THE INTERACTIONS OF JACK PINE TREES (*PINUS BANKSIANA)* AND WATER

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ABSTRACT

This research was conducted in a native jack pine stand within Narrow Hills Provincial Park, Saskatchewan, Canada. The goals of this research were to 1) compare jack pine sap flow with environmental parameters (volumetric water content of the soil [VWC], net radiation, air humidity, air temperature, and wind speed) and internal water storage in the tree under pre-augmented (normal) conditions and augmented (drought) conditions, and 2) demonstrate that at a sandy site under drought conditions jack pine trees facilitate hydraulic redistribution of soil water.

Net radiation, air humidity, and VWC were the primary drivers of sap flow within jack pine trees in this study. Net radiation was the primary driver of sap flow throughout the day. Air humidity was important for inducing sap flow. The VWC was influential on the volume of water being transported up the tree to support transpiration. Sap flow was found to have hysteretic relationships with all environmental parameters except VWC. Throughout the diurnal cycle, sap flow and the tree trunk circumference have a divergent and hysteretic relationship. The daily amplitude of the change in tree trunk circumference was primarily controlled by sap flow, however the overall circumference of the tree trunk was controlled by the VWC and internal water storage. Jack pine trees only exhibited tree growth under normal conditions on days where sap did not flow. Jack pine tree trunk circumference contracted under drought conditions as the tree used internal water storage to supply evapotranspiration.

The movement of an isotopically labelled solution was used to demonstrate that at a sandy site under drought conditions, jack pine trees facilitate hydraulic redistribution. After injecting the isotopically labelled solution to a depth of 100 cm below the soil surface, soil water collected from 0 cm – 20 cm and 80 cm – 120 cm had statistically significantly higher δ^2H values compared to baseline δ^2H values. At the same time, the δ^2H values of soil water collected from 20 cm – 80 cm were statistically not different compared to baseline δ^2H values. The presence of the isotopically labelled solution at 0 cm – 20 cm and 80 cm – 120 cm, and absence of it between 20 cm – 80 cm, indicated jack pine trees facilitated hydraulic redistribution using their taproot and lateral roots.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

°C	Degrees Celsius
ABH	At breast height (1.4 metre)
AOSR	Athabasca oil sands region
BERMS	Boreal Ecosystem Research and Monitoring Sites
CCRN	Changing Cold Regions Network
cm	centimetre
CO_2	Carbon dioxide
GWC	Gravimetric water content
^{1}H	Deuterium, stable isotope of hydrogen with 0 neutrons and 1 proton
^{2}H	Stable isotope of hydrogen with 1 neutron and 1 proton
HR	Hydraulic redistribution
HRM	Heat Ratio Method
m	metre
MPa	Megapascal
^{16}O	Stable isotope of oxygen with 8 neutrons and 8 protons
^{17}O	Stable isotope of oxygen with 9 neutrons and 8 protons
^{18}O	Stable isotope of oxygen with 10 neutrons and 8 protons
PAW	Plant available water
VWC	Volumetric water content
$\delta^{2}H$	Isotope composition of ^{2}H expressed as a ratio of ^{2}H to ^{1}H
$\delta^{18}O$	Isotope composition of ^{18}O expressed as a ratio of ^{18}O to ^{16}O
‰	Parts per thousand

1. INTRODUCTION

1.1 General introduction

Open pit oil sands mining in the Athabasca Oil Sands Region (AOSR) of northern Alberta, Canada, requires the removal of vegetation, surficial organic matter, mineral soil, and overburden to access oil sand deposits. To understand the scale of this mining: in 2013, 121 million cubic metres (m^3) of raw crude bitumen from the AOSR was processed, all of which was located in the boreal forest (Alberta Energy Regulators, 2015). Areas altered by mining are required to be reclaimed to their former undisturbed state (Alberta Queen's Printer, 2000). Reclamation of these sites requires more than just re-vegetation; fully functional ecosystems and biodiversity that reflects the environment prior to mining must be constructed. A growing body of literature is being developed on the critical establishment of vegetation on reclaimed oil sands landscapes (Mackenzie and Naeth, 2009; Rowland et al., 2009; Hemstock et al., 2010; Larney and Angers, 2012; Leatherdale et al., 2012; Hahn and Quideau, 2012).

The entirety of the AOSR is located within the boreal forest. The boreal forest is a circumpolar forest that wraps around the northern hemisphere. Within Canada, the boreal forest extends across the country from northern Yukon to Newfoundland (Weber and Stocks, 1998). The boreal forest contains 25% of earth forest cover and is predominantly coniferous (Burton et al., 2010). The boreal forest is separated into different ecosites, which are determined by the intricate environmental relationships (Willoughby et al., 2017). Soil (geology, geomorphology, topography, available water holding capacity, and nutrient regime), climate (solar radiation, precipitation, and permafrost), and external factors (forest fires, human activity, and pest infestations) determine the ecosite (Sojo et al., 2007). Due to the intricate relationships that determine ecosites, adjacent ecosites can be dramatically different.

Within the boreal forest, *c: bearberry/lichen (subxeric/poor)* ecosites have xeric to submesic moisture regimes and poor nutrient regime (Willoughby et al., 2017). C: *bearberry/lichen (subxeric/poor)* ecosites are on the driest end of the spectrum for ecosites that can sustain deciduous trees, additionally these sites are typically too dry for conifer species (Willoughby et al., 2017). These ecosites are generally associated with sandy or rocky soils, such

as in the AOSR where 20% of the final reclaimed landscapes consist of coarse textured aeolian deposits and fluvial till (Zettl et al., 2011). The canopy cover of *c: bearberry/lichen (subxeric/poor)* ecosites largely consists of *Pinus banksiana* (jack pine trees) and the understory consists of shrubs, moss, and lichen (Willoughby et al., 2017). The dimorphic rooting structure of jack pine trees are advantageous on these dry sites. Most of the jack pine roots extend radially around the base of the tree as lateral roots. These lateral roots provide anchorage and capture rapidly infiltrating soil water after precipitation events (Plourde et al., 2009). Additionally, jack pine trees generally have a taproot that extends down the soil profile. This taproot greatly increased the jack pine tree's access to soil water storage throughout the soil profile (Rudolp and Laidly, 1990). This research was intended to be conducted within the AOSR, however due to the catastrophic wildfires in 2016, the study site had to be moved out of the AOSR. A study site in Narrow Hills Provincial Park, Saskatchewan, Canada was selected to conduct this research. This site was selected because of its homogenous coarse textured soil, ecosite classification, and native species.

This research aimed to measure how jack pine trees utilize internal trunk water storage on a diurnal scale under both pre-augmented (normal) conditions and augmented (drought) conditions. This is important to understand in the context of reclamation because it informs on how the soil water balance affects tree growth, and on a larger scale how the boreal forest may respond to climate change induced drought. Predicting how *c: bearberry/lichen (subxeric/poor)* ecosites will respond to climate change is challenging but by better understanding how these sites are responding now we can prepare and plan for the future. The movement of water within jack pine trees was measured using heat pulse probes and circumference dendrometers. Under both normal soil moisture conditions and drought conditions, sap flow was compared with volumetric water content of the soil, air temperature, air humidity, net radiation, wind speed, and water storage within the tree trunk.

In addition to investigating jack pine trees water use and storage, this study aimed to determine if jack pine trees facilitate hydraulic redistribution (HR). At these xeric to submesic moisture regime sites, soil water can possibly be moved from areas of low soil matric potential to areas of high matric potential through a passive process known as HR. Hydraulic redistribution

requires no energy from the vascular plant and is driven by soil water potential gradients. The dimorphic rooting structure of jack pine trees may act as conduits, which passively move soil water from areas of high soil water potential (wet soil) to areas of low soil water potential (dry soil). Understanding how jack pine trees redistribute deep soil water throughout the soil profile is important when considering soil water storage, especially on dry or drought susceptible soils. Furthermore, if jack pine trees facilitate HR, increased water at the soil surface due to HR may support the jack pine lateral roots and understory. Stable hydrogen isotopes in the water molecule can be used to monitor the movement of soil water and therefore provide a tool to determine if HR is occurring at a site. Prior to this study, little research had been conducted on the contributions of HR to soil water content at *c: bearberry/lichen (subxeric/poor)* ecosites.

1.2 Research objectives

This thesis consists of two main studies. The objective of the first study was to understand the response of jack pine sap flow to environmental parameters and how sap flow impacts internal water storage of jack pine trees at breast height (1.4 m). The first study consists of three main components:

1) measure how jack pine sap flow responded to environmental parameters during the diurnal cycle;
2) characterize changes in jack pine sap flow during a period of extended drought;
3) establish an understanding of how sap flow and drought conditions impacted the water storage of jack pine trees.

The objective of the second study was to detect the contributions of HR to plant available water (PAW) in the top 20 cm of soil at a jack pine stand in Narrow Hills Provincial Park, Saskatchewan, Canada. The second study can be broken into two main components:

1) define the transfer of soil water at a jack pine stand using an isotopically labelled solution;
2) determine if jack pine roots facilitate HR.

1.3 Organization of thesis

This thesis is organized into a manuscript format with two articles that cover the breadth of the research. Chapter one provides an introduction and basic concepts of this research project. Chapter two provides an in-depth literature review to demonstrate the knowledge base this project was built upon. All concepts and equipment used for this research are initially covered in chapter two. Chapters three and four are the two chapters that cover the breadth of the research. In chapter three the focus of the first study, water storage in jack pine trees, is evaluated. In chapter four the focus of the second study, jack pine trees ability to facilitate HR, is evaluated. Chapter five summarizes the findings of the research project, provides concluding statements, and suggests further research. Due to the manuscript formatting of this thesis, please excuse redundant content between chapters.

2. LITERATURE REVIEW

2.1 Boreal forests and climate change

The boreal forest, or taiga in Europe and Asia, covers 1.890 billion hectares in the northern hemisphere and is the largest biome on earth (Brandt, 2013), containing over 25% of the world's forest cover (Burton et al., 2010). For a forest to be defined as part of the boreal forest, trees must be capable of growing to five metre (m) in height and have a canopy cover of at least ten percent (Gauthier et al., 2015), while the temperature reaches below zero degrees Celsius for six to eight months of the year (Burton et al., 2010). Boreal forests are largely coniferous. In Canada's central prairie provinces, where the boreal forest extends down from the north, the common coniferous species are *Picea glauca* (white spruce), *Picea mariana* (black spruce), *Pinus banksiana* (jack pine), *Abies balsamea* (balsam fir), and *Larix laricina* (tamarack). The common deciduous species within this region are *Populus tremuloides* (trembling aspen), *Populus balsamifera* (balsam poplar), and *Betula papyrifera* (white birch). The intricate environmental factors driven by soil (geology, geomorphology, topography, available water holding capacity, and nutrient regime), climate (solar radiation, precipitation, and permafrost), and external factors (forest fires, human activity, and pest infestations) determine what species of trees, and ultimately what kind of ecosite, will be present at a site within the boreal forest (Willoughby et al., 2017; Sojo et al., 2007).

