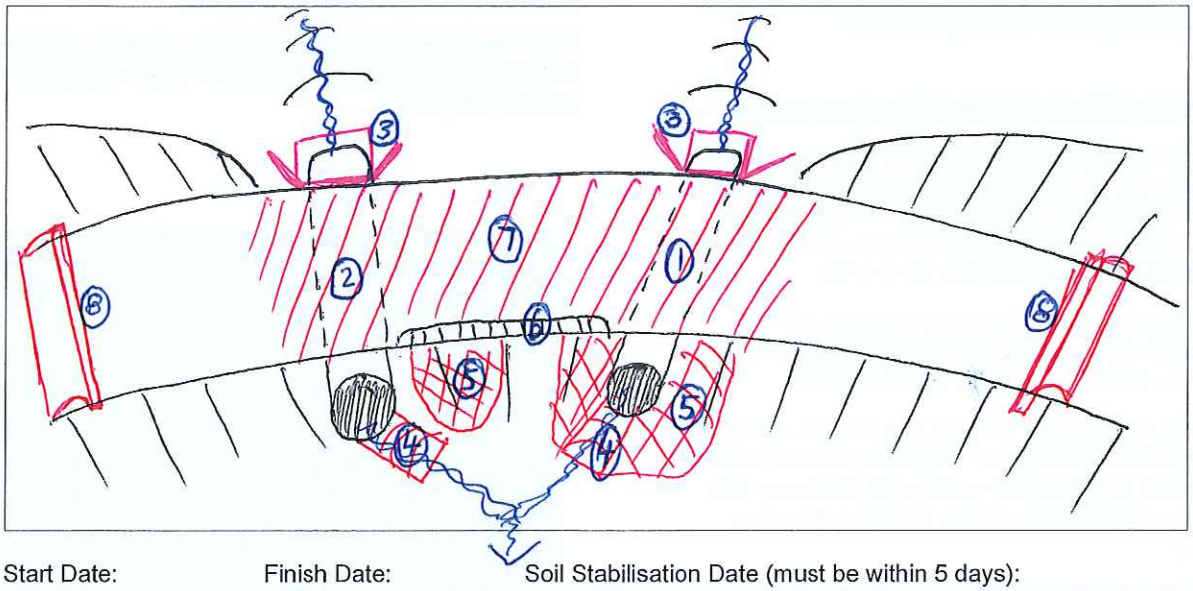
* See design details from Bob Cooper (attached). *

Crossing Name E **Road Name** Star Ridge Rd **Location** 496248E 6656144N

Drainage Feature 1st order DL **Stream Permanency** n

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
Culvert	450mm	Unstable	Upgrade existing	Multiple	Permanent

Crossing Works		Approaches and Road Drainage	
Pavement/Structure	Install new 600mm pipe, works to inlet headwalls, outlets, 5-30 rollover drains and embankment. Gravel to be applied to crossing surface.	Approaches	ok
Reshape Bed/banks	n	Temporary Drainage	na
Disposal of Spoil	Into road surface	5-30m Upstream Left	Install rollover
Inlet	Minor work required	5-30m Upstream Right	Install rollover
Outlet	Minor slip	Practices where no 5-30	na
Stabilisation	na	OutletControl	Natural vegetation
ErosionControl	Required at outlet	TableDrain	ok



