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Moisture variation in dried hardwood timber

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Moisture Variation in
Dried Hardwood Timber

Prepared for the

Forest & Wood Products
Research & Development Corporation

by

A. Redman

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Introduction

This was a joint project of the Timber Research Unit (TRU) of the University of Tasmania and the Queensland Forest Research Institute (QFRI). It was supported by the Tasmanian Forests and Forest Industry Council (FFIC), and many of Australia's major hardwood producers including Hume and Kerrison, Hyne & Son, Clennett Timbers, Hurfords Hardwoods and J. Notaras & Sons.

This project was nominated by the Australian hardwood timber industry and therefore demonstrates that the desired outcomes should be directly beneficial to this sector. The focus of the Australian hardwood timber industry is currently moving from producing predominantly structural grade products to appearance grade products. This is due to increased demand for appearance grade timber for products such as flooring and furniture, increasing competition in the structural timber market from softwoods and non-timber products and expanding export markets.

The objectives of this project were to:

1. Understand why moisture gradients occur in Australian hardwoods during drying and their affects on the performance of timber in service;

2. Improve existing technology(ies) and/or processes to reduce moisture content (MC) variability between and within boards during drying of Australian hardwoods in an economical and practical manner.

The equilibrium moisture content (EMC) tolerances for appearance grade timbers are more demanding than those for structural grade timbers due to performance requirements, as is reflected in the grade quality requirements. Varying MC within and between pieces leads to problems in timber utilisation, mainly through shrinkage and instability. Eucalypts are regarded as being notorious for exhibiting problems with MC variation and this problem is a significant threat to the successful marketing of Australian hardwoods in markets such as flooring, joinery and furniture. Additionally, problems with MC variation are regarded as a serious impediment to the drying of hardwoods.

Anecdotally it is reported that the problems are more pronounced in younger plantation and regrowth material. Increasing pressure to produce appearance grade products, where there is reduced tolerance of moisture variation in the relevant standards, compounds the problem. As a direct result of this, the increased incidence of MC related problems in the marketplace has in turn led to an increase in the number of consumer claims against timber processors. Additionally, moisture variation in hardwood timber during drying increases production costs because of the longer kiln drying time required to produce more uniformly dried timber.

Therefore, the importance of identifying problematic species, establishing causal factors and their affect on service performance and investigation of potential economically viable solutions would be of great benefit to the current hardwood timber industry.

Originally this project had a two-year time span. However due to the unexpected nature of the results obtained the project has been terminated, after approximately one year, under unanimous agreement between FWPRDC, QFRI, TRU and other industry collaborators. The section of research covered in this document involves an intensive case study by QFRI at Hurfords Building Supplies Pty. Ltd. (NSW) to identify the cause of MC variation and its effect on the performance of timber in service. Additionally, dry stock appraisal studies were performed at Clennett Timber, Hume and Kerrison, Hurfords Building Supplies, Hyne & Son and J. Notaras & Sons mills.

Executive Summary

This project comprised two parts. The first involved an extensive study conducted at Hurfords Building Supplies sawmill to investigate the cause of the moisture variation problem. The second concerned the determination of the extent of the problem's occurrence through appraisals of randomly selected dried stock at various industrial hardwood sawmills.

The case study at Hurfords Building Supplies was performed predominately to examine appropriate variables of regrowth spotted gum (*E. maculata*) from the harvest site to the final dried product in order to obtain problematic material and thus establish the cause of the problem. The variables examined in this study were: coupe location; board location within a log; moisture content (MC) of boards before and after pre-drying; location of board within a stack; kiln airflow and temperature distribution during drying; and board length and sawn (growth ring) orientation. Each variable was considered a potential cause of the moisture variation problem. They were measured with the premise of determining if a correlation exists between any of the variables, and the final MC of problematic material selected at the end of the trial.

Initially, approximately 1350 100 × 25mm (nominal dimension) were sawn from a selection of logs from 4 different coupes. Approximately half of the boards contained templates adhered to their ends to identify their within log position. The boards were racked and left in the air-drying yard to dry to an average MC of 19%. The timber is usually dried to a lower average MC but it was believed that this higher MC would exacerbate the variation problem. The material was then kiln dried. Temperature and airflow tests at the stack face proved to be stable with little variation. After kiln drying and equalising to a target MC of 11%, the MC of each board was tested using a resistance type moisture meter.

Results at this stage revealed that MC values for the entire set of boards ranged from 8% to 16%. The 50 wettest, 50 driest and 50 boards with MCs closest to the target (control boards) were selected and tested for MC at 500mm intervals using the more accurate oven dry method (in accordance with AS/NZS 1080.1). This revealed the MC variation of the selected material to be even less, ranging from 9.2% to 12.8%. For the number of boards and associated variables used in this study these results, did not produce any problematic moisture variable material to be used for further research.

This second part of this project involved dry stock appraisals conducted at, Clennett Timber (Tas), Hume and Kerrison Pty. Ltd. (Tas), Hurfords Building Supplies Pty. Ltd. (NSW), J. Notaras & Sons Pty. Ltd. (NSW), Hyne & Son Pty. Ltd. (QLD). The two highest output volume species of timber were appraised for each sawmill, concentrating on high grade joinery and flooring material. The species investigated were *E. delegatensis, E. pilularis, E. regnans,* and *Corymbia maculata*.

The appraisals themselves involved measurements of both average MC and MC gradient from a subset (in accordance with AS/NZ 4787). Results from the dry stock appraisals indicated that a moisture variation problem did exist. Additionally, further questions have been raised relating drying practice to the problem, indicating that timber properties are not necessarily the underlining cause as initially believed.

As the results obtained from the mill study section of this research prevented further investigations, through consensus from the industry stakeholders, FWPRDC, University of Tasmania and QFRI, the project was terminated after approximately one year. The results from this study have however, broadened our knowledge of the moisture variation and have changed the scope for further investigations into the problem.

Contents

Chapter 1. Literature Review

The objective of timber drying, simply stated, is to remove moisture from a board as quickly as possible without an unacceptable amount of degrade. Inherent in the terms "moisture removal" is the concept of changing the moisture level from some initial, often variable, value to a lower level or range that is dictated by either standards or customer requirements. Generally, this end point moisture content value is specified to be within a certain range of values and is dictated by the atmospheric conditions of the end use location so that it is close to the equilibrium moisture content of the timber. Occasionally, problematic boards occur after drying which are wetter or drier than the average and which are not believed to be due to drying practices. Thus, a review of previous literature was conducted to explore potential reasons for the occurrence of this phenomenon.

Equilibrium Moisture Content (EMC) & EMC Charts

The equilibrium moisture content (EMC) of timber is the moisture content (MC), at which the timber neither gains nor loses moisture from the surrounding atmosphere. The EMC varies to some extent with seasonal changes and, for practical purposes, an EMC range is normally quoted for a particular locality. Subsequent shrinkage or expansion will be minimal when timber is used at a MC within the quoted EMC range (McNaught, 1987).

The atmospheric variables that affect the EMC of timber include: the surrounding temperature, relative humidity (RH) and atmospheric pressure. Of these, the one that has by far the largest influence is RH. RH is defined as a measure of the amount of water vapour in the air at any particular temperature, expressed as a percentage of the vapour that can be carried by the air when it is saturated at that temperature.

The term isotherm is defined as a graphical line or map connecting temperature to other variables. This data is often presented as a chart or table made up of a number of isotherms relating dry bulb temperature, wet bulb depression, RH and corresponding EMC values. The chart most commonly used in the timber industry in Australia was created by CSIRO and is presented in figure 1.1. It is also reproduced in Waterson (1997).

This chart has significant importance for the timber industry in terms of creating drying schedules and determining the best conditions to give end point MCs corresponding to atmospheric EMC conditions.

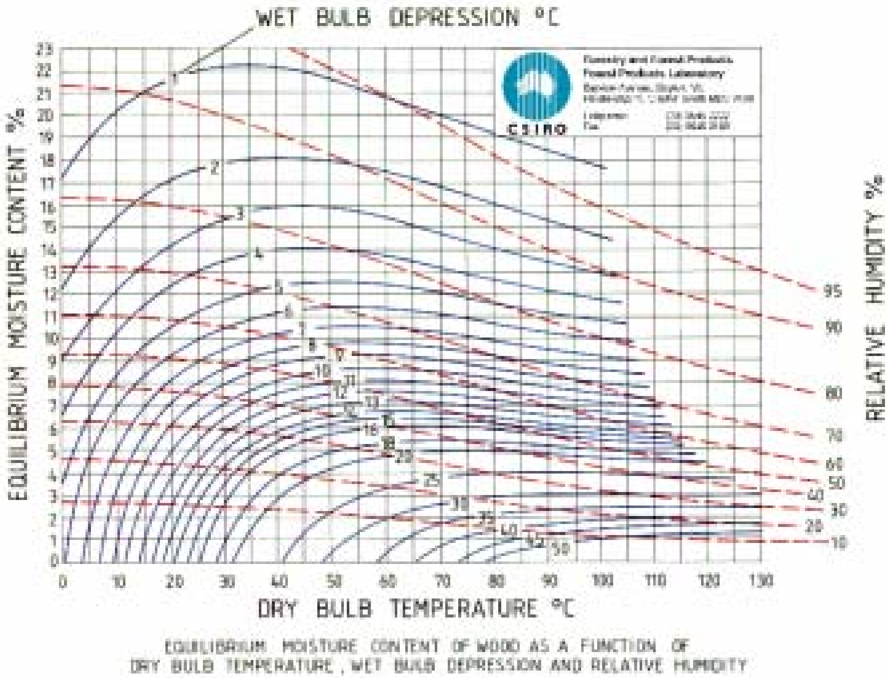


Figure 1.1 – Equilibrium Moisture Content (EMC) chart

Wood Hygroscopicity

The term hygroscopic describes a material's tendency to absorb moisture from the air. Wood, by nature, is hygroscopic as it is able to absorb (adsorption) and expel (desorption) water to the surrounding environment depending on atmospheric conditions. The following is an account of the interactions that take place between the wood substance and water during moisture flow.

The cell wall of wood microstructure is organised as a structural system involving filamentous microfibrils, mostly cellulosic and crystalline in composition, and orientated essentially in the direction of the longitudinal axis, embedded in an amorphous matrix of noncrystalline cellulose, hemicelluloses, and lignin (Wangaard, 1979). The molecules of the amorphous regions, primarily because of –OH groups in their structure, are all capable of forming hydrogen bonds. Unlike the close-packed cellulose chains in the crystal lattice within the microfibrils, they are accessible to water molecules through diffusion from the surrounding atmosphere. Water molecules themselves are highly susceptible to hydrogen bonding. The intermolecular hydrogen bond that develops between them when a water molecule approaches within 0.3 nm (Wangaard, 1979) of the attractive site on the polymer is the basis for the hygroscopicity of wood. The adsorbed water is "bound" to molecular surfaces within the polymer matrix which expands in proportion to the quantity of water adsorbed. The microfibrillar network is distended, and the wood swells.

The range of hygroscopic activity is limited to the range of equilibria between bound water and water vapour below the fibre saturation point. Above fibre saturation, the fully swollen cell wall can take up no more water. Consequently, at this point all MC change occurs through the addition or subtraction of "free" water held in the cell cavities.

Potential Causes and Theories Relating to moisture variation

A number of factors have been previously researched and related to the cause of moisture variation. Chafe (1991) states that factors which can affect the EMC of timber (as researched by others) include the desorption-adsorption hysteresis effect, temperature, previous drying history, stress, species and wood extractives. The following is an account of previous research regarding these factors. In addition, there are factors that do not affect the EMC but influence the drying rate of a particular board. These can cause affected boards to be at a different MC to others in a stack at the end of drying.

1.3.1. Moisture Sorption Hysteresis in Wood

The term hysteresis is derived from the Greek word hysterein, which means to "lag behind" (Skaar, 1979). The term was initially used to describe the observed lag in magnetisation of ferromagnetic material subjected to varying magnetic fields.

Hygroscopic materials such as wood also exhibit an analogous phenomenon to magnetic hysteresis, known as moisture sorption hysteresis. This refers to the lag or reduction in the sorption isotherm of EMC of wood against RH, compared with its EMC when it desorbs or loses moisture. Figures 1.2 and 1.3, respectively, show hypothetical adsorption and desorption isotherms and the approach to desorption and adsorption equilibrium with increasing time (figures extracted from Skaar, 1979).

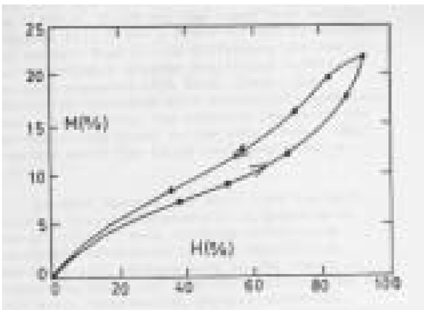


Figure A2 – Hysteresis- (Humidity)

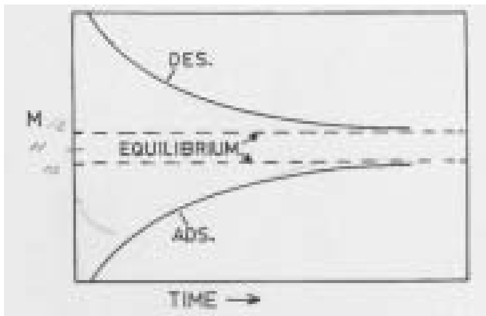


Figure A3 – Hysteresis (Time)

Kadir et al. (2001) studied the effect of different sample size and grain configuration on the EMC of red oak. Microtome slices and cross sections of increasing dimension parallel to the grain where sampled from both backsawn and quartersawn boards. The samples achieved constant weight in a steady state air environment of 43.3 °C dry bulb temperature and 84% RH. Matched batches were then created from the samples and one batch was desorbed from green while the other was adsorbed from the oven dry condition. Results showed a significant effect of sample type upon the EMC's. The greater the dimension of the cross section along the grain, the higher the desorption MC and the lower the adsorption MC. Back sawn cross sections consistently equilibrated to a higher MC for desorption than did quartersawn, while for adsorption the reverse was true. Microtome slices equilibrated to a higher MC for adsorption than for desorption. It was concluded that the overall results provide empirical evidence of stress relating to hysteresis.

Campean, Ispas et al. (1999) investigated adsorption/desorption hysteresis on a selection of timber species. The results of this study showed that the speed of desorption is much higher than for adsorption. The difference between the adsorption and desorption EMCs (hysteresis) differed between species. The highest value recorded was 10% MC (±5%) for beech.

1.3.2. Theories of Sorption Hysteresis

Several theories have been proposed for explaining sorption hysteresis. The following is a summary of these theories cited in Skaar (1979).

1.3.2.1. Capillary Theories

The earlier theories were based on the assumption that moisture sorption was primarily through capillary forces within the tiny interstices in the wood cell wall. The earliest capillary theory produced in 1911 postulated that hysteresis was caused primarily by the lower contact angle of water within these cell wall capillaries during adsorption rather than desorption. This theory was useful in explaining sorption hysteresis at high humidities but not at low humidities.

Another capillary theory was proposed in 1949 and termed the “ink bottle” theory. According to this theory, capillaries are not of even taper, but contain constrictions. During adsorption the capillaries will gradually fill from the smaller to the larger spaces. However, during desorption some of the water in the larger spaces between the narrower “bottlenecks” will tend to be trapped at lower vapour pressures, in equilibrium with those lower vapour pressures. Again this theory does not explain the sorption hysteresis occurring at lower humidities.

1.3.2.2. Sorption Site Availability Theory

This theory of sorption hysteresis is generally thought most accurate. It is based on the reduction in the availability of hydroxyl sorption sites in wood which is absorbing moisture after having been dried. These hydroxyl groups are believed to be the primary, though not necessarily the only, sorption sites for the attachment of water molecules in the accessible regions of the cell wall.

In green wood, according to this concept, the hydroxyl groups are attached to water molecules. When the wood dries some of the hydroxyl groups are freed from the attached water molecules and mutually bond to each other as they draw closer due to shrinkage. When water is regained or adsorbed, some of the hydroxyl groups are no longer easily available to bond with water molecules. This results in less adsorption of water at a given humidity compared with the initial desorption.

As humidity increases still further, and additional water is taken up, the swelling pressures tend to break some of the hydroxyl-hydroxyl bonds, freeing some but not all of the originally water bonded hydroxyl groups or sorption sites. These are then available to be rehydrated or to absorb water molecules. During subsequent or secondary desorption the EMC is therefore higher than for absorption. However, it is generally lower than during initial desorption from the green condition, particularly at higher humidities, presumably because some of the bonds, which formed between hydroxyl groups during initial desorption, are not broken. The process repeats itself during subsequent cycling of the relative humidity, forming a more or less repetitive hysteresis loop.

1.3.2.3. Thermodynamic Hysteresis Theory

The previous theories for describing sorption hysteresis are mechanistic as they postulate one or more specific mechanisms. The Thermodynamic Hysteresis Theory is a more general theory based on thermodynamic considerations only.

It is common knowledge that wood and other hygroscopic materials exhibit plastic or inelastic behaviour when subjected to mechanical stresses. This behaviour results in the familiar hysteresis loop in the stress-strain diagram of wood and other completely inelastic materials. The thermodynamic hysteresis theory builds on the above concepts, where the hysteresis is explained as being caused by stress effects on the sorption isotherms of hygroscopic materials such as wood.

1.3.3. Extractives

Extractives are intermediate between wood substance and water in molecular weight and range widely in water solubility and volatility. In terms of their action in, or influence on sorption, extractives are difficult to classify as to being either adsorbent or adsorbate (an adsorbing substance or a substance that is adsorbed). Extractives complicate the drying, gluing and finishing of wood, however some timbers with a high extractive content are reported to be more durable and stable (Spalt, 1979). Spalt (1979) suggested that previous work uncovered extractive-related problems in the kiln drying of these woods, especially at higher kiln operating temperatures which are now coming into wider use.

1.3.3.1. Formation and Classification

The following has been summarised from Spalt (1979).

The formation of extractives is closely associated with the transition of sapwood to heartwood. Starch and sugars stored in xylem ray and parenchyma cells are believed to be the raw materials for extractive production. At the sapwood-heartwood boundary, starch and sugars disappear and respiration rates increase. As the heartwood is approached from the sapwood, dark coloured globules that have formed and migrated to the semi-permeable cell membrane appear in the ray cells. In obligate heartwood species (those subject to the following condition) the death and disappearance of the membrane enables the extractives to migrate from the ray cells into adjoining xylem cells where they are deposited in cell lumen and infiltrate pits and cell walls. Some of these substances undergo condensation reactions that increase their molecular weight and modify their solubility and mobility.

The extractives in wood that are found in the cell wall in the greatest quantities are the polyphenols. These are primarily lignans, stilbenes, flavanoids and tannins. These substances are biosynthesised and condensed along pathways similar to lignin, and seem to have much in common with the infiltration and molecular weight building processes that lead to lignification. Deposition of the extractives into intermolecular cell wall spaces occurs when the cell wall is highly dispersed by water. Upon subsequent drying when cell wall density, strength and stability are developed, the non-volatile extractives remain as a permanent adsorbate that retains the cell wall in a partially swollen state. This phenomenon has been commonly labelled as bulking of the cell wall.

1.3.3.2. Effects of Extractives on Timber Properties

Previous research has shown that extractives can dramatically affect the water-vapour sorption of wood.

The role of extractives in monomolecular sorption was presented by Soriano and Evans (1997). It was stated that in sorption and shrinkage studies of six Argentine woods, two species namely: *Schinopsis balansae* (Quebracho colorado santiagueno) and *Hymenaea courbaril* (Algarrobo blanco) were observed to have relatively low EMCs at 97% RH. It was found that high tannin contents displace void volume in wood, resulting in low EMCs. This indicated that in this case the extractives occupied bonding sites usually occupied by water, thus have a bulking effect.

Similarly studies have shown that the fiber saturation point of once-dried black walnut decreased from 31% in the unextracted condition to 28% after removal of hot water-soluble exractives. This led to the conclusion that the extractives in black walnut are more hygroscopic than the cell wall and that water bound by extractives is absorbed to a greater extent than water in the cell walls. Soriano and Evans (1997) state, ‘In most sorption studies reported, differences in sorption behaviour are often attributed to the bulking effect and the hygroscopicity of extractives compared to other cell wall components. Furthermore the effect of extractives has been deduced from sorption isotherms fitted using known sorption equations based on the concept of continuous layering of sorbed water on active surfaces.' Theoretical studies of selective sorption, however, point out strongly that sorption of water is selective of sorption sites, and the progression of sorption with increasing RH remains selective as well.

All previous extractive versus EMC research, as cited by Spalt (1979), indicate a reduction in the EMC values of wood samples which have had a significant percentage of extractives removed compared with unextracted control samples. Various methods of extracting extractives were used including soaking in benzene alcohol, and flushing with hot or cold water.

Spalt (1979) also cited that extractive levels were generally inversely proportional to shrinkage levels. This can be attributed to the bulking nature of the extractives.

The extractive properties themselves can change with temperature and hence change the overall wood properties. For instance, at ambient temperatures extractives act as relatively benign low-volatile adsorbates in the cell wall which displace water in larger voids. At temperatures above approximately 50°C (Spalt, 1979), the extractives in moist wood appear to become more active absorbates that move in response to concentration gradients. In this way, they may participate in sorption and increase the overall shrinkage. As a mobile material, extractives may also serve to plasticise the cell wall, especially in desorption. The added plasticity may reduce warp related defects in kiln drying but may exacerbate collapse (Spalt, 1979).

1.3.4. Species

Predictions of the expected EMC for timber are frequently made by reference to published EMC charts for relative humidity versus temperature, which often give values founded on amalgamated data for a number of species. When applying such charts to specific species, discrepancies can be substantial (Ahmet, Dai et al., 1999).

Ahmet, Dai et al. (1999) previously demonstrated that the EMC for a wide range of species, conditioned in the same environment, could vary substantially. As an example, in one investigation MCs spanned 12.8 to 21% after conditioning at 85% relative humidity, at a temperature of 20°C.

Ahmet, Dai et al. (1999) produced individual sets of EMC values for three commercially important species for interior use in the UK. The purpose of this work was to provide a powerful diagnostic tool for both specifiers and consumers in investigations of mis-supply or mismatching of MC and service conditions. As part of this experiment a pilot study was performed to investigate the following issues: 1) the effect of sample size on EMC for a given condition; 2) the influence of drying history on the final EMC; and 3) whether observable differences occur in the final EMC between samples conditioned in large commercial environmental cabinets and those conditioned in small-scale chambers containing saturated salt solutions.

The results of the pilot study indicated that systematic differences resulting from drying history (air and kiln drying) and sample size were observed. The differences in drying history were very small and not significant. The differences in EMC values in varying sample sizes was explained by the substantial differences in the ratio of surface area to sample volume. Inconsistencies between the commercial built chambers and the prototypes were negligible. The three species used in the preliminary experiments all showed consistent variations in EMC from the commonly used RH versus temperature chart over a range of RH used.

Wengert and Mitchell (1979) suggest that although the proportion of hemicellulose, holocelulose, and lignin may slightly influence the sorption behaviour between species, extractive levels cause much of the variation.

1.3.5. Stress

Previous research has shown that internal and external stresses can affect the MC of wood at equilibrium. Simpson (1971), by inducing either compressive or tensile forces in red oak samples proved conclusively that MC decreases when wood is compressed and increased when wood is subjected to tension. The rate of MC per unit stress was greater for specimens loaded in tension than those loaded in compression, and the effect of stress induced moisture change was more pronounced in the tangential direction than in the radial direction.

Stress effects are not necessarily confined to external stresses. Stresses can result from internal factors such as moisture gradients, which, if severe enough during drying will result in casehardened timber. Microscopic tissue anisotropy due to a) rays and differences between earlywood and latewood, b) fibril orientation differences in the S1 and S3 layers compared to the S2 layer, and c) interfibril bonds which limit swelling between fibril, also result in causing internal stresses.

1.3.6. Specific Gravity

Research conducted by Chafe (1991) show that a relationship also exists between wood specific gravity and EMC. An examination of wood blocks and thin sections of *Eucalyptus regnans* (mountain ash) showed that for each of three nominal EMC's (17%, 12%, 5%) actual MC was positively related to specific gravity.

1.3.7. Temperature

A number of researchers (as cited in Wengert and Mitchell, 1979) have reported the suppressive effect that exposure to high temperatures for lengthy periods of time has on wood EMC. Studies have been undertaken on the physical and mechanical properties of high temperature dried wood that indicate the reduction in EMC through high temperature drying is of the same magnitude. The reduction is approximately between 0.5 to 3 percent compared with conventional temperature kiln drying and between 1 to 5 percent when compared to air drying (Wengert and Mitchell, 1979). The magnitude of reduction is affected primarily by species, schedule, initial MC before equalisation and extractive content.

The most widely used explanation for the thermal reduced reduction in hyroscopicity is the hydrolysis reaction in the degradation of the hemicellulose that results in the reduction of sorption sites. Other explanations have been offered such as the MC reduction due to large drying stresses created during high temperature drying, or the hysteresis effect created in the high temperature kiln.

Kubinsky and Ifju (1974) studied the effect of steaming on wood properties of red oak. The material was converted into 24mm cubes and steamed at atmospheric pressure for various lengths of time, ranging from 1-1/2 to 96 hours. The steaming process lowered the EMC of the samples. This was attributed to a decreased bulking effect due to the reduction of extractive levels, and to a more mutual bonding of OH-groups.

1.3.8. Mechanical

Mechanical treatments refer to the mechanical breakdown of solid wood. As the wood is broken down, it becomes slightly more absorptive. This may be due to a mechanical breakdown of the crystallinity of the fibres (Wengert and Mitchell, 1979).

1.3.9. Chemical

Chemical treatments can affect wood and its sorption properties in many ways and by modifying the extractives and/or cellulose constituents.

1.3.10. Radiation

The effect of gamma radiation on Sitka spruce wood shows a distinct decrease in hygroscopicity (in the order of 1 to 2% with a radiation of 10^8 rads) (Paton and Hearmon, 1957).

Chapter 2. Mill Study

Introduction

An extensive study at Hurfords Building Supplies sawmill was conducted to investigate the cause of the moisture variation problem. According to the managers of Hurfords Building Supplies (NSW) Pty. Ltd., large variations in MC at equilibrium occur in regrowth spotted gum (*Corymbia maculata)* after final drying. Hurfords management believe the problem is not caused by poor practices or inadequate kiln control. They suggest that the problem is more likely to be a function of inherent properties of the resource and refer to examples of timber of the same species equilibrating to a final moisture content very different to other timbers of the same species. Minutes from discussions with Hurfords management are provided in Appendix A.

The case study at this mill was performed predominantly to examine appropriate variables of regrowth spotted gum, from the log to final dried product, in order to obtain problematic material and thus establish the cause (and extent) of the problem. The variables examined in this study were:

- Coupe location,
- board location within a log,
- MC of boards before and after pre-drying,
- MC of boards after kiln drying,
- location of board within a stack,
- Airflow and temperature distribution during kiln drying.
- Board length.
- Sawn orientation

Trial Methodology

Sourcing and Tagging of Logs

Forty-five regrowth spotted gum logs were segregated in the log yard into four groups pertaining to different coupe locations. The four locations were from surrounding areas of Northern NSW, namely: two coupes side by side at Woodburn, one coupe at Banyabba, and one coupe at Tarre/Kiwarrka.

Each log was cross cut into two to three billets depending on log quality and size. Operational staff at Hurfords, performed this task, as per their standard procedures.

Three logs from each group (twelve logs) were chosen for tagging with specially designed end tags used to determine board location within a log after processing. Each billet from each log was also tagged at both ends. These tags are made of paper and are adhered to clean-cut ends of logs using Boncrete™ glue. Care must be taken to ensure that the tags do not become wet during the curing of the glue, which takes approximately two days depending on weather conditions. The tags themselves contain a printed pattern of labelled concentric circles spaced 10mm apart with labelled radial lines spaced 10° apart (see figures 2.1 and 2.2). The tags are paired, having the same identification number but with different symbols (^ and @), so that the top end and butt end of the log/board, in relation to the tree, can be recognised. All labels and symbols are located on the template in such a way that each board sawn from the tagged logs are easily identified in terms of radial, tangential and longitudinal (in terms of top and butt) position, and specific log number. The templates were adhered to each log so that the centre of the concentric circles were placed over the pith and the 0° radial lines of the top and butt templates were orientated along the same longitudinal plane of the log.

Figure 2.1 - Log tags

Figure 2.2 - Tagged billets

The remaining logs billets were colour coded on each end using four different coloured spray paints denoting each of the four coupe locations (see figure 2.3).

Figure 2.3 - Colour tagged logs.

Sawing, Stacking and Pre-Air Dry Analysis

Each billet was converted into predominantly back sawn boards of nominal (does not include overcut) dimension 100 × 25mm using Hurford's standard log conversion procedures for the production of flooring boards. Flooring boards were targeted in this study for the following two reasons.

1. The occurrence of complaints concerning unacceptable variations in MC of this finished product is the greatest, and

2. The final stage of this study involves using a resistance type moisture meter to measure MC on one face of all of boards utilised leaving unsightly holes. Therefore the board face that has not been tested can be dressed as the top face and still be used for flooring. The ends of the billets were not docked during conversion in order to maintain the identity of the sawn boards via either the end tags, or coloured markings.

The boards were blocked packed off the green chain and were immunised (boron) against insect attack in a pressurised treatment vessel.

The boards were then stripped into four racks with approximate dimensions of 6m x 1.8m (wide) x 1m (high). The four racks consisted of a total of 1351 boards. During stripping each board was individually weighed (see figure 2.4) to extrapolate approximate initial average MC of each board from actual MC measurements conducted after kiln drying. Two sample boards (one each side) were included within each rack to monitor MC during kiln and air-drying in order to determine the transition between air and kiln drying and the kiln drying end point. During stripping each board was individually numbered and the position of each board within the stack was noted. The racks were stacked (see figure 2.5) and placed in the air-drying yard.

Figure 2.4 - Weighing boards during racking

Figure 2.5 - Completed stack ready for air-drying

Air Drying

The mill staff periodically monitored the sample board weights to determine when kiln drying should begin. In accordance with the air/kiln dry schedule, provided by Hurfords, this should occur when the average MC of the sample boards reaches approximately 15-20%. According to the Hurfords management greater variation in MC after final drying occurs when kiln drying begins at an average MC of 18-20%. Therefore, an MC value of 19% was chosen as the target air-drying end point MC, so as to exacerbate MC variation and provide an adequate number of samples for further analysis. After air-drying for approximately nine weeks, the material was deemed ready for kiln-drying based on the sample board MCs.

Before kiln drying each rack was de-stripped and approximately half of the boards were reweighed to determine MC after air-drying. Only half of the boards were weighed at this stage due to time constraints. As approximately half of the material consisted of template tagged boards and it was to be these boards that the most in-depth analysis was to be undertaken on they were targeted for weighing.. The boards were re-stripped to their original positions within each rack. The racks were restacked in the same order as used during air-drying (see figure 2.5) and placed in the kiln.