Climate change is impacting boreal forests (IPCC, 2007; IPCC, 2014). Climate change at the upper latitudes of the northern hemispheres has resulted in increased average temperatures (IPCC, 2007; Soja et al., 2007; IPCC, 2014) and changing precipitation patterns (Lindner et al., 2008; Beaumont et al., 2011; IPCC, 2013). These climate driven changes have resulted in, or could result in, increased drought stress (Barber et al., 2000; Allen et al., 2010; Carnicer et al., 2011; Ma et al., 2012), invasive species (Sambaraju et al., 2012), and megafires (Amiro et al., 2001; Gillett et al., 2004; Randerson et al., 2006; Balshi et al., 2009; Stephens et al., 2014) within the boreal forest. Moreover, the carbon sequestration cycle and hydrological cycle within the boreal forest will likely be affected by climate change (Ireson et al., 2015).

Trees synthesize carbohydrates using carbon dioxide (CO_2) as a source of carbon and water as a source of hydrogen, through the process of photosynthesis. Photosynthesis is limited by the amount of sunlight which triggers activity within the stomatal, atmospheric CO_2 supply, and water availability. As CO_2 is an atmospheric greenhouse gas, carbon sequestration by trees within the boreal forest is important for providing a feedback loop for CO_2 (Stephenson et al., 2014). The boreal forest stores 30% to 35% of global terrestrial carbon, which is the largest reserve of sequestered terrestrial carbon on earth (Soja et al., 2007). Increased drought stress, invasive species, and megafires due to climate change could each interrupt carbon sequestration in the boreal forest. Ultimately the boreal forest could become a carbon source instead of a carbon sink, which could lead to further climate change (Soja et al., 2007; Gauthier et al., 2015; Ireson et al., 2015). In addition to changes in carbon sequestration, it is important to consider changes to the hydrological cycle due to climate change within the boreal forest (Soja et al., 2007; Ireson et al., 2015). The hydrological cycle within the boreal forest is highly complex. For example, evapotranspiration rates change based on the canopy cover and time of year; snowmelt and runoff vary based on vegetation, canopy cover, and leaf area index; and infiltration rates vary based on soil texture, water holding capacity, and if soil are frozen (Ireson et al., 2015). Due to the complexity of the hydrological cycle within the boreal forest, it is very hard to measure and predict climate induced changes to the hydrological cycle.

2.2 Athabasca oil sands region

The Athabasca oil sands region (AOSR) is located entirely within the boreal forest. Open pit oil sands mining within the AOSR requires the removal of vegetation, surficial organic material, soil, and overburden to access the oil sands ore body. Therefore, mining initially results in the dismantling of boreal ecosites. Successful reclamation to re-establish ecosites requires building fully functional, self-sustaining ecosystems that support the biodiversity and land use equal to that of the site prior to mining (Alberta Environmental Protection, 1998). Intricate environmental relationships results in different types of ecosites within the AOSR. Therefore, successful reclamation of these sites after mining requires understanding the intricate relationships between soil, climate, water, and nutrients that create ecosystems (Willoughby et al., 2017). Due to the complexity of these environmental relationships, which is further complicated by climate

change, establishing vegetation after reclamation can be quite challenging. There is a growing body of literature being developed on the challenges and successes of establishing vegetation in the AOSR after mining (Mackenzie and Naeth, 2009; Rowland et al., 2009; Hemstock et al., 2010; Larney and Angers, 2012; Leatherdale et al., 2012; Hahn and Quideau, 2012; Farnden et al., 2013).

Ecosites with jack pine trees as the main canopy cover and understories that consist of shrubs and lichen are classified as *TS2: Jack Pine – Black Spruce/Lichen* within Saskatchewan (McLaughlan et al., 2010). For consistency with literature pertaining to the AOSR, in Alberta these ecosites are called *c: bearberry/lichen (subxeric/poor)* ecosites (Willoughby et al., 2017). These ecosites are on the driest end of the spectrum that can sustain deciduous trees with xeric to submesic moisture regimes and poor nutrient supplies. Parent material for these ecosites generally originate from aeolian, fluvial, fluvial-aeolian, or glacial-fluvial systems, and are often associated with glacial morphology features (Willoughby et al., 2017). In the AOSR, 20% of the soil is generated on glacial fluvial till and aeolian deposits (Zettl et al., 2011; Huang et al., 2013). Therefore, understanding the intricate environmental relationships, and in particular soil moisture regime and soil water use by jack pine trees, at *c: bearberry/lichen (subxeric/poor)* ecosites is important for implementing successful reclamation at comparable sites within the AOSR.

2.3 Jack pine trees

In Canada's boreal forest, *Pinus banksiana* (jack pine trees) are a predominant species found east of the Rocky Mountains extending all the way to Newfoundland (Grimm, 1983). Jack pine trees are a shade intolerant, drought tolerant tree species that grow in dense even-aged stands. Jack pine stands are especially prevalent in areas with dry sterile soils such as on glacial and fluvial plains (Preston and Braham, 2002). Mature jack pine trees range from 9 – 22 m in height, depending on soil quality and site conditions (Burns and Honkala, 1990). Often the trees are irregular shaped with the majority of new growth at the crown of the tree. Their yellowish-green needles (2 – 4 cm) diverge in a V-shape, making the jack pine tree readily identifiable (Grimm, 1983). Even-aged jack pine stands are common because of regeneration after forest fires. Heat from the fire releases the resinous bond of the serotinous pine cone, which releases

the seeds (Alexander and Cruz, 2012). Due to the requirement of heat to open the pine cone and release the seeds, regeneration after harvesting or reclamation typically requires planting saplings.

Jack pine tree stem and branch physiology can be split into four main components: xylem, cambium, phloem (inner bark), and outer bark. Primary growth, or new shoots, is when the pith and vascular tissue (primary xylem and primary phloem) grow longer. Secondary growth is the radial expansion of the stem (secondary xylem and secondary phloem). Trees grow radially away from the central pith, which is the axis of the stem. Radiating around the central pith of the tree is the xylem. The tissue in the xylem is primarily composed of tracheids (90 – 94%) and rays (6 – 10%) (Thomas, 2014). Tracheids vessels are elongated, hollow and continuous dead cells running up the stem, that are interconnected by pits, which make up a network of interconnected tubes filled with water (Thomas, 2014). In general, pits act as valves allowing water to move from one tracheid to another. Rays are cellular sheets that run perpendicular to the tracheid cells. The xylem consists of heartwood and sapwood. Heartwood is accumulated tissue surrounding the pith that conducts little or no water. The tracheid vessels within the heartwood are often filled with resin, giving heartwood a darker colour and harder physical properties. Sapwood surrounds the heartwood and contains much of the water filled tracheids that provide water for transpiration (Kozlowski, 1962; Thomas, 2014). Sapwood is further divided into earlywood and latewood. In the spring and early summer, earlywood is formed when water is generally plentiful. Earlywood consists of large cells with thin walls allowing for greater quantities of water to be transported, allowing for active growth (branch and leader development). Latewood is formed as the season progresses and less water is required for growth. Latewood is comprised of smaller cells with thicker walls to produce stronger tissue (Kozlowski, 1962; Thomas, 2014). The annual growth ring is usually apparent, as the earlywood is lighter in colour and the latewood is darker in colour.

Wherever there is secondary growth, a cellular sheath known as the cambium separates the xylem and phloem (Kozlowski, 1962; Thomas, 2014). The cambium generates cells that become secondary vascular tissues. Depending on what side of the cambium the cells are formed they either become xylem or phloem tissues. Some of the cells formed from the cambium do not

transform into xylem or phloem tissues; instead these living cells form the rays that radiate outwards from the center of the tree (Kozlowski, 1962; Thomas, 2014). Rays convey water, nutrients, and organic material radially between the xylem and phloem (Kozlowski, 1962; Thomas, 2014). However, unlike rays, the cambium does not transport water, minerals, or nutrients. To deal with the radial strain of tree growth the cambium grows sideways. Cambium expansion generates irreversible diameter growth in the stem (or trunk).

Phloem (or inner bark) is the tissue between the xylem and dead outer bark. Phloem consists of living cells compared to the xylem that is mostly comprised of dead cells (Thomas, 2014). The phloem transports soluble organic compounds (sugars) made during photosynthesis at the needles to parts of the tree that do not perform photosynthesis (Thomas, 2014). The outer bark is the protective sheath that surrounds the phloem. Outer bark is comprised of old inner phloem with the addition of cork cells that are filled with tannins and waxy material (suberin) (Thomas, 2014).

Jack pine rooting morphology is fundamental for the tree's success and survival. Roots are essential for providing anchorage, water and nutrient uptake, and contributing to hormone production (Plourde et al., 2009). Jack pine roots at natural sites have a characteristic dimorphic rooting morphology; with the main lateral roots growing out radially at a 90° angle from the base of the tree in the upper 20 cm of the soil and a taproot extending down from the base of the tree (Plourde et al., 2009). Taproots of jack pine have been found to penetrate soil depths greater than 270 cm (Rudolp and Laidly, 1990). The development of a taproot allows jack pine trees to access soil water and nutrients from deep soil. During large groundwater table fluctuations, taproots can often remain in contact with groundwater. A taproot's access to deep soil water may be critical for the tree's water supply when the surface soil that supports lateral roots is under dry or drought conditions.

Jack pine tree roots have complex symbiotic associations with fungi in their rhizosphere, known as mycorrhiza. Studies in north-eastern Alberta have demonstrated that jack pine trees are largely ectomycorrhizal, with at least 56 species of fungi (Visser, 1994). As jack pine stands mature, the fungi community successively changes as one mycorrhiza species is replaced by

another (Danielson, 1991). Ectomycorrhizal fungi form intercellular networks with the tree's epidermal root cells, aiding in nutrient and water uptake (Visser, 1994).

Planted jack pine tree roots do not necessarily have the same rooting morphology as naturally regenerated jack pine trees. Root spiralling can result from seedling production in containers, which may result in no taproot development (Plourde et al., 2009). This change in root morphology has large implications for water and nutrient accessibility and tree stability. Additionally, there may be limited or no mycorrhiza development in containers (Danielson and Visser, 1989). To promote healthy rooting systems, inoculation of ectomycorrhizal fungi is beneficial (Danielson and Visser, 1989) but does not resolve issues with root spiralling (Plourde et al., 2009).

