ESTABLISHMENT GUIDELINES FOR KARRI FOREST REGENERATION FOLLOWING HARVESTING

CONTENTS:

1. SCOPE

This guideline deals with the regeneration of the Karri forest following the final harvesting of the existing stand. The methods by which the forest is harvested are discussed in Silvicultural Guideline 2/95 'Silvicultural Practice in the Karri Forest'.

This specification should be read in conjunction with the above Silvicultural Guideline as well as Silvicultural Guideline 1/90 'Karri Regeneration Surveys'.

2. INTRODUCTION

Karri regenerates only from seed, and successful germination and growth of seedlings depends on seed falling onto recently exposed mineral soil following the removal of the overstorey canopy. It is important that the site is free of competing understorey vegetation to allow the opportunity for karri seeds to become successfully established. Exposure of mineral soil may be achieved by fire or by mechanical disturbance.

3. METHODS OF REGENERATION

There are three methods by which regeneration of the karri forest following final harvesting may be achieved. These are:

- retention of seed trees to provide for natural seed fall;
- artificial seed spread;
- planting of nursery raised seedlings.

The favoured option for regeneration is by natural seedfall from retained seed trees. This method cannot be relied on however, to achieve regeneration in all coupes harvested in any one year. Natural karri seed cycles are irregular, and adequate seed to achieve successful regeneration by seed trees is usually restricted to about 1 year in every 5.

As harvesting of the karri forest is ongoing, relying on naturally available seed from seed trees would involve delaying regeneration of harvested coupes until adequate seed was available. This would result in unacceptable delays in regeneration of the forest, large accumulations of fuel, a resultant fire hazard, sub-optimum fuel conditions for regeneration burning and a large regeneration program in any one year which would be difficult to achieve with available resources.

To overcome these problems and provide for an annual regeneration program the artificial regeneration methods of planting or seeding are used to augment the use of seed trees.

The artificial spreading of seed is preferred to the planting of nursery raised seedlings, but the application of this method on any large scale is limited by the availability of seed. Broadcast seeding uses 15 times more seed per hectare than raising the required number of seedlings in the nursery to plant a similar area. Planting is therefore a much more conservative use of a scarce resource.

4. REGENERATION STOCKING

High initial stocking of seedlings is required to restrict branch size, promote clean branch abscission and provide for clean bole development. Limited data and observation suggests that there may not be much improvement in bole length beyond 3000 spha. Stocking rates of less than 1666 stems per hectare will not provide adequate stocking of crop trees with acceptable bole length at first thinning.

Three stocking level categories based on the above are recognised. These are:

- *Optimal stocking* - that at which crop trees will develop the maximum possible clean bole length. Optimal stocking is identified as being 3000 spha or more.

- *Adequate stocking* - that at which crop trees will develop less than the maximum possible clean bole length, but still provide a full stocking of acceptable crop trees at first thinning. Adequate stocking is identified as being 1666-3000 spha.

- *Understocked* - that at which the bole length of crop trees at first thinning will be unacceptable. Understocking is identified as being less than 1666 spha.

The target stocking rates to be achieved following regeneration will be 85% of the regenerated area at (Optimal + Adequate), with no continuous areas at less than this stocking rate larger than 1 hectare.(see silvicultural specification 1/90)

5. REGENERATION BURNING

Irrespective of the method by which regeneration is achieved, fire is the principle means by which a suitable site for seedling establishment is created.

The objectives of burning are:

- to create maximum receptive seed bed;
- induce seed fall from seed trees;
- remove logging debris;
- achieve maximum burn Intensity consistent with control and safety.
- temporarily remove competition from the understorey.

Regeneration burning is the subject of separate guidelines Refer to Fire Protection Instructions No.46 'Slash Burning Prescription Preparation' and No.54 'Standards For Coupe Preparation For Karri Regeneration Burning'.