Kiln Drying

The kiln used was an Incomac™ conventional drying kiln. The entire charge consisted of four stacks, each stack consisting of four racks. The four stacks were orientated two deep × two wide. The kiln load consisted of the research stack plus three other air-dried stacks of similar spotted gum flooring material. Figures 2.6 and 2.7 show the kiln at various stages of loading.

Figure 2.6 - Research stack

Figure 2.7 - Full kiln charge

Prior to starting the kiln, air velocity uniformity was measured using an anemometer. The air velocity was set to 2m/s as determined by the kiln-drying schedule used by Hurfords. Over a 2-dimensional grid, the measurements were taken at various locations on one face of the research stack as air was expelled from this face. The measurements were taken at 7 evenly spaced locations in the horizontal direction and at 7 locations in the vertical direction, making a total of 49 measurements for each individual rack. Air velocity measurements were also taken between the stacks (bearer gluts).

A series of eight thermocouples were placed on one face of the stack 1.5m in from each end of each rack (see figure 2.8). This allowed real time measurements of temperature distribution vertically and horizontally at the stack face throughout the entire kiln drying process. The temperatures were measured at 15 minute intervals.

Figure 2.8 - Thermocouple

The kiln schedule used is given in table 2.1.

Table 2.1 - Kiln schedule

Time (hrs)	Temp (deg C)	RH%
2	35	60
3	40	60
5	45	60
7	50	60
9	50	57
11	55	57
17	56	53
29	60	52
41	60	49
65	65	43
105	65	35
106	63	45
107	63	58
108	63	64
110	63	68
114	65	73
132	65	70
144	55	68
150	52	65

After 105 hours, an equalisation period at an approximate EMC of 11% was performed for 45hours.

Identification of over dry and under dry timber after kiln drying

After kiln drying and subsequent equalisation (to 11% MC) was complete, the rack was de-stripped and every board tested for average MC. During this process a calibrated resistance type moisture meter was used to determine the average MC of each board. The measurements were taken at a point in the centre of each board at a depth of approximately 1/3 the thickness, in accordance with AS/NZ 4787:2001 –Timber-assessment of drying quality. Each board was re-weighed again for the purpose of extrapolating the MC of the boards before air and kiln drying using the previous board weights measured.

Over dry or under dry boards were then selected by the deviation of the average MCs from the expected EMC of the charge (11%). Fifty boards with the highest positive MC deviation and 50 boards with the lowest deviation were segregated from the original boards. Additionally 50 boards with the lowest level of MC deviation were segregated as control boards.

Finally, the selected boards were block stacked, wrapped in impermeable plastic and transported to Queensland Forestry Research Institute – Salisbury Research Centre, Queensland for further testing.

Testing of selected material

Each board selected was tested for average MC at varying positions along the length using the oven dry testing method, in accordance with AS/NZS 1080.1 – Methods of test – Timber-Moisture content. A 400mm length section was cut from the end of each board and discarded to negate the effects of end drying. Each board was then cut into 550mm length sections, a 25mm length sections was then cut from each end to calculate average MC using the oven dry method. The MC of each 500mm length section was calculated as the average MC of the two 25mm section cut from each end. Each 500mm length section was appropriately labelled with the original board number consecutively appended with a,b,c etc. As the original board length varied (dependent on the original billet size) differing numbers of 500mm length sections were produced from each board.

Additional board attributes were measured during board dissection, namely; original board length, sawing orientation (back sawn, quarter sawn or transitional) and centre reference point at top and butt ends of boards (originating from templated billets).

Each of the 500mm length sections were end coated with sealant and re-wrapped in impermeable plastic for further testing. However, due to the nature of the MC results obtained from the 25mm sections, further testing was terminated.

Results

2.3.1 Sawing, Stacking & Air Drying

Approximately the same volume of logs was sawn from each of the four coupe locations for the trial. Table 2.2 shows the percentage of boards from each location used in this trial. Both, the ratio of the total number of boards and the ratio of tagged boards (converted from tagged logs) are given.

Table 2.2

	Total Boards		Tagged Boards	
Coup	**# Boards**	**% Total**	**# Boards**	**% Total**
Woodburn1	154	12	117	23
Woodburn2	550	41	141	28
Banyabba	296	22	121	24
Tarre	332	25	124	25
Total	1332		503	

The data shows that relatively even proportions of tagged boards were included in this study, even though 41% of all of the boards used were from the Woodburn1 coupe and only 12% came from the Woodburn2 coupe. This was because the volume of timber converted from each coupe exceeded the amount required for the actual trial. When the material was racked, the most convenient material was removed form the block packs first and so material from the Woodburn1 coupe was predominantly left over. An exception to this rule was the tagged boards, which were all used, hence the even coupe proportions

The air drying phase of this trial took approximately 68 days. The initial and final average MC of the sample boards were 47.6% and 19.1%, respectively. The air drying period was slower than expected due to a two week period of constant rain.

The kiln drying process took approximately 6.25 days including equalisation.

2.3.2 Kiln Conditions

1.3.2.4. Air Velocity

The air velocity was set to 2m/s using the PC kiln control unit. Measurements were taken over a two-dimensional grid at various locations on one face of the research stack as air was expelled from this face.

The measurement results are given in appendix B, section B.2.1, where rack numbers are sequential, i.e. rack1 denotes the top rack (nearest the roof of the kiln), and rack 4 denotes the bottom rack. Table 2.3 contains the average air velocity values for each stack, the total average, maximum and minimum values recorded. Figures 2.9 - 2.12 graphically illustrate the air velocity measurements as a two-dimensional grid.

Table 2.3 - Air velocity results

	Average Air flow Values		
	Average	Minimum	Maximum
Rack1	1.8	1.3	2.3
Rack2	1.8	1.0	2.4
Rack3	1.9	1.5	2.6
Rack4	1.9	1.3	2.3
Total	1.8		

The average air velocity results for each rack are comparatively consistent with an average value of 1.8m/s over the entire rack face (excluding gluts). This is 10% below the set value of 2m/s but is very accurate for a kiln of this size.

The minimum and maximum values recorded seem to indicate quite large variations, however the air velocity maps (figures 2.9-2.12) show that the lower values recorded occur predominantly at the rack edges where baffling is rarely perfect. Overall the airflow results show good uniformity for each rack in both the horizontal and vertical directions.

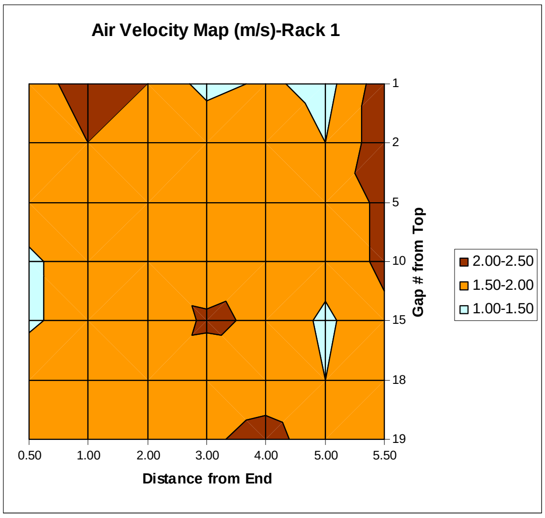


Figure 2.9 - Air Velocity Map Rack 1

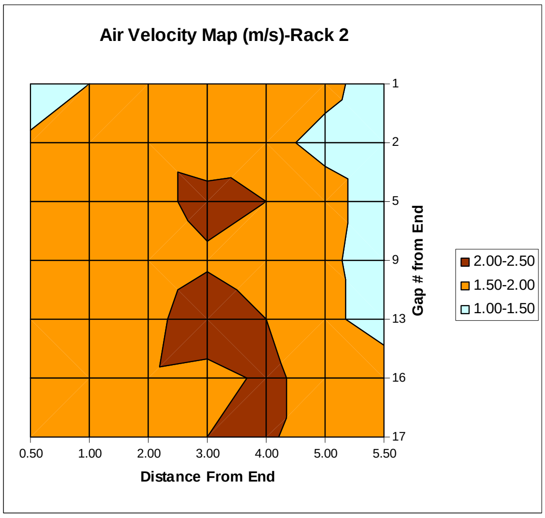
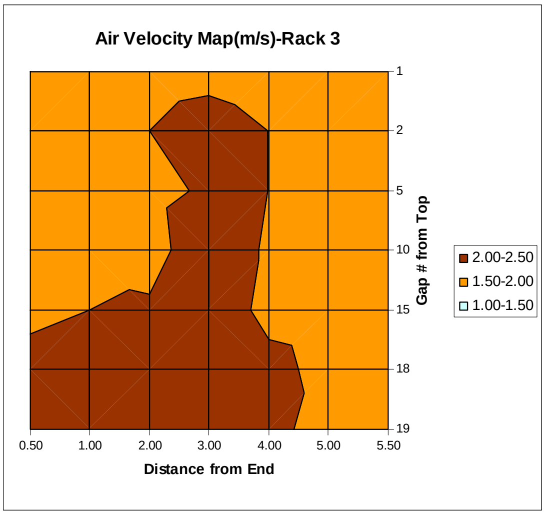


Figure 2.10 - Air Velocity Map Rack 2



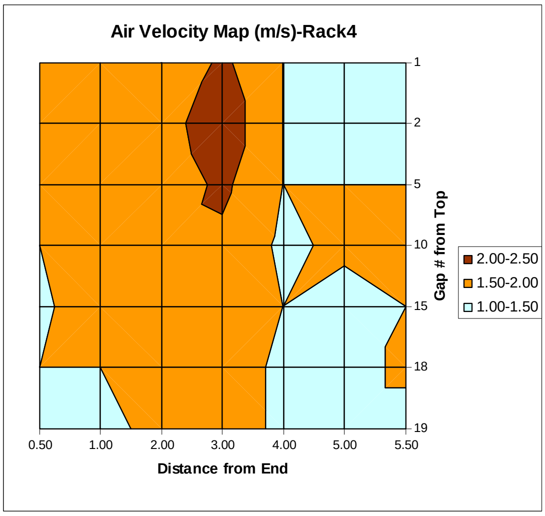


Figure 2.11 - Air Velocity Map Rack 3

Figure 2.12 - Air Velocity Map Rack 4

1.3.2.5. Temperature

Figure 2.13 is a temperature versus time graph of these real time thermocouple temperatures. Appendix B.2.2 contains the thermocouple data used to produce this graph.

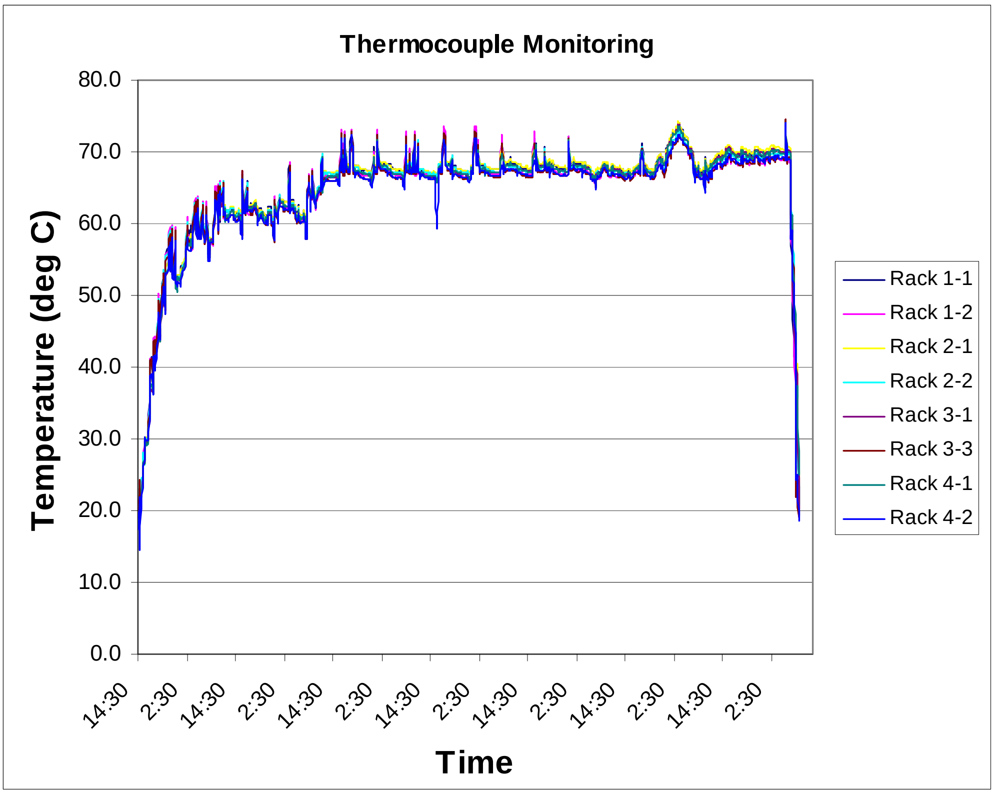


Figure 2.13 – Thermocouple temperature graph

The resulting graph indicates that the temperature variation through the research stack was consistent both vertically and horizontally. The maximum difference recorded between thermocouples was approximately 3°C. This is insignificant for a kiln of this size. The spikes shown on the graph represent either fan reversals or kiln openings during periodic measurement of sample board weights.

2.3.3 Moisture Content (Moisture Meter)

Using a calibrated resistance type moisture meter, the corrected (for temperature and species) MC of each board used in this study was measured. From these values, estimated initial and air-dry MCs of the boards were calculated. These values were calculated to observe if a correlation existed between, oven drv MCs calculated for the problematic selected material, and the estimated MCs of the same material before and after air-drying.

The estimated MCs of the boards were calculated using the following formulae 2.1 and 2.2.

Firstly the estimated oven dry weight of each board was calculated using,

$$W_{ode} = \frac{W_{kd} \times 100}{MC_m + 100} \qquad (2.1)$$

where W_{ode} = Estimated oven dry weight.

W_{kd} = Kiln dried final measured weight.

MC_m = Kiln dried moisture meter measured MC.

The initial and air dried estimated MC of the boards were calculated using,

$$MC_{i/a} = \left(\frac{W_{i/a} - W_{ode}}{W_{ode}} \right) \times 100 \qquad (2.2)$$

where $MC_{i/a}$ = Either initial of air dried moisture content.

$W_{i/a}$ = Either initial or air dried measured weight.

The estimated initial and air dried MCs, kiln dried moisture meter MCs, associated weights and corresponding coupe numbers for each board are given in appendix B.1. The coupe numbers 1 to 4 correspond to Woodburn1, Woodburn2, Banyabba, and Tarre/Kiwarrka coupes respectively. The average, minimum and maximum MCs were calculated from the initial air dried and final dried estimated MC data and is tabulated below (table 2.4).

Table 2.4 – Inital, air dried and final dried MC analysis

	Moisture Content (Whole Boards)		
	Initial	Pre-Kiln Post-Air	Final
Average	52.4	21.5	11.2
Maximum	85.8	28.7	16.0
Minimum	28.5	17.4	8.0

The maximum and minimum MC variation is reduced dramatically from the initial value of 57.2% to the air-dried (pre-kiln post-air) value of 11.3%. A further reduction is evident after final drying (8%).

The average final dried MC (11.2%) is close to the target MC (11%).

The maximum and minimum variation after drying was not as large as was desired in terms of the objective of this study. Only five boards (0.4% of total) had a measured MC below 9% and 3 boards above 15% MC (0.2% of total). In fact 96% of the boards had moisture contents in the range of 9 to 13%MC (± 2% of target MC).

A greater maximum/minimum MC variation was expected after kiln drying. Hurford's staff has previously measured greater variations (boards with MCs over 18% have been recorded).

3 Selected Material Testing (Oven Dry MC)

As detailed in section 2.2.5, 150 boards were selected for further testing. These boards consisted of the 50 wettest, 50 driest and 50 boards with a measured MC closest to the target MC (11%).

Each board was cut into 500mm sections such that a 25mm section was cut from each end for oven dry MC testing. The results of these tests are given in appendix B.3.1. The average MC of each 500mm section was calculated as the average of the two 25mm sections cut from each end. The average MC of each whole board was calculated as the average of the 500mm sections cut from that board. Table 2.5 summarises these results tabulating the average, maximum and minimum values for the whole volume of 25mm, 500mm and full length boards respectively.

Table 2.5 – Summary of oven dry test results

	Moisture Content Data		
	25mm Sections	500mm Sections	Whole Board
Average	10.6	10.6	10.6
Maximum	13.5	13.4	12.8
Minimum	7.9	8.5	9.2

The summary of results further emphasises the lack of problematic MC variable material obtained from this study. From the 150 boards selected 822 25mm sections were oven dry tested for MC. The range from this large selection of samples was minimal (7.9% to 13.5%). The maximum and minimum MCs for the whole boards ranged from 9.2 to 12.8%.

A low r^2 correlation of 0.41 was calculated between the average board oven dry MCs and the measured moisture meter MCs. This is illustrated in figure 2.1.4.

Additional board attributes were also measured during board dissection, namely; original board length, sawing orientation (back sawn, quarter sawn or transitional) and centre reference point at top and butt ends of boards originating from templated billets. These attributes were measured as potential variables to analyse their correlation against the existence of problematic material. However, as no problematic material was observed these attributes were not analysed. The data has been included in this report (see appendix B.3.2.).

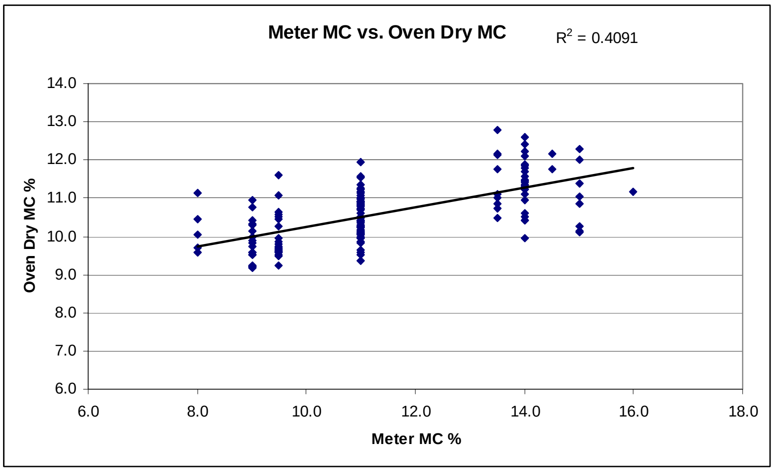


Figure 2.14 – Moisture meter MC vs. Oven dry MC

Conclusions

The main outcome from this study was the unexpected lack of material with undesirable final dry moisture contents. This was unexpected due to previous history at the site when drying this material using similar drying techniques. Exacerbation of problematic material through initialising kiln drying at higher than normal moisture contents did not occur. Given this and the large volume of material tested, from a production point of view, the results are exceptional.

An additional outcome from the mill study was the greater variation in MC readings obtained from the moisture meter compared with oven dry results. This is also emphasised by the low correlation observed between the two. It is common knowledge in the industry that moisture meters are not as accurate as the oven dry method for determining MC.

It should be noted that the kiln conditions, in terms of temperature and air-flow distribution, were also exceptionally stable with little variation. With this in mind and the lack of problematic material obtained, it can be theorised that the initial assumption that unacceptable variation in final moisture contents is a caused by variations in timber properties may only be partly true. Kiln performance and drying practice may also be factors causing the reported problem.

Although this section of work was prevented by the lack of obvious problematic material it is believed that by broadening the scope of this project could be continued in the future. The final section of this report (section 3.5) proposes recommendations toward furthering this study based on the results obtained throughout this report.

Chapter 3. Dry Stock Appraisals

Introduction

The dry stock appraisals were undertaken to determine the extent of moisture content variation through the inspection of randomly selected dried stock. The appraisals were conducted at various commercial hardwood sawmills which were collaborating in this project. The inspections were conducted at Clennett Timber (Tas), Hume and Kerrison Pty. Ltd. (Tas), Hurfords Building Supplies Pty. Ltd. (NSW), J. Notaras & Sons Pty. Ltd. (NSW), Hyne & Son Pty. Ltd. (QLD). At each mill, the two species that are processed to produce the highest volume of quality joinery or flooring sawn timber were appraised. As such, the species investigated were *Eucalyptus delegatensis, E. regnans, Corymbia maculata,and E. pilularis.*

It should be noted that due to the sensitive 'commercial in confidence' nature of the outcomes, the results are not linked to the commercial names of each sawmill. Rather, each sawmill is given a number from one to five (that does not correspond to the order given above). Additionally, species names are not given for each mill due to obvious geographical linkages.

The appraisals themselves involved measurement of MC average and gradient from a material subset. These two properties are the most relevant for investigating MC variation. The average MC is directly related to the desired target MC sought after drying. Additionally, the moisture gradient (difference in MC across a set distance of the case and core of a board) is important as it is linked to the MC variation through the thickness of a board.

Methodology

Dried stock appraisals were conducted in accordance with AS/NZS 4787:2001 – Timber – Assessment of drying quality.

Using this standard as a guide, assessment of average MC and MC gradient were investigated on dried stock to give drying quality class classifications for these two properties. It should be noted that to easily explain the procedures used, the following methodology section contains excerpts from the aforementioned standard.

Initial Information

In order to compare the quality of grade output the following information was obtained from the management of each participating site:

- What are the most common two species of dried quality stock with a cross sectional thickness not greater than 80mm (maximum thickness at which standard is valid) produced?
- What are the cross sectional dimensions of these products?
- What is your target final average MC for these products?

At each mill, after the initial questions were answered, sampling was undertaken on 25mm and 50mm thick rough sawn material, and 19mm thick dressed material of the target species, dependant on availability of stock.

Sampling

At each mill, forty boards of each species were tested for average MC and MC gradient. The boards were selected randomly from either dressed or rough sawn packed stock, so that five individual pieces were selected from each of eight packs. Where this was not possible, material was selected directly from the dry chain such that eight groups of five boards were selected leaving sufficient time between each group of boards to cover an approximate volume of one pack. The number of samples chosen was sufficient to cover all quality class groups (see section 3.2.4), as specified by AS/NZS 4787:2001.

Measurements

All measurements were taken at least 400mm from the end of a test piece. Additionally, the ambient air temperature where the packs were stored was measured before testing. The following summarises moisture content measuring procedures.

- ***Average Moisture Content***

The average MC was measured using an insulated electrode resistance type moisture meter (pre calibrated to Douglas Fir) at a depth of $^{1}/_{3}$ of the thickness of each test piece (denoted by $MC_{1/3}$).

- ***Moisture Content Gradient***

Assessment of MC gradient was carried out by successive MC measurements, on the same cross-section of each sample piece at two defined depths. The first reading was taken at a depth of $^{1}/_{6}$ the thickness or 5mm, whichever was the larger (denoted by $MC_{1/6}$). The second reading was taken at a depth of ½ the thickness of the test piece (denoted by $MC_{1/2}$).

All MC measurements were corrected for temperature and species in accordance with AS/NZS 1080.1 – Timber Methods of Test – Moisture Content.

Quality Class Specifications

In accordance with AS/NZS 4787:2001 drying quality class specifications can be made dependant on the results of the MC gradient and average MC measurements.

For average MC, 90% of samples must comply with moisture content tolerances from the target average MC (denoted by MC_t) as specified by the sawmill management.

Table 3.1 lists the allowable range and associated quality class for 90% of all MC readings around the target MC.

Table 3.1 – Moisture content quality class specifications

Quality class	Allowable deviation between measured moisture content ($MC_{1/3}$%) and target moisture content (MC_t%)				
	$MC_t = 8$	$MC_t = 10$	$MC_t = 12$	$MC_t = 14$	$MC_t = 18$
Class A	1	1	2	3	3
Class B	1	2	3	4	5
Class C	2	3	4	5	5
Class D	3	4	5	6	7
Class E	4	5	6	7	9

For MC gradients, 90% of samples must adhere to MC tolerances from case ($MC_{1/6}$) to core ($MC_{1/2}$).

Table 3.2 lists the maximum allowable deviation in MC between $MC_{1/2}$ and $MC_{1/6}$, by target MC and quality class.

Table 3.2 – Moisture gradient quality class specifications

Quality class	Allowable deviation between core ($MC_{1/2}$) and case($MC_{1/6}$) moisture content by target moisture content (MC_t%)				
	$MC_t = 8$	$MC_t = 10$	$MC_t = 12$	$MC_t = 14$	$MC_t = 18$
Class A	1	1	2	3	3
Class B	1	2	3	4	5
Class C	2	3	4	5	5
Class D	3	4	5	6	7
Class E	4	5	6	7	9

The quality class descriptions described in AS/NZS 4787:2001 are as follows:

Class A – caters for specific end uses and very specific requirements for drying quality;

Class B – applies where tight control over drying is required to limit 'in service' movement resulting from changes in equilibrium moisture content;

Class C – applies where higher drying quality is required and the final use environment is clearly defined;

Class D – applies when the final use environment is more clearly defined but again the drying quality requirements are not considered high; and

Class E – applies when the final use and drying quality requirements are not high.

Results

All measurements were conducted in accordance with the methodology (section 3.2). Table 3.3 summarises the dried stock quality assessment results for each sawmill. Contained in the table are the, species identification number (for some mills only one species was available for testing), thicknesses for each species, target moisture content, average MC grade quality class, and the MC gradient grade quality class (see 3.2 for description of class classifications). Full sets of results are included in appendix C**.**

Table 3.3 - Dried stock quality assessment results

	Site 1		**Site 2**		**Site 3**		**Site 4**		**Site 5**
Species	1	2	1	1	1	2	1	2	1
Thickness	19mm	19mm	25mm	50mm	19mm	19mm	19mm	19mm	25mm
Target MC (%)	12	10	12	12	10	10	10	10	12
Average MC Grade	B	A	C	Fail	B	B	B	B	A
MC Gradient Grade	A	A	B	C	B	B	A	A	D

In terms of the objective, the following results from each site are considered to be of importance:

Site 1: The resulting grade quality of the selected samples for this site (species 1 and 2) are high quality in terms of average MC and MC gradient. However sample number 7, species 1 (see C.1.1), had a moisture content value considered to be much higher or wetter than the other samples, which is a cause for concern. This sample would be viewed as being a problematic piece in terms of the scope of this project.

Site 2: For the 25mm material the average MC quality was poor (see C.2.1). This is because the majority of the board average MC values were higher than the target MC of 12%. This indicates insufficient drying to reach the target MC. Additionally, samples number 2, 11 and 18 (see C.2.1) have considerably higher average MC values than the other samples. Again these samples would be viewed as being problematic pieces.

The grade quality results for the 50mm material were very poor (see C.2.2). The average MC value for each board was well above the target MC of 12%, with 47.5% of boards failing to even receive a quality classification (greater than 6%MC above target). The average MC of all samples was 18.1%. This material had definitely not been dried for a long enough period to reach the desired target MC. Due to insufficient drying it is not possible to identify problematic moisture variable timber at this stage.

Site 3: In terms of average MC grade, there were no over or under dry boards measured (species 1 and 2). The grade quality in terms of average MC and MC gradient was high.

Site 4: In terms of average MC grade, there were no over or under dry boards measured (species 1 and 2). The grade quality in terms of average MC and MC gradient was high.

Site 5: In terms of average MC grade, there were no over or under dry boards measured. However, the MC gradient grade for the majority of these boards (see C.5.1) were average. A result such as this is a common indicator of material that has not been sufficiently equalised to EMC conditions after drying.

Note: In terms of MC gradient grade quality, sites 1, 3, and 4 performed better than sites 2 and 5. This may be affected by the thinner (19mm) dressed material tested at these sites. As MC gradients generally occur such that the surface of a board is drier than the core, obviously the MC gradient will be reduced when the surfaces of a board is dressed.

Conclusions

Through appraisals of randomly selected dried stock the extent of moisture content variation was examined at various commercial hardwood sawmills.

Although the series of appraisals were only taken on one day of production, from a random selection of material on a small cross-section of the Australian hardwood industry, the study has uncovered enough information to a) indicate that a problem does exist and b) a number of underlying issues are also in evidence. These underlying issues are predominantly concerned with drying practice. This second issue is relatively sensitive, and although a series of postulations leading to recommendations are included in these conclusions, this was not within the scope of this project and hence becomes an opportunity for further research (see section 3.5).

Analysis of data taken at sites 1 and 2 indicate the existence of small numbers of boards with average MCs much greater than other boards dried under the same conditions. The reasons for this are still yet unknown. The existence of this type of material is of great concern to the industry due to its potential to create problems between timber processors and their clients (and in application).

From the results given for sites 2 and 5 it is evident that the moisture variation/drying issue can easily be confused with issues pertaining to practice. The 50 mm material tested at site 2 specifically shows insufficient drying to the target MC. Reasons for this may be caused by; relying on MC resistance probes instead of using sample boards, incorrect use and/or using uncorrected moisture content readings of moisture meters, relying on time based drying schedules, kiln limitations, and storing material in wet climatic conditions after drying. Without further study however, only postulations can be considered at this stage.

The MC gradient quality of the material tested at site 5 was considered to be poor. The average MC quality for the same material however, was high. This seems to indicate insufficient equalisation at the end of the drying process. This is again a drying practice issue rather than an issue pertaining to timber properties.

Even though the results from the previous chapter did not produce the required results to continue this study, the results from the sawmill dry stock appraisals definitely indicate that the moisture variation problem, consisting of rogue wet material, does exist. Additionally, further questions have been raised relating drying best practice to this issue. The potential to identify the cause of this problem exists and further research is required, building on the scope of this project. Outlines containing further recommendations for continuing this study are given in the following section.

Recommendations for Future Work

At the time of writing this report the moisture variation issue still remains unresolved. This is due to unforseen circumstances governing the outcomes of the mill study (as detailed in Chapter Two). Results obtained in this chapter however, have given enough insight into the problem to continue this line of research in order to find a solution.

The dry stock appraisal survey has shown that the existence of the moisture variation problem may not be entirely caused by timber properties as first postulated. Rather, drying practice may also be a causal factor.

An outline of a future project to complete the research started in this project may be as follows:

1) Survey a greater number of sawmills throughout Australia to identify those that are experiencing problems with moisture content variation after final drying.

2) Perform on site investigations at sites that are experiencing the problem. This would involve personal interviews with site managers and staff. Additionally data measurement of air drying and kiln drying conditions including air velocity, humidity and temperature variation would also be conducted.

3) Obtain problematic material from these sites along with non-problematic control material, over a set time period, to compare timber properties. Timber property measurement could include, vessel frequency, lumen diameter, cell wall thickness, percentage of hemi-cellulose, extractive content (using both methanol + hot water extraction methods).

4) Perform stability measurements in a constant environment chamber on the material obtained from 2).

5) Provide economically feasible solutions to address the problem.

It is believed that this type of approach would not only guarantee that problematic material will be obtained for testing, but also the underlying best practice issue would be investigated.