2.4 Water storage and stress within tress

Under the right environmental conditions, hundreds of liters of water are acquired and transpired by a single tree in one day. For the development of biomass, trees utilize 1% of acquired water, while the other 99% of acquired water is lost through transpiration (Lambers et al., 1998). Trees transport water from their roots to their needles, meaning some trees need to transport water to heights of over 100 m. However, jack pines do not generally exceed heights of 22 m (Burns and Honkala, 1990). Trees are able to transport water to these great heights because of a continuous water column within their xylem (Thomas, 2014). As water evaporates from pine needle pores, negative pressure is created within the cell walls of the xylem of the tree (-1.5 MPa in the average tree but this number varies greatly) (Irvine et al., 1998). This negative pressure creates a water potential gradient within the tree that pulls water up the tree from the roots to the needles, within the xylem tubes. Water tension in the tree from transpiration is so great that the xylem tubes within the tree compress, causing the tree's circumference to contract during the day and expand at night (Irvine and Grace, 1997). The surface tension of water and the nano-scale pores (2 – 5 nm) of the xylem ensures that the water-air interface does not break under these high tensions. The xylem water reaches a metastable state, as there are no nucleation sites (gas or bubbles) within the xylem. In the event of bubbles forming, pits catch any small bubbles and prevent the build up of large bubbles. This catchment of bubbles is especially important in the spring as dissolved gasses from frozen water are released into the xylem stream

(Thomas, 2014). In addition to the tension from transpiration, water molecules adhere to each other and to their surrounding surfaces, moving water up the tree (Thomas, 2014). This process of water moving up a tree due to tension from transpiration and cohesion from the cohesive dipolar water molecules is known as the Tension-Cohesion theory (Boehm, 1893). The simplicity of the Tension-Cohesion theory has been debated (Zimmerman et al., 2004; Angels et al., 2004). Current research shows that in addition to the Tension-Cohesion theory, hydraulic coupling between the evaporative stream in the xylem and water storage within the phloem plays a large role in supplying water for transpiration (Sevanto et al., 2011; Steppe et al., 2015).

In general, water is transported upwards in the sapwood, downwards in the phloem, and radially between the two tissues. The phloem tissue provides a pathway to move sugars produced during photosynthesis at the needles to nutrient sinks within the tree. Osmotic pressure differences within the live cells of the phloem generates the pressure difference to move sugar and water within the phloem. To maintain turgor pressure in the live cells of the phloem, osmotic pressure is adjusted. However, this cellular water also serves as internal tree water storage that can be utilized if the transpiration rate exceeds the rate of root water uptake. Therefore, if the water potential in the xylem is low enough (more negative), water is moved from the phloem to the xylem. As sap flow generally increases throughout the day and tapers off in the evening, sap flow follows a symmetric bell-shaped curve. This diurnal change in demand for water results in large water potential differences and changes in water storage within the tree throughout the day. During the day when transpiration is at its highest the turgor pressure within the phloem cells is at its lowest, which ultimately limits radial growth of the stem. Therefore, tree growth generally occurs at night when turgor pressure is at its highest (Steppe et al., 2015).

The species and scale of a tree determines how that tree will respond to environmental parameters, and govern the tree water use (i.e., transpiration, sap flow, and internal water storage) (Li et al., 2016a). Short-term changes to regulate transpiration are controlled by changes to stomatal conductance, while long-term changes to regulate transpiration are due to changes in leaf area and root growth (McDowell et al., 2008). Stomatal conductance is impacted by water storage within the tree, which depends on the amount of sapwood and height of the tree

(Gartner and Meinzer, 2005; Scholz et al., 2007; Ewers et al., 2011). Additionally, stomatal conductance is regulated by environmental parameters such as soil water content, air temperature, air humidity, vapour pressure deficits, net radiation, precipitation, and wind speed (McDowell et al., 2008). Internal water stress occurs in the trees when the evaporative demand of the crown and branches exceeds soil water availability (Waring and Running, 1978; Waring et al., 1979).

Fluctuating evaporative demands and limited soil water availability cause jack pine trees to experience water stress; this stress is felt on both diurnal and seasonal scales. Hydraulic dysfunctions such as stomatal closure and xylem embolism can result from water stress within the evaporative xylem stream. To alleviate this stress, internal water storage can be released into the evaporative xylem stream (Gartner and Meinzer, 2005; Scholz et al., 2007; Meinzer et al., 2009). Available water storage in trees is the volume of water that can be extracted from leaves, stems, and roots to be used in the evaporative stream, however much of the internal water storage is within the trunk of the tree (Goldstein et al., 1998; James et al., 2003; Hao et al., 2013). Internal water storage is thought to contribute to 5 – 25% of the daily transpired water, depending on environmental parameters and tree species (Loustau et al., 1996; Goldstein et al., 1998; Köcher et al., 2013; Steppe and Lemeur, 2014). Contributions to the daily water budget from internal water storage is thought to fluctuate during the growing season. For example, during a period of ample soil water supply 12% of transpired water from a *Pinus pinaster* came from internal water storage, but for the same tree under drought conditions 25% of transpired water was from internal water storage (Loustau et al., 1996).

To be accessible to the tree, this internal water must be in the physiological range of water potentials (0 to – 3 MPa) (Tyree and Yang, 1990). A tree's ability to retrieve and utilize stored water gives the adaptive advantage of being able to survive periods of drought. Water storage within trees consists of three components: capillary, elastic, and embolism (Zimmerman, 1983; Tyree and Yang, 1990; Jupa et al., 2016). Capillary water storage is the water stored within intercellular spaces and embolized wood cells of the xylem (vessels, wood fibres, and tracheids). Capillary water is thought to be released at a water potential close to zero MPa (Jupa et al., 2016). Elastic water storage is the water stored within cells that have elastic walls (Tyree and Yang,

1990). As water potential changes around the cell walls, cells expand or contract enabling water to flow in or out (Tyree and Yang, 1990). Water stored within elastic tissue is thought to be accessed at water potentials more negative than capillary water storage (Jupa et al., 2016). Ultimately, internal water stress can cause hydraulic dysfunctions, such as xylem embolism and cavitation formation. This occurs when water stored within water filled vessels, tracheids, and fibres, is released due to a gas bubble being sucked into the vessel. Cavitation begins to occur when water potential exceeds -1 MPa (Tyree and Yang, 1990). Embolism formation is generally irreversible in large woody plants during the growing season, however some embolized cells may refill in the spring (Tyree and Yang, 1990).

2.5 Measuring sap flow and tree trunk circumference

The movement and storage of internal water within trees can be inferred by using instruments to measure sap flow and changes in tree trunk circumference, such as heat pulse probes to measure sap flow and circumference dendrometers to measure changes in tree trunk circumference. Techniques using heat pulse probes have been developed to measure sap flow, sap flow velocity, and sap flow direction (Salama et al., 1994; Zotz et al., 1997; Burgess et al., 2001). Burgess et al., (2001) pioneered the heat ratio method (HRM) which allows for sap flow and direction to be measured. The HRM gives improved measurement range and resolution, simple linear functions to describe wound effects, and corrections for errors in sensor deployment (Burgess et al., 2001). The HRM heat pulse probes consist of three needles that are inserted into the xylem tissue of a tree, the center needle emits a short heat pulse and then the upstream and downstream needles measure change in temperature with time. The HRM measures the ratio increase in temperature at points 0.6 cm upstream and downstream from the heater, following the emission of a heat pulse (Burgess et al., 2001). The HRM can measure low flow velocity and reverse flow, is not overly invasive to the tree, takes little energy, and the heat pulse probes are relatively easy to construct (Burgess et al., 2001). Heat pulse velocity is calculated by:

$$V_h = \frac{4kt \ln\left(\frac{v_1}{v_2}\right) - (x_2^2) + (x_1^2)}{2t(x_1 - x_2)} 3600$$

(2.1)

where, V_h is heat pulse velocity, k is thermal diffusivity of fresh wood, t is measurement time, x_1 and x_2 are the respective distances (cm) of the temperature probes from the heater, and v_1 and v_2 are increases from initial temperature at the downstream and upstream needles, respectively (Burgess et al., 2001). Initially, thermal diffusivity (k) is assigned a value of 2.5 x 10^{-3} cm^2 s^{-1} until the actual value can be resolved from the sapwood properties using an empirical measurement. The ratio (v_1/v_2) does not remain constant with time because of damage to xylem vessels during probe insertion and due to slightly asymmetrical probe placement. Burgess et al., (2001) found that even in extreme cases after 60 s v_1/v_2 ratios are essentially linear with a slope of less than 0.01. Therefore, ratios should be averaged from 60 to 100 s. The following is used to account for incorrect probe spacing:

$$x_2 = \sqrt{4kt \ln\left(\frac{v_1}{v_2}\right) + x_1^2}$$

(2.2)

where, x_2 is the incorrectly spaced probe and x_1 is assumed correctly spaced at 0.6 cm (Burgess et al., 2001). A simple linear relationship can be generated by comparing corrected and uncorrected values for a small subset of the data. This relationship can then be used to correct the remaining data (Burgess et al., 2001). This process of calculating the incorrectly spaced probe is then repeated but with the assumption that x_2 is correctly spaced and x_1 is incorrectly spaced. The average of the two solutions for equation 2.2 is then taken as the unbiased distances of the probes (Burgess et al., 1998).

Xylem tissue is damaged during probe insertion, but there are correction coefficients from a numerical model developed by Burgess et al., (2001) to account for damages and allows for the heat pulse velocity to be corrected. The correction coefficients are provided in Appendix A. Heat pulse velocity is then corrected by:

$$V_c = bV_h + cV_h^2 + dV_h^3$$

(2.3)

where, *b*, *c,* and *d* are the coefficients provided by Burgess et al., (2001) and V_c is the corrected heat pulse velocity. According to Barrett et al., (1995) and Marshall (1958) sap velocity can then be calculated as:

$$V_s = \frac{V_c \rho_b (c_w + m_c c_s)}{\rho_s c_s}$$

(2.4)

where, ρ_b is the density of wood (dry weight/green volume), c_w is the specific heat capacity of wood (1200 J kg^{-1} $°C^{-1}$ at 20 °C [Becker and Edwards 1999]), c_s is the specific heat capacity of sap (4182 J kg^{-1} $°C^{-1}$ at 20 °C [Lide, 1996]), m_c is the water content of the sapwood, and ρ_s is the density of water (Burgess et al., 2001). A cross-sectional area of the conducting jack pine sapwood and the sap velocity can then be used to calculate volumetric sap flow. A cross-sectional area of the sapwood can be determined by taking a radius core of the jack pine tree with an increment borer. The bark and the heartwood (dark wood) are removed from the sample, as they do not conduct sap. Sap flow can then be extrapolated based on the point scale measurement of sap velocity, sapwood water content, and the cross-sectional area of sapwood at that height (Goldstein et al., 1998; Burgess et al., 2001). However, when extrapolating sap velocity to sap flow, one assumes a uniform depth of sapwood and consistent flow rates throughout the sapwood. These assumptions can lead to over or under extrapolations of sap flow.