6. SITE PREPARATION REQUIREMENTS

Harvesting operations carried out during winter conditions using equipment with high ground pressures results in the mixing of soil horizons and soil compaction. Although soil damage in terms of the mixing of soil horizons is largely confined to major snig tracks and landings, soil compaction will occur on any part of a harvesting coupe traversed by machinery. This will seriously effect the ability of germinating seed to establish and reduce seedling growth.

To ameliorate this effect, all coupes harvested in winter must be ripped prior to establishing regeneration. This is to include all parts of the coupe traversed by machines.

Ripping is to be programmed following regeneration burning to ensure the maximum area is available free of harvesting debris. This operation may also involve rough heaping of debris where a high percentage of debris remains following the regeneration burn. Access requirements for other tasks such as planting must also be considered.

Ripping is not feasible where seed tree regeneration systems are used due to excessive debris being present prior to burning and limited opportunity after burning before seed fall. Therefore where harvesting to seed trees is considered harvesting is to be scheduled for the summer months. This minimises the risk of soil compaction occurring and negates the need for ripping of the site.

6.1. SPECIFICATIONS FOR SITE PREPARATION

6.1.1 Machine

Dozer, minimum flywheel 110 h.p., fitted with rake blade and ripping tyne capable of ripping to a depth of 0.5 metres.

6.1.2 Rough Heaping

Heaps to be as compact as possible. Where windrows are to be constructed they must have a 10 metre break every 40 metres to allow access by logging machinery in future harvesting operations. Heaps to exclude soil. Heaps to be reignited as required under suitable conditions.

6.1.3 Ripping

Where rough heaping is not required, logs and debris are to be pushed to one side back over ripped ground as the ripping operation progresses. This may be done either by the same machine as used for ripping, or by a separate machine used in tandem.

Ripping is to be carried out along the contour with a fall of no more than 5 metres in every 100 metres (3 degrees). Where it is considered that ripping may lead to problems with soil erosion it is recommended the first rip line be pegged using a dumpy level and further reference lines pegged every 150 metres.

Rip lines are to be 2 metres apart ripped to a depth of 0.5 metres. Ripping must be completed during dry soil conditions to ensure soil shatter is achieved and soil damage is avoided.

6.1.4 Access Tracks

Where regeneration is to be by planting ,temporary access tracks are required every 150 to 200 metres apart through the coupe. Access tracks are to be roughly constructed 3 metres wide and cleared of debris.

As these tracks will be planted as planting of the coupe progresses movement of topsoil is to be minimised. Access tracks are to be positioned to minimise the risk of erosion. Erosion control measures will be installed as per section 5 of the "*Timber Harvesting Manual in W.A.*"

7. REGENERATION METHOD

7.1 Choice

Priority is to be given to achieving regeneration following harvesting through the use of seed trees. The goal is to achieve at least 30% of regeneration requirements per year by this method.

Seed forecasting of the karri forest according to Silvicultural Guideline 2/97 provides a precise guide as to the suitability of coupes to be harvested to seed trees. Every effort is to be made to schedule harvesting to allow full use of this regeneration method.

Where seed availability or other harvesting constraints exclude the use of seed trees as the regeneration method for proposed harvesting coupes, these coupes are to be scheduled for regeneration by either seeding or planting. Planting will be the usual option applied, although direct seeding will be applied to the extent of seed stocks available.

The goal is to fully regenerate all coupes within 2 years of harvesting being completed.

7.2 Seed Trees

Refer to Silvicultural Guideline 2/95, 'Silvicultural Practice in Karri Forests', for details.

7.3 Direct Seeding

Where this method of regeneration is considered the following requirements will be satisfied:

- Application rate is to be 45,000 viable karri seeds per hectare.
- Seed source is to be from the same karri zone as the coupe to which it is to be applied (see Appendix 1) .
- The seed is to be applied without pre treatment ie (pelleting).
- The seed is to be broadcast sown using cyclone seeders or a similar device. Seeders are to be calibrated to ensure seed application rate is accurate.
- Seed is to be bulked with sand as required.
- Spacing between seeder operators will be determined prior to seeding commencing to ensure at least a 1 metre overlap between seeding swathes.