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Appendices

- Appendix A. Survey Meeting Minutes at Hurfurds
- Appendix B. Mill Study Data
- Appendix C. Dry Stock Appraisal Data

[redacted]

Appendix A. Survey Meeting Minutes-Hurfords

Bob Engwirda is the manager of the dry mill at Hurford Hardwood – Lismore NSW. This is the site for the case study examination. The following is an account of an informal meeting held on 13/12/01.

In the past Bob has experienced problems with moisture variation particularly "wet wood" after kiln drying, predominantly with spotted gum and blackbutt.

The material is generally air dried first to below FSP and enters the kiln for final drying when the average moisture content of the material is between approximately 15% and 20%. Under his current schedule Bob states, 'at 15%MC the material usually takes approximately 5-6 days to dry and at 18-20%MC the material takes approximately 6-7 days to dry.

Bob has trialed higher temperatures during final drying to speed up the process. The drying times were faster, however the moisture variation problem was exacerbated. A greater proportion of under-drys were present. Less variation is currently present with the slower/colder drying schedules being used. Other observations conducted by Bob were:

a) moisture content variation seems to be worse for timber entering the kiln drying phase at higher average moisture contents (ie. 20% c/f. 15%),

b) by observation, a large proportion of wet wood boards are quarter/transitional sawn and/or exhibit comparatively closely packed (denser) growth rings,

c) the best method to reduce moisture variation is to over dry the material from the desired target MC to 8-9%, then steam to approximately to 13-14% before redrying at the same final conditions to 10%. Additionally, it was observed that the steaming treatment did not seem to effect the permeability (drying rate) of the material.

When sawing, Hurfords usually saw the same species for approximately 1 weeks to produce approximately 50-60 stacks of green boards. Air drying takes approximately 12 weeks and the kiln charge consists of 16 stacks. The stacks are orientated inside the kiln 4 high × 2 wide × 2 long

Graeme Palmer, was also present at this meeting, and suggested that drying at higher temperatures increases the transport rate of water movement exponentially with temperature so that the material that is more permeable will dry faster compared with the material of lower permeability. Hence a greater number of wet wood boards will be present at the end of drying.

Graeme also suggested a number of potential areas of research regarding this project as follows:

1) The variation trends of MC between boards has not yet been investigated when comparing the same boards at the end of air drying with those at the end of kiln drying.

2) Intermittent cyclic/humidity treatments during final drying.

3) Holding the material at a fixed EMC for a period of time towards the end of drying to equalise before drying is completed.

4) Drying schedule/Energy cost issue. Ie. would it be more cost effective to kiln dry at lower initial temperatures and a higher wet bulb depression initially when compared with current schedules?

Appendix B. Mill Study Data

A.1. Board weight, MC, and Coup Location Data

Board #	Pre-dry Weight (kg)	Calculated MC (%)	Pre-kiln Weight (kg)	MC Calculated (%)	Post-kilnWeight (kg)	Meter MC (%)	Predicted O.D.W. (kg)	Coup #
1	18.53	55.9	-	-	13.31	12	11.88	4
2	16.30	49.3	-	-	12.17	11.5	10.91	2
3	17.30	43.1	-	-	13.30	10	12.09	2
4	16.73	50.9	-	-	12.31	11	11.09	2
5	20.48	43.5	-	-	15.70	10	14.27	2
6	16.41	46.0	-	-	12.36	10	11.24	2
7	16.81	51.6	-	-	12.31	11	11.09	2
8	16.80	48.6	-	-	12.44	10	11.31	2
9	17.01	48.5	-	-	12.60	10	11.45	2
10	16.03	49.3	-	-	11.81	10	10.74	2
11	17.53	52.1	-	-	12.79	11	11.52	2
12	16.96	57.5	-	-	12.06	12	10.77	2
13	20.54	56.4	-	-	14.45	10	13.14	2
14	19.93	57.7	-	-	14.15	12	12.63	2
15	16.99	48.3	-	-	12.72	11	11.46	2
17	9.53	56.0	-	-	6.72	10	6.11	3
18	13.95	53.8	-	-	10.07	11	9.07	4
19	14.24	51.8	-	-	10.60	13	9.38	3
20	13.35	55.5	-	-	9.87	15	8.58	3
21	18.89	57.8	-	-	13.35	11.5	11.97	3
22	13.00	62.7	-	-	9.03	13	7.99	3
23	13.25	61.8	-	-	9.42	15	8.19	3
24	14.70	57.1	-	-	10.34	10.5	9.36	3
25	12.66	52.5	-	-	9.13	10	8.30	3
26	9.92	53.5	-	-	7.27	12.5	6.46	3
27	18.09	58.7	-	-	12.94	13.5	11.40	3
28	13.69	56.6	-	-	9.88	13	8.74	3
29	12.57	58.0	-	-	9.15	15	7.96	3
30	12.29	64.8	-	-	8.65	16	7.46	3
31	11.66	56.6	-	-	8.34	12	7.45	4
32	12.00	60.5	-	-	8.41	12.5	7.48	4
33	9.54	53.3	-	-	6.97	12	6.22	2
34	11.77	52.2	-	-	8.74	13	7.73	3
35	13.75	53.7	-	-	9.84	10	8.95	3
36	9.51	49.0	-	-	7.15	12	6.38	2
37	8.76	44.3	-	-	6.68	10	6.07	2
38	11.65	48.3	-	-	8.72	11	7.86	3
39	10.29	52.0	-	-	7.58	12	6.77	3
40	7.92	49.0	-	-	5.90	11	5.32	2
41	17.65	56.5	-	-	12.52	11	11.28	4
42	10.35	51.7	-	-	7.54	10.5	6.82	2
43	10.32	50.7	-	-	7.67	12	6.85	2
44	10.21	60.7	-	-	6.99	10	6.35	2
45	10.36	54.2	-	-	7.39	10	6.72	3
46	14.42	55.9	-	-	10.45	13	9.25	3
47	12.34	50.7	-	-	9.01	10	8.19	3
48	11.17	50.6	-	-	8.16	10	7.42	3
49	13.78	51.0	-	-	10.22	12	9.13	3
50	10.66	55.4	-	-	7.58	10.5	6.86	2
51	10.22	51.3	-	-	7.43	10	6.75	2
52	13.37	57.2	-	-	9.44	11	8.50	3
53	11.91	53.2	-	-	8.55	10	7.77	3
54	9.54	47.9	-	-	7.29	13	6.45	2
55	10.65	56.3	-	-	7.63	12	6.81	2
56	14.77	58.3	-	-	10.45	12	9.33	3
57	13.34	59.0	-	-	9.44	12.5	8.39	4
58	11.95	52.5	-	-	8.70	11	7.84	2
59	13.77	57.2	-	-	9.81	12	8.76	4
60	9.31	46.3	-	-	7.00	10	6.36	2
61	11.84	44.7	-	-	9.00	10	8.18	2
62	11.54	47.7	-	-	8.75	12	7.81	3
63	10.23	49.6	-	-	7.59	11	6.84	3
64	11.20	55.0	-	-	7.95	10	7.23	4
65	8.09	52.2	-	-	5.90	11	5.32	3
66	16.54	56.6	-	-	11.62	10	10.56	3
67	10.97	45.4	-	-	8.30	10	7.55	3
68	12.61	54.8	-	-	9.37	15	8.15	3
69	11.04	50.2	-	-	8.23	12	7.35	3
70	14.11	60.9	-	-	9.82	12	8.77	4
71	13.67	56.4	-	-	9.70	11	8.74	4
72	11.77	52.5	-	-	8.72	13	7.72	2
73	13.61	65.3	-	-	9.14	11	8.23	3
74	12.24	56.4	-	-	8.65	10.5	7.83	3
75	12.52	44.4	-	-	9.58	10.5	8.67	3
76	12.29	47.0	-	-	9.11	9	8.36	3
77	11.85	48.1	-	-	9.08	13.5	8.00	2
78	9.40	50.0	-	-	7.02	12	6.27	2
79	10.88	49.7	-	-	8.07	11	7.27	4
80	12.63	51.6	-	-	9.33	12	8.33	4
81	13.65	66.0	-	-	9.29	13	8.22	4
82	14.46	56.3	-	-	10.36	12	9.25	4
83	14.34	50.4	-	-	10.49	10	9.54	4
84	13.51	53.0	-	-	9.80	11	8.83	4
85	9.66	47.4	-	-	7.21	10	6.55	3
86	9.55	55.0	-	-	6.90	12	6.16	2
87	13.90	55.2	-	-	9.94	11	8.95	3
88	13.20	55.7	-	-	9.58	13	8.48	4
89	13.22	49.4	-	-	10.00	13	8.85	3
90	10.93	47.8	-	-	8.21	11	7.40	2
91	13.06	54.5	-	-	9.47	12	8.46	4
92	12.87	51.2	-	-	9.45	11	8.51	4
93	13.25	53.1	-	-	9.69	12	8.65	4
94	13.61	45.0	-	-	10.37	10.5	9.38	4
95	12.13	38.5	-	-	9.59	9.5	8.76	4
96	11.23	46.3	-	-	8.56	11.5	7.68	4
97	14.06	46.9	-	-	10.53	10	9.57	4
98	15.20	49.5	-	-	11.39	12	10.17	4
99	12.40	53.0	-	-	9.20	13.5	8.11	4
100	14.07	56.7	-	-	10.01	11.5	8.98	4
101	13.82	55.9	-	-	9.97	12.5	8.86	4
102	13.40	50.5	-	-	9.97	12	8.90	4
103	13.95	50.1	-	-	10.41	12	9.29	4
104	14.16	48.2	-	-	10.70	12	9.55	4
105	13.52	47.3	-	-	10.28	12	9.18	4
106	13.18	52.5	-	-	9.68	12	8.64	3
107	11.08	62.6	-	-	7.60	11.5	6.82	4
108	10.11	43.5	-	-	7.82	11	7.05	3
109	9.67	47.2	-	-	7.29	11	6.57	3
110	11.77	57.4	-	-	8.45	13	7.48	4
111	10.64	28.5	-	-	9.40	13.5	8.28	4
112	12.44	56.4	-	-	9.07	14	7.96	4
113	11.15	61.2	-	-	7.78	12.5	6.92	4
114	11.17	56.3	-	-	7.97	11.5	7.15	4
115	10.72	59.2	-	-	7.54	12	6.73	4
116	8.91	45.7	-	-	6.79	11	6.12	3
117	9.10	46.8	-	-	6.82	10	6.20	3
118	10.56	62.7	-	-	7.17	10.5	6.49	4
119	10.93	63.1	-	-	7.37	10	6.70	4
120	11.20	60.1	-	-	7.80	11.5	7.00	4
121	11.07	47.2	-	-	8.27	10	7.52	3
122	12.26	50.2	-	-	9.14	12	8.16	3
123	12.62	56.0	-	-	8.98	11	8.09	3
124	17.32	47.1	-	-	13.07	11	11.77	1
125	16.03	41.1	-	-	12.61	11	11.36	1
126	12.05	57.0	-	-	8.44	10	7.67	3
127	13.22	44.1	-	-	10.09	10	9.17	1
128	14.32	40.9	-	-	11.38	12	10.16	1
129	12.88	52.1	-	-	9.57	13	8.47	2
130	11.12	47.2	-	-	8.46	12	7.55	3
131	11.94	57.8	-	-	8.40	11	7.57	4
132	11.03	53.4	-	-	8.09	12.5	7.19	4
133	11.26	47.4	-	-	8.48	11	7.64	4
134	11.30	58.2	-	-	7.93	11	7.14	4
135	10.40	59.6	-	-	7.17	10	6.52	4
136	10.90	49.6	-	-	8.16	12	7.29	4
137	10.82	53.4	-	-	7.76	10	7.05	3
138	13.64	56.4	-	-	9.64	10.5	8.72	3
139	13.81	49.6	-	-	10.25	11	9.23	2

140	10.73	58.6	-	-	7.44	10	6.76	4
141	18.92	56.2	-	-	13.57	12	12.12	2
142	19.27	54.4	-	-	13.73	10	12.48	2
143	20.99	46.1	-	-	15.52	8	14.37	2
144	11.25	52.0	-	-	8.14	10	7.40	2
145	10.86	47.2	-	-	8.19	11	7.38	4
146	11.46	57.2	-	-	8.02	10	7.29	3
147	11.38	46.3	-	-	8.71	12	7.78	3
148	12.58	70.3	-	-	8.20	11	7.39	2
149	10.80	54.1	-	-	7.78	11	7.01	4
150	10.70	50.7	-	-	7.81	10	7.10	4
151	14.08	68.5	-	-	9.36	12	8.36	3
152	11.40	58.9	-	-	7.89	10	7.17	3
153	10.55	52.1	-	-	7.77	12	6.94	2
154	19.66	54.3	-	-	14.02	10	12.75	2
155	17.73	56.2	-	-	12.54	10.5	11.35	2
156	19.57	61.0	-	-	13.37	10	12.15	2
159	17.57	60.5	-	-	12.04	10	10.95	2
160	10.10	50.9	-	-	7.43	11	6.69	4
161	9.44	57.8	-	-	6.64	11	5.98	3
162	10.61	48.9	-	-	7.98	12	7.13	2
163	14.24	55.8	-	-	10.24	12	9.14	3
164	13.38	54.0	-	-	9.82	13	8.69	2
165	11.85	56.0	-	-	8.51	12	7.60	4
166	10.35	48.6	-	-	7.73	11	6.96	3
167	10.53	48.2	-	-	7.96	12	7.11	3
168	10.87	42.8	-	-	8.45	11	7.61	2
169	13.13	58.5	-	-	9.28	12	8.29	3
170	18.83	52.6	-	-	13.57	10	12.34	2
173	18.08	54.9	-	-	13.07	12	11.67	2
174	13.60	56.5	-	-	9.82	13	8.69	4
175	10.76	58.1	-	-	7.69	13	6.81	4
176	11.02	62.0	-	-	7.55	11	6.80	4
177	10.99	56.3	-	-	7.84	11.5	7.03	4
178	10.14	51.6	-	-	7.49	12	6.69	2
179	13.79	62.4	-	-	9.47	11.5	8.49	3
180	14.25	57.5	-	-	10.04	11	9.05	3
181	10.36	55.8	-	-	7.38	11	6.65	4
182	13.24	48.4	-	-	10.04	12.5	8.92	2
183	10.75	53.3	-	-	7.75	10.5	7.01	3
184	10.92	51.3	-	-	8.01	11	7.22	3
185	9.34	52.9	-	-	6.78	11	6.11	4
186	11.15	49.4	-	-	8.21	10	7.46	3
187	10.28	45.6	-	-	7.91	12	7.06	3
188	21.13	62.7	-	-	14.74	13.5	12.99	2
189	18.40	62.3	-	-	12.70	12	11.34	4
190	11.23	59.7	-	-	7.77	10.5	7.03	4
191	11.40	47.9	-	-	8.48	10	7.71	4
192	11.64	54.2	-	-	8.38	11	7.55	4
193	9.64	57.8	-	-	6.75	10.5	6.11	4
194	11.22	50.0	-	-	8.38	12	7.48	2
195	11.63	59.5	-	-	8.02	10	7.29	3
196	12.90	65.6	-	-	8.57	10	7.79	3
197	10.56	54.1	-	-	7.71	12.5	6.85	4
198	10.64	58.6	-	-	7.38	10	6.71	4
199	10.77	56.7	-	-	7.63	11	6.87	3
200	11.55	53.5	-	-	8.43	12	7.53	4
201	10.00	55.3	-	-	7.21	12	6.44	4
202	15.33	52.1	-	-	11.09	10	10.08	4
203	19.00	52.8	-	-	13.68	10	12.44	2
204	19.15	52.6	-	-	13.80	10	12.55	2
205	17.87	49.5	-	-	13.63	14	11.96	3
206	19.56	41.2	-	-	15.51	12	13.85	3
207	9.12	65.5	-	-	6.17	12	5.51	2
208	10.44	60.0	-	-	7.31	12	6.53	2
209	18.41	64.2	-	-	12.78	14	11.21	2
210	17.78	77.5	-	-	11.02	10	10.02	3
211	13.87	57.5	-	-	9.73	10.5	8.81	2
212	13.73	54.7	-	-	9.85	11	8.87	2
213	9.98	53.3	-	-	7.16	10	6.51	4
214	15.76	56.6	-	-	11.07	10	10.06	4
215	11.38	62.4	-	-	7.71	10	7.01	4
216	9.50	52.6	-	-	6.85	10	6.23	4

217	13.15	52.9	-	-	9.46	10	8.60	2
218	10.08	69.5	-	-	6.78	14	5.95	2
219	11.42	57.3	-	-	8.06	11	7.26	2
220	10.27	64.4	-	-	7.06	13	6.25	2
221	11.47	62.4	-	-	7.77	10	7.06	2
222	18.26	58.0	-	-	12.94	12	11.55	2
223	19.60	58.0	-	-	13.89	12	12.40	2
224	20.56	61.8	-	-	14.23	12	12.71	2
225	9.50	65.5	-	-	6.43	12	5.74	2
226	11.64	57.3	-	-	8.14	10	7.40	4
227	10.09	62.6	-	-	6.89	11	6.21	2
228	9.67	58.3	-	-	6.75	10.5	6.11	4
229	9.09	72.9	-	-	5.81	10.5	5.26	2
230	9.99	52.2	-	-	7.32	11.5	6.57	4
231	13.54	54.4	-	-	9.69	10.5	8.77	2
232	10.38	85.8	-	-	6.20	11	5.59	2
233	9.26	43.0	-	-	7.19	11	6.48	2
234	15.63	48.1	-	-	11.82	12	10.55	2
235	14.75	54.9	-	-	10.57	11	9.52	3
236	19.12	53.2	-	-	14.10	13	12.48	3
237	15.85	56.6	-	-	11.13	10	10.12	2
238	18.30	52.8	-	-	13.17	10	11.97	2
239	18.96	64.0	-	-	12.66	9.5	11.56	4
240	14.49	49.5	-	-	10.66	10	9.69	2
241	18.63	49.6	-	-	13.95	12	12.46	2
242	18.53	55.0	-	-	13.15	10	11.95	2
243	16.26	49.4	-	-	12.19	12	10.88	4
244	8.98	61.1	-	-	6.13	10	5.57	2
245	12.20	63.3	-	-	8.22	10	7.47	4
246	10.30	68.2	-	-	6.86	12	6.13	2
247	11.71	57.3	-	-	8.41	13	7.44	2
248	15.33	49.7	-	-	11.21	9.5	10.24	2
249	10.53	53.0	-	-	7.57	10	6.88	2
250	15.22	48.0	-	-	11.21	9	10.28	2
251	14.73	65.0	-	-	9.73	9	8.93	4
252	22.10	58.7	-	-	15.32	10	13.93	2
253	9.18	53.0	-	-	6.63	10.5	6.00	4
254	10.05	68.0	-	-	6.61	10.5	5.98	2
255	11.78	57.9	-	-	8.28	11	7.46	2
256	20.36	62.1	-	-	14.26	13.5	12.56	2
257	20.21	58.3	-	-	14.30	12	12.77	2
258	21.40	55.2	-	-	15.44	12	13.79	2
259	15.79	62.2	-	-	10.61	9	9.73	4
260	14.67	53.4	-	-	10.52	10	9.56	2
261	11.34	56.9	-	-	7.95	10	7.23	2
262	11.59	58.6	-	-	8.15	11.5	7.31	2
263	11.18	58.9	-	-	7.88	12	7.04	2
264	12.10	60.7	-	-	8.28	10	7.53	2
265	10.05	61.9	-	-	6.83	10	6.21	2
266	13.25	55.1	-	-	9.48	11	8.54	2
267	10.05	52.1	-	-	7.27	10	6.61	4
268	12.03	69.7	-	-	7.87	11	7.09	4
269	10.96	62.4	-	-	7.39	9.5	6.75	2
270	14.43	59.6	-	-	10.08	11.5	9.04	2
271	14.32	58.1	-	-	10.10	11.5	9.06	2
272	13.61	56.2	-	-	9.76	12	8.71	2
273	19.51	55.4	-	-	13.81	10	12.55	2
274	18.21	44.0	-	-	13.91	10	12.65	3
275	19.97	58.9	-	-	14.08	12	12.57	4
276	13.91	50.4	-	-	10.31	11.5	9.25	2
277	11.48	57.1	-	-	8.11	11	7.31	2
278	13.37	54.4	-	-	9.70	12	8.66	2
279	10.78	53.8	-	-	7.71	10	7.01	2
280	13.71	54.0	-	-	9.97	12	8.90	2
281	8.19	45.6	-	-	6.16	9.5	5.63	4
282	11.62	54.2	-	-	8.48	12.5	7.54	2
283	14.13	51.8	-	-	10.24	10	9.31	2
284	9.89	56.9	-	-	7.06	12	6.30	2
285	17.51	56.5	-	-	12.36	10.5	11.19	2
286	19.44	54.1	-	-	13.94	10.5	12.62	2
287	19.02	53.2	-	-	13.72	10.5	12.42	2
288	21.80	60.2	-	-	15.04	10.5	13.61	4
289	15.72	48.9	-	-	11.56	9.5	10.56	2

A.2.1.

A.2.2.

A.2.3.

290	18.92	46.2	-	-	14.49	12	12.94	3
291	17.47	43.1	-	-	13.67	12	12.21	2
292	14.34	49.5	-	-	10.55	10	9.59	4
293	11.97	58.3	-	-	8.47	12	7.56	2
294	10.75	48.5	-	-	8.00	10.5	7.24	2
295	15.85	48.1	-	-	11.72	9.5	10.70	2
296	20.79	55.0	-	-	15.10	12.56	13.42	2
297	14.28	62.7	-	-	9.74	11	8.77	4
298	18.31	49.2	-	-	13.50	10	12.27	2
299	15.89	45.3	-	-	12.14	11	10.94	2
300	9.59	44.5	-	-	7.30	10	6.64	2
301	20.29	47.0	-	-	15.46	12	13.80	2
302	13.80	50.4	-	-	10.09	10	9.17	4
303	14.09	52.6	-	-	10.34	12	9.23	4
304	15.55	51.5	-	-	11.29	10	10.26	2
305	17.76	45.9	-	-	13.39	10	12.17	2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
493	10.62	42.1	-	-	8.52	14	7.47	2
494	9.18	53.5	-	-	6.70	12	5.98	2
495	10.64	56.2	-	-	7.63	12	6.81	3
496	10.79	54.5	-	-	7.82	12	6.98	3
497	10.23	65.2	-	-	6.81	10	6.19	4
498	9.36	37.5	-	-	7.49	10	6.81	2
499	11.35	53.2	-	-	8.15	10	7.41	4
500	9.18	54.8	-	-	6.64	12	5.93	4
501	9.51	57.8	-	-	6.63	10	6.03	4
502	9.08	48.0	-	-	6.81	11	6.14	3
503	12.27	58.2	-	-	8.65	11.5	7.76	4
504	11.17	49.1	-	-	8.54	14	7.49	2
505	11.49	48.6	-	-	8.66	12	7.73	2
506	10.44	43.1	-	-	8.21	12.5	7.30	2
507	11.03	47.2	-	-	8.28	10.5	7.49	2
508	10.36	58.5	-	-	7.19	10	6.54	4

363	9.00	43.1	-	-	6.92	10	6.29	2
364	9.80	42.4	-	-	7.64	11	6.88	2
365	9.47	46.3	-	-	7.25	12	6.47	2
366	8.96	48.4	-	-	6.73	11.5	6.04	2
367	8.76	49.1	-	-	6.52	11	5.87	2
368	9.85	49.1	-	-	7.30	10.5	6.61	3
369	8.68	44.4	-	-	6.64	10.5	6.01	2
370	10.01	45.2	-	-	7.65	11	6.89	3
371	11.32	48.6	-	-	8.38	10	7.62	2
372	10.32	50.1	-	-	7.77	13	6.88	3
373	10.84	62.2	-	-	7.35	10	6.68	4
374	11.25	54.5	-	-	8.01	10	7.28	4
375	12.98	49.1	-	-	9.84	13	8.71	3
376	11.18	59.9	-	-	7.97	14	6.99	4
377	11.41	53.7	-	-	8.39	13	7.42	4
378	11.60	62.0	-	-	8.02	12	7.16	4
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
570	11.71	45.7	-	-	8.84	10	8.04	1
571	11.86	47.6	-	-	8.96	11.5	8.04	1
572	9.94	44.6	-	-	7.70	12	6.88	3
573	11.14	41.2	-	-	8.76	11	7.89	3
574	12.38	43.3	-	-	9.50	10	8.64	1
575	13.48	49.3	-	-	10.11	12	9.03	2
576	11.89	45.3	-	-	9.00	10	8.18	1
577	12.78	49.1	-	-	9.60	12	8.57	2
578	13.15	51.2	-	-	9.74	12	8.70	4
579	13.05	54.2	-	-	9.27	9.5	8.47	3
580	12.89	53.3	-	-	9.25	10	8.41	3
581	11.96	53.4	-	-	8.54	9.5	7.80	3
582	18.35	58.1	-	-	12.77	10	11.61	4
583	22.79	47.8	-	-	17.19	11.5	15.42	2
584	12.50	50.1	-	-	9.16	10	8.33	3
585	11.55	58.5	-	-	8.16	12	7.29	4

A.2.4.

586	13.76	44.7	-	-	10.46	10	9.51	2
587	11.45	56.5	-	-	8.27	13	7.32	4
588	9.66	72.9	-	-	6.37	14	5.59	2
589	10.96	44.7	-	-	8.41	11	7.58	2
590	10.12	41.3	-	-	7.88	10	7.16	2
591	13.25	44.0	-	-	10.12	10	9.20	2
592	11.46	46.9	-	-	8.58	10	7.80	1
593	11.52	57.2	-	-	8.06	10	7.33	4
594	12.34	46.3	-	-	9.36	11	8.43	1
595	12.15	46.4	-	-	9.13	10	8.30	1
596	23.41	47.5	-	-	17.78	12	15.88	2
597	18.63	59.7	-	-	12.83	10	11.66	4
598	20.19	57.2	-	-	14.00	9	12.84	2
599	23.50	55.2	-	-	17.11	13	15.14	2
600	21.22	54.9	-	-	15.07	10	13.70	2
601	14.24	52.5	-	-	10.55	13	9.34	2
602	13.93	49.5	-	-	10.34	11	9.32	2
603	13.27	46.3	-	-	9.89	9	9.07	3
604	11.71	41.0	-	-	9.22	11	8.31	3
605	14.78	48.7	-	-	10.93	10	9.94	4
606	11.97	53.8	-	-	8.56	10	7.78	3
607	12.59	56.7	-	-	9.08	13	8.04	4
608	12.83	56.5	-	-	9.18	12	8.20	3
609	13.12	53.4	-	-	9.58	12	8.55	2
610	11.33	47.4	-	-	8.61	12	7.69	3
611	12.71	51.7	-	-	9.30	11	8.38	4
612	12.93	56.3	-	-	9.10	10	8.27	3
613	17.86	53.5	-	-	13.15	13	11.64	4
614	21.12	50.0	-	-	15.77	12	14.08	2
615	24.54	47.7	-	-	18.86	13.5	16.62	2
616	21.95	49.6	-	-	16.14	10	14.67	2
617	12.16	51.1	-	-	8.85	10	8.05	3
618	14.64	52.8	-	-	10.73	12	9.58	2
619	12.07	48.7	-	-	8.93	10	8.12	2
620	10.41	51.9	-	-	7.54	10	6.85	4
621	17.84	48.8	-	-	13.31	11	11.99	2
622	17.73	45.0	-	-	13.39	9.5	12.23	2
623	15.94	45.6	-	-	12.04	10	10.95	2
624	10.75	46.8	-	-	8.02	9.5	7.32	1
625	12.79	45.5	-	-	9.76	11	8.79	2
626	12.13	53.2	-	-	8.79	11	7.92	3
627	11.18	40.1	-	-	8.86	11	7.98	3
628	12.91	54.0	-	-	9.64	15	8.38	4
629	20.81	48.1	-	-	15.60	11	14.05	2
630	21.24	44.2	-	-	16.06	9	14.73	2
631	20.48	50.2	-	-	15.00	10	13.64	4
632	18.38	51.5	-	-	13.71	13	12.13	4
633	13.92	48.9	-	-	10.38	11	9.35	2
634	13.22	52.9	-	-	9.77	13	8.65	2
635	13.56	54.8	-	-	9.90	13	8.76	4
636	13.30	55.2	-	-	9.60	12	8.57	3
637	8.81	48.8	-	-	6.57	11	5.92	4
638	8.00	49.5	-	-	5.94	11	5.35	2
639	13.04	49.2	-	-	9.79	12	8.74	2
640	12.73	45.0	-	-	9.66	10	8.78	2
641	11.45	45.9	-	-	8.71	11	7.85	1
642	19.75	57.9	-	-	13.88	11	12.50	2
643	19.23	47.8	-	-	14.57	12	13.01	2
644	17.33	48.9	-	-	12.80	10	11.64	2
645	21.23	49.7	-	-	15.88	12	14.18	2
646	17.85	58.7	-	-	12.82	14	11.25	2
647	18.38	51.6	-	-	13.34	10	12.13	4
648	20.17	63.8	-	-	14.04	14	12.32	4
649	18.80	55.1	-	-	13.58	12	12.13	4
650	13.02	57.4	-	-	9.35	13	8.27	2
651	11.98	41.8	-	-	9.42	11.5	8.45	3
652	13.03	53.0	-	-	9.54	12	8.52	4
653	10.71	50.5	-	-	8.04	13	7.12	3
654	10.72	44.3	-	-	8.32	12	7.43	3
655	12.79	55.8	-	-	9.03	10	8.21	3
656	18.06	57.3	-	-	12.97	13	11.48	3
657	13.70	47.7	-	-	10.20	10	9.27	4
658	17.93	56.7	-	-	12.93	13	11.44	4
659	17.93	53.7	-	-	12.83	10	11.66	4
660	17.16	44.0	-	-	13.11	10	11.92	2
661	16.84	52.6	-	-	12.58	14	11.04	4
662	16.98	46.4	-	-	12.76	10	11.60	4
663	21.59	52.9	-	-	15.53	10	14.12	2
664	23.79	49.0	-	-	17.88	12	15.96	2
665	21.92	44.8	-	-	16.96	12	15.14	2
666	14.77	48.1	-	-	11.07	11	9.97	2
667	13.74	44.8	-	-	10.53	11	9.49	2
668	12.62	44.3	-	-	9.71	11	8.75	1
669	11.24	47.2	-	-	8.40	10	7.64	2
670	12.13	56.2	-	-	8.62	11	7.77	2
671	11.84	49.5	-	-	8.71	10	7.92	1
672	13.38	51.9	-	-	9.69	10	8.81	3
673	10.57	57.3	-	-	7.46	11	6.72	3
674	11.37	42.4	-	-	8.94	12	7.98	3
675	9.30	51.3	-	-	6.76	10	6.15	4
676	13.49	51.4	-	-	9.89	11	8.91	4
677	21.56	54.7	-	-	15.33	10	13.94	2
678	21.78	45.0	-	-	16.82	12	15.02	2
679	17.17	55.3	-	-	12.60	14	11.05	4
680	16.15	49.7	-	-	12.08	12	10.79	2
681	17.79	56.4	-	-	12.97	14	11.38	4
682	13.23	53.5	-	-	9.48	10	8.62	4
683	13.91	51.1	-	-	10.31	12	9.21	2
684	14.93	48.1	-	-	11.29	12	10.08	2
685	11.80	47.8	-	-	8.86	11	7.98	2
686	12.57	45.9	-	-	9.48	10	8.62	1
687	11.76	53.4	-	-	8.51	11	7.67	4
688	12.46	58.5	-	-	8.65	10	7.86	3
689	11.34	44.0	-	-	8.82	12	7.88	3
690	13.69	57.4	-	-	9.83	13	8.70	4
691	18.62	60.6	-	-	12.87	11	11.59	4
692	18.66	53.6	-	-	13.73	13	12.15	4
693	16.78	50.9	-	-	12.68	14	11.12	4
694	18.62	49.2	-	-	14.10	13	12.48	4
695	13.68	53.7	-	-	9.97	12	8.90	3
696	12.06	49.9	-	-	9.01	12	8.04	4
697	18.58	54.9	-	-	13.67	14	11.99	4
698	19.13	42.2	16.71	24.19	15.07	12	13.46	3
699	19.55	55.3	15.98	26.91	14.48	15	12.59	2
700	15.07	52.7	12.20	23.66	11.05	12	9.87	3
701	15.77	53.5	12.63	22.90	11.51	12	10.28	3
702	13.58	50.6	10.88	20.65	9.92	10	9.02	3
703	15.09	55.6	11.95	23.20	10.67	10	9.70	3
704	14.92	55.5	11.95	24.55	10.65	11	9.59	3
705	14.98	56.0	11.80	22.92	10.56	10	9.60	3
706	14.35	71.7	10.55	26.24	9.36	12	8.36	3
707	14.58	52.4	11.79	23.23	10.62	11	9.57	3
708	16.94	57.7	13.07	21.71	11.92	11	10.74	4
709	18.61	48.1	15.46	23.06	14.07	12	12.56	4
710	14.72	63.7	11.00	22.35	9.89	10	8.99	3
711	15.23	59.6	11.84	24.05	10.69	12	9.54	3
712	14.74	54.4	11.69	22.48	10.69	12	9.54	3
713	19.86	51.1	16.01	21.83	14.85	13	13.14	4
714	12.09	47.1	9.86	19.99	9.08	10.5	8.22	1
715	11.98	40.8	10.15	19.32	9.40	10.5	8.51	1
716	11.85	46.5	9.86	21.89	9.06	12	8.09	1
717	12.23	42.1	10.38	20.65	9.55	11	8.60	1
718	12.44	45.8	10.51	23.20	9.64	13	8.53	1
719	17.89	42.6	15.13	20.63	13.86	10.5	12.54	2
720	19.00	45.4	15.79	20.87	14.37	10	13.06	2
721	13.03	39.8	11.12	19.34	10.25	10	9.32	3
722	4.80	35.8	4.32	22.18	3.96	12	3.54	3
723	14.46	67.8	10.59	22.88	9.48	10	8.62	3
724	12.00	55.5	9.46	22.57	8.49	10	7.72	3
725	14.84	58.9	11.71	25.38	10.46	12	9.34	3
726	15.81	51.0	12.59	20.22	11.52	10	10.47	4
727	10.98	39.9	9.42	20.06	8.67	10.5	7.85	1
728	9.10	56.1	7.08	21.47	6.47	11	5.83	4
729	18.88	55.8	14.78	21.98	13.45	11	12.12	2
730	18.62	57.1	14.79	24.79	12.80	8	11.85	2
731	15.92	60.7	12.15	22.61	10.90	10	9.91	3