To measure changes in tree trunk circumference, circumference dendrometers can be deployed to measure diurnal activities (swelling and shrinking) and long-term morphological changes (growth) (Zweifel and Häsler, 2001; Deslauriers et al., 2003; McLaughlin et al., 2003; Bouriaud et al., 2005; Daudet et al., 2005; Vieira et al., 2013; Siegmund et al., 2016). A tree trunk's response to environmental conditions can be analysed using high temporal and spatial resolution circumference dendrometers (McLaughlin et al., 2003; Drew and Downes, 2009; Denneler et al., 2010; Miralles-Crespo et al., 2010; Oberhuber and Gruber, 2010; Jezik et al., 2011; Butt et al., 2014; Siegmund et al., 2016). DC2 circumference dendrometers (Ecomatik; Dachau, Germany)

provide this high temporal and spatial resolution. DC2 circumference dendrometers use an invar wire ($Fe_{65}Ni_{35}$), which has a very low coefficient of thermal expansion (< 1.4 x 10^{-6} k^{-1}) (Ecomatik User Manual, 2014). The invar wire is wrapped around a tree creating radial tension and threaded through a sensor. Changes in radial tension increase or decrease the compression of the sensor, and these changes within the sensor are recorded as changes in resistance in a data logger (Onset HOBO 4-channel analog logger; Massachusetts, USA). Resistance can then be converted to circumference size. Tree trunk circumference is given by the following equation (Ecomatik User Manual 2014):

$$C_i = 2 \times (\pi \times R_0 - R_0 \times \arccos\left(\frac{R_0}{R_0 + 102 - V_0}\right) + \sqrt{(R_0 + 102 - V_0)^2 - R_0^2}$$

$$+ R_{i-1} \times \arccos\left(\frac{R_{i-1}}{R_{i-1} + 102 - V_i}\right) - \sqrt{(R_{i-1} + 102 - V_i)^2 - R_{i-1}^2}$$

(2.5)

where, C_i is the circumference of the tree, R_0 is the radius of the tree at the beginning of the measurements, V_0 is the first valid record of the dendrometers, R_{i-1} is the radius of the tree the day prior of measurement, and V_i is data records of the dendrometers.

2.6 Measuring hydraulic redistribution of soil water

Hydraulic redistribution (HR) is the passive movement of soil water through roots, driven by gradients in soil water potential, and requires no energy from vascular plants (Burgess et al., 1998). Soil water gradients result from adjacent areas of high soil water potential (wet soil) and low soil water potential (dry soil) (Richards and Caldwell, 1987). Trees that facilitate HR can potentially sustain roots in dry soil depths (Bauerle et al., 2008), access nutrients from dry soil (Querejeta et al., 2008), maintain hydraulic conductance with the soil (Domec et al., 2004; Irvine et al., 2008), increase rates of transpiration and photosynthesis, and extend the growing season (Brooks et al., 2002).

Burgess and Bleby (2006) demonstrated that HR can induce sap flow rates greater than that induced by transpiration. Theoretically soil water movement driven by potential gradients follows the pathway of least resistance, however the layout of the rooting system may hinder

HR. This is due to inherent resistance within the rooting network to water moving away from the tree trunk towards the soil, even though the resistance within the individual root is the same for water moving in either direction (Burgess and Bleby, 2006). Bleby et al., (2010) states that all woody roots are capable of HR, however the roots that actually play a role in HR depends on the hydraulic architecture of the xylem conduits. It is thought that young non-suberised roots, that have not yet developed Casparian strips, release water to the soil (Caldwell et al., 1998). Multiple species have exhibited their ability to move water upwards (Caldwell and Richards, 1989; Burgess et al., 1998; Moreira et al., 2003; Bleby et al., 2010), downwards (Smith et al., 1999; Burgess et al., 2001; Bleby et al., 2010), and laterally (Smart et al., 2005; Burgess and Bleby, 2006; Bleby et al., 2010) through HR. The soil water potential gradient typically exceeds that of the potential gradient created by evapotranspiration at night, when water for transpiration and photosynthesis is not required, therefore HR typically occurs at night. However, during the day when the soil water potential gradient exceeds that of the potential gradient from evapotranspiration, HR can occur (Caldwell and Richards, 1989; Caldwell et al., 1998; Bleby et al., 2010). Bleby et al., (2010) found that after a rainfall, shallow lateral roots provided much of the water for evapotranspiration and HR, while during drought conditions the deep roots contributed much of the water for these processes. Ultimately, Bleby et al., (2010) determined HR to be a dominant process that can significantly alter the water balance of semi-arid woodlands and ecosystems.

Hydraulic redistribution of soil water has been detected across species and ecosystems: amazon (Oliveira et al., 2005; Wang et al., 2011; Stahl et al., 2012; Yan and Dickinson, 2014), desert (Hultine et al., 2003; Hao et al., 2013; Yu et al., 2013), savannas (Scott et al., 2008; Yu and D'Odorico, 2015; Priyadarchini et al., 2016), and mixed forests (Brooks et al., 2002; Warren et al., 2007; Zapater et al., 2011). Jackson et al., (2000) found that although multiple plant species can perform HR, trees are the most proficient at HR. Within a semi-arid woodland ecosystem all deciduous or evergreen tree species were found to perform HR (Bleby et al., 2010). Furthermore, Bleby et al., (2010), found that 80% of surface roots and 100% of deep roots performed HR. A tree's ability to access water and nutrients through its deep roots or taproot may be critical for growth and survival during dry or drought conditions. Jack pine trees dimorphic rooting structure

extends to multiple soil depths with different volumes of PAW, therefore their roots likely sit in depths with different soil water potentials which may facilitate HR. Determining if, how, and when jack pine trees facilitate HR is important in the context of reclamation in the AOSR because HR may contribute to surface soil PAW and success of jack pine trees on *c: bearberry/lichen (subxeric/poor)* ecosites.

Contributions of HR to soil water content at a *c: bearberry/lichen (subxeric/poor)* ecosites and what these contributions mean for AOSR reclamation are not known. Detecting or quantifying HR through measuring volumetric water content, soil water potentials, and volumetric humidity generates ambiguous data (Milikin-Ishikawa and Bledsoe, 2000; Domec et al., 2004; Warren et al., 2005; Meinzer et al., 2007; Bauerle et al., 2008). Previous studies have measured the movement of water through roots using heat pulse probes (Smith et al., 1999; Burgess et al., 1998; Hultine et al., 2003; Oliveira et al., 2005; Burgess and Bleby, 2006; Bleby et al., 2010; Yu et al., 2013). Measuring the movement of water in tree roots using heat pulse probes requires accessing the below ground roots through excavation or working in environments with underground voids that can be accessed, such as in karst systems (Bleby et al., 2010). Excavating to install heat pulse probes is disruptive to tree roots and mycorrhizal fungi, while working in underground voids, such as in karst systems, is only possible in unique scenarios and is not relevant to the AOSR. Instead isotopically labelled solutions can be utilized to determine the movement and storage of soil and xylem water (Dawson, 1993; Brooks et al., 2002; Zapater et al., 2011; Stahl et al., 2012; Hao et al., 2013; David et al., 2013). Using isotopically labelled solutions to monitor HR does not quantify the amount or rate of soil water being moved via HR, but it allows us to determine the existence of HR and general locations of where water is being redistributed to and from in the soil profile.

In the context of monitoring HR, isotopically labelled solutions use naturally occurring isotopes of oxygen or hydrogen to create water molecules with measurable physical differences. Oxygen (O) has three natural and stable isotopes: ^{16}O, ^{17}O, and ^{18}O. The most common, ^{16}O, makes up 99.796% of terrestrial oxygen, whereas ^{18}O makes up 0.204% (Clark and Fritz, 1997). Hydrogen (H) has two natural and stable isotopes: ^{1}H and ^{2}H. The prevalent ^{1}H makes up 99.98% of terrestrial hydrogen, whereas ^{2}H makes up the remaining 0.0184% (Clark and Fritz, 1997).

Isotopic compositions are reported as the ratio of heavy isotopes to light isotopes. For example, the ratio of ^{18}O to ^{16}O is reported as:

$$R = \frac{^{18}O}{^{16}O}$$

(2.6)

where, R is the isotope ratio of oxygen, ^{18}O is the number of ^{18}O atoms, and ^{16}O is the number of ^{16}O atoms. The ratio of ^{2}H to ^{1}H is reported as:

$$R = \frac{^{2}H}{^{1}H}$$

(2.7)

where, R is the isotope ratio of hydrogen, ^{2}H is the number of ^{2}H atoms, and ^{1}H is the number of ^{1}H atoms. Isotopic compositions are expressed in terms of delta (δ) in units of per mille (‰). The relative difference in isotope abundances between two samples (i.e., a sample and a standard) can be measured with more precision than the absolute isotopic composition of a specific sample. Reference standards are used to calculate the isotopic composition, allowing for international sample comparison. Delta values are calculated by:

$$\delta = \left(\frac{R}{R_{std}} - 1\right) \times 1000\ ‰$$

(2.8)

where, δ is the isotope composition of the sample expressed in ‰, *R* is the measured isotopic ratio of the sample, and R_{std} is the known isotopic ratio of the standard. Vienna Standard Mean Ocean Water (VSMOW) is the most commonly used reference standard. VSMOW isotopic ratios are $\frac{^{2}H}{^{1}H}$ = δ ^{2}H = 155.76 ppm (de Wit et al., 1980) and $\frac{^{18}O}{^{16}O}$ = $\delta^{16}O$ = 2005.8 ppm (Baertschi, 1976).