Seed is to be sown only during March/April following site preparation but prior to the break of the season. It is of utmost importance that seed is applied before the first winter rains to achieve success. If this cannot be achieved for any coupe planned to be regenerated by direct seeding, then the coupe should be rescheduled for planting.

Seed should be obtained daily from the seed store, adequate for the days sowing. This will avoid inappropriate handling of large quantities of valuable seed and reduce the risk of failure through poor seed storage. At all times seed is to be handled carefully to avoid damage or loss.

Coupe selection for application of regeneration by direct seeding will be determined by the Southern Forests B.U. silvicultural officer.

7.4 Planting

Nursery procedures will aim to produce containerised karri seedlings to the following specifications:

- 150 to 300 mm in height.
- 2 mm or greater in diameter at soil level.
- single erect stem
- well developed root ball which allows seedling to be removed from tray with soil mass intact.

The planting season in the karri area is usually limited to the months of June and July, although suitable planting weather can occur in May or August in the Walpole/Northcliffe areas.

Before planting commences, the soil must be thoroughly moist (a clod of soil can be formed by squeezing in the hand) to a depth of 25 cm. An experienced officer should walk over the planting site and examine soil profile moisture before the decision to start planting is made.

Permission to commence planting, or to continue it after July 31st, must be obtained from the Southern Forests B.U. silvicultural officer.

Planting should cease during periods of no rainfall of more than 7 consecutive days in duration, particularly in early June.

At all times plants will be handled with due care to avoid damage.

Plants will be delivered to the field in an enclosed truck to avoid desiccation. Where possible no more than 3 days planting requirements of plants are to be delivered to any planting site in the field at any one time. This will avoid the risk of loss of plants through theft or environmental conditions.

Plant storage in the field is to be in an easily accessible site protected from exposure, particularly wind and sun. The site chosen must be out of view from roads regularly used by the public and industry, to minimise the risk of theft. Plants must be stored off all road surfaces so that plants are not inadvertently run over. Plants must not be stored in running water or in a position where flooding may occur.

If delays in planting have occurred, and plants stored in the field have been without rain for a period exceeding 2 days, arrangements must be made to water these plants.

The scheduling of plant deliveries to the field is to ensure that a minimum of plants are held in field storage dumps during weekends eg. (do not deliver 3 days planting requirement on a Friday).

Records of all plants delivered to the field from the nursery must be kept by the Districts to which the plants have been delivered.

Planting will be by means of a potti putki planting spear. Plants will be broken out of plant trays carefully to avoid damage to roots or shoots. Plant trays and liners are to be handled carefully and stacked neatly at the plant dump for later pickup.

Unacceptable defects in plants are:
- multiple leaders;
- less than 100 mm in height;
- unthrifty (dead or part dead).

Trees exhibiting the above defects are to be discarded.

The planting rate will be 2200 spha unless otherwise specified. This equates to a spacing of 2 metres by 2.2 metres.

During the planting of seedlings the following requirements must be adhered to:
- avoid planting in straight rows.
- aim to position plants immediately on the edges of rip lines where possible.
- plants must not be planted closer than 1 metre to logs and stumps.
- Planting lines must not commence within 3 metres of the edge of any road.
- plants must be planted between 10 mm and 20 mm deeper than the nursery level.
- plants are to be heeled or toed in to remove air pockets from around roots and to ensure they are firmly positioned. (Plants should not be able to be removed from the soil when held firmly by the stem and a gentle lifting motion applied.)
- the stem of planted seedlings must be vertical or near vertical.

Regular checks of planting stocking rates must be completed. This must be done at least twice daily on each planting site. This will be done by random point sampling (see Appendix 2). Spacing will be altered as necessary to ensure the correct stocking is achieved.