732	8.94	57.8	6.89	21.62	6.26	10.5	5.67	3
733	13.39	52.0	10.53	19.54	9.69	10	8.81	2
734	18.07	51.3	14.50	21.38	13.26	11	11.95	4
735	12.64	48.4	10.46	22.80	9.54	12	8.52	1
736	10.31	55.4	8.02	20.85	7.30	10	6.64	4
737	9.35	54.9	7.39	22.43	6.67	10.5	6.04	4
738	18.36	49.0	14.91	21.04	13.55	10	12.32	2
739	14.93	57.4	11.69	23.26	10.48	10.5	9.48	3
740	15.56	54.8	12.30	22.34	11.11	10.5	10.05	3
741	9.70	60.5	7.51	24.23	6.71	11	6.05	4
742	15.85	52.4	12.48	20.00	11.44	10	10.40	4
743	12.16	45.3	10.21	22.04	9.37	12	8.37	1
744	12.76	43.5	10.77	21.11	9.96	12	8.89	1
745	20.02	49.5	16.35	22.13	14.86	11	13.39	2
746	19.98	59.3	15.55	24.00	14.17	13	12.54	2
747	19.13	49.9	15.57	21.97	14.17	11	12.77	2
748	17.32	53.0	13.57	19.90	12.45	10	11.32	4
749	14.99	60.7	11.59	24.22	10.45	12	9.33	3
750	15.67	51.9	12.59	22.02	11.35	10	10.32	3
751	19.10	52.8	15.46	23.68	14.00	12	12.50	2
752	17.07	52.6	13.54	21.05	12.36	10.5	11.19	4
753	17.69	50.8	14.19	21.00	12.90	10	11.73	4
754	9.13	59.9	6.93	21.39	6.28	10	5.71	4
755	9.96	52.1	8.04	22.76	7.27	11	6.55	4
756	11.32	63.1	8.65	24.61	7.74	11.5	6.94	3
757	14.64	60.1	11.20	22.47	10.06	10	9.15	3
758	9.22	58.5	7.08	21.69	6.40	10	5.82	4
759	16.24	47.5	13.21	19.99	12.11	10	11.01	2
760	14.72	59.7	11.31	22.69	10.14	10	9.22	3
761	15.00	54.7	12.04	24.15	10.91	12.5	9.70	3
762	13.40	52.9	10.51	19.93	9.64	10	8.76	4
763	12.73	44.5	10.63	20.62	9.87	12	8.81	3
764	16.31	48.2	13.04	18.45	12.22	11	11.01	2
765	17.96	43.5	14.99	19.75	13.77	10	12.52	2
766	9.31	59.2	7.27	24.28	6.61	13	5.85	4
767	9.42	53.7	7.39	20.61	6.74	10	6.13	4
768	17.58	49.7	14.37	22.40	13.09	11.5	11.74	4
769	20.04	46.4	16.51	20.59	15.06	10	13.69	2
770	21.27	49.7	17.70	24.54	16.06	13	14.21	2
771	17.55	49.9	14.22	21.44	12.88	10	11.71	2
772	19.89	49.7	16.55	24.59	15.01	13	13.28	2
773	11.00	49.9	8.82	20.22	8.07	10	7.34	1
774	10.64	51.7	8.53	21.62	7.75	10.5	7.01	1
775	11.15	45.6	9.26	20.95	8.46	10.5	7.66	1
776	10.61	50.2	8.55	21.04	7.77	10	7.06	1
777	12.17	66.7	8.96	22.74	8.03	10	7.30	4
778	16.98	44.3	14.07	19.61	12.94	10	11.76	1
779	13.33	54.0	10.36	19.71	9.52	10	8.65	4
780	10.37	46.4	8.54	20.59	7.79	10	7.08	1
781	12.79	69.3	9.17	21.38	8.31	10	7.55	4
782	12.38	70.2	8.83	21.41	8.00	10	7.27	4
783	13.37	64.3	10.08	23.91	9.03	11	8.14	4
784	10.87	45.6	8.88	18.98	8.21	10	7.46	1
785	9.07	41.4	7.74	20.67	7.12	11	6.41	1
786	19.22	53.8	15.08	20.64	13.75	10	12.50	1
787	19.83	45.3	16.76	22.77	15.29	12	13.65	1
788	20.99	44.0	17.90	22.79	16.40	12.5	14.58	1
789	13.05	65.5	10.00	26.84	8.83	12	7.88	4
790	13.82	61.1	10.79	25.75	9.61	12	8.58	4
791	21.42	50.5	17.55	23.31	15.94	12	14.23	1
792	20.45	48.3	16.95	22.95	15.44	12	13.79	1
793	19.89	45.9	16.60	21.76	15.27	12	13.63	1
794	9.82	47.6	8.00	20.22	7.32	10	6.65	1
795	10.85	51.2	8.73	21.65	7.93	10.5	7.18	1
796	10.62	49.0	8.67	21.66	7.91	11	7.13	1
797	13.80	73.7	9.83	23.72	8.74	10	7.95	4
798	13.64	66.2	10.15	23.64	9.03	10	8.21	4
799	13.42	69.5	9.74	23.01	8.71	10	7.92	4
800	12.86	59.9	9.92	23.31	9.01	12	8.04	4
801	19.86	51.1	15.80	20.19	14.46	10	13.15	1
802	20.25	44.3	16.94	20.69	15.51	10.5	14.04	1
803	10.91	47.1	9.05	22.06	8.23	11	7.41	1
804	10.16	48.2	8.35	21.79	7.61	11	6.86	1

805	10.61	49.3	8.72	22.69	7.96	12	7.11	1
806	10.85	50.4	8.91	23.50	8.08	12	7.21	1
807	11.38	47.1	9.36	20.99	8.51	10	7.74	1
808	12.31	68.7	9.13	25.11	8.10	11	7.30	4
809	13.69	63.5	10.59	26.50	9.46	13	8.37	4
810	14.01	62.5	10.90	26.46	9.74	13	8.62	4
811	10.94	51.0	8.80	21.46	7.97	10	7.25	1
812	11.56	47.7	9.54	21.86	8.69	11	7.83	1
813	10.85	74.7	7.67	23.53	6.83	10	6.21	4
814	12.85	65.8	9.78	26.19	8.68	12	7.75	4
815	13.57	61.5	10.44	24.26	9.41	12	8.40	4
816	12.86	55.0	10.02	20.74	9.17	10.5	8.30	4
817	11.09	49.1	8.91	19.82	8.18	10	7.44	1
818	19.85	51.2	15.75	20.00	14.70	12	13.13	1
819	18.23	51.9	14.69	22.42	13.44	12	12.00	2
820	21.46	58.3	16.53	21.96	15.18	12	13.55	2
821	20.58	60.4	16.09	25.39	14.50	13	12.83	2
822	11.38	44.2	9.55	21.01	8.76	11	7.89	2
823	12.20	43.2	10.26	20.45	9.37	10	8.52	2
824	19.81	54.9	15.68	22.64	14.32	12	12.79	2
825	11.95	41.5	10.14	20.06	9.29	10	8.45	2
826	12.05	50.3	9.88	23.22	8.98	12	8.02	2
827	11.55	48.3	9.60	23.27	8.80	13	7.79	2
828	11.88	40.0	10.47	23.37	9.59	13	8.49	2
829	9.71	50.0	7.73	19.42	7.12	10	6.47	4
830	19.22	52.1	15.31	21.19	13.96	10.5	12.63	1
831	20.68	54.3	16.50	23.12	15.01	12	13.40	1
832	21.22	46.1	17.61	21.26	16.12	11	14.52	1
833	20.90	43.3	17.38	19.19	16.04	10	14.58	1
834	16.09	64.7	12.15	24.36	11.04	13	9.77	2
835	20.35	43.7	16.94	19.60	15.58	10	14.16	1
836	22.99	45.5	19.17	21.30	17.70	12	15.80	1
837	9.66	49.7	7.78	20.54	7.10	10	6.45	1
838	9.88	47.1	8.09	20.42	7.39	10	6.72	1
839	12.70	57.7	10.00	24.17	9.02	12	8.05	4
840	13.11	64.8	9.85	23.83	8.75	10	7.95	4
841	13.38	63.1	10.46	27.53	9.35	14	8.20	4
842	12.60	68.0	9.27	23.60	8.25	10	7.50	4
843	10.59	51.7	8.56	22.60	7.75	11	6.98	1
844	8.04	60.5	6.19	23.58	5.56	11	5.01	2
845	19.43	58.4	15.04	22.57	13.62	11	12.27	2
846	10.85	48.3	8.95	22.35	8.12	11	7.32	2
847	19.88	48.4	16.12	20.30	14.74	10	13.40	1
848	19.00	60.9	14.84	25.69	13.46	14	11.81	2
849	13.29	65.6	9.92	23.58	8.83	10	8.03	4
850	14.65	63.1	11.56	28.69	10.33	15	8.98	4
851	18.10	47.7	14.74	20.28	13.48	10	12.25	1
852	12.45	63.2	9.38	22.93	8.47	11	7.63	4
853	20.13	45.9	16.75	21.42	15.45	12	13.79	3
854	20.23	48.1	16.70	22.25	15.30	12	13.66	1
855	18.19	42.0	15.50	20.99	14.22	11	12.81	1
856	14.28	63.0	11.04	26.04	9.81	12	8.76	4
857	11.30	49.6	9.28	22.86	8.46	12	7.55	1
858	13.30	64.9	10.00	24.01	8.87	10	8.06	4
859	13.55	65.0	10.48	27.64	9.36	14	8.21	4
860	13.26	58.2	10.49	25.12	9.39	12	8.38	4
861	10.55	53.7	8.32	21.22	7.55	10	6.86	1
862	11.80	45.5	9.79	20.73	8.92	10	8.11	2
863	11.36	49.4	9.22	21.26	8.44	11	7.60	2
864	10.21	49.0	8.18	19.34	7.54	10	6.85	2
865	11.46	49.7	9.25	20.82	8.46	10.5	7.66	2
866	20.88	53.4	16.80	23.43	15.38	13	13.61	2
867	20.81	58.0	16.35	24.16	14.88	13	13.17	2
868	21.00	42.1	17.79	20.39	16.55	12	14.78	4
871	9.08	50.9	7.21	19.80	6.62	10	6.02	4
872	9.34	49.8	7.51	20.42	6.86	10	6.24	4
873	8.98	43.6	7.49	19.75	6.88	10	6.25	4
874	9.52	47.7	7.74	20.08	7.09	10	6.45	4
875	11.50	43.4	9.65	20.35	8.90	11	8.02	2
877	11.63	40.1	9.96	20.00	9.13	10	8.30	2
878	12.08	52.5	9.63	21.60	8.87	12	7.92	2
879	12.09	48.3	9.98	22.43	9.13	12	8.15	2
880	11.40	47.1	9.40	21.33	8.60	11	7.75	2

881	15.39	53.2	12.15	20.96	11.15	11	10.05	2
882	11.44	42.0	9.66	19.93	8.86	10	8.05	2
883	10.77	46.2	8.87	20.41	8.14	10.5	7.37	2
884	11.16	38.6	9.64	19.68	8.86	10	8.05	2
887	19.78	43.8	16.68	21.25	15.27	11	13.76	2
888	14.96	51.5	11.86	20.13	10.86	10	9.87	2
889	17.44	40.7	15.09	21.76	13.88	12	12.39	2
890	11.55	45.4	9.68	21.82	8.82	11	7.95	2
891	12.10	43.7	9.94	18.02	9.18	9	8.42	2
892	10.86	40.9	9.25	19.99	8.48	10	7.71	2
893	11.74	41.3	9.95	19.75	9.14	10	8.31	2
894	10.00	48.2	8.09	19.93	7.42	10	6.75	3
895	11.58	51.7	9.01	18.03	8.55	12	7.63	2
896	11.06	41.0	9.34	19.07	8.55	9	7.84	2
897	12.52	43.5	10.67	22.32	9.77	12	8.72	2
898	13.23	45.4	11.05	21.45	10.19	12	9.10	2
899	12.04	46.2	9.90	20.20	9.06	10	8.24	2
900	12.43	41.7	10.60	20.80	9.74	11	8.77	2
901	20.51	51.4	16.50	21.78	15.04	11	13.55	2
902	21.19	49.2	16.80	18.31	15.62	10	14.20	2
903	12.40	57.7	9.46	20.30	8.65	10	7.86	3
904	12.26	42.6	10.42	21.19	9.63	12	8.60	2
905	19.41	53.3	15.36	21.32	13.99	10.5	12.66	2
906	18.55	48.6	15.10	21.00	13.79	10.5	12.48	2
907	16.94	62.2	13.00	24.44	11.70	12	10.45	3
908	17.47	60.1	13.36	22.40	12.17	11.5	10.91	3
909	16.40	65.3	12.33	24.30	11.11	12	9.92	3
910	19.80	53.8	15.36	19.32	14.16	10	12.87	2
911	19.61	48.2	16.09	21.58	14.69	11	13.23	2
912	11.61	53.9	9.30	23.27	8.45	12	7.54	2
913	13.78	58.9	10.54	21.53	9.54	10	8.67	3
914	9.15	66.0	6.71	21.70	6.12	11	5.51	2
915	9.59	60.6	7.27	21.72	6.57	10	5.97	2
916	17.95	43.6	15.27	22.16	14.00	12	12.50	2
917	9.46	63.4	6.97	20.36	6.37	10	5.79	2
918	9.94	59.4	7.50	20.26	6.86	10	6.24	2
919	16.99	43.1	14.40	21.26	13.30	12	11.88	2
920	9.46	57.7	7.19	19.83	6.66	11	6.00	2
921	6.99	53.2	5.42	18.76	5.02	10	4.56	2
922	12.89	64.9	9.45	20.87	8.60	10	7.82	3
923	9.70	61.2	7.38	22.64	6.74	12	6.02	2
924	9.15	65.3	6.83	23.38	6.20	12	5.54	2
925	15.79	41.1	13.46	20.24	12.37	10.5	11.19	2
926	14.20	61.7	10.46	19.11	9.66	10	8.78	4
927	13.03	54.9	10.10	20.08	9.21	9.5	8.41	2
928	17.90	45.5	14.84	20.59	13.66	11	12.31	2
929	12.73	46.1	10.34	18.64	9.50	9	8.72	2
930	11.73	49.5	9.54	21.56	8.79	12	7.85	2
931	18.36	49.2	14.90	21.05	13.54	10	12.31	2
932	20.29	50.1	16.76	24.03	15.27	13	13.51	2
933	13.20	64.8	9.78	22.11	8.81	10	8.01	4
934	12.03	53.7	9.39	19.97	8.61	10	7.83	4
935	16.02	40.6	13.63	19.66	12.53	10	11.39	2
936	9.69	46.0	7.93	19.49	7.30	10	6.64	3
937	12.59	48.9	10.01	18.40	9.30	10	8.45	2
938	19.73	52.7	15.58	20.60	14.34	11	12.92	2
939	20.29	50.8	16.56	23.05	15.14	12.5	13.46	2
940	21.98	48.6	18.25	23.41	16.71	13	14.79	2
941	14.71	56.2	11.64	23.57	10.55	12	9.42	4
942	18.40	43.8	15.38	20.22	14.20	11	12.79	2
943	15.22	56.9	11.84	22.03	10.77	11	9.70	4
944	20.36	48.7	16.66	21.72	15.33	12	13.69	2
945	19.82	44.5	16.64	21.36	15.22	11	13.71	2
946	11.13	47.5	9.03	19.64	8.34	10.5	7.55	2
947	11.86	53.5	9.30	20.35	8.50	10	7.73	4
948	17.41	42.4	14.96	22.39	13.69	12	12.22	2
949	9.80	45.7	8.04	19.51	7.40	10	6.73	3
950	12.29	42.6	10.37	20.33	9.48	10	8.62	3
951	17.91	43.1	14.96	19.51	13.77	10	12.52	2
952	16.57	55.3	12.85	20.40	11.74	10	10.67	3
953	12.03	42.1	10.13	19.69	9.31	10	8.46	3
954	16.61	42.1	13.90	18.90	12.86	10	11.69	3
955	11.07	61.2	8.61	25.38	7.76	13	6.87	4
956	11.84	43.3	9.97	20.70	9.21	11.5	8.26	3
957	18.50	41.3	15.90	21.47	14.66	12	13.09	3
958	10.22	56.4	7.85	20.10	7.19	10	6.54	4
959	9.50	54.3	7.35	19.41	6.74	9.5	6.16	4
960	12.75	52.9	10.22	22.55	9.34	12	8.34	2
961	12.15	56.0	9.29	19.24	8.57	10	7.79	2
962	13.19	52.1	10.64	22.73	9.71	12	8.67	2
963	13.11	52.0	10.60	22.90	9.66	12	8.63	2
964	12.74	52.4	10.25	22.65	9.36	12	8.36	2
965	13.40	52.6	10.74	22.32	9.79	11.5	8.78	2
966	12.26	50.9	9.86	21.34	9.02	11	8.13	2
967	18.80	50.0	15.16	20.93	13.79	10	12.54	3
968	13.09	48.4	10.63	20.47	9.75	10.5	8.82	2
969	17.43	45.6	14.29	19.35	13.17	10	11.97	2
970	18.50	57.2	14.34	21.86	13.18	12	11.77	2
971	16.82	53.5	13.40	22.31	12.27	12	10.96	2
972	12.72	47.0	10.36	19.71	9.52	10	8.65	3
973	10.37	48.5	8.48	21.45	7.82	12	6.98	2
974	10.21	55.4	8.12	23.57	7.36	12	6.57	4
975	10.03	59.7	7.68	22.26	6.91	10	6.28	4
976	10.60	57.2	8.20	21.62	7.45	10.5	6.74	4
977	9.95	64.4	7.40	22.24	6.75	11.5	6.05	2
978	17.20	54.3	13.60	22.04	12.37	11	11.14	2
979	9.85	63.9	7.30	21.48	6.58	9.5	6.01	4
980	10.68	51.0	8.61	21.76	7.92	12	7.07	2
981	10.01	59.0	7.80	23.91	7.05	12	6.29	4
982	10.63	62.9	8.00	22.56	7.18	10	6.53	4
983	19.08	46.3	15.70	20.35	14.35	10	13.05	3
984	16.70	54.6	13.23	22.46	12.10	12	10.80	3
985	17.18	54.1	13.53	21.35	12.32	10.5	11.15	3
986	20.05	51.2	16.42	23.86	14.98	13	13.26	3
987	20.25	43.7	16.85	19.58	15.50	10	14.09	2
988	18.38	46.8	15.09	20.50	13.90	11	12.52	2
989	18.81	45.5	15.46	19.59	14.22	10	12.93	2
990	16.19	47.1	13.34	21.17	12.33	12	11.01	3
991	10.98	59.1	8.51	23.32	7.66	11	6.90	4
992	10.59	53.4	8.16	18.23	7.73	12	6.90	4
993	10.24	54.4	7.85	18.35	7.23	9	6.63	4
994	9.87	54.3	7.78	21.66	7.13	11.5	6.39	2
995	9.96	49.9	8.07	21.48	7.44	12	6.64	2
996	9.97	57.3	7.55	19.12	6.94	9.5	6.34	4
997	10.73	57.6	8.30	21.90	7.49	10	6.81	4
998	11.39	59.5	8.92	24.90	8.07	13	7.14	4
999	12.30	47.5	10.00	19.91	9.09	9	8.34	3
1000	13.60	49.0	10.97	20.19	10.04	10	9.13	4
1001	13.08	47.6	10.40	17.37	9.57	8	8.86	2
1002	10.34	56.5	7.97	20.59	7.27	10	6.61	4
1003	10.56	46.3	8.64	19.70	7.94	10	7.22	2
1004	9.63	54.2	7.50	20.09	6.87	10	6.25	2
1005	10.21	60.9	7.80	22.92	6.98	10	6.35	4
1006	10.20	60.6	7.85	23.60	7.05	11	6.35	4
1007	9.73	57.4	7.37	19.20	6.77	9.5	6.18	4
1008	18.28	50.2	14.87	22.19	13.63	12	12.17	2
1009	17.93	63.7	13.18	20.33	12.00	9.56	10.95	3
1010	20.20	60.1	15.20	20.46	13.88	10	12.62	3
1011	11.92	47.5	9.68	19.78	8.89	10	8.08	2
1012	12.71	38.6	11.03	20.27	10.18	11	9.17	3
1013	10.12	70.5	7.26	22.30	6.53	10	5.94	4
1014	12.90	51.3	10.21	19.73	9.38	10	8.53	4
1015	12.20	52.2	9.68	20.73	8.82	10	8.02	2
1016	9.91	60.4	7.65	23.78	6.86	11	6.18	4
1017	17.47	48.7	14.09	19.96	12.92	10	11.75	3
1018	18.64	55.8	14.50	21.20	13.16	10	11.96	3
1019	17.73	41.4	15.05	20.05	13.79	10	12.54	2
1020	17.37	43.4	14.48	19.58	13.32	10	12.11	1
1021	22.34	43.1	19.11	22.44	17.48	12	15.61	1
1022	17.80	48.7	14.30	19.44	13.17	10	11.97	1
1023	18.52	46.7	15.11	19.66	13.89	10	12.63	2
1024	20.50	48.8	16.92	22.80	15.57	13	13.78	1
1025	19.53	53.4	15.49	21.68	14.13	11	12.73	1
1026	16.84	54.6	13.13	20.54	12.20	12	10.89	2
1027	17.88	47.5	14.61	20.56	13.33	10	12.12	1
1028	16.76	52.5	13.07	18.92	12.09	10	10.99	2

1029	15.34	46.4	12.61	20.35	11.63	11	10.48	2
1030	18.75	49.1	15.01	19.39	13.83	10	12.57	1
1031	19.04	40.1	16.28	19.79	14.95	10	13.59	2
1032	20.83	51.8	16.75	22.08	15.23	11	13.72	1
1033	18.82	49.4	15.14	20.16	13.86	10	12.60	2
1034	16.89	48.4	13.98	22.84	12.86	13	11.38	2
1035	17.64	48.3	14.25	19.84	13.08	10	11.89	2
1036	14.47	50.4	11.45	19.05	10.58	10	9.62	2
1037	15.77	52.2	12.43	19.94	11.40	10	10.36	3
1038	17.33	50.8	13.85	20.53	12.64	10	11.49	3
1039	14.19	53.7	10.91	18.21	10.06	9	9.23	3
1040	15.27	45.1	12.38	17.65	11.47	9	10.52	1
1041	17.23	44.9	14.06	18.24	13.08	10	11.89	1
1042	16.35	42.7	13.66	19.25	12.60	10	11.45	1
1043	14.22	43.2	11.76	18.46	10.92	10	9.93	1
1044	17.44	44.5	14.52	20.28	13.40	11	12.07	1
1045	18.46	46.8	15.30	21.68	14.02	11.5	12.57	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1235	12.70	60.0	9.46	19.20	8.73	10	7.94	4
1236	13.29	47.5	10.86	20.55	10.00	11	9.01	2
1237	13.44	49.9	10.93	21.87	10.00	11.5	8.97	2
1238	10.73	45.4	8.88	20.30	8.12	10	7.38	3
1239	12.60	47.8	10.34	21.33	9.46	11	8.52	3
1240	10.09	50.8	7.99	19.42	7.36	10	6.69	2
1241	10.77	51.7	8.51	19.87	7.88	11	7.10	2
1242	16.10	53.8	12.62	20.58	11.46	9.5	10.47	3
1243	15.85	58.4	12.05	20.39	11.01	10	10.01	2
1244	18.09	58.1	14.04	22.71	12.70	11	11.44	2
1245	13.74	57.9	10.27	18.05	9.57	10	8.70	4
1246	17.50	60.4	13.17	20.73	12.00	10	10.91	3
1247	18.15	52.5	14.55	22.25	13.33	12	11.90	2
1248	20.19	59.2	15.29	20.59	13.82	9	12.68	3
1249	18.57	56.4	14.40	21.26	13.30	12	11.88	3
1250	18.46	62.1	13.73	20.57	12.64	11	11.39	3
1251	13.53	66.9	9.72	19.88	9.00	11	8.11	4

1102	11.64	61.3	8.81	22.05	7.94	10	7.22	4
1103	21.41	43.2	18.20	21.77	16.74	12	14.95	2
1104	18.47	55.9	14.55	22.82	13.15	11	11.85	3
1105	19.32	48.3	15.87	21.82	14.33	10	13.03	3
1106	17.13	52.0	13.80	22.47	12.62	12	11.27	2
1107	9.54	51.2	7.80	23.63	6.94	10	6.31	1
1108	9.79	53.3	7.60	19.02	7.12	11.5	6.39	1
1109	20.57	63.7	15.70	24.92	13.95	11	12.57	3
1110	16.25	44.7	13.66	21.67	12.35	10	11.23	2
1111	18.95	59.7	14.40	21.38	13.05	10	11.86	3
1112	19.38	47.4	15.80	20.19	14.46	10	13.15	2
1113	18.38	46.3	15.03	19.63	13.82	10	12.56	2
1114	17.55	40.7	14.77	18.42	13.72	10	12.47	2
1115	17.25	62.3	12.92	21.54	11.80	11	10.63	3
1116	15.50	50.3	12.51	21.29	11.50	11.5	10.31	3
1117	14.79	46.1	12.13	19.79	11.24	11	10.13	3
1118	15.37	47.6	12.50	20.03	11.56	11	10.41	2
1119	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1120	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1121	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1122	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1123	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1124	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1125	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1126	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1127	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1128	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1129	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1130	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1131	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1132	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1133	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1134	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1135	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1136	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1137	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1138	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1139	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1140	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1141	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1142	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1143	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1144	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1145	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1146	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1147	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1148	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1149	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1150	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1151	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1152	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1153	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1154	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1155	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1156	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1157	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1158	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1159	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1160	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1161	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1162	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1163	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1164	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1165	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1166	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1167	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1168	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1169	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1170	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
1171	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1172	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1173	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
1174	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
1308	9.77	58.3	7.41	20.04	6.79	10	6.17	4
1309	9.90	65.5	7.19	20.20	6.58	10	5.98	4
1310	9.85	52.8	7.78	20.71	7.09	10	6.45	4
1311	9.61	62.9	7.14	21.02	6.49	10	5.90	4
1312	18.62	53.5	14.47	19.31	13.22	9	12.13	3
1313	18.10	59.7	13.49	19.00	12.47	10	11.34	3
1314	17.72	60.8	13.36	21.25	12.12	10	11.02	3
1315	16.90	54.1	13.16	20.03	12.06	10	10.96	3
1316	16.53	59.9	12.48	20.74	11.37	10	10.34	3
1317	19.96	53.0	15.87	21.66	14.61	12	13.04	3
1318	18.28	47.5	15.19	22.57	13.88	12	12.39	3
1319	12.40	48.3	9.89	18.25	9.20	10	8.36	2
1320	10.54	57.3	8.21	22.49	7.44	11	6.70	4
1321	13.00	51.0	10.29	19.52	9.47	10	8.61	2
1322	11.13	56.6	8.58	20.72	7.96	12	7.11	2
1323	9.18	57.5	7.08	21.43	6.53	12	5.83	2
1324	11.12	49.3	8.93	19.86	8.27	11	7.45	2