Isotopically light (or depleted) samples have negative or lower δ values, indicating there are fewer heavy isotopes in the sample than in the reference sample. In contrast, isotopically heavy (or enriched) samples have positive or higher δ values, indicating there are more heavy isotopes in the sample than in the reference sample (Clark and Fritz, 1997). The atomic mass of

the water molecule depends on the atomic mass of the hydrogen isotopes and oxygen isotope that make up the water molecule. Therefore, due to the isotopic composition of water molecules, bodies of water have measurable differences in weight. Meteorological processes affect isotopic compositions, through a process known as fractionation. Fractionation results in unique isotopic signatures for different environments (Clark and Fritz, 1997). Oxygen and H isotopes are partitioned through physical changes: evaporation, precipitation, snow and ice accumulation, and melting. Differences in isotopic composition can be used as a natural tracer for the movement of water. Typically, isotopically heavy (or enriched) waters are associated with warm regions or warmer seasons, while isotopically light (or depleted) waters are associated with cold regions or colder seasons (Clark and Fritz, 1997). For instance, Baer et al., (2016) study at Mildred Lake Mine, Alberta, Canada found the average stable isotopic ratios for rainfall to be $\delta^{2}H$ = -123.5‰ and $\delta^{18}O$ = -15.4‰, while the average stable isotopic ratios for snow was $\delta^{2}H$ = -204.7‰ and $\delta^{18}O$ = -26.4‰.

Soil water taken up by tree roots is not fractionated during uptake or transport (Gessler et al., 2014). Water is enriched with ^{2}H and ^{18}O at the needle stomata due to evapotranspiration, therefore the starch and sugar moving down the phloem are ^{2}H and ^{18}O enriched (Gessler et al., 2014). As these sources of enriched ^{2}H and ^{18}O move down the tree, water exchanges readily between the xylem and the phloem, mixing these two pools of water (Zimmerman 1964). However, this enrichment does not confound data monitoring for isotopically labelled solutions because the enrichment from isotopically labelled solutions is much greater than the naturally occurring enrichment.

2.7 Soil water potential energy

The primary form of energy in soil water is potential energy, resulting from the fundamental forces acting on the soil water. Potential energy is measured as the amount of force that is required to move water a certain distance. As soil water is transferred from one system in equilibrium to another, energy is either gained or lost. Soil water can perform work as it moves between these systems; this potential to do work is potential energy. Temperature must be uniform or cause negligible changes to the system for potential energy concepts to apply (Scott, 2000). The movement of soil water, known as water flux, is described by energy potentials.

Therefore, by knowing or estimating the soil water potential the movement of soil water can be described.

In soil, total water potential energy is the net sum of gravitational, matric, and osmotic forces acting upon the soil water. Gravitational potential is the result of the position of the soil water in the gravitational force field; soil water at the soil surface will have higher gravitational potential then soil water at depth. Gravitational potential moves water vertically down through the soil profile and is often associated with macropores. Matric potential is the result of the capillary and electromagnetic properties of the soil particle matrix acting upon soil water. Therefore, the soil texture and structure govern the magnitude of the matric potential. Osmotic potential is the result of free ions within the soil acting on the water molecules polarity. As soil water moves through the soil profile free ions in solution are electrically attracted to either the negative or positive side of the water molecules dipole moment (Scott, 2000).

A water retention curve is the unique relationship of volumetric water content and soil water potential for a given soil. At a given water potential, soil with a fine texture will have a higher associated volumetric water content than a soil with a coarser texture. Coarse textured soils, with their large macropores and limited micropores, will drain quickly under a small increase in potential energy. In contrast, fine textured soils have more micropores, capillary breaks, and surface area resulting in higher water holding capacity. The high water holding capacity of fine textured soils means more potential energy is required to move the same amount of soil water relative to that of coarse textured soils. Field capacity is the water content retained in a soil at -33 kPa of hydraulic head (Scott, 2000). Permanent wilting point is the water content retained in a soil at -1500 kPa of hydraulic head (Scott, 2000).

This project focused on a study site with homogeneous sandy soils. These sites have low water holding capacity due to continuous macropores, few capillary breaks, insignificant electromagnetic charges, and poor nutrient supply. Therefore, small changes in soil water potential will result in rapid vertical drainage.

2.8 Measuring volumetric water content of soil water

Soil water content is expressed gravimetrically or volumetrically. Gravimetric water content (θ_g) of soil is a ratio that describes the mass of water to a mass of soil. Gravimetric water content is calculated as:

$$\theta_g = \frac{m_{water}}{m_{soil}} = \frac{m_{wet} - m_{dry}}{m_{dry}} \quad \textbf{(2.9)}$$

where, θ_g is the gravimetric water content, m_{water} is total mass of water, m_{soil} is the total mass of soil (m_{soil} = m_{water} + m_{solids}), m_{wet} is the mass of wet soil, and m_{dry} is the mass of dry soil. Gravimetric water content is directly measured from soil samples by weighing a wet soil sample, drying the sample in the oven at 105° C for 24 hours, and then weighing the dry soil sample.

Volumetric water content (θ_V) of soil is a ratio that describes the quantity of water stored within a given volume of soil. Volumetric water content is calculated as:

$$\theta_V = \frac{V_W}{V_T} = \frac{\frac{m_{water}}{\rho_{water}}}{\frac{m_{soil}}{\rho_{soil}}} = \frac{\theta_g \times \rho_{soil}}{\rho_{water}} \quad \textbf{(2.10)}$$

where, θ_V is the fractional volumetric water content, V_W is total volume of water, and V_T is the total volume of the soil (V_T = V_{water} + V_{soil} + $V_{air\ space}$), m_{water} is the mass of water, ρ_{water} is the density of water, m_{soil} is the mass of soil, ρ_{soil} is the density of soil, and θ_g is the gravimetric water content of soil. Volumetric water content can be measured directly by collecting cores of soil, weighing a wet soil core sample, drying the core sample in the oven at 105°C for 24 hours, and then weighing the dry soil core sample. Directly measuring θ_V can be labor intensive and sometimes impossible to collect if many measurements are required. Therefore, it is advantageous if ongoing and consistent θ_V measurements can be indirectly collected. Volumetric water content can be indirectly measured through a variety of methods such as neutron probes, gamma-ray attenuation, or electromagnetic techniques. For this research project an electromagnetic technique was utilized; volumetric water content was measured using CS616: Water Content Reflectometers probes (CS616 probes) (Campbell Scientific, USA).

CS616 probes are sensitive to dielectric permittivity. Soil water is the only constitute of soil that has a high value for dielectric permittivity and since air and water are the only parts of soil that change in concentration, CS616 probes can measure the changes in water content. To measure the dielectric permittivity of soil, an electromagnetic pulse is sent down the two rods of the CS616 probe, this pulse propagates at a velocity that is dependent on the dielectric permittivity of the soil surrounding the rods. The pulse travels to the rod end, is then reflected, travels back up the rod to the probe head, and then the net travel time is recorded. This electromagnetic pulse is slower when passing through wet soil, as the water molecules become polarized. Therefore, the net travel time of the pulse can be used to determine the water content of the soil.

The net travel time is recorded as output period in a CR1000 (Campbell Scientific, USA). There is a temperature dependence for the period reported that fluctuates with water content of the soil. The following equation corrects for temperature dependence (CS616 and CS625 Water Content Reflectometers, 2016):

$$\tau_{\text{corrected}}\,(T_{\text{soil}}) = \tau_{\text{uncorrected}} + (20 - T_{\text{soil}}) \times (0.526 - 0.052 \times \tau_{\text{uncorrected}} + 0.00136 \times \tau_{\text{uncorrected}}{}^{2})$$

(2.11)

where, $\tau_{\text{corrected}}$ is the corrected output period in microseconds, T_{soil} is the measured temperature of the soil, and $\tau_{\text{uncorrected}}$ is the uncorrected output period in microseconds. This temperature correction assumes a fixed temperature and water content along the length of the rods. Calibration is needed to calculate θ_v from the corrected output period. Campbell Scientific provides both linear and quadratic calibration equations. If the water content range of the soil is between 10% and 35%, a linear equation can be used to calculate θ_v. While if the range of soil water content is between 0% and 50%, a quadratic equation should be used to calculate θ_v. The quadratic equation provides a θ_v accuracy of up to ±2.5% (CS616 and CS625 Water Content Reflectometers, 2016). For a mineral soil with bulk electrical conductivity less than 0.5 dS m^{-1}, bulk density less than 1.55 g cm^{-3}, and clay content less than 30% the following equations provide accurate θ_v (CS616 and CS625 Water Content Reflectometers, 2016):

Linear equation: $\theta_v = -0.4677 + 0.0283 \times \tau_{corrected}$

(2.12)

Quadratic equation: $\theta_v = -0.0663 - 0.0063 \times \tau_{corrected} + 0.0007 \times \tau_{corrected}^2$

(2.13)

where, $\tau_{corrected}$ is the corrected output period in microseconds and θ_v is fractional and can be expressed as a percentage by multiplying by 100.

3. JACK PINE TREES: DIURNAL FLUCTUATIONS OF SAP FLOW AND TREE TRUNK CIRCUMFERENCE

3.1 Preface

In the boreal forest, climate change is changing precipitation patterns and increasing average temperatures. These changes result in consequences for the boreal forest such as drought stress, invasive species, and megafires. Furthermore, climate change may induce changes to other environmental cycles, such as the carbon sequestration cycle or the hydrological cycle. To better understand how the boreal forests may respond to climate change, the goal of this empirical study was to measure how jack pine trees utilize internal water storage on a diurnal scale under both pre-augmented (normal) conditions and augmented (drought) conditions. Water movement within jack pine tree trunks was measured using heat pulse probes and circumference dendrometers. To interpret the movement of water within jack pine trees under both normal conditions and drought conditions, sap flow within the trunk was compared with volumetric water content of the soil, air temperature, air humidity, net radiation, wind speed, and water storage within the tree trunk.

3.2 Abstract

Understanding how forests respond to drought stress is important for anticipating changes to carbon sequestration and the hydrological cycle due to climate change. This research was conducted at a characteristic *c: bearberry/lichen (subxeric/poor)* ecosite. Under normal and drought conditions, jack pine sap flow rates were compared with volumetric water content of the soil (VWC), net radiation, air humidity, air temperature, and wind speed (environmental parameters); and with the expansion and contraction of the tree trunk circumference.