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

Date	Event	Initial

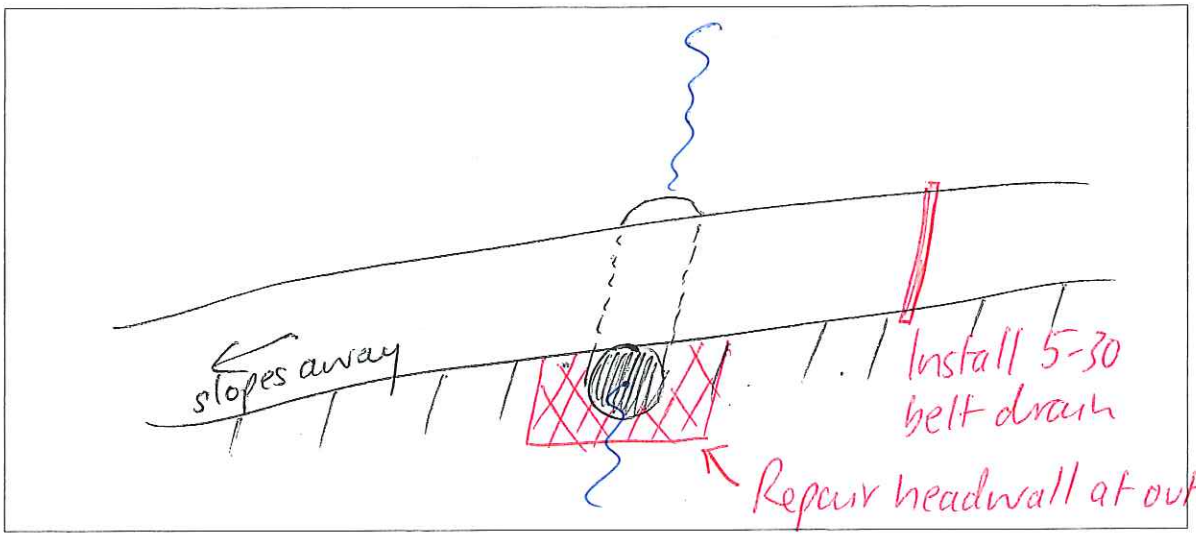
(1) RETAIN EXISTING 450MM PIPE
(2) INSTALL 600MM PIPE
(3) INSTALL HEADWALLS AT INLETS
(4) INSTALL DROPDOWN PROTECTION - FLUMING
(5) REPAIR EMBANKMENT FAILURES
(6) CONSTRUCT BERM
(7) GRAVEL ROAD AT CROSSING LOCATION
(8) INSTALL 5-30 ROLLOVERS

Crossing Name F **Road Name** Star Ridge Rd **Location** 496991E 6655326N

Drainage Feature UDL **Stream Permanency** n

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
Culvert	600mm	stable	Existing	na	Permanent

Crossing Works		Approaches and Road Drainage	
Pavement/Structure	Existing natural surface.	**Approaches**	Install 5-30m drain.
Reshape Bed/banks	n	**Temporary Drainage**	na
Disposal of Spoil	na	**5-30m Upstream Left**	na - downhill
Inlet	ok	**5-30m Upstream Right**	belt required
Outlet	repair headwall	**Practices where no 5-30**	na
Stabilisation	na	**OutletControl**	Natural vegetation
ErosionControl	Natural vegetation	**TableDrain**	ok



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

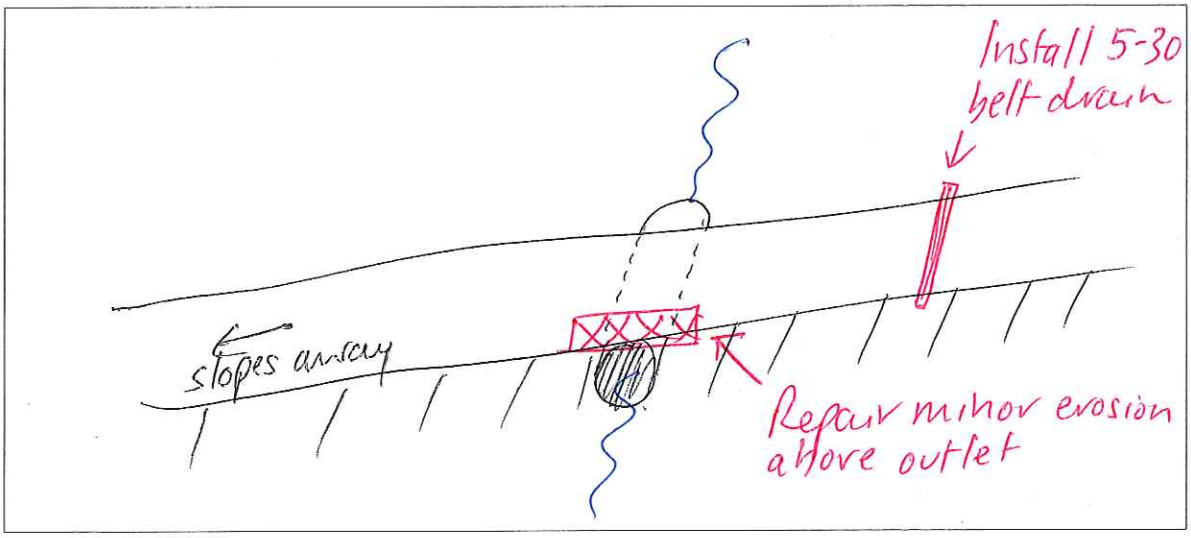
Date	Event	Initial

Crossing Name G **Road Name** Star Ridge Rd **Location** 497174E 6655220N

Drainage Feature UDL **Stream Permanency** n

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
Culvert	750mm	stable	Existing	na	Permanent