Either during or at the end of the planting season all plant trays must be collected and returned to the nursery. All rubbish eg. (tray liners) must be collected and disposed of appropriately.

8. FERTILISER APPLICATION

5 days prior to tree seedlings leaving the nursery they are to be given a fertiliser application of granular NPK-Blue at the rate of 0.15 grams per seedling (10 grams per tray). No fertiliser application is therefore necessary following planting in the field.

9. MIXED STANDS

Management of the regeneration process in these stands must consider the stocking status of jarrah regeneration. Where ground coppice is present and adequate harvesting should be programmed for dry soil to avoid the need for ripping. Regeneration burning intensity must be such that damage to ground coppice is minimised.

Where jarrah ground coppice is inadequate these considerations do not apply.

For regeneration requirements for mixed stands refer to page 8 of Silvicultural Guideline 2/95.

10. REGENERATION SURVEYS

For regeneration survey requirements refer to Silvicultural Guideline 1/90 'Karri Regeneration Surveys'.

11. INFILLING OF FAILED AREAS

All areas identified in initial establishment surveys as being unacceptably stocked with seedlings must be programmed for infill planting the following winter.

Areas identified for infill planting must be ripped during dry soil conditions to improve soil structure and remove developing understorey competition. Ripping specifications to be applied are as outlined in Section 6.1.3.

A regeneration survey is to be applied to all areas infilled to measure planting success in the summer following establishment.

12. ENVIRONMENTAL PROTECTION

All establishment operations will conform to requirements to minimise the spread of dieback disease. Requirements will have been documented in hygiene evaluations for roading and harvesting operations. The same constraints are to be applied to all establishment operations.

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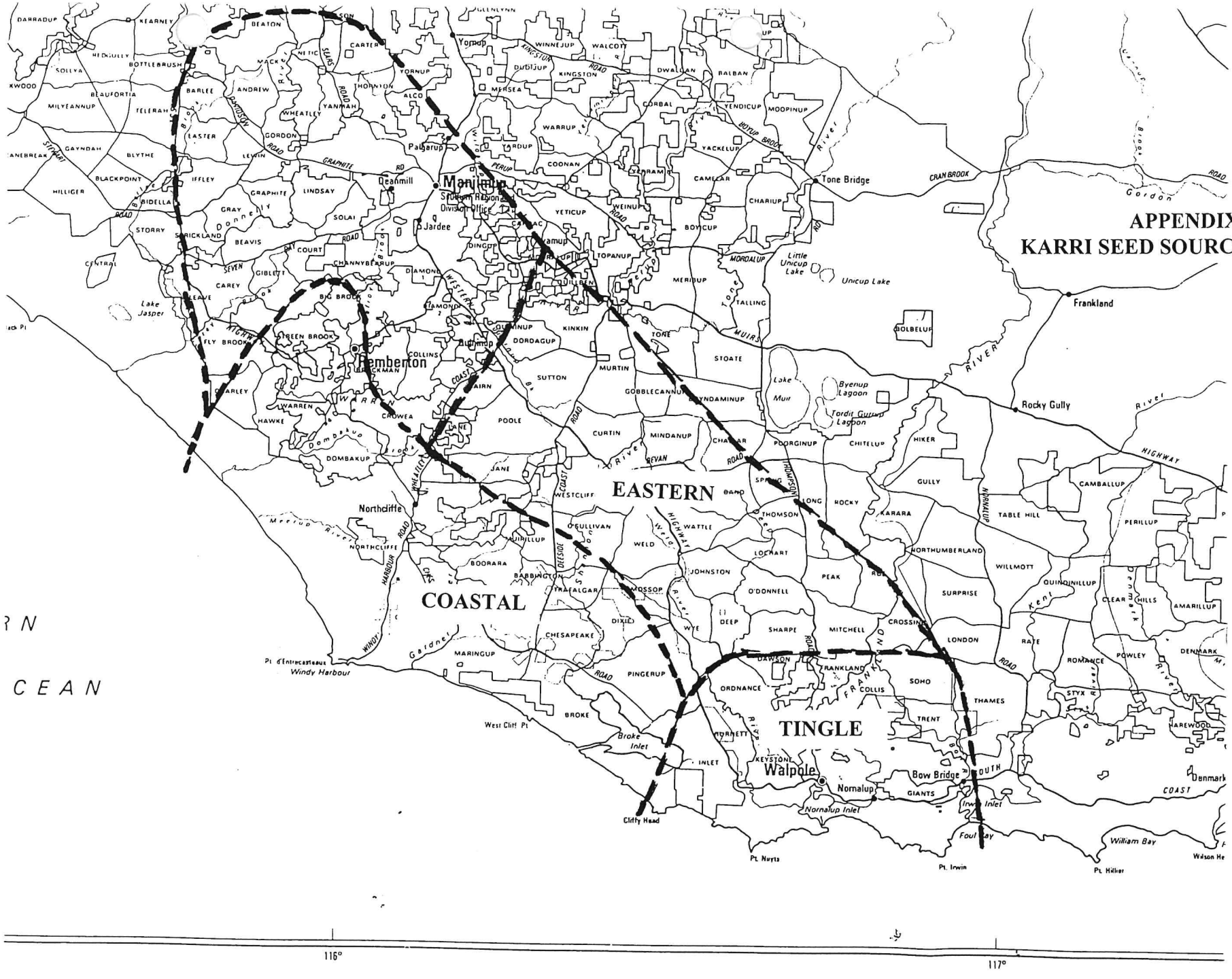
Hardwood Silviculturist S.F.R.B.U.