1325	10.06	46.9	8.32	21.49	7.67	12	6.85	2
1326	9.46	47.4	7.76	20.88	7.19	12	6.42	2
1327	10.15	56.4	7.99	23.09	7.27	12	6.49	4
1328	15.63	53.4	12.28	20.50	11.21	10	10.19	3
1329	17.10	44.7	14.28	20.83	13.00	10	11.82	3
1330	11.50	49.7	9.11	18.59	8.45	10	7.68	3
1331	20.81	53.5	16.74	23.51	15.18	12	13.55	2
1332	17.92	50.9	14.60	22.95	13.30	12	11.88	4
1333	20.99	60.3	16.71	27.64	14.99	14.5	13.09	4
1334	18.72	44.5	15.34	18.41	14.25	10	12.95	2
1335	18.57	42.0	15.49	18.42	14.52	11	13.08	2
1336	17.13	46.2	14.53	23.99	13.24	13	11.72	2
1337	17.49	45.8	14.36	19.67	13.20	10	12.00	4
1338	20.91	48.5	17.28	22.72	15.77	12	14.08	2
1339	22.77	47.8	18.67	21.15	17.26	12	15.41	2
1340	17.01	43.9	14.13	19.56	13.00	10	11.82	2
1341	19.63	45.3	16.04	18.70	15.54	15	13.51	4
1342	22.09	40.8	18.69	19.11	17.26	10	15.69	2
1343	17.68	46.2	14.80	22.42	13.54	12	12.09	2
1344	18.56	44.2	15.75	22.33	14.42	12	12.88	2
1345	17.93	47.6	14.98	23.29	13.73	13	12.15	2
1346	17.34	49.0	14.24	22.40	13.03	12	11.63	2
1347	18.59	51.9	15.23	24.46	13.95	14	12.24	4
1348	17.11	48.1	14.38	24.47	13.17	14	11.55	4
1349	12.45	56.5	9.71	22.06	8.83	11	7.95	3
1350	14.28	49.7	11.75	23.17	10.78	13	9.54	2
1351	11.70	44.3	9.65	19.02	9.00	11	8.11	2

A.2. Kiln Data

B.2.1. Air Flow

	Distance From End (m)							
Gap #	**0.50**	**1.00**	**2.00**	**3.00**	**4.00**	**5.00**	**5.50**	
1	1.8	2.2	2.0	1.3	1.6	1.3	2.3	
2	1.5	2.0	1.5	2.0	1.9	1.5	2.3	
5	1.8	1.5	1.8	1.8	1.9	1.7	2.1	
10	1.4	1.8	1.7	1.6	1.8	1.7	2.1	**Rack 1**
15	1.4	1.8	1.5	2.1	1.9	1.4	1.9	
18	1.9	1.6	1.7	1.6	1.7	1.5	1.8	
19	1.9	1.9	2.0	1.9	2.2	1.7	1.7	
	1.9	2.0	3.2	3.1	3.5	2.0	2.3	**Glut 1**
Gap #								
1	1.1	1.5	2.0	1.6	1.6	1.7	1.1	
2	1.6	1.7	1.8	1.6	1.7	1.3	1.6	
5	1.6	1.9	1.8	2.2	2.0	1.8	1.0	
9	1.6	1.8	1.6	1.9	1.6	1.7	1.0	**Rack 2**
13	1.6	1.8	1.8	2.4	2.0	1.7	1.1	
16	1.5	2.0	1.9	1.8	2.1	1.8	2.0	
17	1.8	2.0	1.8	2.0	2.1	1.6	1.7	
	3.2	3.4	3.4	3.4	3.4	3.0	2.5	**Glut 2**
Gap #								
1	1.5	1.6	1.7	1.8	2.6	1.5	1.7	
2	1.8	1.8	2.0	2.3	2.0	1.7	1.8	
5	1.9	1.8	1.8	2.1	2.0	1.8	1.8	
10	2.0	1.8	1.7	2.5	1.9	1.7	1.8	**Rack 3**
15	1.8	2.0	2.1	2.5	1.8	1.7	1.7	
18	2.3	2.0	2.4	2.4	2.2	1.8	1.6	
19	2.2	2.0	2.2	2.4	2.3	1.6	1.7	
	3.7	3.8	3.5	3.9	3.3	3.3	2.3	**Glut 3**
Gap #								
1	1.6	1.7	1.5	2.1	1.5	1.5	1.3	
2	1.6	1.5	1.8	2.3	1.5	1.3	1.5	
5	1.8	1.5	1.7	2.1	1.5	1.5	1.5	
10	1.5	1.7	1.8	1.9	1.4	1.6	1.6	**Rack 4**
15	1.4	1.8	1.6	2.0	1.5	1.3	1.5	
18	1.5	1.5	1.7	2.0	1.3	1.3	1.6	
19	1.4	1.4	1.6	2.0	1.3	1.3	1.3	
	3.0	3.4	3.7	3.2	2.7	2.8	2.5	**Glut 4**

B.2.2. Temperature

Date	Time	Rack 1-1	Rack 1-2	Rack 2-1	Rack 2-2	Rack 3-1	Rack 3-3	Rack 4-1	Rack 4-2
29/5	14:30	18.7	18.3	18.9	19.2	17.3	19.1	17.6	17.4
29/5	14:45	23.1	23.8	23.7	23.6	23.1	24.4	21.0	21.8
29/5	15:00	21.6	22.1	22.2	21.3	20.4	21.8	19.4	14.6
29/5	15:15	24.1	23.8	23.8	24.1	22.8	22.6	23.0	22.2
29/5	15:30	25.2	25.1	25.9	25.6	24.7	24.1	24.7	23.8
29/5	15:45	26.7	27.3	27.8	28.2	26.4	25.7	26.5	25.5
29/5	16:00	27.2	29.0	27.2	26.4	26.8	26.7	27.2	27.0
29/5	16:15	29.3	29.7	30.0	29.8	29.8	29.8	29.9	30.3
29/5	16:30	30.0	29.6	30.4	30.0	29.6	29.3	29.0	29.8
29/5	16:45	29.7	29.7	30.2	30.2	29.7	29.9	29.8	30.1
29/5	17:00	29.9	30.2	30.4	30.7	30.0	30.2	30.2	30.0
[illegible]									
31/5	17:00	68.2	67.4	68.2	67.8	67.8	67.2	67.8	67.5
31/5	17:15	67.9	67.1	67.9	67.4	67.4	66.8	67.4	67.0
31/5	17:30	72.9	72.9	71.9	72.3	71.3	72.4	72.0	71.9
31/5	17:45	68.4	67.7	68.4	68.0	68.0	67.4	68.0	67.7
31/5	18:00	68.2	67.4	68.3	67.8	67.9	67.3	67.9	67.5
31/5	18:15	68.1	67.3	68.4	67.9	67.9	67.3	67.9	67.5
31/5	18:30	67.9	67.0	68.1	67.6	67.6	67.0	67.6	67.2
31/5	18:45	69.4	67.3	68.9	67.6	68.2	67.1	68.3	67.4
31/5	19:00	72.8	73.1	71.5	72.7	70.9	72.8	71.9	72.3
31/5	19:15	69.0	68.2	68.8	68.7	68.2	68.0	68.4	68.0
31/5	19:30	68.2	67.3	68.3	67.8	67.8	67.1	67.8	67.3
31/5	19:45	68.0	67.1	68.2	67.6	67.7	67.0	67.7	67.2
31/5	20:00	67.9	67.2	67.7	67.6	67.2	66.9	66.9	66.4
31/5	20:15	68.1	67.4	68.1	67.8	67.4	67.1	67.5	67.1

30/5	8:00	56.1	56.1	56.1	56.4	55.6	55.2	55.2	54.7
30/5	8:15	57.4	57.2	58.1	57.9	57.5	57.2	57.6	57.1
30/5	8:30	57.7	57.1	57.9	57.8	57.8	57.3	57.5	57.3
30/5	8:45	57.6	57.1	58.1	57.7	57.6	57.4	57.7	57.3
30/5	9:00	57.3	56.9	57.8	57.4	57.6	57.1	57.5	57.3
30/5	9:15	62.5	62.9	61.4	62.6	60.8	62.6	61.4	61.5
30/5	9:30	64.0	64.8	62.8	64.0	62.0	64.6	62.7	63.3
30/5	9:45	64.4	65.2	62.9	64.4	62.4	64.4	63.2	63.2
30/5	10:00	62.5	58.9	61.3	59.2	60.7	58.5	60.4	59.0
30/5	10:15	64.6	65.4	63.6	65.0	62.9	65.3	64.0	64.1
30/5	10:30	60.3	63.1	60.8	62.8	60.4	62.6	60.6	61.2
30/5	10:45	65.4	66.0	64.4	65.6	63.6	65.3	64.5	64.5
30/5	11:00	63.4	63.4	63.1	64.3	62.4	63.4	63.1	63.0
30/5	11:15	66.0	65.9	64.9	65.9	63.8	65.8	64.8	65.0
[illegible]									
1/6	11:15	70.7	71.5	70.4	71.6	69.7	71.1	70.4	70.7
1/6	11:30	67.5	67.0	67.9	67.6	67.4	67.1	67.4	67.3
1/6	11:45	67.2	67.1	67.6	67.6	67.0	67.1	67.1	67.1
1/6	12:00	67.3	66.9	67.4	67.3	66.8	66.8	66.3	66.2
1/6	12:15	67.4	67.2	67.7	67.7	67.0	67.0	67.1	67.0
1/6	12:30	67.4	67.0	67.4	67.5	66.9	66.7	66.9	66.8
1/6	12:45	67.5	67.3	67.7	67.6	66.9	66.8	67.1	66.7
1/6	13:00	67.2	66.9	67.3	67.2	66.7	66.4	66.8	66.5
1/6	13:15	67.0	66.6	67.2	67.1	66.6	66.4	66.7	66.4
1/6	13:30	67.2	66.8	67.3	67.2	66.7	66.4	66.7	66.4
1/6	13:45	67.1	66.7	67.2	67.0	66.6	66.3	66.7	66.3
1/6	14:00	67.1	66.7	67.1	67.0	66.6	66.2	66.7	66.3
1/6	14:15	67.0	66.8	67.2	67.1	66.6	66.2	66.7	66.3
1/6	14:30	66.9	66.6	67.1	66.9	66.5	66.2	66.6	66.2

1/6	14:45	66.9	66.6	67.1	66.9	66.5	66.1	66.6	66.2
1/6	15:00	67.0	66.6	67.1	66.9	66.6	66.2	66.7	66.2
1/6	15:15	67.2	66.9	67.3	67.1	66.7	66.3	66.8	66.3
1/6	15:30	67.2	66.8	67.2	66.4	66.7	66.3	66.8	66.3
1/6	15:45	67.2	66.7	67.2	67.0	66.7	66.2	66.7	66.3
1/6	16:00	66.7	66.2	66.6	66.5	66.1	65.7	65.6	59.4
1/6	16:15	68.1	67.6	68.3	68.2	67.7	67.5	67.8	67.7
1/6	16:30	67.7	67.1	67.8	67.6	67.3	67.0	67.4	67.1
1/6	16:45	68.4	67.8	68.5	68.4	68.0	67.7	68.0	67.8
1/6	17:00	68.1	67.3	68.1	67.7	67.7	67.1	67.7	67.3
1/6	17:15	68.0	67.2	68.0	67.6	67.5	67.0	67.5	67.2
1/6	17:30	67.9	67.1	67.9	67.4	67.3	66.8	67.4	67.0
1/6	17:45	72.8	73.2	71.2	72.2	70.6	72.6	71.7	71.6
1/6	18:00	70.9	71.2	69.8	70.4	69.0	70.5	69.4	69.3
1/6	18:15	69.2	68.4	69.1	69.0	68.6	68.2	68.7	68.4
1/6	18:30	68.6	67.9	68.7	68.4	68.2	67.8	68.2	67.9
1/6	18:45	68.4	67.6	68.6	68.1	68.0	67.5	68.0	67.7
1/6	19:00	68.3	67.5	68.5	68.1	68.0	67.4	68.0	67.6
1/6	19:15	68.2	67.4	68.3	67.9	67.8	67.3	67.9	67.4
1/6	19:30	68.2	67.2	68.3	67.6	67.8	67.0	67.8	67.2
1/6	19:45	69.5	69.0	69.4	69.6	68.8	68.8	69.0	68.9
1/6	20:00	67.6	67.1	67.5	67.4	67.0	66.8	66.6	66.2
1/6	20:15	68.0	67.4	68.0	67.7	67.4	67.0	67.4	67.0
1/6	20:30	67.9	67.2	68.0	67.7	67.4	66.9	67.4	67.0
1/6	20:45	67.7	67.1	67.7	67.5	67.3	66.8	67.3	66.9
1/6	21:00	67.6	67.0	67.6	67.3	67.1	66.6	67.2	66.7
1/6	21:15	67.6	67.0	67.6	67.3	67.1	66.6	67.1	66.6
1/6	21:30	67.5	66.9	67.5	67.2	67.0	66.5	67.0	66.6
1/6	21:45	67.5	66.9	67.6	67.3	67.1	66.5	67.1	66.6
1/6	22:00	67.5	66.9	67.5	67.2	66.9	66.4	67.0	66.5
1/6	22:15	67.3	66.8	67.4	67.1	66.9	66.4	66.9	66.5
1/6	22:30	67.4	66.8	67.4	67.1	66.9	66.4	66.9	66.4
1/6	22:45	67.4	66.8	67.4	67.0	66.8	66.3	66.8	66.3
1/6	23:00	67.3	66.7	67.3	67.1	66.8	66.3	66.8	66.4
1/6	23:15	67.3	66.7	67.3	67.0	66.8	66.3	66.8	66.3
1/6	23:30	67.2	66.7	67.3	67.1	66.8	66.3	66.8	66.3
1/6	23:45	67.4	66.9	67.5	67.3	66.9	66.4	66.9	66.4
2/6	0:00	67.1	66.5	67.1	66.8	66.5	66.2	66.1	65.8
2/6	0:15	67.7	67.1	67.7	67.4	67.2	66.9	67.3	67.0
2/6	0:30	68.1	67.3	68.2	67.9	67.7	67.3	67.8	67.5
2/6	0:45	67.9	67.2	68.0	67.6	67.6	67.1	67.6	67.3
2/6	1:00	67.8	67.0	67.9	67.5	67.4	66.8	67.4	67.0
2/6	1:15	73.1	73.5	71.8	72.5	70.9	72.9	71.8	72.0
2/6	1:30	72.6	73.1	71.6	72.3	70.9	72.5	71.8	71.9
2/6	1:45	70.5	70.3	69.7	69.7	68.6	69.5	69.0	68.5
2/6	2:00	69.7	70.4	69.1	69.7	68.2	69.4	68.3	68.1
2/6	2:15	71.8	71.6	70.5	70.6	69.7	70.9	70.2	69.7
2/6	2:30	68.0	67.2	68.0	67.5	67.5	67.0	67.5	67.2
2/6	2:45	68.0	67.1	68.1	67.6	67.6	67.0	67.6	67.2
2/6	3:00	68.1	67.3	68.3	67.9	67.7	67.2	67.7	67.4
2/6	3:15	68.1	67.3	68.2	67.7	67.7	67.1	67.7	67.3
2/6	3:30	68.2	67.3	68.4	67.8	67.8	67.2	67.8	67.3
2/6	3:45	68.3	67.4	68.4	67.8	67.9	67.2	67.9	67.4
2/6	4:00	68.4	67.8	68.1	68.3	67.8	67.5	66.7	67.0
2/6	4:15	67.9	67.3	67.9	67.7	67.4	67.0	67.4	67.1
2/6	4:30	67.9	67.2	67.8	67.5	67.3	66.9	67.4	67.0
2/6	4:45	67.8	67.1	67.8	67.4	67.2	66.7	67.3	66.8
2/6	5:00	67.7	67.0	67.8	67.4	67.3	66.7	67.3	66.8
2/6	5:15	67.6	67.1	67.7	67.3	67.2	66.6	67.3	66.7
2/6	5:30	67.6	67.0	67.7	67.3	67.2	66.6	67.2	66.7
2/6	5:45	67.6	67.0	67.7	67.3	67.2	66.5	67.2	66.7
2/6	6:00	67.6	66.9	67.7	67.3	67.2	66.5	67.2	66.6
2/6	6:15	67.6	66.9	67.7	67.2	67.1	66.5	67.2	66.6
2/6	6:30	67.5	66.9	67.7	67.2	67.1	66.5	67.1	66.6
2/6	6:45	67.6	66.9	67.7	67.2	67.2	66.5	67.2	66.6
2/6	7:00	67.6	66.9	67.6	67.2	67.1	66.4	67.1	66.6
2/6	7:15	67.5	67.0	67.7	67.2	67.1	66.5	67.2	66.6
2/6	7:30	67.6	67.0	67.6	67.2	67.1	66.4	67.1	66.6
2/6	7:45	67.6	66.9	67.6	67.2	67.1	66.4	67.2	66.6
2/6	8:00	71.5	72.3	71.0	70.1	70.0	71.2	69.7	68.1
2/6	8:15	67.7	66.9	67.9	67.4	67.4	66.8	67.5	67.0
2/6	8:30	69.2	68.5	69.2	69.2	68.7	68.5	68.9	68.6
2/6	8:45	68.3	67.3	68.4	67.8	67.9	67.2	68.0	67.4

2/6	9:00	68.2	67.2	68.4	67.8	68.0	67.1	68.0	67.4
2/6	9:15	68.3	67.4	68.6	68.0	68.1	67.4	68.1	67.6
2/6	9:30	68.3	67.4	68.5	67.9	68.1	67.4	68.1	67.6
2/6	9:45	68.9	67.6	68.9	68.0	68.2	67.5	68.3	67.6
2/6	10:00	68.8	67.6	68.7	67.9	68.1	67.4	68.1	67.5
2/6	10:15	69.2	68.1	69.1	68.2	68.5	67.7	68.5	67.6
2/6	10:30	68.4	67.5	68.7	68.0	68.1	67.4	68.2	67.6
2/6	10:45	68.3	67.3	68.5	68.0	68.0	67.3	68.0	67.5
2/6	11:00	68.3	67.3	68.6	67.9	68.1	67.3	68.1	67.5
2/6	11:15	68.3	67.4	68.5	67.9	68.1	67.3	68.1	67.5
2/6	11:30	68.4	67.4	68.7	68.0	68.2	67.4	68.2	67.6
2/6	11:45	68.3	67.3	68.4	67.7	68.0	67.2	68.0	67.4
2/6	12:00	68.2	67.5	67.9	68.0	67.6	67.3	66.9	66.7
2/6	12:15	68.3	67.4	68.3	67.8	67.7	67.1	67.7	67.2
2/6	12:30	68.1	67.3	68.1	67.6	67.6	67.0	67.6	67.0
2/6	12:45	68.0	67.1	68.0	67.5	67.5	66.9	67.6	67.0
2/6	13:00	67.9	67.1	67.9	67.4	67.5	66.7	67.5	66.9
2/6	13:15	67.8	67.0	67.9	67.3	67.4	66.7	67.4	66.8
2/6	13:30	67.7	66.9	67.8	67.3	67.4	66.6	67.4	66.8
2/6	13:45	67.7	66.9	67.9	67.3	67.4	66.7	67.4	66.8
2/6	14:00	67.7	66.8	67.8	67.2	67.4	66.5	67.3	66.7
2/6	14:15	67.7	66.9	68.0	67.4	67.5	66.7	67.5	66.8
2/6	14:30	67.7	66.8	67.8	67.2	67.3	66.5	67.3	66.6
2/6	14:45	67.6	66.9	67.7	67.2	67.3	66.5	67.2	66.6
2/6	15:00	67.7	67.0	67.8	67.2	67.3	66.5	67.3	66.7
2/6	15:15	67.6	66.9	67.7	67.2	67.2	66.5	67.2	66.6
2/6	15:30	67.6	66.9	67.7	67.2	67.3	66.5	67.3	66.7
2/6	15:45	67.6	67.0	67.8	67.3	67.3	66.6	67.3	66.7
2/6	16:00	71.8	72.9	70.9	70.4	70.0	71.3	70.3	68.8
2/6	16:15	68.2	67.3	68.5	67.9	68.0	67.3	68.0	67.5
2/6	16:30	71.2	70.3	70.9	70.9	70.5	70.3	70.8	70.3
2/6	16:45	68.1	67.3	68.3	67.8	67.8	67.2	67.8	67.4
2/6	17:00	69.0	68.9	68.9	68.8	68.2	68.3	68.3	67.9
2/6	17:15	68.2	67.3	68.3	67.7	67.8	67.2	67.9	67.4
2/6	17:30	68.1	67.2	68.4	67.7	67.9	67.2	67.9	67.4
2/6	17:45	68.1	67.3	68.4	67.8	68.0	67.3	68.0	67.5
2/6	18:00	68.2	67.3	68.4	67.8	68.0	67.2	67.9	67.4
2/6	18:15	68.3	67.4	68.5	67.8	68.0	67.3	68.0	67.5
2/6	18:30	68.5	67.5	68.7	68.0	68.2	67.4	68.2	67.6
2/6	18:45	70.7	70.5	70.3	70.5	69.5	70.0	69.8	69.2
2/6	19:00	68.2	67.3	68.4	67.7	67.9	67.2	67.9	67.4
2/6	19:15	68.2	67.2	68.5	67.7	67.9	67.2	67.9	67.3
2/6	19:30	68.4	67.4	68.6	67.9	68.1	67.4	68.1	67.5
2/6	19:45	68.7	67.7	68.9	68.3	68.5	67.7	68.5	67.9
2/6	20:00	67.8	67.3	67.8	67.7	67.4	67.1	66.8	66.5
2/6	20:15	68.6	67.8	68.7	68.2	68.2	67.5	68.2	67.6
2/6	20:30	68.5	67.7	68.6	68.1	68.1	67.4	68.1	67.5
2/6	20:45	68.3	67.5	68.4	67.9	67.9	67.2	67.9	67.3
2/6	21:00	68.1	67.3	68.2	67.7	67.7	67.0	67.7	67.2
2/6	21:15	68.0	67.3	68.1	67.7	67.7	67.0	67.6	67.1
2/6	21:30	67.8	67.1	68.0	67.5	67.5	66.9	67.5	67.0
2/6	21:45	67.8	67.1	67.9	67.5	67.5	66.8	67.5	66.9
2/6	22:00	67.8	67.0	68.0	67.5	67.5	66.8	67.5	67.0
2/6	22:15	67.6	66.8	67.7	67.3	67.3	66.6	67.2	66.7
2/6	22:30	67.8	67.0	67.9	67.3	67.4	66.6	67.3	66.8
2/6	22:45	67.6	66.9	67.8	67.3	67.3	66.6	67.3	66.7
2/6	23:00	67.6	66.8	67.8	67.3	67.3	66.6	67.3	66.7
2/6	23:15	67.6	66.9	67.9	67.3	67.4	66.6	67.3	66.8
2/6	23:30	67.7	67.0	67.9	67.4	67.4	66.7	67.4	66.8
2/6	23:45	67.8	67.1	68.0	67.5	67.5	66.7	67.5	66.9
3/6	0:00	67.5	66.8	67.7	67.1	67.2	66.7	67.1	66.6
3/6	0:15	68.1	67.2	68.3	67.6	67.8	67.1	67.8	67.3
3/6	0:30	72.2	72.1	71.6	71.9	71.0	72.0	71.6	71.4
3/6	0:45	68.8	67.7	68.9	68.3	68.3	67.6	68.3	67.8
3/6	1:00	68.4	67.5	68.6	67.9	68.1	67.3	68.1	67.5
3/6	1:15	68.5	67.5	68.6	67.9	68.2	67.3	68.2	67.5
3/6	1:30	68.7	67.6	68.9	68.2	68.4	67.6	68.4	67.8
3/6	1:45	69.1	67.9	69.2	68.6	68.7	67.9	68.7	68.1
3/6	2:00	68.3	67.3	68.5	67.8	68.1	67.3	68.0	67.4
3/6	2:15	68.4	67.4	68.6	67.8	68.2	67.3	68.1	67.5
3/6	2:30	68.3	67.3	68.5	67.8	68.1	67.3	68.1	67.4
3/6	2:45	68.3	67.3	68.5	67.8	68.0	67.2	68.0	67.4
3/6	3:00	68.3	67.3	68.5	67.8	68.1	67.3	68.1	67.5