Crossing Works		Approaches and Road Drainage	
Pavement/Structure	Existing natural surface. Outlet-works required.	Approaches	Install 5-30m drain.
Reshape Bed/banks	n	Temporary Drainage	na
Disposal of Spoil	na	5-30m Upstream Left	na - down hill
Inlet	ok	5-30m Upstream Right	belt required
Outlet	minor erosion	Practices where no 5-30	na
Stabilisation	na	OutletControl	Natural vegetation
ErosionControl	Natural vegetation	TableDrain	ok



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

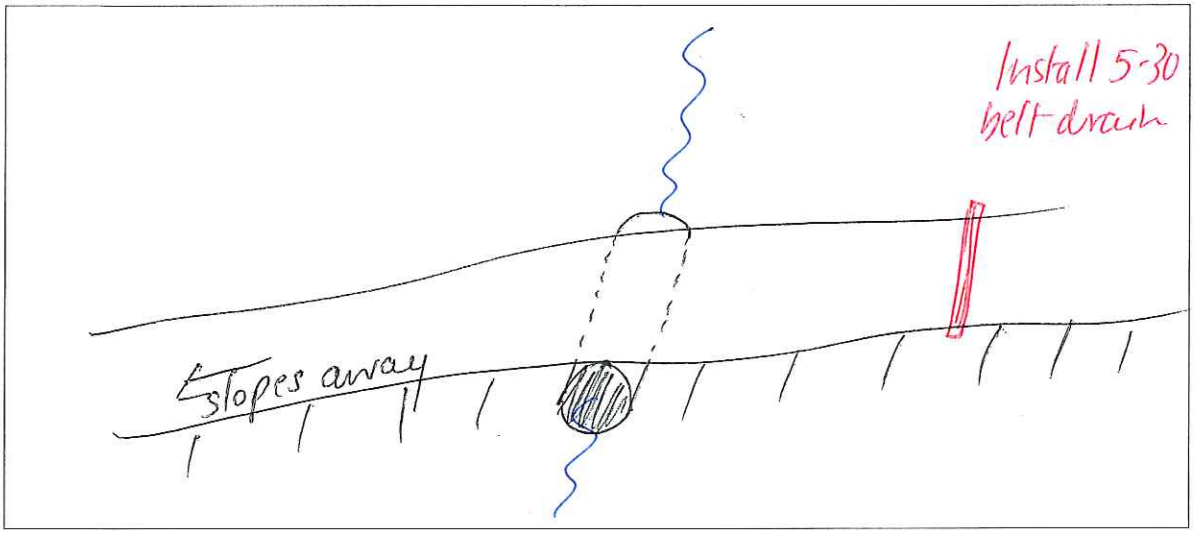
Date	Event	Initial

Crossing Name H **Road Name** Star Ridge Rd **Location** 497209E 6655199N

Drainage Feature UDL **Stream Permanency** n

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
Culvert	750mm	stable	Existing	na	Permanent

Crossing Works		Approaches and Road Drainage	
Pavement/Structure	Existing natural surface.	Approaches	Install 5-30m drain.
Reshape Bed/banks	n	Temporary Drainage	na
Disposal of Spoil	na	5-30m Upstream Left	na - down hill
Inlet	ok	5-30m Upstream Right	belt required
Outlet	ok	Practices where no 5-30	na
Stabilisation	na	OutletControl	Natural vegetation
ErosionControl	Natural vegetation	TableDrain	ok