August 12, 1997.

APPENDIX 1
KARRI SEED SOURCE ZONE MAP



APPENDIX 2

STOCKING CONTROL CHART
MEAN & RANGE

PROCEDURE:

UWL - *Upper Warning Limit*
UCL - *Upper Control Limit*
LWL - *Lower Warning Limit*
LCL - *Lower Control Limit*

1. If plotted mean/range falls within the UWL and LWL lines, no action is required. Sample stocking and range is acceptable.

2. If plotted mean/range falls between UWL and UCL or between LWL and LCL, take another sample. If the sample stocking is still in the same range when re-sampled, take action to either increase or decrease stocking as necessary to achieve required 2200 stems / ha.

3. If plotted mean/range falls above the UCL or below LCL take action immediately to improve stocking or range outcome.

4. If a run or trend of 6 or more samples lies above or below the mean value, take action to improve stocking or range outcome.

5. If a run or trend of 6 or more samples is either rising or falling, take action to improve stocking or range outcome.

APPENDIX 2

(Part A)

DAILY WORKSHEET - STOCKING MEAN & RANGE

TEAM NAME: _____

DATE: _____ *COUPE ID:* _____

	SIDES			STOCKING	PLANTING QUALITY		
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
TOTAL							

RANGE

HIGHEST - LOWEST	
RANGE	

MEAN

TOTAL
MEAN = 10 =

ESTIMATION OF POINT DENSITY USING TRIANGLES

Example: 3 metres x 4 metres x 6 metres = Density of 937 spha.

Shortest Triangle Side *(metres)*

Longest Triangle Side *(metres)*

Remaining Triangle Side *(metres)*

Estimate of Point Density *(spha)*

3	3	4	5	6
3	1283	1118	1206	
4		899	833	937
5			699	668
6				574

1	1	1.5	2	2.5	3	4
1	11547	10079				
1.5		7071	6886			
2			5164	5264		
2.5				4082	4270	
3					3381	
4						2520

1.5	1.5	2	2.5	3	4	5
1.5	5132	4472	4824			
2		3596	3333	3750		
2.5			2795	2673		
3				2296	2616	
4					1697	2016