Under normal conditions the VWC was at or above 0.080 $cm^3 \cdot cm^{-3}$ and the average sap flow was 404.51 $cm^3 \cdot hr^{-1}$. Under drought (or augmented) conditions the VWC was at or below 0.045 $cm^3 \cdot cm^{-3}$ and the average sap flow was 342.36 $cm^3 \cdot hr^{-1}$. All other environmental parameters were consistent between the normal and drought conditions, indicating that VWC limited the volume of sap flow. Sap flow was found to have hysteretic relationships with all environmental parameters except for VWC and tree trunk circumference fluctuations. Linear

relationships were found between these variables as sap flow increased in the morning and decreased in the afternoon. In the morning as sap flow increased, sap flow and air temperature under normal conditions were found to have a strong positive correlation (r^2=0.72), and under drought conditions were found to have a very strong positive correlation (r^2=0.92). While in the afternoon as sap flow decreased, there was only moderate positive correlation between sap flow and air temperature under both normal (r^2=0.39) and drought (r^2=0.39) conditions. Air humidity was found to be very influential in inducing sap flow in the morning during both normal (r^2=0.97) and drought (r^2=0.90) conditions. This suggests the vapour potential difference that triggers transpiration in the morning, and the associated sap flow, depends on a decrease in air humidity. There was a very strong positive correlation between sap flow and net radiation in the morning as sap flow increased (normal conditions r^2=0.88, drought conditions r^2=0.70) and in the afternoon as sap flow decreased (normal conditions r^2=0.83, drought conditions r^2=0.94). However, net radiation began to increase prior to sap flow, continued to increase in the afternoon as sap flow decreased, and peak net radiation and corresponding sap flow were quite variable.

Under normal conditions, as sap flow increased in the morning there was a moderate negative correlation (r^2=0.31) between sap flow and tree trunk circumference. Under drought conditions, as sap flow increased in the morning there was a strong negative correlation (r^2=0.82) between sap flow and tree trunk circumference. However, during both normal and drought conditions, as sap flow decreased in the afternoon there was a very strong negative correlation (normal conditions r^2=0.87, drought conditions r^2=0.99) between sap flow and tree trunk circumference. The diurnal amplitude of change for the tree trunk circumference was statistically similar during the normal and drought conditions. However, the daily median minimum tree trunk circumference was statistically different between the normal and drought conditions (344.59 mm and 344.30 mm, respectively). Jack pine trees experienced growth under normal conditions, while under drought conditions the overall tree trunk circumferences contracted due to internal water stress.

3.2.1 Introduction

The boreal forest is a circumpolar forest that wraps around the northern hemisphere, just south of the Arctic Circle. Boreal forests are defined as forests in latitudes high enough that the temperature reaches below zero degrees Celsius for six to eight months of the year (Burton et al., 2010). Trees within the boreal forest are capable of reaching five metres in height and having a canopy cover of at least ten percent (Gauthier et al., 2015). The boreal forest is the largest biome on the planet, containing 25% of the world's forest cover and is predominantly coniferous (Burton et al., 2010). Within the boreal forest there are many different ecosites, these sites can be dramatically different from adjacent ecosites due to intricate environmental relationships (Beckingham and Archibald, 1996). Ecosites are determined by the soil (geology, geomorphology, topography, available water holding capacity, and nutrient regime), climate (solar radiation, precipitation, and permafrost), and external factors (forest fires, human activity, and pest infestations) (Sojo et al., 2007).

In the northern hemispheres upper latitudes where the boreal forest exists, climate change is resulting in changed precipitation patterns (Lindner et al., 2008; Beaumont et al., 2011; IPCC, 2013) and increased average temperatures (Soja et al., 2007). These changes in precipitation patterns and increased average temperatures result in consequences for the boreal forest such as drought stress (Barber et al., 2000; Allen et al., 2010; Carnicer et al., 2011; Ma et al., 2012), invasive species (Sambaraju et al., 2012), and megafires (Amiro et al., 2001; Gillett et al., 2004; Randerson et al., 2006; Balshi et al., 2009; Stephens et al., 2014). Furthermore, climate change will likely induce changes to other environmental cycles, such as the carbon sequestration cycle or the hydrological cycle (Ireson et al., 2015).

Carbon sequestration in the boreal forest provides substantial feedback to atmospheric greenhouse gasses (Stephenson et al., 2014). The boreal region contributes enormously to global carbon sequestration and has the largest reservoirs of global terrestrial carbon (30% – 35%) (Soja et al., 2007). Changes in average temperatures and precipitation patterns, due to climate change, could result in changes to carbon sequestration, making the boreal forest a carbon source rather than a carbon sink (Soja et al., 2007; Gauthier et al., 2015; Ireson et al., 2015). Therefore, changes to carbon sequestration could lead to further climate change. In addition to carbon sequestration

changes, climate change may alter the hydrological cycle within the boreal forest (Soja et al., 2007; Ireson et al., 2015). The hydrological cycle within the boreal forest is highly complex and outcomes due to changes in the hydrological cycle are very hard to predict. For example, within the boreal forest evapotranspiration rates vary based on canopy cover and change throughout the year, spring snowmelt and runoff varies based on vegetation, canopy cover, and leaf area index, and the infiltration of precipitation and runoff varies based on soil texture, frozen soils, and water holding capacity of soils (Ireson et al., 2015). There is a growing body of research on the effects of climate change on the boreal forest but due to the complex nature of the ecosystems, predicting how different ecosites within the boreal forest will respond to climate change is challenging.

One ecosite type within boreal forests that is unique for xeric to submesic moisture regimes and a poor nutrient supply is the *c: bearberry/lichen (subxeric/poor)* ecosite (Willoughby et al., 2017). *C: bearberry/lichen (subxeric/poor)* ecosites are often found on the Canadian Shield and on the sandy or rocky soils south of the Canadian Shield (Beckingham and Archibald, 1996). Such as in the Athabasca oil sands region (AOSR) of Alberta, Canada, where approximately 20% of the soils are comprised of glacial fluvial till and aeolian deposits (Zettl et al., 2011). *C: bearberry/lichen (subxeric/poor)* ecosites primarily have jack pine trees as the canopy cover and shrubs and lichen as the understory (Willoughby et al., 2017). This ecosite represents the driest end of the spectrum that can sustain deciduous trees. Jack pine trees dimorphic rooting structure provides anchorage and extends access to soil water storage (Plourde et al., 2009). The majority of jack pines roots are lateral roots in the shallow soil that capture rapidly infiltrating soil water after a precipitation event. In addition to the lateral roots, jack pines typically have a taproot. While taproots make up a small proportion of the rooting mass, they can extend greater than 270 cm vertically into the soil, which can greatly increases the tree's access to soil water storage (Rudolp and Laidly, 1990).

Relationships between tree water use (i.e., transpiration, sap flow, and internal water storage) and environmental parameters changes with species and scale (Li et al., 2016a). Trees regulate transpiration based on short-term changes to stomatal conductance and long-term changes to leaf area and increased access to soil water reservoirs due to root growth (McDowell

et al., 2008). Stomatal conductance is regulated by parameters such as net irradiance, soil water content, air temperature, air humidity, vapour pressure deficits, net radiation, precipitation, and wind speed (McDowell et al., 2008). In addition to these parameters, the morphology of the tree such as the amount of sapwood and height, affects water storage within the tree, which ultimately impacts stomatal conductance (Gartner and Meinzer, 2005; Scholz et al., 2007; Ewers et al., 2011). When the evaporative demands at the crown and branches of the tree exceed the soil water availability, internal water stress occurs (Waring and Running, 1978; Waring et al., 1979). Water stress within the evaporative stream can cause hydraulic dysfunctions such as stomatal closure, xylem embolism, and xylem cavitation. Internal water storage from within the trunk can be utilized to alleviate this water stress (Gartner and Meinzer, 2005; Scholz et al., 2007; Meinzer et al., 2009). The majority of internal water storage and water transport occurs within the trunk of the tree (Goldstein et al., 1998; James et al., 2003; Hao et al., 2013). A trees ability to respond to fluctuating storage is critical for the success of the tree. Contributions from internal water storage to the daily water budget of the tree can fluctuate during the growing season. For instance, Loustau et al., (1996) found that 12% of the transpired water of a *Pinus pinaster* came from internal water storage when there was ample water supply in the soil but 25% of the transpired water came from internal water storage during a period of drought. Therefore, by better understanding how jack pine trees respond to limited soil water availability, diurnal changes of environmental parameters, and diurnal shifts of water storage within jack pine trees, we can better predict how jack pine trees on *c: bearberry/lichen (subxeric/poor)* ecosites will fare under increasingly stressed environmental conditions due to climate change.

Instrumentation such as heat pulse probes to measure sap flow and circumference dendrometers to measure diurnal tree trunk circumference fluctuation can be used to inform on how trees move water and store internal water. The heat ratio method (HRM) pioneered by Burgess et al., (2001) allows for sap flow and direction to be measured at a point scale within the sapwood of a tree. Heat pulse probes emit a short heat pulse and measure the change in sapwood temperature upstream and downstream from the heat source. The HRM measures the ratio of the change in temperature after a heat pulse is emitted. Sap flow velocity is found by the heat pulse velocity, density of the wood, density of the sap, specific heat capacity of the wood, specific

heat capacity of the sap, and water content of the sapwood (Burgess et al., 2001). Sap flow is then extrapolated based on the point measurement of sap velocity, sapwood water content, and the cross-sectional area of sapwood at that height (Goldstein et al., 1998; Burgess et al., 2001). The HRM is advantageous to previously developed heat pulse methods as it can detect low flow and reverse flow rates, is not overly invasive to the tree, requires little instrumentation, and uses little battery power (Burgess et al., 2001). However, extrapolating the sap flow assumes a uniform depth of sapwood and that all sap is flowing at the same rate. These assumptions result in a potential over or under extrapolation of sap flow. Despite the potential over or under extrapolation of sap flow, the diurnal pattern of sap flow is representative of the tree's water use patterns. This study uses point scale sap flow measurements in jack pine trees to monitor the diurnal changes of sap flow under varying environmental conditions. Circumference dendrometers capture short term or diurnal activities such as swelling, shrinking, recovery cycles within the tree's trunk, and if installed for appropriate lengths of time long-term morphological changes such as growth (Zweifel and Häsler, 2001; Deslauriers et al., 2003; McLaughlin et al., 2003; Bouriaud et al., 2005; Daudet et al., 2005; Vieira et al., 2013; Siegmund et al., 2016). Circumference dendrometers allow for high temporal and spatial resolution to analyse a tree trunk's response to environmental conditions (McLaughlin et al., 2003; Drew and Downes, 2009; Denneler et al., 2010; Miralles-Crespo et al., 2010; Oberhuber and Gruber, 2010; Jezik et al., 2011; Butt et al., 2014; Siegmund et al., 2016). This study utilized dendrometers to monitor the diurnal expansion and contraction of the tree trunk circumference and related this to tree growth and internal water storage.

How trees respond to environmental parameters and evapotranspiration has been studied extensively. However, a comparative study of how jack pine trees respond to environmental parameters under both normal and drought conditions has not been investigated. The aim of this research is therefore to understand the response of jack pine sap flow to environmental parameter and how sap flow impacts internal water storage at breast height (ABH) (1.4m). The objectives of this research were threefold (1) measure how jack pine sap flow responded to environmental parameters during the diurnal cycle, (2) characterize changes in jack

pine sap flow during a period of extended drought, and (3) establish an understanding of how sap flow and drought conditions impacted the water storage of jack pine trees.