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

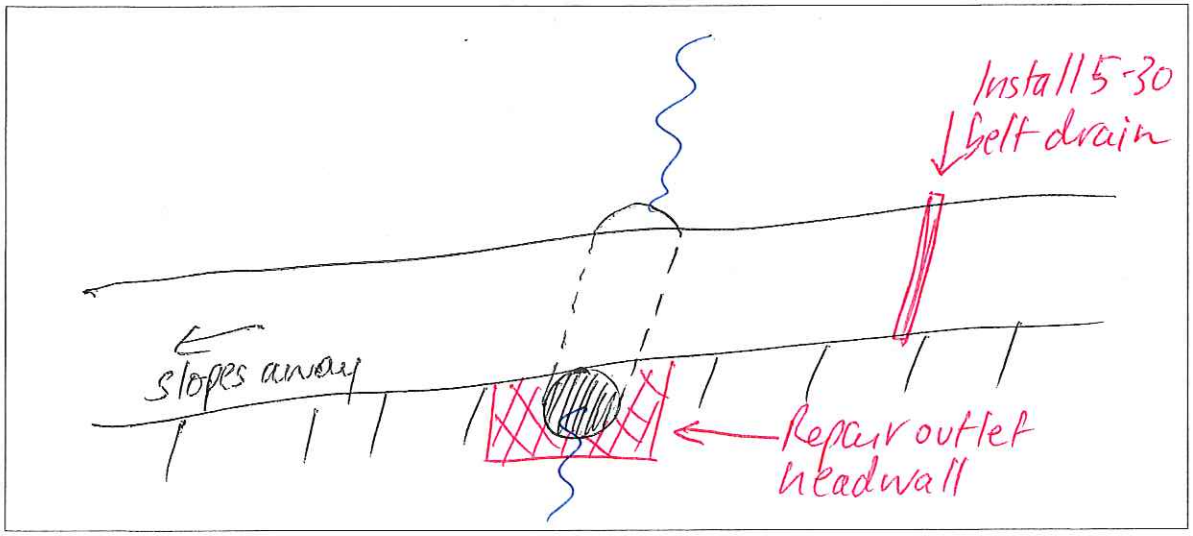
Date	Event	Initial

Crossing Name I **Road Name** Mirum Creek Road **Location** 486762E 6654721N

Drainage Feature UDL **Stream Permanency** n

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
Culvert	750mm	stable	Existing	na	Permanent

Crossing Works		Approaches and Road Drainage	
Pavement/Structure	Existing natural surface. Outlet works required.	Approaches	install 5-30m drain.
Reshape Bed/banks	n	Temporary Drainage	na
Disposal of Spoil	na	5-30m Upstream Left	na - down hill
Inlet	ok	5-30m Upstream Right	belt required
Outlet	reapir headwall	Practices where no 5-30	na
Stabilisation	na	OutletControl	Natural vegetation
ErosionControl	Natural vegetation	TableDrain	ok



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

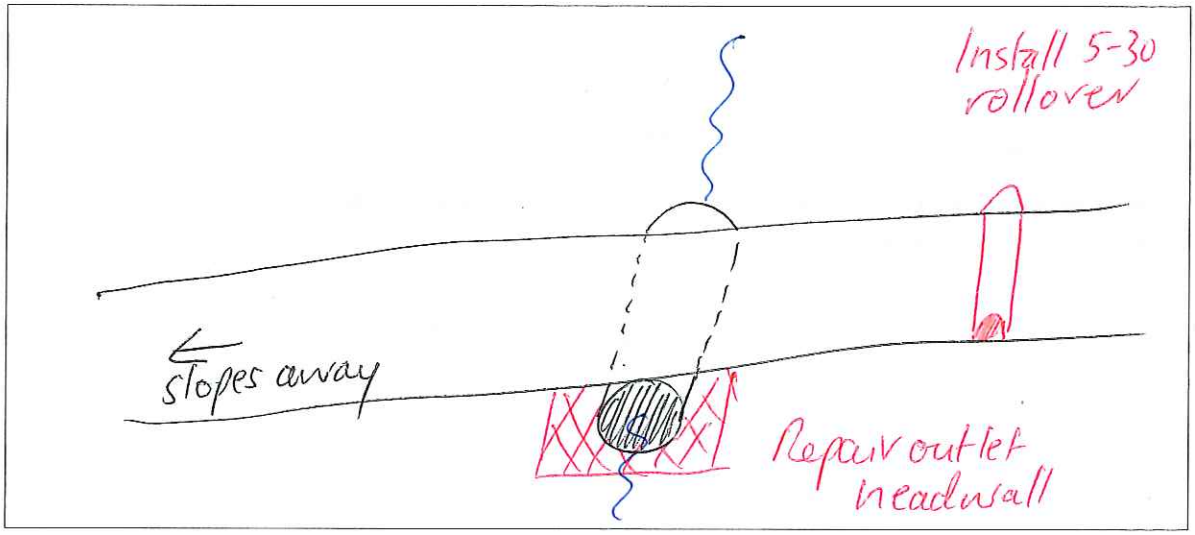
Date	Event	Initial

Crossing Name J **Road Name** Mirum Creek Road **Location** 496792E 6654761N

Drainage Feature UDL **Stream Permanency** n

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
Culvert	750mm	stable	Existing	na	Permanent

Crossing Works		Approaches and Road Drainage	
Pavement/Structure	Existing gravel surface. Outlet works required.	Approaches	Install 5-30m drain.
Reshape Bed/banks	n	Temporary Drainage	na
Disposal of Spoil	na	5-30m Upstream Left	na - down hill
Inlet	ok	5-30m Upstream Right	rollover required
Outlet	repair headwall	Practices where no 5-30	na
Stabilisation	na	OutletControl	natural vegetation
ErosionControl	natural vegetation	TableDrain	ok