3	3	4	5
3	1283	1118	1206
4		899	833

2.5	2.5	3	4	5	6
2.5	1848	1667	1667		
3		1467	1335	1755	
4			1053	1010	1377
5				826	815

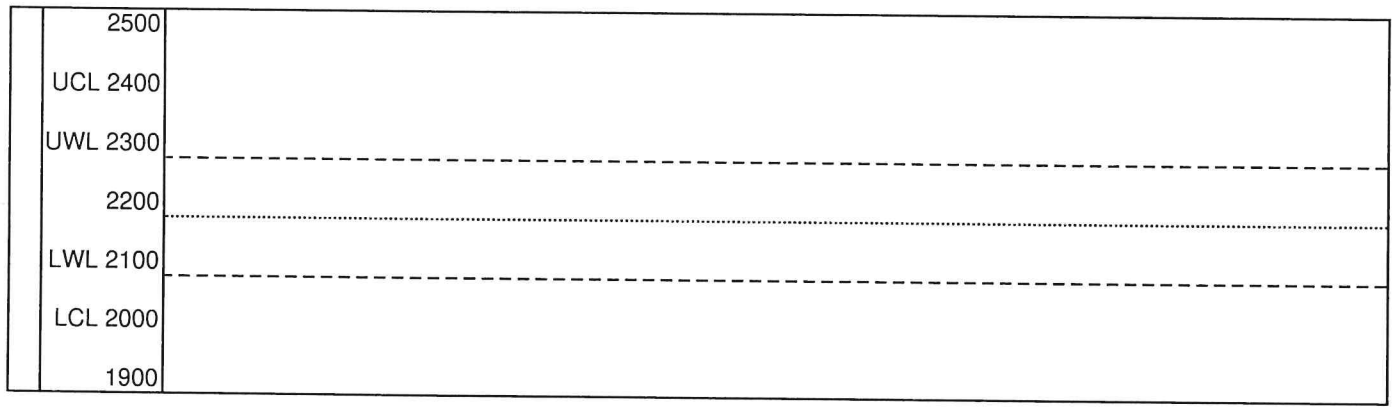
2	2	2.5	3	4	5	6
2	2887	2562	2520			
2.5		2182	2016	2445		
3			1768	1721		
4				1291	1316	
5					1020	1068

APPENDIX 2
(Part B)

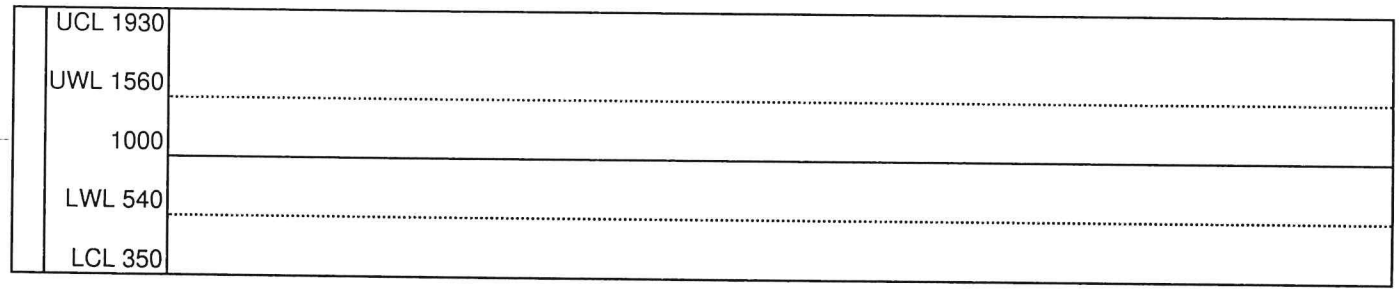
STOCKING CONTROL CHART - MEAN & RANGE

TEAM NAME: _____

MEAN



RANGE



DATE										
RANGE										
MEAN										