3/6	3:15	68.4	67.3	68.5	67.7	68.1	67.3	68.1	67.5
3/6	3:30	68.4	67.3	68.6	67.8	68.2	67.3	68.2	67.5
3/6	3:45	68.5	67.4	68.7	67.8	68.2	67.3	68.2	67.6
3/6	4:00	68.0	67.5	67.8	68.0	67.5	67.2	67.2	66.5
3/6	4:15	68.5	67.6	68.5	67.9	68.0	67.3	68.0	67.4
3/6	4:30	68.4	67.5	68.5	67.9	67.9	67.2	67.9	67.4
3/6	4:45	68.1	67.3	68.2	67.7	67.7	67.0	67.7	67.1
3/6	5:00	68.1	67.3	68.2	67.6	67.8	67.0	67.7	67.1
3/6	5:15	68.0	67.2	68.1	67.5	67.7	66.9	67.7	67.1
3/6	5:30	67.9	67.1	68.1	67.6	67.6	66.9	67.6	67.0
3/6	5:45	67.8	67.0	67.9	67.4	67.5	66.8	67.4	66.9
3/6	6:00	67.0	66.3	67.3	66.5	67.0	66.2	66.8	66.2
3/6	6:15	66.6	66.3	67.3	67.0	66.9	66.2	66.7	66.2
3/6	6:30	66.7	66.1	67.3	66.9	66.8	66.1	66.5	66.0
3/6	6:45	66.4	66.0	67.1	66.6	66.7	66.1	66.7	66.3
3/6	7:00	65.3	65.1	66.0	65.6	65.5	64.9	65.0	64.8
3/6	7:15	66.9	66.4	67.6	67.3	66.8	66.1	66.8	66.3
3/6	7:30	66.7	66.3	67.3	66.9	66.9	66.1	66.6	66.2
3/6	7:45	67.5	66.7	67.8	67.4	67.2	66.5	67.2	66.6
3/6	8:00	66.9	66.3	67.6	66.9	67.0	66.4	66.8	66.5
3/6	8:15	67.1	66.6	67.9	67.3	67.4	66.8	67.3	67.1
3/6	8:30	67.5	66.7	67.7	67.3	67.4	66.7	67.2	66.7
3/6	8:45	68.0	67.1	68.3	67.7	67.9	67.2	67.9	67.5
3/6	9:00	68.1	67.1	68.4	67.8	67.8	67.2	67.8	67.3
3/6	9:15	68.5	67.4	68.6	68.2	68.2	67.5	68.4	67.8
3/6	9:30	68.0	67.2	68.2	67.7	67.8	67.2	67.9	67.4
3/6	9:45	68.3	67.3	68.5	67.7	68.0	67.2	68.0	67.4
3/6	10:00	68.2	67.2	68.5	67.8	68.0	67.3	68.0	67.5
3/6	10:15	67.4	66.7	67.9	67.2	67.6	66.7	67.4	66.9
3/6	10:30	67.4	66.4	67.5	66.9	67.4	66.6	67.4	66.8
3/6	10:45	67.6	66.8	68.0	67.0	67.4	66.6	67.3	66.7
3/6	11:00	68.0	66.9	68.0	67.5	67.6	66.7	67.6	67.1
3/6	11:15	68.1	67.1	68.3	67.5	67.9	67.2	68.0	67.3
3/6	11:30	67.8	66.9	68.1	67.2	67.6	66.7	67.4	66.9
3/6	11:45	67.8	66.7	68.1	67.0	67.6	66.8	67.5	66.8
3/6	12:00	67.9	66.6	67.9	67.2	67.4	66.6	67.3	66.6
3/6	12:15	67.5	66.5	67.9	67.3	67.6	66.8	67.5	66.8
3/6	12:30	67.5	66.5	67.9	67.2	67.7	66.8	67.5	66.8
3/6	12:45	67.6	66.7	67.9	67.4	67.4	66.4	67.2	66.6
3/6	13:00	67.0	66.4	67.5	66.8	67.2	66.5	67.3	66.6
3/6	13:15	67.8	66.9	68.0	67.5	67.5	66.8	67.5	66.9
3/6	13:30	67.1	66.6	67.5	67.0	67.1	66.3	67.0	66.6
3/6	13:45	67.5	66.5	67.5	67.2	67.1	66.3	67.1	66.5
3/6	14:00	67.0	66.4	67.2	66.8	66.8	66.3	66.8	66.3
3/6	14:15	67.1	66.4	67.2	66.8	66.8	66.0	66.9	66.4
3/6	14:30	67.2	66.5	67.4	67.0	67.0	66.3	66.8	66.3
3/6	14:45	67.2	66.6	67.3	67.1	66.9	66.2	66.7	66.2
3/6	15:00	67.5	66.7	67.6	67.2	67.1	66.6	67.1	66.8
3/6	15:15	67.4	66.8	67.5	67.1	67.1	66.4	67.0	66.6
3/6	15:30	67.4	66.8	67.6	67.2	67.1	66.4	67.1	66.6
3/6	15:45	67.1	66.5	67.2	66.8	66.7	66.0	66.6	66.2
3/6	16:00	67.0	66.4	67.4	66.9	66.9	66.3	66.8	66.5
3/6	16:15	67.4	66.7	67.4	67.0	67.1	66.5	67.0	66.7
3/6	16:30	67.5	66.9	67.7	67.5	67.2	66.9	67.2	66.9
3/6	16:45	67.6	66.7	67.8	67.3	67.4	66.8	67.3	67.0
3/6	17:00	67.7	67.0	67.7	67.4	67.5	66.8	67.4	67.1
3/6	17:15	68.1	67.3	68.1	67.8	67.6	67.1	67.9	67.2
3/6	17:30	68.1	67.0	68.3	67.5	67.6	67.0	67.5	67.1
3/6	17:45	68.3	67.5	68.4	67.8	67.9	67.4	68.0	67.4
3/6	18:00	67.7	66.9	67.8	67.2	67.3	66.8	67.3	66.8
3/6	18:15	67.6	66.9	67.8	67.5	67.6	66.8	67.5	67.1
3/6	18:30	71.2	70.8	70.5	70.8	69.5	70.6	70.1	70.1
3/6	18:45	67.8	66.9	68.1	67.3	67.4	66.7	67.4	66.8
3/6	19:00	68.4	67.5	68.7	68.1	68.2	67.5	68.1	67.7
3/6	19:15	68.3	67.4	68.5	67.8	68.0	67.3	67.9	67.5
3/6	19:30	67.6	66.9	67.9	67.3	67.5	67.0	67.7	67.2
3/6	19:45	67.6	66.8	67.8	67.1	67.2	66.6	67.3	66.8
3/6	20:00	68.1	67.2	68.1	67.5	67.4	66.7	67.2	66.6
3/6	20:15	67.4	66.6	67.7	67.3	67.3	66.7	67.1	66.7
3/6	20:30	67.6	66.7	67.6	67.2	67.0	66.3	66.8	66.4
3/6	20:45	67.5	66.7	67.5	67.1	67.0	66.1	66.8	66.3
3/6	21:00	67.7	66.9	67.7	67.3	67.2	66.6	67.2	66.7
3/6	21:15	67.3	66.4	67.4	66.9	66.8	66.1	66.7	66.3
3/6	21:30	67.1	66.3	67.3	66.9	66.8	66.1	66.9	66.5
3/6	21:45	68.4	67.4	68.3	67.8	67.8	66.9	67.7	67.1
3/6	22:00	68.0	67.5	68.2	67.7	67.8	67.0	67.7	67.1
3/6	22:15	68.7	67.8	68.6	68.2	68.2	67.4	68.0	67.5
3/6	22:30	68.8	67.9	68.8	68.2	68.4	67.6	68.3	67.7
3/6	22:45	69.6	68.6	69.6	68.8	69.0	68.0	69.0	68.1
3/6	23:00	69.8	68.7	69.8	69.0	69.3	68.3	69.1	68.5
3/6	23:15	69.2	68.2	69.4	68.3	68.7	67.8	68.5	67.7
3/6	23:30	69.2	67.9	69.3	68.5	68.9	67.9	68.6	67.8
3/6	23:45	69.3	68.2	69.3	68.6	69.1	68.2	69.0	68.1
4/6	0:00	68.4	67.1	68.3	67.5	68.0	66.3	68.1	67.1
4/6	0:15	69.9	68.6	70.1	68.8	69.6	68.4	69.5	68.6
4/6	0:30	69.9	68.2	69.8	68.5	69.3	67.5	68.9	67.9
4/6	0:45	70.8	69.0	70.7	69.3	70.3	68.6	70.1	68.8
4/6	1:00	69.9	68.6	69.8	69.0	69.8	68.1	69.9	68.6
4/6	1:15	71.7	70.0	71.9	70.3	71.4	69.8	71.3	70.0
4/6	1:30	71.2	69.8	71.4	70.2	70.9	69.1	70.9	69.8
4/6	1:45	71.8	70.1	72.2	70.7	71.7	69.9	71.5	70.1
4/6	2:00	72.5	70.6	72.4	71.2	72.3	70.4	72.1	70.8
4/6	2:15	73.0	71.4	73.1	71.8	72.7	71.1	72.5	71.5
4/6	2:30	72.7	71.2	72.6	71.7	72.3	70.9	72.4	71.3
4/6	2:45	73.4	71.6	73.6	72.1	73.1	71.3	73.0	71.6
4/6	3:00	73.3	71.9	73.5	72.5	73.0	71.6	72.9	72.0
4/6	3:15	73.5	71.8	73.3	72.2	73.0	71.4	72.9	71.8
4/6	3:30	74.0	72.3	74.3	72.8	73.7	72.0	73.6	72.2
4/6	3:45	73.8	72.3	73.6	72.8	73.3	71.9	73.2	72.3
4/6	4:00	74.0	72.6	74.0	73.1	73.7	72.4	73.5	72.5
4/6	4:15	73.2	71.9	73.1	72.2	72.7	71.6	72.6	71.7
4/6	4:30	73.0	71.8	72.9	72.2	72.7	71.6	72.6	71.8
4/6	4:45	72.5	71.3	72.5	71.7	72.1	71.2	72.0	71.3
4/6	5:00	72.2	71.1	72.4	71.5	72.0	71.0	71.8	71.1
4/6	5:15	72.2	71.1	72.2	71.3	71.8	70.8	71.6	71.0
4/6	5:30	72.1	71.0	72.1	71.3	71.8	70.8	71.7	71.0
4/6	5:45	71.5	70.6	71.7	70.8	71.3	70.3	71.1	70.3
4/6	6:00	70.5	69.6	71.1	70.2	70.8	69.8	70.4	69.8
4/6	6:15	69.9	69.5	70.8	70.0	70.4	69.6	70.3	69.7
4/6	6:30	70.6	69.6	70.7	69.8	70.2	69.2	70.0	69.6
4/6	6:45	70.5	69.4	70.7	70.1	70.6	69.6	70.3	69.7
4/6	7:00	69.5	68.5	68.9	68.8	68.9	68.2	68.0	67.7
4/6	7:15	69.6	68.8	69.8	69.1	69.3	68.3	68.8	68.5
4/6	7:30	67.5	66.7	67.5	66.9	66.9	66.6	66.1	65.6
4/6	7:45	68.2	67.5	68.5	67.8	68.1	67.5	68.1	67.6
4/6	8:00	67.3	66.6	67.6	67.0	67.2	66.5	67.3	66.7
4/6	8:15	68.2	67.1	68.5	67.7	67.9	67.2	68.0	67.3
4/6	8:30	67.4	66.7	67.5	67.1	67.1	66.5	66.8	66.6
4/6	8:45	67.5	66.7	67.7	66.9	67.1	66.4	67.1	66.3
4/6	9:00	67.5	66.3	67.4	66.5	66.9	66.2	66.6	66.4
4/6	9:15	67.3	66.3	67.4	66.8	66.8	66.1	66.7	66.3
4/6	9:30	67.3	66.3	67.5	66.9	67.2	66.3	67.0	66.6
4/6	9:45	67.6	66.6	67.9	67.2	67.3	66.7	67.4	66.9
4/6	10:00	65.7	65.0	65.7	65.5	65.1	65.0	65.1	64.3
4/6	10:15	69.2	67.5	69.1	68.3	68.6	67.4	68.8	67.4
4/6	10:30	67.7	66.4	67.9	66.9	67.3	66.3	67.3	66.2
4/6	10:45	67.2	65.9	67.4	66.2	66.9	65.7	66.9	66.0
4/6	11:00	67.9	66.6	68.1	67.5	67.5	66.7	67.5	67.0
4/6	11:15	68.1	66.5	68.1	67.2	67.9	66.2	67.8	66.4
4/6	11:30	68.6	67.2	68.7	67.9	68.3	67.3	68.2	67.4
4/6	11:45	67.9	66.5	68.2	67.4	67.8	66.1	68.0	66.4
4/6	12:00	68.4	67.2	68.6	67.9	68.3	67.1	68.2	67.3
4/6	12:15	68.7	67.6	69.1	68.1	68.4	67.4	68.6	67.7
4/6	12:30	69.2	68.0	69.5	68.7	69.0	68.0	68.8	68.1
4/6	12:45	68.9	68.0	69.3	68.5	68.9	67.5	68.8	67.9
4/6	13:00	68.9	67.8	69.3	68.5	68.9	67.7	68.4	67.7
4/6	13:15	69.5	68.5	69.8	68.9	69.4	68.3	69.1	68.4
4/6	13:30	69.5	68.4	69.8	68.9	69.3	68.3	69.1	68.4
4/6	13:45	69.4	68.5	69.8	68.9	69.4	68.4	69.1	68.4
4/6	14:00	68.8	67.7	69.4	68.4	68.7	67.9	68.7	68.0
4/6	14:15	69.6	67.9	70.2	68.4	69.6	68.0	69.4	68.2
4/6	14:30	68.5	67.6	69.2	68.7	69.1	67.6	68.9	67.7
4/6	14:45	69.7	68.3	70.1	69.0	69.6	68.3	69.6	68.6
4/6	15:00	69.4	68.2	70.1	68.9	69.3	68.1	69.3	68.4
4/6	15:15	69.8	68.5	70.7	69.3	70.4	68.8	70.0	69.0
4/6	15:30	69.7	68.4	69.9	69.1	69.7	68.6	69.7	68.7

4/6	15:45	70.3	68.7	70.9	69.5	70.2	68.5	70.0	68.5
4/6	16:00	70.6	69.2	70.9	69.9	70.6	69.5	70.5	69.7
4/6	16:15	70.3	68.9	70.5	69.3	70.1	68.7	69.5	69.0
4/6	16:30	69.4	68.4	70.1	69.4	69.7	68.7	69.5	68.8
4/6	16:45	70.1	69.0	70.5	69.6	69.8	69.0	69.8	68.8
4/6	17:00	69.8	68.8	70.4	69.8	70.0	69.0	69.8	68.9
4/6	17:15	69.5	68.5	70.1	69.3	69.8	68.5	69.7	69.1
4/6	17:30	69.8	68.6	69.8	69.3	69.5	68.4	69.2	68.4
4/6	17:45	69.8	68.7	70.0	69.3	69.6	68.5	69.2	68.4
4/6	18:00	69.7	68.3	69.9	69.3	69.3	68.3	69.5	68.6
4/6	18:15	69.1	68.0	69.8	68.8	69.4	68.3	69.5	68.6
4/6	18:30	69.8	68.2	70.0	68.7	69.7	68.0	69.3	68.4
4/6	18:45	69.6	68.6	70.1	69.1	69.4	68.0	69.3	68.3
4/6	19:00	70.4	68.9	70.8	69.6	70.2	68.6	70.2	69.1
4/6	19:15	70.3	69.2	70.8	69.8	70.3	69.4	70.2	69.5
4/6	19:30	69.8	68.3	70.2	68.7	69.3	67.9	69.4	68.3
4/6	19:45	69.8	68.8	70.4	69.3	69.9	69.0	69.7	68.8
4/6	20:00	69.5	68.5	70.3	69.0	69.7	68.6	69.6	68.9
4/6	20:15	69.8	68.6	70.4	69.3	69.6	68.5	69.4	68.7
4/6	20:30	69.3	68.5	69.6	68.7	69.5	68.4	69.2	68.7
4/6	20:45	69.9	68.7	70.2	69.2	69.4	68.5	69.2	68.5
4/6	21:00	68.8	68.0	69.6	68.6	69.5	68.7	69.2	68.7
4/6	21:15	69.9	68.9	70.3	69.5	69.9	68.8	69.7	69.0
4/6	21:30	69.4	68.4	69.8	68.8	69.3	68.3	69.0	68.7
4/6	21:45	69.7	68.7	70.0	69.3	69.4	68.4	69.1	68.6
4/6	22:00	69.3	68.3	70.0	69.5	69.4	68.7	69.2	68.7
4/6	22:15	69.7	68.7	70.1	69.3	69.5	68.4	69.3	68.7
4/6	22:30	70.3	68.8	70.6	69.6	70.3	68.7	70.1	69.1
4/6	22:45	70.3	69.3	70.8	69.9	70.3	69.4	70.2	69.6
4/6	23:00	70.2	68.8	70.5	69.5	70.2	68.6	70.1	68.9
4/6	23:15	69.5	68.6	70.2	69.4	69.9	68.9	69.5	69.2
4/6	23:30	69.7	68.2	69.9	68.9	69.6	68.0	69.7	68.6
4/6	23:45	70.1	68.8	70.5	69.2	69.7	68.8	69.7	69.0
5/6	0:00	69.3	68.4	70.1	69.2	69.9	68.9	69.6	68.9
5/6	0:15	70.0	68.7	70.3	69.2	69.5	68.7	69.4	68.6
5/6	0:30	69.7	68.8	70.3	69.6	69.8	68.9	69.9	69.1
5/6	0:45	69.0	68.4	70.0	69.0	69.5	68.4	69.0	68.3
5/6	1:00	69.0	68.1	69.7	69.1	69.4	68.7	69.2	68.7
5/6	1:15	69.8	69.0	70.4	69.7	69.9	69.1	69.9	69.2
5/6	1:30	69.9	69.0	70.4	69.8	70.0	69.2	69.9	69.3
5/6	1:45	69.8	69.0	70.4	69.6	69.8	69.0	69.7	69.1
5/6	2:00	69.6	68.5	70.0	69.3	69.4	68.4	69.5	68.7
5/6	2:15	69.9	68.7	70.2	69.5	69.6	68.5	69.8	68.8
5/6	2:30	70.3	69.0	70.9	69.7	70.4	69.1	70.2	69.2
5/6	2:45	70.0	69.0	70.5	69.8	69.9	68.9	69.9	69.1
5/6	3:00	70.4	68.9	71.0	69.6	70.4	69.0	70.2	69.1
5/6	3:15	70.1	69.1	70.8	69.9	70.2	69.4	70.2	69.4
5/6	3:30	70.1	68.7	70.6	69.5	70.1	68.6	69.9	68.9
5/6	3:45	70.1	69.1	70.7	69.8	70.3	69.3	70.2	69.5
5/6	4:00	70.2	69.0	70.6	69.8	70.3	69.2	70.1	69.2
5/6	4:15	70.0	69.0	70.6	69.8	70.2	69.1	69.9	69.1
5/6	4:30	69.8	68.8	70.4	69.6	69.9	68.9	69.7	69.0
5/6	4:45	69.7	68.9	70.3	69.6	69.9	69.0	69.8	69.1
5/6	5:00	69.7	68.9	70.4	69.6	69.9	69.0	69.8	69.1
5/6	5:15	69.9	69.0	70.5	69.8	69.9	69.1	69.8	69.1
5/6	5:30	69.8	68.9	70.4	69.7	69.9	69.1	69.8	69.2
5/6	5:45	69.6	68.8	70.2	69.6	69.6	68.7	69.5	68.8
5/6	6:00	73.6	74.4	73.9	74.1	73.8	74.5	74.1	74.1
5/6	6:15	70.0	69.0	70.5	69.7	70.1	69.1	70.0	69.5
5/6	6:30	69.9	68.5	70.4	69.4	69.9	68.3	69.6	68.7
5/6	6:45	70.1	68.9	70.8	69.7	70.2	69.2	69.9	69.1
5/6	7:00	69.6	68.4	70.1	69.3	69.7	68.5	69.8	68.8
5/6	7:15	60.7	59.4	61.0	63.2	62.5	62.4	59.6	57.8
5/6	7:30	54.0	56.0	59.9	61.2	59.3	60.3	61.1	59.0
5/6	7:45	51.2	51.2	57.4	58.0	55.1	55.5	58.3	53.4
5/6	8:00	42.2	46.1	48.0	54.5	47.5	53.9	50.2	50.7
5/6	8:15	40.1	29.8	41.9	36.0	38.4	34.6	44.8	37.4
5/6	8:30	36.4	25.2	40.2	32.5	40.3	22.2	38.1	24.4
5/6	8:45	33.9	24.8	40.4	33.6	39.1	24.4	35.6	25.0
5/6	9:00	33.9	23.0	38.1	32.3	36.5	22.0	37.1	23.7
5/6	9:15	19.4	19.0	21.0	20.6	20.3	19.1	25.1	18.6

A.3. Selected material testing data

B.3.1 Moisture Content

25mm MC Sections				500mm Boards Sections				
Sample No.	Green Mass	OD Mass	MC%	500mm Board	MC section Ave.	MC Board Ave.	Max MC Values	Min MC Values
020A	71.75	66.15	8.5	20A	9.4			
020B	80.1	72.63	10.3	20B	10.6			
020C	77.01	69.46	10.9	20C	10.8	10.3	10.8	9.4
020D	79.96	72.16	10.8					
023A	74.08	66.71	11.0	23A	11.0			
023B	72.37	65.25	10.9	23B	10.8			
023C	70.45	63.63	10.7	23C	10.8	10.9	11.0	10.8
023D	73.84	66.64	10.8					
027A	75.01	67.65	10.9	27A	10.8			
027B	69.93	63.17	10.7	27B	10.5			
027C	67.27	60.99	10.3	27C	10.7			
027D	65.23	58.67	11.2	27D	11.5			
027E	66.9	59.8	11.9	27E	11.7			
027F	65.92	59.15	11.4	27F	11.4	11.1	11.7	10.5
027G	74	66.4	11.4					
029A	45.3	41.99	7.9	29A	8.5			
029B	65.21	59.75	9.1	29B	10.3			
029C	76.71	68.81	11.5	29C	11.6	10.1	11.6	8.5
029D	87.31	78.14	11.7					
030A	71.05	64.5	10.2	30A	11.3			
030B	60.55	53.86	12.4	30B	11.7			
030C	48.22	43.42	11.1	30C	10.5	11.2	11.7	10.5
030D	59.86	54.44	10.0					
068A	69.77	64.2	8.7	68A	9.3			
068B	73.72	67.05	9.9	68B	10.3			
068C	71.89	64.94	10.7	68C	10.7	10.1	10.7	9.3
068D	75.17	67.95	10.6					
076A	61.23	55.85	9.6	76A	9.7			
076B	60.98	55.55	9.8	76B	9.8			
076C	51.86	47.22	9.8	76C	9.8			
076D	63.95	58.21	9.9	76D	9.6	9.7	9.8	9.6
076E	68.16	62.32	9.4					
077A	78.26	70.47	11.1	77A	11.0			
077B	73.05	65.84	11.0	77B	11.2			
077C	61.25	54.98	11.4	77C	10.8	11.0	11.2	10.8
077D	74.22	67.3	10.3					
095A	66.11	60.14	9.9	95A	10.3			
095B	73.11	66.11	10.6	95B	10.6	10.5	10.6	10.3
095C	67.33	60.82	10.7					
099A	73.05	65.68	11.2	99A	11.1			
099B	65.39	58.89	11.0	99B	10.8			
099C	65.08	58.88	10.5	99C	10.6	10.8	11.1	10.6
099D	66.89	60.43	10.7					
1001A	65.4	59.85	9.3	1001A	9.4			
1001B	65.18	59.5	9.5	1001B	9.6			
1001C	65.55	59.75	9.7	1001C	9.7			
1001D	63.27	57.73	9.6	1001D	9.6	9.6	9.7	9.4
1001E	65.07	59.37	9.6					
1006A	59.2	53.67	10.3	1006A	10.1			
1006B	61.04	55.57	9.8	1006B	9.9			
1006C	61.93	56.35	9.9	1006C	9.9	10.0	10.1	9.9
1006D	59.15	53.81	9.9					
1007A	63.16	57.66	9.5	1007A	9.6			
1007B	52.32	47.71	9.7	1007B	9.7			
1007C	56.42	51.42	9.7	1007C	9.6	9.6	9.7	9.6
1007D	61.35	56.06	9.4					
1009A	46.95	42.87	9.5	1009A	9.4			
1009B	49.62	45.41	9.3	1009B	9.3			
1009C	62.25	56.92	9.4	1009C	9.5			
1009D	56.78	51.83	9.6	1009D	9.7			
1009E	59.6	54.27	9.8	1009E	9.6			
1009F	59.62	54.48	9.4	1009F	9.5			
1009G	48.45	44.2	9.6	1009G	9.6	9.5	9.7	9.3
1009H	58.2	53.11	9.6					
1012A	79.08	72.53	9.0	1012A	8.9			
1012B	80.39	73.85	8.9	1012B	9.3			
1012C	84.2	76.72	9.7	1012C	9.8	9.3	9.8	8.9
1012D	80.05	72.87	9.9					
1016A	59.83	54.05	10.7	1016A	10.5			
1016B	56.42	51.11	10.4	1016B	10.2			
1016C	59.23	53.88	9.9	1016C	10.1	10.3	10.5	10.1
1016D	61.17	55.44	10.3					
1025A	65.53	59.55	10.0	1025A	10.2			
1025B	66.72	60.48	10.3	1025B	10.4			
1025C	82.85	75.02	10.4	1025C	10.6			
1025D	76	68.58	10.8	1025D	10.6			
1025E	77.21	69.93	10.4	1025E	10.4			
1025F	67.08	60.81	10.3	1025F	10.3			
1025G	59.65	54.08	10.3	1025G	10.4	10.4	10.6	10.2
1025H	63.59	57.58	10.4					
1032A	70.63	64.28	9.9	1032A	10.2			
1032B	73.03	66.07	10.5	1032B	10.6			
1032C	90.82	82.13	10.6	1032C	10.7			
1032D	77.26	69.78	10.7	1032D	10.7			
1032E	81.37	73.58	10.6	1032E	10.4			
1032F	73.38	66.54	10.3	1032F	10.5			
1032G	59.38	53.59	10.8	1032G	10.6	10.5	10.7	10.2
1032H	69.76	63.17	10.4					
1039A	68.09	61.96	9.9	1039A	10.2			
1039B	58.15	52.65	10.4	1039B	10.1	10.2	10.2	10.1
1039C	62.54	56.95	9.8					
1040A	61.42	56.17	9.3	1040A	9.4			
1040B	54.57	49.88	9.4	1040B	9.3			
1040C	53.33	48.85	9.2	1040C	9.2			
1040D	48.77	44.67	9.2	1040D	9.1			
1040E	52.77	48.4	9.0	1040E	9.1			
1040F	66.61	61.05	9.1	1040F	9.1			
1040G	59.78	54.78	9.1	1040G	9.1	9.2	9.4	9.1
1040H	66.26	60.77	9.0					
1044A	46.93	42.2	11.2	1044A	11.1			
1044B	66.97	60.31	11.0	1044B	11.1			
1044C	72.76	65.42	11.2	1044C	11.4			
1044D	63.54	56.97	11.5	1044D	11.7			
1044E	64.52	57.67	11.9	1044E	11.9			
1044F	73.81	65.95	11.9	1044F	12.0	11.5	12.0	11.1
1044G	65.28	58.25	12.1					
1046A	71.64	64.87	10.4	1046A	10.5			
1046B	71.42	64.6	10.6	1046B	10.7			
1046C	75.92	68.52	10.8	1046C	10.9			
1046D	66.89	60.25	11.0	1046D	10.8			
1046E	65.42	59.21	10.5	1046E	10.7			
1046F	77.66	69.98	11.0	1046F	11.2			
1046G	75.27	67.59	11.4	1046G	10.9	10.8	11.2	10.5
1046H	71.3	64.53	10.5					
1048A	66.04	59.39	11.2	1048A	10.8			
1048B	66.06	59.8	10.5	1048B	10.5			
1048C	72.24	65.4	10.5	1048C	10.5			
1048D	62.43	56.43	10.6	1048D	10.7			
1048E	61.43	55.46	10.8	1048E	10.7			
1048F	70.82	64.01	10.6	1048F	10.7			
1048G	73.43	66.29	10.8	1048G	10.9	10.7	10.9	10.5
1048H	68.85	62.02	11.0					
1049A	67.55	60.84	11.0	1049A	10.8			
1049B	63.8	57.65	10.7	1049B	11.0			
1049C	64.42	57.85	11.4	1049C	11.2			
1049D	66.96	60.28	11.1	1049D	11.5			
1049E	70.04	62.63	11.8	1049E	11.3			
1049F	61.77	55.76	10.8	1049F	10.7	11.1	11.5	10.7
1049G	60.36	54.61	10.5					

1053A	54.03	48.38	11.7	1053A	11.6			
1053B	68.09	61.07	11.5	1053B	11.6			
1053C	70.64	63.25	11.7	1053C	11.3			
1053D	63.36	57.14	10.9	1053D	11.5			
1053E	68.07	60.67	12.2	1053E	11.9			
1053F	77.8	69.68	11.7	1053F	11.6	11.6	11.9	11.3
1053G	66.98	60.08	11.5					
1058A	78.69	71.02	10.8	1058A	11.2			
1058B	82.09	73.62	11.5	1058B	11.2			
1058C	87.81	79.12	11.0	1058C	11.0			
1058D	69.73	62.85	10.9	1058D	10.6			
1058E	64.23	58.27	10.2	1058E	10.5			
1058F	76.95	69.52	10.7	1058F	11.1	10.9	11.2	10.5
1058G	79.04	70.86	11.5					
1061A	72.06	65.31	10.3	1061A	10.6			
1061B	62.48	56.37	10.8	1061B	10.9			
1061C	64.07	57.75	10.9	1061C	11.0			
1061D	75.52	67.95	11.1	1061D	11.1			
1061E	74.28	66.91	11.0	1061E	11.0			
1061F	72.74	65.51	11.0	1061F	11.0			
1061G	68.86	62.05	11.0	1061G	11.2	11.0	11.2	10.6
1061H	68.84	61.78	11.4					
1063A	76.29	68.53	11.3	1063A	12.0			
1063B	69.16	61.37	12.7	1063B	12.6			
1063C	71.24	63.32	12.5	1063C	12.4			
1063D	80.7	71.88	12.3	1063D	12.4			
1063E	79.05	70.27	12.5	1063E	12.2			
1063F	73.73	65.91	11.9	1063F	11.7			
1063G	72.99	65.49	11.5	1063G	11.5	12.1	12.6	11.5
1063H	72.82	65.29	11.5					
1074A	69.46	62.25	11.6	1074A	11.2			
1074B	60.89	54.94	10.8	1074B	11.1			
1074C	62.21	55.9	11.3	1074C	11.4			
1074D	75.11	67.41	11.4	1074D	11.0			
1074E	72.04	65.14	10.6	1074E	11.1			
1074F	70.26	62.96	11.6	1074F	11.4	11.2	11.4	11.0
1074G	69.73	62.76	11.1					
1083A	77.9	70.43	10.6	1083A	10.7			
1083B	72.88	65.73	10.9	1083B	11.1	10.9	11.1	10.7
1083C	72.13	64.81	11.3					
1100A	56.59	51.21	10.5	1100A	10.5			
1100B	58.93	53.33	10.5	1100B	10.9			
1100C	59.95	53.87	11.3	1100C	10.5			
1100D	69.45	63.31	9.7	1100D	9.8	10.4	10.9	9.8
1100E	60.91	55.45	9.8					
1104A	58.08	52.86	9.9	1104A	10.3			
1104B	64.89	58.65	10.6	1104B	10.7			
1104C	72.25	65.26	10.7	1104C	10.7			
1104D	64.62	58.37	10.7	1104D	10.9			
1104E	62.82	56.53	11.1	1104E	11.1			
1104F	64.45	58.06	11.0	1104F	11.1			
1104G	65.88	59.21	11.3	1104G	11.1	10.8	11.1	10.3
1104H	68.25	61.49	11.0					
1109A	60.98	55.12	10.6	1109A	10.7			
1109B	62.98	56.85	10.8	1109B	10.8			
1109C	67.21	60.66	10.8	1109C	10.9			
1109D	68.35	61.59	11.0	1109D	11.0			
1109E	70.91	63.87	11.0	1109E	11.1			
1109F	70.21	63.15	11.2	1109F	11.2			
1109G	66	59.29	11.3	1109G	11.3	11.0	11.3	10.7
1109H	73.17	65.72	11.3					
1115A	56.59	51.46	10.0	1115A	10.0			
1115B	58.46	53.09	10.1	1115B	10.2			
1115C	61.19	55.52	10.2	1115C	10.1			
1115D	54.75	49.76	10.0	1115D	10.1			
1115E	56.15	50.96	10.2	1115E	10.1			
1115F	56.22	51.11	10.0	1115F	9.8			
1115G	58.69	53.51	9.7	1115G	10.1	10.1	10.2	9.8
1115H	59.38	53.76	10.5					

1117A	49.54	45.05	10.0	1117A	10.0			
1117B	51.2	46.51	10.1	1117B	10.1			
1117C	52.26	47.49	10.0	1117C	10.0			
1117D	50.59	46.03	9.9	1117D	9.8			
1117E	52.7	48.01	9.8	1117E	9.9			
1117F	51.55	46.87	10.0	1117F	9.6			
1117G	50.94	46.61	9.3	1117G	9.7	9.9	10.1	9.6
1117H	59.5	54.08	10.0					
1118A	65.73	59.58	10.3	1118A	10.7			
1118B	63.42	57.13	11.0	1118B	10.8			
1118C	64.81	58.63	10.5	1118C	10.6			
1118D	60.15	54.36	10.7	1118D	10.4			
1118E	59.45	54.01	10.1	1118E	10.0	10.5	10.8	10.0
1118F	72.75	66.22	9.9					
111A	65.26	58.2	12.1	111A	12.2			
111B	59.85	53.28	12.3	111B	12.2			
111C	58.99	52.64	12.1	111C	12.0	12.1	12.2	12.0
111D	59.33	53.05	11.8					
1122A	66	59.37	11.2	1122A	10.9			
1122B	68.8	62.17	10.7	1122B	11.0			
1122C	72.99	65.55	11.4	1122C	11.5	11.1	11.5	10.9
1122D	76.13	68.19	11.6					
1123A	71.25	64.01	11.3	1123A	11.3			
1123B	72.53	65.13	11.4	1123B	11.4			
1123C	79	70.87	11.5	1123C	11.3	11.4	11.4	11.3
1123D	79.92	71.92	11.1					
112A	73.3	66.7	9.9	112A	10.3			
112B	70.21	63.38	10.8	112B	11.2			
112C	72.05	64.5	11.7	112C	12.1	11.2	12.1	10.3
112D	74.77	66.43	12.6					
1133A	67.2	60.48	11.1	1133A	11.1			
1133B	67.13	60.46	11.0	1133B	11.3			
1133C	68.56	61.43	11.6	1133C	11.4	11.3	11.4	11.1
1133D	78.22	70.36	11.2					
1141A	64.27	58.64	9.6	1141A	9.5			
1141B	62.62	57.26	9.4	1141B	9.5			
1141C	59.99	54.76	9.6	1141C	9.4			
1141D	65.6	60.04	9.3	1141D	9.6			
1141E	63.02	57.29	10.0	1141E	9.9	9.6	9.9	9.4
1141F	62.45	56.88	9.8					
1142A	67.51	61.27	10.2	1142A	11.1			
1142B	74.91	66.89	12.0	1142B	12.5			
1142C	73.46	64.96	13.1	1142C	12.7			
1142D	72.92	64.94	12.3	1142D	12.4	12.2	12.7	11.1
1142E	79.61	70.79	12.5					
1145A	65.4	59.29	10.3	1145A	9.9			
1145B	69.87	63.81	9.5	1145B	9.5			
1145C	60.91	55.61	9.5	1145C	9.7			
1145D	63.47	57.76	9.9	1145D	9.6			
1145E	65.42	59.89	9.2	1145E	9.6			
1145F	57.69	52.49	9.9	1145F	10.0			
1145G	55.27	50.2	10.1	1145G	9.8	9.7	10.0	9.5
1145H	60.45	55.23	9.5					
1153A	69.75	62.57	11.5	1153A	11.1			
1153B	67.82	61.26	10.7	1153B	10.7			
1153C	67.47	60.93	10.7	1153C	10.6			
1153D	66.21	59.95	10.4	1153D	10.7			
1153E	69.69	62.79	11.0	1153E	10.9	10.8	11.1	10.6
1153F	63.42	57.27	10.7					
1158A	72.65	65.56	10.8	1158A	11.1			
1158B	76.44	68.68	11.3	1158B	11.3			
1158C	74.82	67.19	11.4	1158C	11.4			
1158D	76.25	68.43	11.4	1158D	11.2	11.2	11.4	11.1
1158E	84.43	76.14	10.9					
1159A	71.61	65.16	9.9	1159A	10.1			
1159B	69.23	62.8	10.2	1159B	10.3			
1159C	72.79	65.99	10.3	1159C	10.3			
1159D	66.92	60.64	10.4	1159D	10.3			
1159E	73.62	66.78	10.2	1159E	10.3	10.2	10.3	10.1
1159F	73.33	66.5	10.3					