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

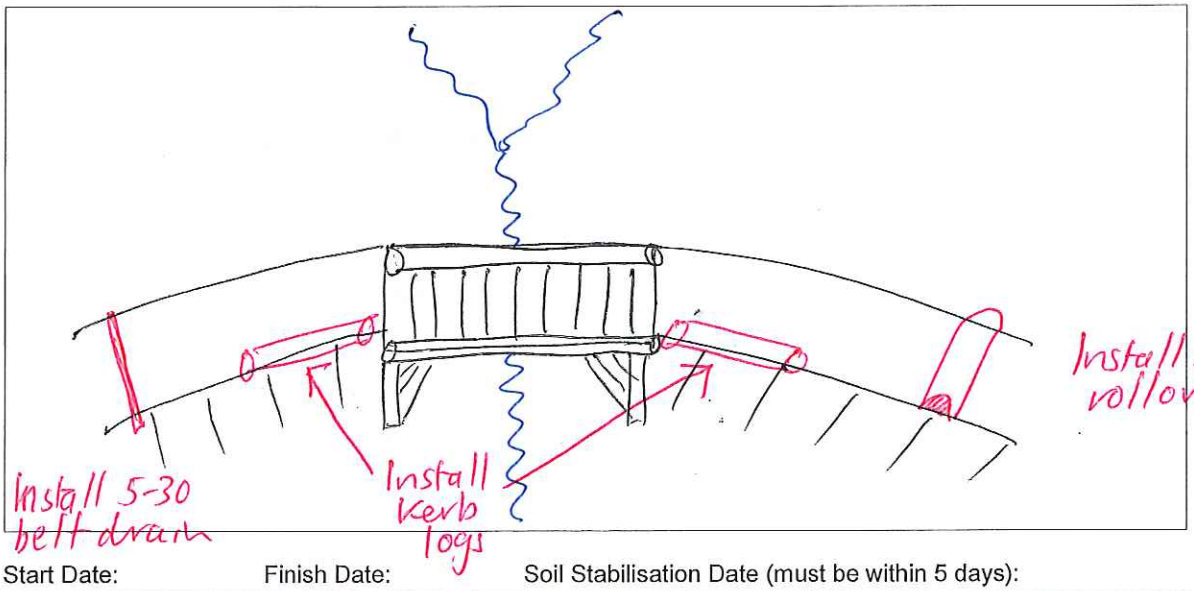
Date	Event	Initial

Crossing Name K **Road Name** Mirum Creek Rd **Location** 496747E 6655088N

Drainage Feature 2nd order DL **Stream Permanency** y

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
log bridge	1.5m high	Stable stability	Existing	na	permanent

Crossing Works		Approaches and Road Drainage	
Pavement/Structure	Existing log bridge with earth surface.	Approaches	Install 5-30m drains.
Reshape Bed/banks	n	Temporary Drainage	na
Disposal of Spoil	na	5-30m Upstream Left	belt required
Inlet	ok	5-30m Upstream Right	rollover required
Outlet	ok	Practices where no 5-30	na
Stabilisation	Install kerb logs	OutletControl	natural vegetation
ErosionControl	Natural vegetation	TableDrain	ok