3.3 Methods

3.3.1 Site description

Due to the catastrophic wildfires in 2016 in the AOSR, a study site outside of the AOSR had to be selected. A native (i.e., anthropologically undisturbed) c*: bearberry/lichen (subxeric/poor)* ecosite within Narrow Hills Provincial Park, Saskatchewan, Canada, was chosen for this research (53°59'40.1"N, -104°39'27.7"W). This c*: bearberry/lichen (subxeric/poor)* ecosite is within the Mid-Boreal Uplands ecoregion (Acton et al., 1998). Due to a wildfire in 1995, the jack pine trees are an even-aged stand of 21 year old trees. The study site was a 10 m by 10 m plot. There were 28 jack pine trees within the plot, the trees had a mean diameter of 27.17 cm, most of the lateral roots were within 0 cm – 15 cm of the soil surface (observational data confirmed by Stamatinos [2019]), and the tree's taproot could reach a depth of 112 cm (observational data from an excavated tree root). A typical *c: bearberry/lichen (subxeric/poor)* ecosite understory was present with blueberry (*Vaccinium angustifolium*), cranberry (*Vaccinium oxycoccos*), prickly rose (*Rosa acicularis*), lily-of-the-valley (*Convallaria majalis*), moss (*Pleurozium schreberi; Polytrichum commune)*, and reindeer lichen (*Cladonia rangiferina*). The study site consisted of Degraded Eutric Brunisolic soils, with a surface (0 cm – 15 cm) texture of loamy sand and then (15 cm – 300 cm) of homogenous sandy soil (Appendix B; observational data confirmed by Stamatinos [2019]). Homogenous sandy soil results in rapid vertical drainage of soil water and low available water holding capacity. Groundwater at the study site never reached a depth of 250 cm below the soil surface.

3.3.2 Meteorological data

All meteorological data for this research was generously supplied by the Changing Cold Regions Network (CCRN), a collaborative research venture funded by the Climate Change and Atmospheric Research Initiative of the National Sciences and Engineering Research Council. The CCRN's Boreal Ecosystem Research and Monitoring Sites (BERMS) are located in the southern

boreal forest of Saskatchewan (mid-boreal uplands and boreal transition ecoregions). The BERMS' Old Jack Pine research site (53°54'58.8"N, 104°41'31.3"W) is located 9 km southwest of the research site. The Old Jack Pine research station collects meteorological, soil moisture, eddy covariance flux, and canopy gas profile data. Air temperature, relative humidity, wind speed, net radiation, and accumulated precipitation data collected every 30 minutes was acquired for this research.

3.3.3 Soil volumetric water content

The VWC is the ratio of water to solids, liquids, and gas in a known volume of soil. The VWC was measured using CS616 water content reflectometers (Campbell Scientific, USA) at the study site. CS616 water content reflectometers utilize the time-domain measurement method. Where an electromagnetic pulse is sent along 30 cm stainless steel rods, the travel time of the pulse depends on the dielectric permittivity of the soil. Water has a higher dielectric constant than the solid and gas fractions of the soil. Therefore, as VWC increases and decreases, the dielectric permittivity of the soil changes. By measuring the travel time of the electromagnetic pulse the VWC can be determined.

For this project, VWC was measured every hour at six soil depths: surface (0 cm – 30 cm), 30 cm, 60 cm, 90 cm, 120 cm, and 150 cm. The net travel time of the electromagnetic pulse (output period) was collected in a CR1000 data logger (Campbell Scientific, USA). It was assumed that a fixed water content and temperature were found along the length of the rods. The temperature dependence of the CS616 water content reflectometers was corrected according to Campbell Scientific (CS616 and CS625 Water Content Reflectometers 2016):

$$\tau_{\text{corrected}}\,(\mathrm{T_{soil}}) = \tau_{\text{uncorrected}} + (20 - \mathrm{T_{soil}}) \times (0.526 - 0.052 \times \tau_{\text{uncorrected}} + 0.00136 \times {\tau_{\text{uncorrected}}}^2) \quad \textbf{(3.1)}$$

where, $\tau_{\text{corrected}}$ is the corrected output period in microseconds, $\mathrm{T_{soil}}$ is the measured temperature of the soil, and $\tau_{\text{uncorrected}}$ is the uncorrected output period in microseconds.

The VWC was then calculated following the quadratic calibration equation provided by Campbell Scientific (CS616 and CS625 Water Content Reflectometers 2016):

$$\theta_v = -0.0663 - 0.0063 \times \tau_{corrected} + 0.0007 \times \tau_{corrected}^2$$

(3.2)

where, $\tau_{corrected}$ is the corrected output period in microseconds, and θ_v is the fractional VWC that can be expressed as a percentage by multiplying by 100. This equation results in accuracy of 2.5% of θ_v for a mineral soil with bulk density less than 1.55 $g \cdot cm^{-3}$, bulk electrical conductivity less than 0.5 $dS \cdot m^{-1}$, and clay content less than 30%. Collected VWC data is presented in Appendix C.

3.3.4 Limiting soil water

Data collected during the normal conditions, was defined as pre-augmented conditions when the VWC in the top 30 cm of soil was greater than or equal to 0.080 $cm^3 \cdot cm^{-3}$, due to natural precipitation. The value of 0.080 $cm^3 \cdot cm^{-3}$ is an arbitrarily value, chosen as it was the lowest VWC measured at the soil surface under normal conditions. Data for the normal conditions was collected between July 8th to 25th, 2016. Data collected during the drought conditions, was defined as augmented conditions when the VWC in the top 30 cm was less than or equal to 0.045 $cm^3 \cdot cm^{-3}$, due to imposed conditions. Data for the drought conditions was collected between August 6th to 19th, 2016. On July 26, 2016, a rain exclusion cover was constructed below the tree canopy to induce drought like conditions. The rain exclusion cover was constructed of heavy-duty, water-proof tarps that overlapped at all seams. The rain exclusion cover was constructed at a height of 1.4 m – 2.4 m from the ground, extended 2 m – 4 m past the edge of the study site, and allowed for air movement. Photos of the rain exclusion cover are presented in Appendix D.

3.3.5 Heat pulse probes

Heat pulse probes (HPP) were installed in three trees trunks, three cm above ABH. The trees were randomly selected within the study site. The temperature of the heater needle, downstream needle, and upstream needle were recorded every second in a CR1000 data logger (Campbell Scientific, USA) (Appendix E). A six second heat pulse was released every 30 minutes, therefore sap flow was measured every 30 minutes. To calculate the ratio of change in temperature for the upstream and downstream temperature needles, the average temperature

between 60 and 80 seconds after the heat pulse was emitted, as well as the average temperature from the five seconds before the heat pulse was emitted were used.

The HPP were constructed following the method described in Appendix F. Prior to installing the HPP into the jack pine trees, three 1.3 millimeters (mm) diameter holes were drilled 30 mm into the xylem tissue. A guide was used while drilling to insure the diameter and depth of the hole were as accurate as possible. The guide was constructed from a thick high-density plastic disk with three parallel 1.3 mm diameter holes, spaced 0.6 cm apart. The guide was fastened to a large rubber belt that could be secured to the tree trunk. The guide was removed after drilling the holes. Petroleum jelly was used to ease insertion of the probe needles and ensure thermal contact between the stainless-steel needles and xylem tissue.

To calculate thermal diffusivity of the sapwood, the water content and density of the sapwood were measured from sapwood cores collected with an increment borer in July and September. Following the method described by Burgess et al., (2001) and Edwards and Warwick (1984), the specific heat capacity of green wood was determined based on these sapwood cores. The void fraction of the wood and thermal conductivity of dry wood were then found following Swanson (1983). The thermal conductivity of the green wood was then calculated following Swanson (1983) and Burgess et al., (2001). All calculated sap flow variables are presented in Appendix F. Finally, the thermal diffusivity of the green wood was found empirically following Marshall (1958):

$$k = \frac{K_{gw}}{\rho c} 10000 \tag{3.3}$$

where, k is the thermal diffusivity, K_{gw} is the thermal conductivity, ρ is the density, and c is the specific heat capacity of the green wood of the tree.

To account for the misalignment of probes during installation, HPP misalignment was calculated *in situ* following Burgess et al., (2001):

$$x_2 = \sqrt{(4kt \ln\left(\frac{v_1}{v_2}\right) + x_1^2)}$$

(3.4)

where, x_2 is the arbitrarily chosen incorrectly spaced probe, k is the thermal diffusivity of fresh wood, t is the median measurement time (80 seconds), v_1 and v_2 are the changes in temperature downstream and upstream respectively, and $x_1$is the assumed to be the correctly spaced probe at 0.6 cm. The thermal diffusivity of the fresh wood was determined from the sapwood's properties using an empirical measurement. It is not possible to know which probe is misaligned, therefore this equation is repeated assuming x_1 is the incorrectly spaced probe. To prevent a bias in sap flow, the resulting misaligned x_1 and x_2 values were averaged to generate an intermediate solution. This equation assumes the heat pulse velocity is zero (i.e., no sap flowing). To impose this condition Burgess et al., (2001) suggests severing the roots or stem. However, this research was carried out in a provincial park and the trees could not be felled to impose this condition. Therefore, probe misalignments were calculated based on v_1 and v_2 values collected between 01:00 am – 04:00 am on September 18th, 19th, and 20th when sap flow was nil.

Accounting for probe misalignment, the heat pulse velocity was then calculated following Burgess et al., (2001):

$$V_h = \frac{4kt \ln\left(\frac{v_1}{v_2}\right) - (x_2^2) + (x_1^2)}{2t(x_1 - x_2)} 3600$$

(3.5)

To account for wounding around the HPP needles, xylem wounding from five dummy probes were measured and then averaged. These dummy probes were installed on the same day as the HPP but on trees in the study site that had no other instrumentation. The dummy probes were left on for two months while the wounds stabilized. The wound widths for the dummy probes

were then averaged and this value was universally used as the jack pines average wound response. To measure the wound width the following steps were taken:

1. Dummy probes were removed from the tree;
2. Bark and cambial layers around the probe holes were removed with a sharp blade;
3. A chisel and hammer was used to remove a thin slice of the sapwood; and
4. A magnifying glass was used to record the width of discolouration around the probe needle holes.

Burgess et al., (2001) developed a numerical model to produce wound correction coefficients based on wound size to be used in conjunction with equation (3.6):

$$V_c = bV_h + cV_h^2 + dV_h^3$$

(3.6)

where, V_c is the corrected heat pulse velocity. The wound correction coefficients $b, c, and\ d$ can be found in Appendix A.