1160A	75.32	68.29	10.3	1160A	10.6			
1160B	69.71	62.86	10.9	1160B	10.8			
1160C	72.62	65.54	10.8	1160C	10.8			
1160D	67.49	60.89	10.8	1160D	10.7	10.7	10.8	10.6
1160E	82.1	74.28	10.5					
1168A	68.04	60.66	12.2	1168A	12.0			
1168B	72.04	64.36	11.9	1168B	11.7			
1168C	68.01	61.01	11.5	1168C	11.4			
1168D	70.77	63.56	11.3	1168D	12.0	11.8	12.0	11.4
1168E	75.51	67.07	12.6					
1172A	63.41	57.81	9.7	1172A	10.0			
1172B	61.07	55.38	10.3	1172B	10.4			
1172C	66.53	60.19	10.5	1172C	10.7			
1172D	59.23	53.41	10.9	1172D	11.0			
1172E	56.76	51.12	11.0	1172E	10.8			
1172F	64.45	58.26	10.6	1172F	10.7			
1172G	67.76	61.13	10.8	1172G	10.7	10.6	11.0	10.0
1172H	67.86	61.38	10.6					
1189A	57.91	52.44	10.4	1189A	9.9			
1189B	61.34	56.05	9.4	1189B	9.8			
1189C	57.22	51.94	10.2	1189C	10.0			
1189D	61.16	55.72	9.8	1189D	9.8			
1189E	64.46	58.72	9.8	1189E	10.0			
1189F	58.25	52.87	10.2	1189F	10.5			
1189G	57.52	51.94	10.7	1189G	10.6	10.1	10.6	9.8
1189H	58.8	53.21	10.5					
1196A	71.65	65.28	9.8	1196A	9.7			
1196B	77.8	71.01	9.6	1196B	9.7			
1196C	85.02	77.39	9.9	1196C	10.5	10.0	10.5	9.7
1196D	84.37	75.91	11.1					
1242A	63.91	58.13	9.9	1242A	10.3			
1242B	64.64	58.44	10.6	1242B	10.5			
1242C	61.41	55.64	10.4	1242C	10.4			
1242D	63.14	57.17	10.4	1242D	10.6			
1242E	59.8	54.01	10.7	1242E	10.7			
1242F	43.88	39.62	10.8	1242F	10.5	10.5	10.7	10.3
1242G	63.02	57.12	10.3					
1248A	64.28	58.39	10.1	1248A	10.2			
1248B	65.61	59.51	10.3	1248B	10.2			
1248C	67.5	61.25	10.2	1248C	10.1			
1248D	66.78	60.74	9.9	1248D	10.1			
1248E	62.96	57.1	10.3	1248E	10.4			
1248F	70.2	63.48	10.6	1248F	10.6			
1248G	70.01	63.26	10.7	1248G	10.6	10.3	10.6	10.1
1248H	71.37	64.57	10.5					
1312A	69.99	63.33	10.5	1312A	10.5			
1312B	63.41	57.38	10.5	1312B	10.3			
1312C	68.99	62.65	10.1	1312C	10.3			
1312D	71.74	64.95	10.5	1312D	10.4			
1312E	74.21	67.24	10.4	1312E	10.5			
1312F	65.48	59.16	10.7	1312F	10.5			
1312G	63.98	58.03	10.3	1312G	10.4	10.4	10.5	10.3
1312H	65.72	59.5	10.5					
1333A	49.46	45.38	9.0	1333A	9.8			
1333B	76.54	69.21	10.6	1333B	11.3			
1333C	86.98	77.68	12.0	1333C	12.3			
1333D	91.1	80.9	12.6	1333D	12.7			
1333E	86.06	76.27	12.8	1333E	12.3			
1333F	82.55	73.85	11.8	1333F	12.0			
1333G	83.13	74.09	12.2	1333G	11.9	11.8	12.7	9.8
1333H	80.79	72.36	11.7					
1341A	69.55	63.31	9.9	1341A	10.2			
1341B	68.85	62.26	10.6	1341B	10.4			
1341C	71.7	65.08	10.2	1341C	10.4			
1341D	78.11	70.64	10.6	1341D	11.1			
1341E	75.86	68.01	11.5	1341E	11.8			
1341F	62.31	55.58	12.1	1341F	12.1			
1341G	82.74	73.79	12.1	1341G	11.4	11.1	12.1	10.2
1341H	71.7	64.75	10.7					

1347A	66.27	60.28	9.9	1347A	10.4			
1347B	67.53	60.87	10.9	1347B	11.1			
1347C	74.16	66.64	11.3	1347C	11.1			
1347D	79.79	71.98	10.9	1347D	11.3			
1347E	78.51	70.29	11.7	1347E	11.8			
1347F	64.45	57.64	11.8	1347F	11.7	11.2	11.8	10.4
1347G	83.25	74.58	11.6					
1348A	64.89	59.25	9.5	1348A	9.7			
1348B	62.13	56.58	9.8	1348B	10.0			
1348C	66.84	60.69	10.1	1348C	10.3			
1348D	75.69	68.47	10.5	1348D	10.7			
1348E	72.45	65.31	10.9	1348E	10.9			
1348F	58.71	52.95	10.9	1348F	10.9	10.4	10.9	9.7
1348G	79.87	72.01	10.9					
143A	76.99	70.65	9.0	143A	9.1			
143B	75.03	68.71	9.2	143B	9.4			
143C	72.19	65.81	9.7	143C	9.7			
143D	71.23	64.89	9.8	143D	10.0			
143E	78.73	71.41	10.3	143E	10.1			
143F	70.63	64.29	9.9	143F	9.8			
143G	70.37	64.16	9.7	143G	9.8	9.7	10.1	9.1
143H	62.3	56.7	9.9					
205A	67.1	61.08	9.9	205A	9.9			
205B	71.87	65.38	9.9	205B	10.1			
205C	70.12	63.53	10.4	205C	10.6			
205D	66.97	60.45	10.8	205D	10.8			
205E	70.73	63.81	10.8	205E	10.8			
205F	63.02	56.87	10.8	205F	10.2	10.4	10.8	9.9
205G	64.96	59.24	9.7					
209A	63.81	57.97	10.1	209A	10.3			
209B	60.59	54.84	10.5	209B	10.5			
209C	67.76	61.31	10.5	209C	10.7			
209D	67.91	61.27	10.8	209D	10.6			
209E	60.94	55.2	10.4	209E	10.5			
209F	69.66	63.02	10.5	209F	10.6	10.5	10.7	10.3
209G	64.43	58.23	10.6					
218A	59.02	52.74	11.9	218A	11.5			
218B	59.61	53.62	11.2	218B	11.1	11.3	11.5	11.1
218C	61.6	55.44	11.1					
248A	53.1	48.51	9.5	248A	9.3			
248B	60.63	55.51	9.2	248B	9.2			
248C	59.23	54.23	9.2	248C	9.6			
248D	51.01	46.39	10.0	248D	9.7			
248E	53.44	48.82	9.5	248E	9.6			
248F	55.34	50.39	9.8	248F	10.0	9.6	10.0	9.2
248G	56.82	51.58	10.2					
250A	67.38	61.51	9.5	250A	9.7			
250B	75.85	69.07	9.8	250B	9.8			
250C	76.21	69.44	9.7	250C	10.0			
250D	72.23	65.46	10.3	250D	9.8	9.8	10.0	9.7
250E	80.98	74.12	9.3					
251A	58.33	53.62	8.8	251A	8.8			
251B	44.11	40.53	8.8	251B	9.1			
251C	47.66	43.6	9.3	251C	9.5			
251D	46.08	41.99	9.7	251D	9.5			
251E	42.97	39.3	9.3	251E	9.4			
251F	47.13	43.08	9.4	251F	9.3			
251G	42.05	38.52	9.2	251G	9.1	9.2	9.5	8.8
251H	50.41	46.22	9.1					
259A	46.37	42.51	9.1	259A	9.4			
259B	54.36	49.5	9.8	259B	9.6			
259C	51.84	47.39	9.4	259C	9.3			
259D	44.42	40.69	9.2	259D	9.0			
259E	46.19	42.45	8.8	259E	8.9			
259F	48.84	44.81	9.0	259F	9.1			
259G	49.96	45.72	9.3	259G	9.0	9.2	9.6	8.9
259H	56.52	51.99	8.7					
269A	62.21	56.93	9.3	269A	9.5			
269B	60.26	54.88	9.8	269B	9.7			
269C	65.42	59.68	9.6	269C	9.8	9.7	9.8	9.5
269D	65.52	59.61	9.9					

281A	54.53	49.75	9.6	281A	9.7			
281B	53.39	48.63	9.8	281B	9.5	9.6	9.7	9.5
281C	54.69	50.04	9.3					
289A	60.87	55.66	9.4	289A	9.6			
289B	54.49	49.62	9.8	289B	10.0			
289C	59.19	53.74	10.1	289C	10.0			
289D	57.87	52.68	9.9	289D	9.9			
289E	55.81	50.77	9.9	289E	9.9			
289F	60.65	55.25	9.8	289F	9.8	9.9	10.0	9.6
289G	54.52	49.63	9.9					
295A	54.66	49.82	9.7	295A	9.8			
295B	61.71	56.19	9.8	295B	9.8			
295C	62.22	56.69	9.8	295C	9.7			
295D	53.45	48.78	9.6	295D	9.6			
295E	55.84	50.92	9.7	295E	9.8			
295F	58.57	53.26	10.0	295F	9.8	9.7	9.8	9.6
295G	59.45	54.2	9.7					
308A	60.41	55.3	9.2	308A	9.4			
308B	64.55	58.95	9.5	308B	9.4			
308C	56.91	52.08	9.3	308C	9.5			
308D	53.54	48.75	9.8	308D	9.7			
308E	54.67	49.92	9.5	308E	9.7			
308F	49.44	45.03	9.8	308F	9.8			
308G	51.34	46.73	9.9	308G	9.9	9.6	9.9	9.4
308H	39.92	36.29	10.0					
314A	66.24	60.28	9.9	314A	9.9			
314B	62.94	57.23	10.0	314B	10.0			
314C	63.97	58.13	10.0	314C	10.0			
314D	68.46	62.26	10.0	314D	9.9			
314E	66.32	60.33	9.9	314E	9.8	9.9	10.0	9.8
314F	60.9	55.49	9.7					
328A	63.02	57.41	9.8	328A	10.0			
328B	63.07	57.23	10.2	328B	9.9			
328C	65.99	60.19	9.6	328C	9.8			
328D	66.95	60.89	10.0	328D	9.9	9.9	10.0	9.8
328E	65.84	59.94	9.8					
330A	66.87	60.89	9.8	330A	9.7			
330B	62.96	57.49	9.5	330B	9.7			
330C	64.01	58.23	9.9	330C	9.7			
330D	68.57	62.6	9.5	330D	9.8			
330E	69.19	62.85	10.1	330E	10.1	9.8	10.1	9.7
330F	63.77	57.96	10.0					
356A	64.53	58.61	10.1	356A	10.6			
356B	64.43	57.98	11.1	356B	11.6			
356C	66.06	58.89	12.2	356C	12.2	11.5	12.2	10.6
356D	67.78	60.45	12.1					
357A	67.9	61.04	11.2	357A	11.6			
357B	66.74	59.66	11.9	357B	11.5			
357C	70.38	63.34	11.1	357C	11.3			
357D	72.9	65.41	11.5	357D	11.4	11.4	11.6	11.3
357E	65.35	58.69	11.3					
382A	60.77	54.42	11.7	382A	12.4			
382B	67.5	59.71	13.0	382B	12.5			
382C	70.11	62.64	11.9	382C	12.1	12.3	12.5	12.1
382D	66.12	58.94	12.2					
387A	69.91	63.76	9.6	387A	10.4			
387B	75.76	68.18	11.1	387B	10.8			
387C	71.61	64.85	10.4	387C	10.5			
387D	70.03	63.37	10.5	387D	10.3	10.5	10.8	10.3
387E	61.01	55.4	10.1					
413A	66.85	60.47	10.6	413A	11.0			
413B	61.4	55.14	11.4	413B	11.6			
413C	71.05	63.49	11.9	413C	11.5			
413D	62.11	55.91	11.1	413D	11.3	11.3	11.6	11.0
413E	66.58	59.75	11.4					
433A	67.57	61.33	10.2	433A	10.8			
433B	71.46	64.08	11.5	433B	11.8			
433C	79.22	70.65	12.1	433C	12.6	11.8	12.6	10.8
433D	68.9	60.93	13.1					

438A	70.99	64.42	10.2	438A	10.7			
438B	73.71	66.23	11.3	438B	11.5			
438C	82.07	73.45	11.7	438C	12.0			
438D	74.2	66.08	12.3	438D	12.3			
438E	75.9	67.61	12.3	438E	12.4			
438F	86.08	76.49	12.5	438F	12.2			
438G	72.07	64.4	11.9	438G	11.8	11.8	12.4	10.7
438H	71.56	64.12	11.6					
445A	59.2	53.57	10.5	445A	10.3			
445B	54.1	49.14	10.1	445B	9.9			
445C	56.88	51.81	9.8	445C	9.9	10.0	10.3	9.9
445D	59.35	53.99	9.9					
446A	59.8	53.36	12.1	446A	12.2			
446B	66.53	59.22	12.3	446B	12.8			
446C	70.4	62.17	13.2	446C	13.4	12.8	13.4	12.2
446D	66.38	58.48	13.5					
447A	74.95	67.87	10.4	447A	10.9			
447B	71.61	64.29	11.4	447B	11.1			
447C	75.97	68.57	10.8	447C	11.4	11.1	11.4	10.9
447D	81.44	72.69	12.0					
468A	66.96	60.35	11.0	468A	11.5			
468B	70.18	62.58	12.1	468B	12.3			
468C	72.86	64.81	12.4	468C	12.6	12.2	12.6	11.5
468D	73.49	65.13	12.8					
475A	65.53	59.04	11.0	475A	10.8			
475B	61.45	55.54	10.6	475B	10.4			
475C	62.2	56.51	10.1	475C	10.6	10.6	10.8	10.4
475D	67.47	60.67	11.2					
504A	91.71	81.25	12.9	504A	12.8			
504B	83.69	74.28	12.7	504B	12.0	12.4	12.8	12.0
504C	83.03	74.53	11.4					
579A	64.07	58.31	9.9	579A	10.4			
579B	60.78	54.8	10.9	579B	10.6			
579C	63.47	57.53	10.3	579C	9.9			
579D	68.3	62.44	9.4	579D	10.2	10.3	10.6	9.9
579E	60.71	54.64	11.1					
581A	60.66	54.8	10.7	581A	10.8			
581B	61.03	55.04	10.9	581B	10.5			
581C	59.82	54.33	10.1	581C	10.3			
581D	58.98	53.4	10.4	581D	10.8	10.6	10.8	10.3
581E	58.36	52.54	11.1					
598A	67.68	62.04	9.1	598A	8.7			
598B	67.7	62.45	8.4	598B	8.6			
598C	68.88	63.33	8.8	598C	9.7			
598D	65.8	59.5	10.6	598D	10.7			
598E	62.71	56.57	10.9	598E	11.0			
598F	59.49	53.54	11.1	598F	10.8			
598G	55.14	49.93	10.4	598G	10.3			
598H	50.86	46.17	10.2	598H	9.8	10.0	11.0	8.6
598I	50.91	46.54	9.4					
603A	73.18	65.79	11.2	603A	11.3			
603B	72.98	65.57	11.3	603B	11.3			
603C	70.09	63.01	11.2	603C	10.8			
603D	68.89	62.41	10.4	603D	10.5	11.0	11.3	10.5
603E	70.35	63.59	10.6					
615A	85.81	78.23	9.7	615A	9.3			
615B	80.89	74.26	8.9	615B	9.7			
615C	85.96	77.86	10.4	615C	11.1			
615D	82.73	74.03	11.8	615D	11.9			
615E	82.88	74	12.0	615E	12.0			
615F	82.36	73.5	12.1	615F	11.1			
615G	76.84	69.74	10.2	615G	10.1			
615H	78.79	71.55	10.1	615H	10.3	10.7	12.0	9.3
615I	74.45	67.42	10.4					

622A	65.56	59.21	10.7	622A	10.8			
622B	75.56	68.19	10.8	622B	11.3			
622C	75.36	67.41	11.8	622C	11.9			
622D	79.28	70.84	11.9	622D	12.0			
622E	74.66	66.66	12.0	622E	12.2			
622F	72.04	64.07	12.4	622F	11.5	11.6	12.2	10.8
622G	69.45	62.77	10.6					
624A	57.97	52.25	10.9	624A	11.4			
624B	56.22	50.24	11.9	624B	11.1			
624C	46.39	42.09	10.2	624C	10.8	11.1	11.4	10.8
624D	61.66	55.38	11.3					
628A	73.13	66.42	10.1	628A	11.6			
628B	72.16	63.83	13.1	628B	12.5			
628C	76.35	68.2	12.0	628C	12.0	12.0	12.5	11.6
628D	72.55	64.77	12.0					
630A	64.89	59.44	9.2	630A	9.1			
630B	68.5	62.82	9.0	630B	9.1			
630C	66.61	61.03	9.1	630C	9.6			
630D	68.51	62.27	10.0	630D	10.0			
630E	67.16	61.08	10.0	630E	9.9			
630F	68.06	62.01	9.8	630F	9.6			
630G	70.59	64.53	9.4	630G	9.8			
630H	69.64	63.18	10.2	630H	10.4	9.6	10.4	9.1
630I	70.3	63.62	10.5					
646A	65.96	59.56	10.7	646A	10.6			
646B	68.29	61.87	10.4	646B	10.8			
646C	69	62	11.3	646C	11.7			
646D	67.95	60.58	12.2	646D	11.9			
646E	70.69	63.31	11.7	646E	11.4			
646F	72.13	64.91	11.1	646F	11.3	11.3	11.9	10.6
646G	68.77	61.71	11.4					
648A	65.94	59.67	10.5	648A	10.6			
648B	71.13	64.29	10.6	648B	11.1			
648C	75.33	67.52	11.6	648C	11.8			
648D	71.42	63.75	12.0	648D	11.9			
648E	73.43	65.71	11.7	648E	11.3			
648F	67.12	60.52	10.9	648F	10.7			
648G	73.15	66.26	10.4	648G	10.5	11.1	11.9	10.5
648H	70.63	63.91	10.5					
661A	68.27	61.32	11.3	661A	12.3			
661B	68.48	60.51	13.2	661B	13.1			
661C	69.95	61.85	13.1	661C	12.9			
661D	67.89	60.28	12.6	661D	12.8			
661E	68.16	60.28	13.1	661E	12.6			
661F	68.58	61.21	12.0	661F	12.0	12.6	13.1	12.0
661G	69.77	62.3	12.0					
666A	62.54	57.12	9.5	666A	9.3			
666B	66.22	60.64	9.2	666B	9.5			
666C	72.66	66.22	9.7	666C	9.7	9.5	9.7	9.3
666D	77.37	70.51	9.7					
669A	68.18	61.57	10.7	669A	10.9			
669B	64.69	58.2	11.2	669B	10.8			
669C	60.06	54.4	10.4	669C	10.4			
669D	58.6	53.08	10.4	669D	10.5	10.6	10.9	10.4
669E	55	49.75	10.6					
679A	62.41	56.22	11.0	679A	11.5			
679B	68.12	60.78	12.1	679B	12.6			
679C	67.22	59.37	13.2	679C	12.5			
679D	70.99	63.54	11.7	679D	11.7			
679E	66.87	59.92	11.6	679E	11.6			
679F	69.75	62.47	11.7	679F	11.3	11.9	12.6	11.3
679G	69.03	62.22	10.9					
681A	67.65	60.83	11.2	681A	11.4			
681B	75.5	67.63	11.6	681B	12.2			
681C	70.01	62.14	12.7	681C	11.5			
681D	67.49	61.18	10.3	681D	10.4			
681E	60.34	54.6	10.5	681E	11.2			
681F	68.77	61.48	11.9	681F	12.0	11.5	12.2	10.4
681G	70.16	62.51	12.2					

693A	69.03	62.83	9.9	693A	10.3			
693B	65.2	58.87	10.8	693B	11.1			
693C	71.64	64.26	11.5	693C	11.8			
693D	74.13	66.13	12.1	693D	12.2			
693E	71.81	63.96	12.3	693E	12.4			
693F	71.19	63.29	12.5	693F	12.3	11.7	12.4	10.3
693G	71.64	63.88	12.1					
697A	73.11	66.71	9.6	697A	9.7			
697B	72.27	65.79	9.8	697B	10.9			
697C	78.08	69.71	12.0	697C	12.0			
697D	78.68	70.3	11.9	697D	12.0			
697E	78.24	69.8	12.1	697E	12.4			
697F	74.39	65.99	12.7	697F	12.5	11.6	12.5	9.7
697G	78.31	69.76	12.3					
704A	27.82	25.29	10.0	704A	10.0			
704B	63.04	57.34	9.9	704B	9.9			
704C	61.54	56.05	9.8	704C	9.9			
704D	63.48	57.69	10.0	704D	10.0			
704E	67.26	61.21	9.9	704E	10.0	9.9	10.0	9.9
704F	76.85	69.81	10.1					
707A	56.13	50.98	10.1	707A	10.1			
707B	67.36	61.23	10.0	707B	10.2			
707C	64.18	58.11	10.4	707C	10.3			
707D	63.74	57.87	10.1	707D	10.1			
707E	66.68	60.55	10.1	707E	10.1	10.2	10.3	10.1
707F	76.06	69.15	10.0					
708A	35.69	32.28	10.6	708A	10.5			
708B	30.64	27.75	10.4	708B	10.3			
708C	65.31	59.22	10.3	708C	10.3			
708D	64.55	58.55	10.2	708D	10.3			
708E	62.56	56.67	10.4	708E	10.3			
708F	57.05	51.78	10.2	708F	10.4			
708G	38.07	34.42	10.6	708G	10.4	10.4	10.5	10.3
708H	62.73	56.97	10.1					
728A	68.77	62.46	10.1	728A	10.2			
728B	60.46	54.86	10.2	728B	10.2	10.2	10.2	10.2
728C	62.61	56.86	10.1					
729A	69.34	63.6	9.0	729A	9.7			
729B	60.71	55.04	10.3	729B	10.3			
729C	64.94	58.91	10.2	729C	10.3			
729D	65.98	59.76	10.4	729D	10.3			
729E	60.18	54.58	10.3	729E	9.9			
729F	64.04	58.41	9.6	729F	10.0			
729G	56.3	51.04	10.3	729G	10.2	10.1	10.3	9.7
729H	63.38	57.54	10.1					
730A	81.67	73.48	11.1	730A	10.8			
730B	74.18	67.19	10.4	730B	10.6			
730C	75.38	68.08	10.7	730C	10.5			
730D	74.74	67.73	10.3	730D	10.2			
730E	75.98	69.02	10.1	730E	10.2	10.5	10.8	10.2
730F	70.37	63.76	10.4					
734A	63.07	57.45	9.8	734A	10.0			
734B	56.05	50.81	10.3	734B	10.3			
734C	74.22	67.35	10.2	734C	10.2			
734D	69.98	63.46	10.3	734D	10.4			
734E	67.22	60.85	10.5	734E	10.5			
734F	70.14	63.45	10.5	734F	10.6			
734G	61.79	55.89	10.6	734G	10.2	10.3	10.6	10.0
734H	68.67	62.57	9.7					
741A	60.57	54.61	10.9	741A	11.0			
741B	58.18	52.4	11.0	741B	10.8	10.9	11.0	10.8
741C	60.03	54.32	10.5					
745A	55.94	51.14	9.4	745A	9.9			
745B	45.61	41.29	10.5	745B	10.4			
745C	49.12	44.51	10.4	745C	10.2			
745D	67.74	61.61	9.9	745D	10.0			
745E	65.64	59.62	10.1	745E	10.1			
745F	69.63	63.26	10.1	745F	10.0			
745G	66.53	60.51	9.9	745G	9.7	10.0	10.4	9.7
745H	69.56	63.51	9.5					

747A	67.46	61.54	9.6	747A	9.6			
747B	63.62	58.02	9.7	747B	9.6			
747C	40.42	36.89	9.6	747C	9.4			
747D	67.74	62.03	9.2	747D	10.1			
747E	61.32	55.29	10.9	747E	10.6			
747F	38.95	35.33	10.2	747F	10.3			
747G	69.61	63.04	10.4	747G	10.3	10.0	10.6	9.4
747H	70.34	63.83	10.2					
759A	74.63	68.64	8.7	759A	9.0			
759B	72.1	65.97	9.3	759B	9.5			
759C	62.24	56.69	9.8	759C	9.7			
759D	74.77	68.27	9.5	759D	9.6			
759E	63.36	57.75	9.7	759E	9.6	9.5	9.7	9.0
759F	60.93	55.63	9.5					
764A	76.77	70.65	8.7	764A	9.1			
764B	65.29	59.62	9.5	764B	9.4			
764C	66.68	61.01	9.3	764C	9.2			
764D	70.17	64.3	9.1	764D	9.8			
764E	62.83	56.91	10.4	764E	10.0			
764F	68.86	62.82	9.6	764F	9.7	9.5	10.0	9.1
764G	66.36	60.46	9.8					
783A	52.93	48.22	9.8	783A	9.7			
783B	62.42	56.93	9.6	783B	9.7			
783C	61.36	55.9	9.8	783C	9.9			
783D	61.09	55.54	10.0	783D	10.1	9.8	10.1	9.7
783E	67.48	61.27	10.1					
796A	70.68	63.77	10.8	796A	10.8			
796B	66.79	60.33	10.7	796B	10.8			
796C	70.25	63.39	10.8	796C	10.8	10.8	10.8	10.8
796D	62.07	56.01	10.8					
812A	74.16	67.21	10.3	812A	10.5			
812B	68.9	62.3	10.6	812B	10.4			
812C	71.07	64.48	10.2	812C	10.3	10.4	10.5	10.3
812D	74.39	67.41	10.4					
822A	72.19	65.07	10.9	822A	10.9			
822B	71.09	64.13	10.9	822B	11.0			
822C	76.98	69.3	11.1	822C	10.9	10.9	11.0	10.9
822D	77.92	70.35	10.8					
832A	72.94	66.81	9.2	832A	9.9			
832B	61.52	55.66	10.5	832B	10.2			
832C	79.64	72.43	10.0	832C	10.0			
832D	78.85	71.62	10.1	832D	10.4			
832E	78.29	70.74	10.7	832E	10.5			
832F	78.53	71.15	10.4	832F	10.5			
832G	68.58	61.99	10.6	832G	10.3	10.3	10.5	9.9
832H	74.21	67.48	10.0					
841A	62.27	56.33	10.5	841A	10.8			
841B	65.36	58.86	11.0	841B	11.0			
841C	67.59	60.91	11.0	841C	11.1			
841D	67.14	60.39	11.2	841D	11.0	11.0	11.1	10.8
841E	77.46	69.95	10.7					
845A	51.74	46.98	10.1	845A	10.3			
845B	66.37	60.12	10.4	845B	10.5			
845C	66.29	59.89	10.7	845C	10.4			
845D	65.33	59.28	10.2	845D	10.2			
845E	62.76	56.92	10.3	845E	10.6			
845F	73.54	66.31	10.9	845F	11.2			
845G	65.57	58.79	11.5	845G	11.7	10.7	11.7	10.2
845H	66.57	59.51	11.9					
848A	56.87	51.09	11.3	848A	11.2			
848B	63.17	56.82	11.2	848B	11.4			
848C	71.55	64.09	11.6	848C	12.1			
848D	59.2	52.61	12.5	848D	12.9			
848E	71.49	63.16	13.2	848E	13.0			
848F	74.76	66.31	12.7	848F	12.8	12.2	13.0	11.2
848G	73.56	65.23	12.8					
850A	74.34	67.36	10.4	850A	10.9			
850B	73.98	66.35	11.5	850B	11.3			
850C	79.09	71.24	11.0	850C	11.5			
850D	68.11	60.87	11.9	850D	11.9	11.4	11.9	10.9
850E	77.01	68.81	11.9					

852A	58.53	53.53	9.3	852A	9.5			
852B	56.64	51.69	9.6	852B	9.7			
852C	58.18	53.01	9.8	852C	9.8			
852D	60.87	55.44	9.8	852D	9.7	9.6	9.8	9.5
852E	69.57	63.53	9.5					
855A	76.59	69.73	9.8	855A	10.4			
855B	73.48	66.26	10.9	855B	11.1			
855C	72.06	64.71	11.4	855C	11.1			
855D	75.94	68.5	10.9	855D	11.2			
855E	74.39	66.73	11.5	855E	11.4			
855F	74.33	66.72	11.4	855F	11.1			
855G	86.27	77.93	10.7	855G	10.5	11.0	11.4	10.4
855H	87.2	79.03	10.3					
896A	62.71	56.78	10.4	896A	10.4			
896B	71.16	64.48	10.4	896B	10.3			
896C	71.4	64.78	10.2	896C	10.2	10.3	10.4	10.2
896D	71.01	64.44	10.2					
901A	60.89	55.07	10.6	901A	10.5			
901B	70.46	63.76	10.5	901B	10.5			
901C	71.52	64.71	10.5	901C	10.8			
901D	71.68	64.59	11.0	901D	10.9			
901E	70.56	63.72	10.7	901E	10.8			
901F	80.43	72.59	10.8	901F	10.9			
901G	71.51	64.4	11.0	901G	11.1	10.8	11.1	10.5
901H	72.89	65.63	11.1					
927A	61.72	56.37	9.5	927A	9.6			
927B	66.91	60.95	9.8	927B	9.6			
927C	73.07	66.77	9.4	927C	9.5			
927D	61.53	56.15	9.6	927D	9.6	9.6	9.6	9.5
927E	64.12	58.5	9.6					
929A	68.28	62.26	9.7	929A	9.7			
929B	72.45	66.01	9.8	929B	9.6			
929C	77.78	71.08	9.4	929C	9.3			
929D	71.44	65.46	9.1	929D	9.4	9.5	9.7	9.3
929E	71.84	65.46	9.7					
966A	70.44	64.2	9.7	966A	9.5			
966A	59.9	54.81	9.3	966A	9.7			
966B	70.1	63.63	10.2	966B	9.7			
966B	66.58	60.93	9.3	966B	9.5			
966C	73.41	66.85	9.8	966C	9.5			
966C	67.56	61.91	9.1	966C	9.5			
966D	67.7	61.67	9.8	966D	9.6	9.6	9.7	9.5
966D	67.24	61.48	9.4					
978A	69.77	63.43	10.0	978A	10.1			
978B	67.17	60.91	10.3	978B	10.3			
978C	57.4	52.06	10.3	978C	10.0			
978D	67.68	61.72	9.7	978D	10.0			
978E	57.71	52.32	10.3	978E	10.5			
978F	62.02	55.99	10.8	978F	10.5	10.2	10.5	10.0
978G	62.55	56.77	10.2					
979A	57.88	53.09	9.0	979A	9.1			
979B	51.23	46.92	9.2	979B	9.2			
979C	55.93	51.17	9.3	979C	9.4	9.2	9.4	9.1
979D	57.23	52.27	9.5					
988A	74.25	66.52	11.6	988A	11.8			
988B	68.18	60.85	12.0	988B	12.0			
988C	76.9	68.75	11.9	988C	11.9			
988D	78.31	69.96	11.9	988D	12.0			
988E	81.6	72.79	12.1	988E	12.1	12.0	12.1	11.8
988F	76.2	68.01	12.0					
991A	62.82	57.23	9.8	991A	9.9			
991B	65.3	59.36	10.0	991B	10.2			
991C	65.78	59.63	10.3	991C	10.2	10.1	10.2	9.9
991D	66.01	59.94	10.1					
993A	61.11	55.91	9.3	993A	9.2			
993B	56.62	51.86	9.2	993B	9.2			
993C	59.47	54.44	9.2	993C	9.2	9.2	9.2	9.2
993D	63.71	58.35	9.2					

B.3.2 Sample length, sawn orientation and template reference.