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

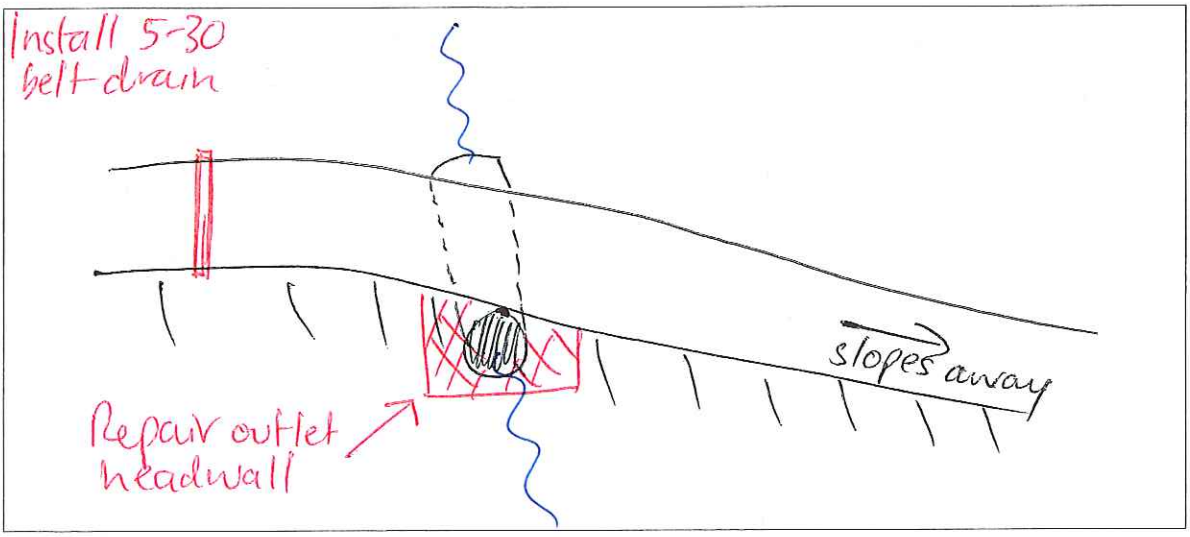
Date	Event	Initial

Crossing Name L **Road Name** Mirum Creek Road **Location** 496686E 6655126N

Drainage Feature UDL **Stream Permanency** n

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
culvert	900mm	stable	Existing	na	Permanent

Crossing Works		Approaches and Road Drainage	
Pavement/Structure	Existing natural surface. Outlet works required.	**Approaches**	Install 5-30m drain.
Reshape Bed/banks	n	**Temporary Drainage**	na
Disposal of Spoil	na	**5-30m Upstream Left**	belt required
Inlet	ok	**5-30m Upstream Right**	na - down hill
Outlet	repair headwall	**Practices where no 5-30**	na
Stabilisation	na	**OutletControl**	natural vegetation
ErosionControl	Natural vegetation	**TableDrain**	ok



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

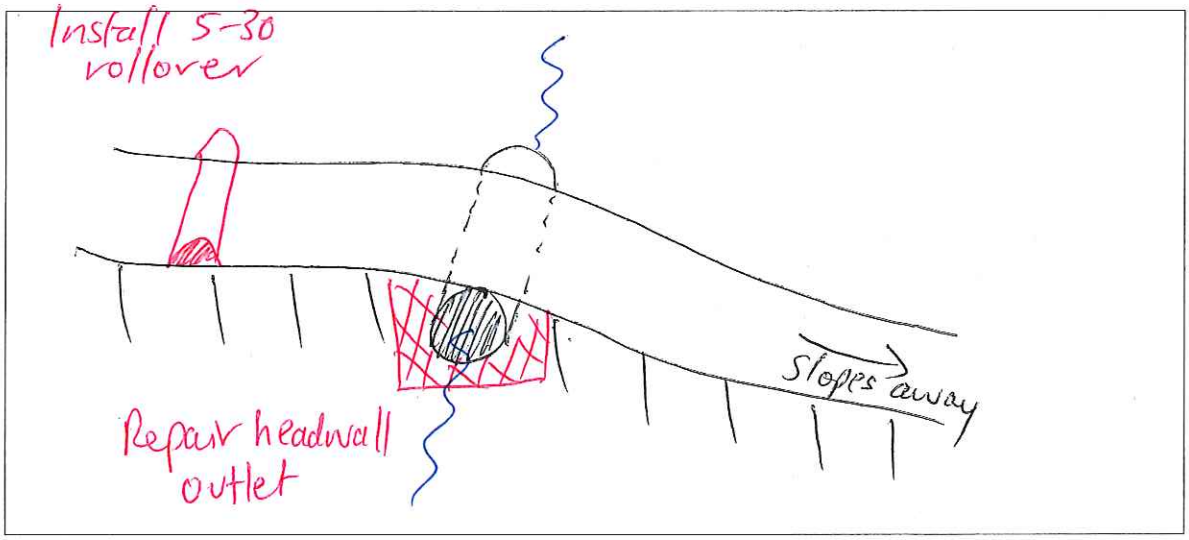
Date	Event	Initial

Crossing Name M **Road Name** Mirum Creek Road **Location** 496853E 6654958N

Drainage Feature UDL **Stream Permanency** n

Existing Crossing	Size	Stability Status	Crossing Required	Size (mm/m	Future
culvert	750mm	stable	Existing	na	Permanent

Crossing Works		Approaches and Road Drainage	
Pavement/Structure	Existing gravel surface.	**Approaches**	Install 5-30m drain.
Reshape Bed/banks	n	**Temporary Drainage**	na
Disposal of Spoil	na	**5-30m Upstream Left**	rollover required
Inlet	ok	**5-30m Upstream Right**	na - down hill
Outlet	repair headwall	**Practices where no 5-30**	na
Stabilisation	na	**OutletControl**	natural vegetation
ErosionControl	Natural vegetation	**TableDrain**	ok



Start Date: Finish Date: Soil Stabilisation Date (must be within 5 days):

Date	Event	Initial

To be included in operational road works plan.

Crossing E design details from Bob Cooper (FNSW Forest Engineering Services)

Updated details 24/07/12.

After speaking with Ray today in relation to Star Ridge Road Telstra cable location centrally located in the roadway crossing at an approximate depth of 1.2m a 600mm pipe can be used in option 3 below in lieu of the box culvert to convey a 1 in 10 peak flow event. Furthermore the road pavement may be raised over the pipe as to provide sufficient pipe cover and to provide an armoured swale for flows in excess of the designed discharge beyond a 1in 10 event.

Details from Bob Cooper email 12/07/12.

In response to site visit and inspection carried out at crossing E compartment 614 on Star Ridge Road and subsequent correspondence in regards to pipe culvert sizing, three options are presented below for your consideration to address additional drainage capacity requirement under FNSW licence agreement for this order crossing to withstand a 1 in 10 storm event.

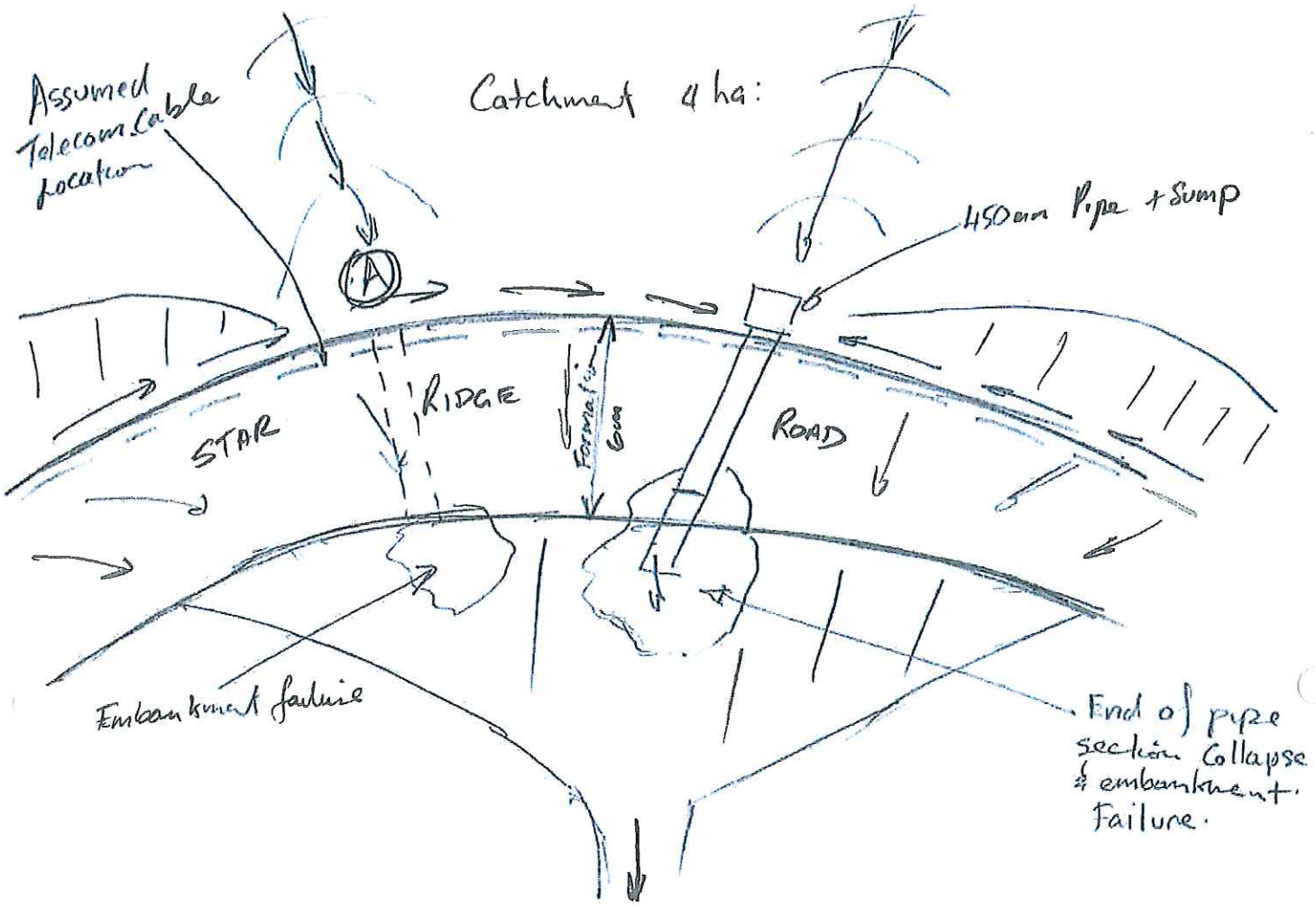
During inspection it was evident that the crossing had been overtopped which caused embankment scouring and a pipe section dislodgement on the downstream side of a fill embankment of approximately 3m in height within an incised drainage channel. Using the corporate modified rational method (MRM), FES Version August 2004 and input data supplied, calculations indicate that the current 450mm pipe will suffice for a 1 in 2 year peak flow of 0.3m^3 /sec and falls well short of the 0.57m^3 /sec required for a 1 in 5 year event.