		Template Ref. (Centre)		Orientation
Sample #	Length (mm)	Butt (@)	Top (^)	Q, B, or T
648	5100	-	-	T
661	4900	-	-	B
693	4800	-	-	B
615	6100	-	-	B
504	2700	-	-	T
387	3700	-	-	B
598	6100	-	-	B
468	3100	-	-	B
646	4900	-	-	B
669	3700	-	-	T
628	3400	-	-	B
603	3600	-	-	B
697	4800	-	-	B
624	3300	-	-	B
681	4900	-	-	B
581	3700	-	-	T
250	3800	-	-	B
446	3100	-	-	T
382	3100	-	-	T
630	6100	-	-	B
622	4900	-	-	B
679	4800	-	-	B
579	3700	-	-	B
447	3000	-	-	T
445	3100	-	-	B
314	3900	-	-	T
330	3900	-	-	T
475	3100	-	-	B
438	5200	-	-	T
413	3600	-	-	T
433	3000	-	-	T
357	3400	-	-	T
356	3300	-	-	B
269	3000	-	-	B
328	3700	-	-	B
281	2800	-	-	B
218	2800	-	-	T
259	5100	-	-	B
295	4900	-	-	T
248	4800	-	-	T
209	4900	-	-	B
251	5100	-	-	B
289	4900	-	-	B
99	3300	-	-	T
111	3000	-	-	Q
112	3000	-	-	B
143	5200	-	-	B
205	4900	-	-	B
308	5200	-	-	T
95	2400	-	-	B
76	3700	-	-	B
77	3000	-	-	T
68	3400	-	-	B
20	3300	-	-	B
29	3300	-	-	T
27	4800	-	-	T
30	3400	-	-	T
23	3400	-	-	B
848	4900	-	-	T
929	3400	-	-	B
927	3700	-	-	T
852	3700	I30	I4	B
666	3300	A26	E12	B
741	2700	B21	D14	B
850	3600	L8.5	L26.5	B
796	3100	H5.5	G29.5	B
728	2700	F34	F2	Q
1040	5200	H16.5	H20.5	B
966	3300	H31	G31.5	T
1001	3700	ILLEGIBLE	J32.5	B
1039	2800	H5.5	I31.5	T
979	3000	E9	I27.5	B
1007	3000	H22	E14.5	B
1032	5200	H34	G3	B
1025	5200	F33	F5	B
1009	5400	B33	E4	Q
901	5400	-	-	B
845	5400	-	-	B
896	3100	-	-	B
764	4800	O16	?	B
729	5500	B1	A1	T
745	5500	H25.5	G9.5	T
978	4900	I3	H32.5	T
747	5500	H31	H4.5	T
759	3900	L30	ILLEGIBLE	T
832	5500	H13	I25.5	B
734	5100	E16	B24	B
708	5100	A17	A35	B
812	3100	H1	F35	T
993	3000	H27	H9	T
1016	3000	E3.5	H31	Q
707	4300	H13	J23	B
704	4300	F2	G32	B
783	3700	G18	H17	T
841	3600	K12	K23	B
991	3000	H33	I.5	B
1012	3300	I33	I5	B
1347	4900	-	-	T
1348	4900	-	-	B
1341	5100	-	-	T
1006	3000	G2	I32	T
966	3000	K9	M26	B
1196	3300	L5	J28	T
1049	4800	H16	H19.5	B
1242	4800	B2	A1	B
1248	5500	H3	G33	B
1189	5500	C11	A28	B
1145	5500	J13	I22.5	T
1168	3700	E21	E15	T
1153	4300	O23.5	J11	Q
1142	3400	B15	D21	B
1158	3400	D5	D29	B
1133	3400	I27	I11	B
1141	4400	I33.5	I2	B
1100	3700	I19	J15	B
1046	5100	J34.5	I1	B
1172	4900	J8	J25	B
1048	5200	D6	ILLEGIBLE	B
1118	4800	I33.5	I1	T
1159	4300	I9	K26.5	B
1160	3400	G16	H20.5	B
822	3200	-	-	B
1123	3000	-	-	T
1122	3000	-	-	T
1104	5500	-	-	B
1333	5100	-	-	B
1115	5500	-	-	B
1109	5500	-	-	B
1117	5500	-	-	T
1044	5200	C27	A12	B
1053	4900	A3	A30	Q
1058	4800	I30	H4.5	B
1061	5200	F6	A28	B
1063	5200	J2	G34	T
1074	4800	C22	G14	B
1312	5500	K6	K29	B
730	4800	K2	K0	B
988	4800	E5	F30	T
855	5200	ILLEGIBLE	H15	B
1083	2800	I26	H11	T

[redacted]

Appendix C. Dry Stock Appraisal Data

A.4. Site 1

A.2.5. Species 1

Species 1	Uncorrected MC (%)			Corrected MC (%)				Individual Qaulity Classes	
25mm	Average	Gradient		Average	Gradient			Assuming Target MC of 12%	
Sample #	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	Difference	Average	Gradient
1	10	9.5	10.5	11	10.5	11.5	1	A	A
2	14	13.5	16	15	14.5	17	2.5	B	B
3	13	13	14	14	14	15	1	A	A
4	15	14.5	16	16	15.5	17	1.5	C	A
5	11	11	11	12	12	12	0	A	A
6	14	13	14	15	14	15	1	B	A
7	17	16	19	18	17	20	3	E	B
8	13	13	14	14	14	15	1	A	A
9	14	13.5	15	15	14.5	16	1.5	B	A
10	15	15	17	16	16	18	2	C	A
11	10.5	10	11	11.5	11	12	1	A	A
12	11	11	12	12	12	13	1	A	A
13	11.5	11	12.5	12.5	12	13.5	1.5	A	A
14	10.5	10.5	11	11.5	11.5	12	0.5	A	A
15	10.5	10	11	11.5	11	12	1	A	A
16	9.5	9.5	10	10.5	10.5	11	0.5	A	A
17	13	13	13.5	14	14	14.5	0.5	A	A
18	12	11.5	12	13	12.5	13	0.5	A	A
19	13	12.5	13.5	14	13.5	14.5	1	A	A
20	11	10	11	12	11	12	1	A	A
21	13	13	15	14	14	16	2	A	A
22	12	11.5	12.5	13	12.5	13.5	1	A	A
23	9.5	9	10	10.5	10	11	1	A	A
24	11	11	11.5	12	12	12.5	0.5	A	A
25	12.5	12	13	13.5	13	14	1	A	A
26	9.5	9	10	10.5	10	11	1	A	A
27	9.5	9	9.5	10.5	10	10.5	0.5	A	A
28	10	10	10.5	11	11	11.5	0.5	A	A
29	11	11	12	12	12	13	1	A	A
30	9.5	9	9.75	10.5	10	10.75	0.75	A	A
31	11	10.5	12	12	11.5	13	1.5	A	A
32	9	8.5	9	10	9.5	10	0.5	A	A
33	10.5	10	11	11.5	11	12	1	A	A
34	10	10	10.5	11	11	11.5	0.5	A	A
35	10	9	10	11	10	11	1	A	A
36	9	8	9.5	10	9	10.5	1.5	A	A
37	12	11.5	12.5	13	12.5	13.5	1	A	A
38	9	8.5	9	10	9.5	10	0.5	A	A
39	8	8	8.5	9	9	9.5	0.5	B	A
40	9	8.5	9.5	10	9.5	10.5	1	A	A

Overall 90% Class	Average	Gradient
	B	A

A.2.6. Species 2

Species 2	Uncorrected MC (%)			Corrected MC (%)				Individual Qaulity Classes Assuming Target MC of 10%	
25mm	Average	Gradient		Average	Gradient				
Sample #	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	Difference	Average	Gradient
1	7.5	7.5	8	8	8	8	0	B	A
2	10	9.5	10	9	9	9	0	A	A
3	9	9	10	9	9	9	0	A	A
4	8	7.5	10	8	8	9	1	B	A
5	8	8	9	8	8	9	1	B	A
6	10.5	10.5	12.5	9.5	9.5	10.5	1	A	A
7	10	10	11	9	9	10	1	A	A
8	9.5	9	10	9	9	9	0	A	A
9	11	11	13	10	10	11	1	A	A
10	11	11	12.5	10	10	10.5	0.5	A	A
11	9	8.5	10	9	8.5	9	0.5	A	A
12	9	9	10	9	9	9	0	A	A
13	10	10	11	9	9	10	1	A	A
14	9	9	10	9	9	9	0	A	A
15	8.5	8.5	10	8.5	8.5	9	0.5	A	A
16	10	9.5	11.5	9	9	10	1	A	A
17	7	7	8	8	8	8	0	B	A
18	9	8.5	10.5	9	8.5	9.5	1	A	A
19	10.5	10.5	13	9.5	9.5	11	1.5	A	B
20	11.5	11.5	15	10	10	12	2	A	B
21	10	10	11.5	9	9	10	1	A	A
22	9.5	9.5	10	9	9	9	0	A	A
23	10	10	11.5	9	9	10	1	A	A
24	10.5	10.5	12	9.5	9.5	10	0.5	A	A
25	12	11.5	13	10	10	11	1	A	A
26	11.5	11.5	13	10	10	11	1	A	A
27	10.5	10.5	12.5	9.5	9.5	10.5	1	A	A
28	10	10	12	9	10	10	0	A	A
29	11	11	12	10	10	10	0	A	A
30	9	8.5	9.5	9	8.5	9	0.5	A	A
31	9.5	9.5	11	9	9	10	1	A	A
32	10.5	10.5	12	9.5	9.5	10	0.5	A	A
33	10	10	11.5	9	9	10	1	A	A
34	10	10	11	9	9	10	1	A	A
35	9.5	9.5	11	9	9	10	1	A	A
36	11	11	12	10	10	10	0	A	A
37	11	11	12.5	10	10	10.5	0.5	A	A
38	10	9.5	10.5	9	9	9.5	0.5	A	A
39	12	11.5	13	10	10	11	1	A	A
40	12	12	13.5	10	10	11.5	1.5	A	B

Overall 90% Class	A	A

A.5. Site 2

B.2.3. Species 1

Species 1	Uncorrected MC (%)			Corrected MC (%)				Individual Qaulity Classes Assuming Target MC of 12%	
25mm	Average	Gradient		Average	Gradient				
Sample #	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	Difference	Average	Gradient
1	9.2	9	9.5	11.2	11	11.5	0.5	A	A
2	18	15	20	20	18	22	4	F	C
3	10.4	9.8	11	13.4	11.8	14	2.2	A	B
4	10.2	9.6	11	13.2	11.6	14	2.4	A	B
5	11	10	12	14	13	15	2	A	A
6	8.8	8.6	9	10.8	10.6	11	0.4	A	A
7	9.6	9.4	9.4	11.6	11.4	11.4	0	A	A
8	10.2	9.8	10.4	13.2	11.8	13.4	1.6	A	A
9	10	9.8	9.6	13	11.8	11.6	-0.2	A	A
10	9	8.6	9.2	11	10.6	11.2	0.6	A	A
11	15	14.2	16	18	17.2	18	0.8	E	A
12	11.6	11	12.4	14.6	14	15.4	1.4	B	A
13	13	12.2	14	16	15.2	17	1.8	C	A
14	12.4	11	13.2	15.4	14	16.2	2.2	B	B
15	12.2	11.4	13.2	15.2	14.4	16.2	1.8	B	A
16	10.6	9.4	11.2	13.6	11.4	14.2	2.8	A	B
17	10	9.4	10.2	13	11.4	13.2	1.8	A	A
18	14.2	12.2	15	17.2	15.2	18	2.8	E	B
19	9.8	9.4	10	11.8	11.4	13	1.6	A	A
20	11.2	10.2	12.4	14.2	13.2	15.4	2.2	B	B
21	13	11.6	13.8	16	14.6	16.8	2.2	C	B
22	11.2	10.4	12	14.2	13.4	15	1.6	B	A
23	12.2	11.6	12.2	15.2	14.6	15.2	0.6	C	A
24	10.2	9.2	11	13.2	11.2	14	2.8	A	B
25	13	12	13.8	16	15	16.8	1.8	C	A
26	11	10.4	11	14	13.4	14	0.6	B	A
27	12.2	10.8	14	15.2	13.8	17	3.2	C	C
28	10.4	9	11.6	13.4	11	14.6	3.6	A	C
29	12.2	11.6	13.4	15.2	14.6	16.4	1.8	C	A
30	12.2	11.6	12.8	15.2	14.6	15.8	1.2	C	A
31	12.8	11.8	13.6	15.8	14.8	16.6	1.8	C	A
32	10.8	9.6	12	13.8	11.6	15	3.4	A	C
33	12.4	11.4	13.4	15.4	14.4	16.4	2	C	A
34	11.2	10.4	12	14.2	13.4	15	1.6	B	A
35	10.4	10	10.4	13.4	13	13.4	0.4	A	A
36	9.8	9.4	10	11.8	11.4	13	1.6	A	A
37	11.4	10.4	12	14.4	13.4	15	1.6	C	A
38	9.6	9.2	9.8	11.6	11.2	11.8	0.6	A	A
39	11.2	10.8	11.8	14.2	13.8	14.8	1	C	A
40	9.8	8.8	10.6	11.8	10.8	13.6	2.8	A	B

Overall 90% Class	C	B

B.2.4. Species 2

Species 2	Uncorrected MC (%)			Corrected MC (%)				Individual Qaulity Classes Assuming Target MC of 12%	
25mm	Average	Gradient		Average	Gradient				
Sample #	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	Difference	Average	Gradient
1	14.4	13	14.6	17.4	16	17.6	1.6	E	A
2	13.2	11.8	14	16.2	14.8	17	2.2	D	B
3	15.4	12.8	17	18.4	15.8	19	3.2	F	C
4	14.4	12.6	15.4	17.4	15.6	18.4	2.8	E	B
5	16.2	13.6	17.6	18.2	16.6	19.6	3	F	B
6	14.6	13.2	14.8	17.6	16.2	17.8	1.6	E	A
7	14	11.8	15.2	17	14.8	18.2	3.4	E	C
8	15.4	13.2	16.2	18.4	16.2	18.2	2	F	A
9	16.2	13	17.6	18.2	16	19.6	3.6	F	C
10	14.2	12.2	15.2	17.2	15.2	18.2	3	E	B
11	15	13.4	15.2	18	16.4	18.2	1.8	E	A
12	15.2	12.4	16.4	18.2	15.4	18.4	3	F	B
13	14.6	12.6	16	17.6	15.6	18	2.4	E	B
14	16	13.2	17.2	18	16.2	19.2	3	E	B
15	16	14.2	16.2	18	17.2	18.2	1	E	A
16	16	16	15	18	18	18	0	E	A
17	16	14.8	16.2	18	17.8	18.2	0.4	E	A
18	15.6	14.2	16	18.6	17.2	18	0.8	F	A
19	18	16	18	20	18	20	2	F	A
20	16	13	16	18	16	18	2	E	A
21	18	16	18.2	20	18	20.2	2.2	F	B
22	14.2	12.6	14.4	17.2	15.6	17.4	1.8	E	A
23	17.4	14.6	18	19.4	17.6	20	2.4	F	B
24	17	15	14.4	19	18	17.4	-0.6	F	A
25	16.2	13.2	16.8	18.2	16.2	18.8	2.6	F	B
26	16.2	12.6	17.6	18.2	15.6	19.6	4	F	C
27	17.2	13.6	18.2	19.2	16.6	20.2	3.6	F	C
28	15	12.4	16	18	15.4	18	2.6	E	B
29	17.8	13	20	19.8	16	22	6	F	E
30	15	12.6	17	18	15.6	19	3.4	E	C
31	14.2	12.8	14.2	17.2	15.8	17.2	1.4	E	A
32	15	13.2	16	18	16.2	18	1.8	E	A
33	14.2	13.2	14.4	17.2	16.2	17.4	1.2	E	A
34	14.8	14	15.8	17.8	17	18.8	1.8	E	A
35	15.6	14	16	18.6	17	18	1	F	A
36	16	15	16	18	18	18	0	E	A
37	15.6	14.2	16	18.6	17.2	18	0.8	F	A
38	15.2	14.2	15	18.2	17.2	18	0.8	F	A
39	16.2	15.6	16	18.2	18.6	18	-0.6	F	A
40	15.2	14	16	18.2	17	18	1	F	A

Overall 90% Class		
	F	C

A.6. Site 3

C.3.1. Species1

Species 1	Uncorrected MC (%)			Corrected MC (%)				Individual Qaulity Classes	
25mm	Average	Gradient		Average	Gradient			Assuming Target MC of 10%	
Sample #	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	Difference	Average	Gradient
1	7.5	7	7.5	8.5	8	8.5	0.5	B	A
2	8	7.5	8	9	8.5	9	0.5	A	A
3	7.5	7	8	8.5	8	9	1	B	A
4	7.5	7.5	8	8.5	8.5	9	0.5	B	A
5	8	8	9	9	9	10	1	A	A
6	8.5	8.5	9	9.5	9.5	10	0.5	A	A
7	7.5	7	7.5	8.5	8	8.5	0.5	B	A
8	8	7.5	8	9	8.5	9	0.5	A	A
9	8	7.5	8	9	8.5	9	0.5	A	A
10	7.5	7	8	8.5	8	9	1	B	A
11	7.5	7.5	8	8.5	8.5	9	0.5	B	A
12	7	7	7	8	8	8	0	B	A
13	7.5	7.5	8.5	8.5	8.5	9.5	1	B	A
14	7.5	7	8.5	8.5	8	9.5	1.5	B	A
15	7	7	9	8	8	10	2	B	B
16	7	6.5	7.5	8	7.5	8.5	1	B	A
17	7	7	9.5	8	8	10.5	2.5	B	C
18	8	7.5	8.5	9	8.5	9.5	1	A	A
19	7.5	7.5	9	8.5	8.5	10	1.5	B	B
20	7.5	7	9	8.5	8	10	2	B	B
21	7	7	8	8	8	9	1	B	A
22	6.5	6.5	7.5	7.5	7.5	8.5	1	C	A
23	7	6.5	7.5	8	7.5	8.5	1	B	A
24	7	7	7.5	8	8	8.5	0.5	B	A
25	8	8	9	9	9	10	1	A	A
26	7	6.5	7.5	8	7.5	8.5	1	B	A
27	7.5	7.5	8.5	8.5	8.5	9.5	1	B	A
28	7.5	7.5	10	8.5	8.5	11	2.5	B	C
29	9	9	10.5	10	10	11.5	1.5	A	A
30	8	8	9.5	9	9	10.5	1.5	A	A
31	9	8.5	10	10	9.5	11	1.5	A	A
32	7	7	8	8	8	9	1	B	A
33	7.5	7.5	10	8.5	8.5	11	2.5	B	C
34	8.5	8	10	9.5	9	11	2	A	B
35	7	7	8	8	8	9	1	B	A
36	7.5	7	9	8.5	8	10	2	B	B
37	8	8	10	9	9	11	2	A	A
38	7	6.5	7	8	7.5	8	0.5	B	A
39	7	7	8	8	8	9	1	B	A
40	11.5	11	12	12.5	12	13	1	B	A

Overall 90% Class	B	B

C.3.2. Species 2

Species 2	Uncorrected MC (%)			Corrected MC (%)				Individual Qaulity Classes Assuming Target MC of 10%	
25mm	Average	Gradient		Average	Gradient				
Sample #	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	Difference	Average	Gradient
1	7.5	7	8	8	8	8	0	B	A
2	7	6.5	9	8	7.5	9	1.5	B	B
3	7	7	8.5	8	8	8.5	0.5	B	A
4	8	7.5	10	8	8	9	1	B	A
5	8	8	12	8	8	10	2	B	B
6	8	7.5	9.5	8	8	9	1	B	A
7	7	6.5	8	8	7.5	8	0.5	B	A
8	8	8	12	8	8	10	2	B	B
9	6.5	6	7	7.5	7	8	1	C	A
10	13	12.5	14	11	10.5	12	1.5	A	B
11	7	6.5	7	8	7.5	8	0.5	B	A
12	8	8	12	8	8	10	2	B	B
13	8	7.5	9	8	8	9	1	B	A
14	7	6.5	7.5	8	7.5	8	0.5	B	A
15	11	11	13	10	10	11	1	A	A
16	7.5	7	9	8	8	9	1	B	A
17	8.5	8.5	14	8.5	8.5	12	3.5	B	D
18	8	8	12	8	8	10	2	B	B
19	16	15	16	13	12	13	1	B	A
20	14	13.5	15	12	12	12	0	A	A
21	16	15	17	13	12	13	1	B	A
22	8.5	8.5	13	8.5	8.5	11	2.5	B	C
23	7	6.5	7	8	7.5	8	0.5	B	A
24	7	7	10	8	8	9	1	B	A
25	8	7.5	10	8	8	9	1	B	A
26	11	11	14	10	10	12	2	A	B
27	14	13.5	14.5	12	12	12	0	A	A
28	13	13	14.5	11	11	12	1	A	A
29	14	13.5	14.5	12	12	12	0	A	A
30	13	13	15	11	11	12	1	A	A
31	10	9	11	9	9	10	1	A	A
32	14.5	14	16	12	12	13	1	A	A
33	8	8	12	8	8	10	2	B	B
34	7	6.5	8.5	8	7.5	8	0.5	B	A
35	9	9	13	9	9	11	2	A	B
36	12.5	12	13	10	10	11	1	A	A
37	8	8	11.5	8	8	10	2	B	B
38	10.5	10	12.5	9	9	10.5	1.5	A	B
39	13	12.5	15	11	10.5	12	1.5	A	B
40	12	11	13	10	10	11	1	A	A

Overall 90% Class	Average	Gradient
Overall 90% Class	B	B

A.7. Site 4

C.4.1. Species 1

Species 1	Uncorrected MC (%)			Corrected MC (%)				Individual Qaulity Classes	
25mm	Average	Gradient		Average	Gradient			Assuming Target MC of 10%	
Sample #	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	Difference	Average	Gradient
1	9	8.5	9.5	10	9.5	10.5	1	A	A
2	8.5	8.5	9	9.5	9.5	10	0.5	A	A
3	9	8.5	9	10	9.5	10	0.5	A	A
4	9	8.5	9	10	9.5	10	0.5	A	A
5	9	9	9.5	10	10	10.5	0.5	A	A
6	8	7.5	8.5	9	8.5	9.5	1	A	A
7	8.5	8	9	9.5	9	10	1	A	A
8	9.5	9.5	10	10.5	10.5	11	0.5	A	A
9	8	8	9	9	9	10	1	A	A
10	8.5	8.5	9	9.5	9.5	10	0.5	A	A
11	8.5	8	9	9.5	9	10	1	A	A
12	9	9	9	10	10	10	0	A	A
13	8.5	8	8.5	9.5	9	9.5	0.5	A	A
14	8	8	8.5	9	9	9.5	0.5	A	A
15	9	8.5	9	10	9.5	10	0.5	A	A
16	9	8.5	9.5	10	9.5	10.5	1	A	A
17	8	8	8.5	9	9	9.5	0.5	A	A
18	9.5	9	9.5	10.5	10	10.5	0.5	A	A
19	9	9	9.5	10	10	10.5	0.5	A	A
20	9.5	9	10	10.5	10	11	1	A	A
21	9.5	9	10	10.5	10	11	1	A	A
22	9	8.5	9	10	9.5	10	0.5	A	A
23	9	9	9	10	10	10	0	A	A
24	9	9	9.5	10	10	10.5	0.5	A	A
25	9	8.5	9	10	9.5	10	0.5	A	A
26	8.5	8	9	9.5	9	10	1	A	A
27	8	8	8.5	9	9	9.5	0.5	A	A
28	9	9	10	10	10	11	1	A	A
29	9	8.5	9.5	10	9.5	10.5	1	A	A
30	9	8.5	9	10	9.5	10	0.5	A	A
31	9	9	9.5	10	10	10.5	0.5	A	A
32	8.5	8.5	10	9.5	9.5	11	1.5	A	B
33	8.5	8	9	9.5	9	10	1	A	A
34	10	10	10	11	11	11	0	A	A
35	10	10	10.5	11	11	11.5	0.5	A	A
36	10	9.5	10.5	11	10.5	11.5	1	A	A
37	9.5	9	9.5	10.5	10	10.5	0.5	A	A
38	9	9	9.5	10	10	10.5	0.5	A	A
39	9	8.5	9	10	9.5	10	0.5	A	A
40	10	9.5	10.5	11	10.5	11.5	1	A	A

Overall 90% Class	**A**	**A**

C.4.2. Species 2

Species 2	Uncorrected MC (%)			Corrected MC (%)				Individual Qaulity Classes Assuming Target MC of 10%	
25mm	Average	Gradient		Average	Gradient				
Sample #	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	Difference	Average	Gradient
1	9.5	9	11	9	9	10	1	A	A
2	10	9	10	9	9	9	0	A	A
3	10	9.5	11	9	9	10	1	A	A
4	10	9	10.5	9	9	9.5	0.5	A	A
5	10	9	11	9	9	10	1	A	A
6	8.5	8.5	9	8.5	8.5	9	0.5	B	A
7	10	9.5	10.5	9	9	9.5	0.5	A	A
8	10.5	10	11	9.5	9	10	1	A	A
9	12	11	12.5	10	10	10.5	0.5	A	A
10	9.5	9.5	10.5	9	9	9.5	0.5	A	A
11	10	10	10.5	9	9	9.5	0.5	A	A
12	9.5	9	10	9	9	9	0	A	A
13	10.5	10	11.5	9.5	9	10	1	A	A
14	9.5	9	10	9	9	9	0	A	A
15	9.5	9	10	9	9	9	0	A	A
16	10	10	10.5	9	9	9.5	0.5	A	A
17	10	10	11	9	9	10	1	A	A
18	10.5	10	12	9.5	9	10	1	A	A
19	10	10	11	9.5	9	10	1	A	A
20	9.5	9	10	9	9	9	0	A	A
21	9	9	10	9	9	9	0	A	A
22	10	9.5	10.5	9	9	9.5	0.5	A	A
23	9.5	9	10	9	9	9	0	A	A
24	10.5	10	12	9.5	9	10	1	A	A
25	12	11.5	13	10	10	11	1	A	A
26	10	9.5	11	9	9	10	1	A	A
27	10	10	10.5	9	9	9.5	0.5	A	A
28	11	10.5	12	10	9.5	10	0.5	A	A
29	10.5	10	11	9.5	9	10	1	A	A
30	11	10.5	12	10	9.5	10	0.5	A	A
31	9.5	9	10	9	9	9	0	A	A
32	11	11	13	10	10	11	1	A	A
33	11	10.5	12	10	9.5	10	0.5	A	A
34	11	10.5	12	10	9.5	10	0.5	A	A
35	9	8.5	10	9	8.5	9	0.5	A	A
36	10	10	10.5	9	9	9.5	0.5	A	A
37	10	10	11	9	9	10	1	A	A
38	10.5	10	11	9.5	9	10	1	A	A
39	11.5	11	12	10.5	10	11	1	A	A
40	10.5	10	11	9.5	9	10	1	A	A

Overall 90% Class	A	A

A.8. Site 5

C.5.1. Species 1

Species 1	Uncorrected MC (%)			Corrected MC (%)				Individual Qaulity Classes Assuming Target MC of 12%	
25mm	Average	Gradient		Average	Gradient				
Sample #	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	$MC_{1/3}$	$MC_{1/6}$	$MC_{1/2}$	Difference	Average	Gradient
1	10.1	8	12.5	13.1	10	15.5	5.5	A	E
2	10.9	9.1	12.4	13.9	11.1	15.4	4.3	A	D
3	10.1	8.1	12.1	13.1	10.1	15.1	5	A	D
4	11	9.3	13.5	14	11.3	16.5	5.2	A	E
5	10.9	9.2	13	13.9	11.2	16	4.8	A	D
6	10.1	8.4	12	13.1	10.4	15	4.6	A	D
7	10.2	8.5	12.2	13.2	10.5	15.2	4.7	A	D
8	10.1	7.9	12.3	13.1	9.9	15.3	5.4	A	E
9	10	8.1	12	13	10.1	15	4.9	A	D
10	10	9.1	12	13	11.1	15	3.9	A	C
11	10.9	9.8	12.8	13.9	11.8	15.8	4	A	D
12	9	8.3	10.1	11	10.3	13.1	2.8	A	B
13	10.4	9.5	11.8	13.4	11.5	14.8	3.3	A	C
14	8.4	8	8.9	10.4	10	10.9	0.9	A	A
15	8	7.9	8	10	9.9	10	0.1	A	A
16	8.4	8	8.5	10.4	10	10.5	0.5	A	A
17	9.6	7.9	11.3	11.6	9.9	14.3	4.4	A	D
18	9.8	8.5	11	11.8	10.5	14	3.5	A	C
19	9.8	9	11.5	11.8	11	14.5	3.5	A	C
20	11	8.5	13	14	10.5	16	5.5	A	E
21	8.5	8	9.2	10.5	10	11.2	1.2	A	A
22	9.3	9	8.8	11.3	11	10.8	-0.2	A	A
23	9.7	8	11.4	11.7	10	14.4	4.4	A	D
24	10	8.3	12	13	10.3	15	4.7	A	D
25	9.5	8	11.2	11.5	10	14.2	4.2	A	D
26	10.6	9	12.2	13.6	11	15.2	4.2	A	D
27	10.8	9	13	13.8	11	16	5	A	D
28	10.4	8.5	12.2	13.4	10.5	15.2	4.7	A	D
29	9.2	7.4	11.2	11.2	9.4	14.2	4.8	A	D
30	10	9.2	12	13	11.2	15	3.8	A	C
31	11	9.9	11.8	14	11.9	14.8	2.9	A	B
32	9	8.3	10	11	10.3	13	2.7	A	B
33	11.2	10.8	12.1	14.2	13.8	15.1	1.3	B	A
34	12	11.2	12.1	15	14.2	15.1	0.9	B	A
35	10.6	10	11.4	13.6	13	14.4	1.4	A	A
36	11	10.2	11	14	13.2	14	0.8	A	A
37	11	10.5	11.8	14	13.5	14.8	1.3	A	A
38	10.8	10	12	13.8	13	15	2	A	A
39	10.5	10	11	13.5	13	14	1	A	A
40	12	11.3	12	15	14.3	15	0.7	B	A
							Overall 90% Class	A	D