Using the corporate MRM (FES Version August 2004) it appears there are three economical options that can be considered for Crossing E, Compartment 614, Orara West SF as listed below. Each option will need to be considered from a practically and cost point of view, given the location and location of a telecommunication cable in the upstream roadway shoulder of unknown depth. On all crossings the downstream embankment will need to be stabilised with a large rock toe wall at the base of the embankment and embankment slope reconstruction with geogrid layering at 600mm compacted lifts similar to that of other embankment stabilisation procedures successfully carried out in the region. Batter face is to be protected with geoweb matting filled with rubble (or similar product or technique) to protect batter face in the event of overtopping.

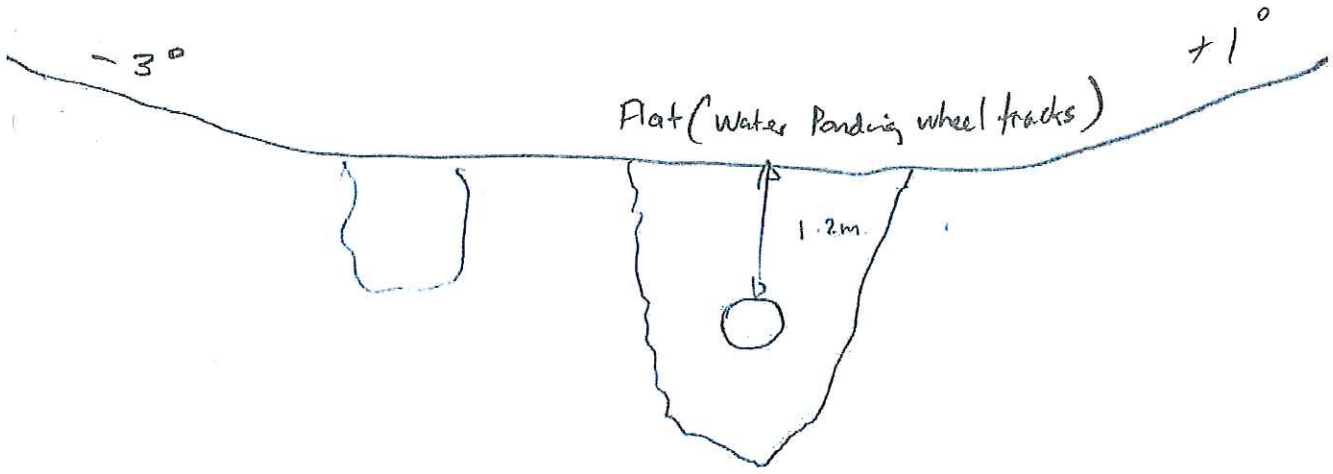
Option 1 – Replace existing 450mm pipe with a 600mm pipe in order to convey a 1 in 5 peak flow (0.6m^3 /sec flow) and provide an armoured level roadway section at least 5m wide to withstand a 1 in 10 peak flow (depth of water over the roadway 150mm for 0.47m^3 /sec).

Option 2 – Retain existing 450mm pipe (0.3m^3 /sec), restore end section, headwall and dropdown drain and install a second 450mm at cut /fill interface at crossing approach (0.3m^3 /sec) to convey 0.57m^3 /sec for 1 in 5 y event. The invert of this pipe can be 100mm lower than the overt of the existing pipe. This may assist in avoiding cable, however recommended manufacture pipe cover for loads on pipe class should be adhered to. Again with option a 5m level roadway section between the pipes will be required to cater for a 0.95m^3 /sec or 1 in 10y event.

Option 3 - Retain existing 450mm pipe (0.3m^3 /sec), restore end section, headwall and dropdown. Install a 900 x 450mm box culvert with precast base at cut /fill interface at crossing approach (0.65m^3 /sec) which in conjunction with 450mm pipe will contain a 1 in 10y event. Apart from the culvert capacity the advantage of a box culvert is the excavation depth of 600mm for the base and culvert which may be above cable depth. Only 100mm of pavement is required to protect the surface of the culvert.



CROSSING E – BOB COOPER DIAGRAM



Long section –