Sap velocity was calculated following Barrett et al., (1995) and Marshall (1958) (Appendix E):

$$V_s = \frac{V_c \rho_b (c_w + m_c c_s)}{\rho_s c_s}$$

(3.7)

where, ρ_b is the density of wood (dry weight/green volume), c_w is the specific heat capacity of wood (1200 $J \cdot kg^{-1} \cdot °C^{-1}$ at 20°C [Becker and Edwards, 1999]), m_c is the water content of the sapwood, c_s is the specific heat capacity of sap (4182 $J \cdot kg^{-1} \cdot °C^{-1}$ at 20°C [Lide, 1996]), and ρ_s is the density of water.

Sap flow was calculated from the cross-sectional area of sap conducting xylem in the sapwood and the calculated sap velocity:

$$Q = A \times V_s$$

(3.8)

where, Q is sap flow, A is the cross-sectional area of sap conducting xylem of the sapwood, and V_s is the sap velocity. This yielded a point measurement ABH of sap flow within the jack pine tree

(Burgess et al., 2001). To determine the cross-sectional area of the conducting sapwood the following steps were taken:

1. A green wood core with an increment borer was excavated;
2. The green wood core was soaked in blue dye (Brilliant Blue FCF, Sigma-Aldrich; Darmstadt, Germany);
3. Wood that does not absorb blue dye was discounted as being non-conducting heartwood;
4. Under bark radius of the sapwood was measured; and
5. Cross-sectional area of conducting sapwood was calculated based on the radius of the sapwood.

Extrapolating sap flow from sap velocity and sapwood area can result in the over assumption of sap flow. This over assumption is due to assuming a uniform depth of sapwood and static sap flow around the trunk of the tree. However, sap flow patterns and trends are consistent even if the magnitude of the extrapolated sap flow is exaggerated.

3.3.6 Band dendrometers

Circumference dendrometers (DC2 Ecomatik; Dachau, Germany) were installed ABH on the three trees equipped with a heat pulse probe. The invar cable of the circumference dendrometer was wrapped around the tree and threaded through a sensor. Changes in the wires radial tension were recorded as changes in resistance. The resistance was recorded every 30 minutes (Onset HOBO 4-channel analog logger; Massachusetts, USA) (Appendix H). Resistance was then converted to circumference size following the equation supplied by the DC2 dendrometers manufacturer (Ecomatik User Manual, 2014):

$$C_i = 2 \times (\pi \times R_0 - R_0 \times \arccos\left(\frac{R_0}{R_0 + 102 - V_0}\right) + \sqrt{(R_0 + 102 - V_0)^2 - R_0^2}$$

$$+ R_{i-1} \times \arccos\left(\frac{R_{i-1}}{R_{i-1} + 102 - V_i}\right) - \sqrt{(R_{i-1} + 102 - V_i)^2 - R_{i-1}^2}$$

(3.9)

where, C_i is the circumference of the tree, R_0 is the radius of the tree at the beginning of the measurements, V_0 is the first valid record of the dendrometers in mm, R_{i-1} is the radius of the tree the day prior of measurement in mm, and V_i is data records of the dendrometers in mm.

Diurnal cycles of tree trunk expansion and contraction were interpreted using two methods: overall change in the tree trunk circumference and diurnal change in the tree trunk circumference. Overall change of the tree was measured by the direct change of tree trunk circumference ABH. Diurnal change of the tree was calculated from the expansion and contraction of the tree over a 24 hour cycle, with the minimum circumference of that 24 hour cycle set to zero.

3.3.7 Statistical analysis

Mann-Whitney *U* tests were performed to statistically confirm that environmental parameters, other than VWC, were statistically not different during the normal conditions and the drought conditions. The Mann-Whitney *U* test assumes independent variables within the samples and groups, ordinal measurement scale, and samples selected from a population are random.

$$U_1 = \sum R_2 - \frac{n_1(n_1+1)}{2} \quad \textbf{(3.10)}$$

where, U_1 is the U statistic for the first sample set, R_2 is the rank within the second sample set, n_1 is the number of observations for the first sample set.

$$U_2 = \sum R_1 - \frac{n_2(n_2+1)}{2} \quad \textbf{(3.11)}$$

where, U_2 is the U statistic for the second sample set, R_1 is the rank within the first sample set, n_2 is the number of observations for the second sample set. The smaller value of U_1 and U_2 becomes the U statistic, which is compared to the 0.05 *z*-score. If the U statistic is greater than the z-score, the two sample sets are statistically not different with a 0.05% chance of error.

The Pearson correlation coefficient (R) was calculated to show the magnitude of linear correlation between each set of variables. Pearson correlation coefficients range from ± 1.0. A positive value indicating positive correlation is when one variable increases or decreases, the other variable changes in the same direction. A negative value indicating negative correlation is when one variable increases or decreases, the other variable changes in the opposite direction.

$$R = \frac{\sum xy - \frac{\sum x \sum y}{n}}{\sqrt{\sum x^2 - \frac{(\sum x)^2}{n}} \sqrt{\sum y^2 - \frac{(\sum y)^2}{n}}}$$

(3.12)

where, x values are the measured values of the first parameter, y values are the measures values of the second parameter, and n is the number of observations.

The coefficient of determination (R^2) was calculated for each set of variables. The R^2 is the amount of variation in the dependent variable that can be predicted by the independent variable, or in other words the predictability of one variable given the value of another variable.

$$R^2 = \left[\frac{\sum xy - \frac{\sum x \sum y}{n}}{\sqrt{\sum x^2 - \frac{(\sum x)^2}{n}} \sqrt{\sum y^2 - \frac{(\sum y)^2}{n}}}\right]^2$$

(3.13)

where, x values are the measured values of the first parameter, y values are the measures values of the second parameter, and n is the number of observations.

To confirm the validity of the null hypothesis is true, two-tailed t-tests were performed in Microsoft Excel (Excel version 1811) to find the *p*-values for each statistical question. A *p*-value is the calculated probability of finding the observed value when a null hypothesis is true. To interpret the probability: *p*-values are statistically significant if *p*-values are less than 0.05 and statistically highly significant if *p*-values are less than 0.001.

3.3.8 Data Collection

Sap flow, tree trunk circumference, environmental parameters, and VWC were monitored from June 15th, 2016 through to October 1st, 2016. Sap flow, tree trunk circumference, and environmental parameters were collected on a 30 minute interval, while VWC was measured every hour. Data was truncated to mid-summer (July 8th to August 19th, 2016) when environmental parameters were consistent, and subsequently separated into 14 days of normal conditions and 14 days of drought conditions. To prevent confounding the test statistics, days where xylem sap did not flow, during the normal conditions, were excluded from the data set.

3.4 Results and discussion

3.4.1 Descriptive Statistics

Descriptive statistics for sap flow, tree trunk circumference, and daily change in tree trunk circumference for jack pine trees ABH at the study site, during the normal and drought conditions, are presented in Table 3.1. The measured rates of jack pine sap flow, during both normal conditions and drought conditions, are consistent with other sap flow research (Marshall 1958; Smith and Allen 1996; Wullschleger et al., 2004; Ma et al., 2017; Quanyan et al., 2018). The average tree trunk circumference was slightly smaller during the drought conditions (344.70 mm), compared to the normal conditions (344.98 mm). However, the average daily change in tree trunk circumference was fairly consistent between the normal conditions (0.42 mm) and drought conditions (0.46 mm). It is important to note that the change in tree trunk circumference during the drought conditions was due to overall trunk contraction, while during the normal conditions it is due to overall trunk expansion (Figure 3.17; Figure 3.18). Trunk expansion verses contraction and the implication for internal water storage are further discussed in Section 3.4.7.

Table 3.1 Descriptive statistics of jack pine trees during normal and drought conditions

	Sap Flow ($cm^3 \cdot h^{-1}$)		Circumference[3] (mm)		Daily Change in Circumference (mm)	
	Normal[1]	Drought[2]	Normal	Drought	Normal	Drought
Min	-7.98	12.41	344.28	343.81	0.00	0.00
Median[4]	220.35	162.39	344.94	344.73	0.41	0.46
Average	404.51	342.36	344.98	344.70	0.42	0.46
Max	1189.25	1049.05	345.86	345.44	1.07	1.13

Footnote:
[1] Top 30 cm of soil had a volumetric water content greater than or equal to 0.080 $cm^3 \cdot cm^{-3}$.
[2] Top 30 cm of soil had a volumetric water content less than or equal to 0.045 $cm^3 \cdot cm^{-3}$.
[3] Tree trunk circumference at breast height (1.4 m)
[4] Median values vary slightly from the medians reported for the Mann-Whitney *U* tests. This discrepancy is due to the Mann-Whitney *U* test being based on daily averages.

Descriptive statistics for environmental parameters at the study site, during the normal and drought conditions, are presented in Table 3.2. Environmental parameters conditions were comparable during both the normal and drought conditions, but there were large daily variances ach air temperature, air humidity, and net radiation. Wind speed was consistently low throughout both periods. Therefore, the effects of wind speed on sap flow are not overly conspicuous in this dataset. Both normal and drought conditions have similar median and average values for air temperature, air humidity, and wind speed; suggesting the data is evenly distributed around the average for these parameters. In contrast, net radiation median values are much lower than the average net radiation, suggesting net radiation data has some degree of a positive skew.

Table 3.2 Descriptive statistics of the environmental parameters during normal and drought conditions

	Air Temperature (°C)		Air Humidity (%)		Net Radiation ($W \cdot m^{-2}$)		Wind Speed ($km \cdot h^{-1}$)	
	Normal[1]	Drought[2]	Normal	Drought	Normal	Drought	Normal	Drought
Min	6.838	6.484	27.23	29.26	-86.82	-92.02	< 0.20	< 0.20
Median[3]	17.488	16.514	77.03	76.94	60.60	24.30	0.24	0.21
Average	18.021	16.879	72.46	72.94	174.11	141.96	0.35	0.31
Max	30.638	28.196	100.63	100.29	836.51	726.36	1.08	0.96

Footnote:
[1] Top 30 cm of soil had a volumetric water content greater than or equal to 0.080 $cm^3 \cdot cm^{-3}$.
[2] Top 30 cm of soil had a volumetric water content less than or equal to 0.045 $cm^3 \cdot cm^{-3}$.
[3] Median values vary slightly from the medians reported for the Mann-Whitney *U* tests. This discrepancy is due to the Mann-Whitney *U* test being based on daily averages.

Descriptive statistics of VWC throughout the soil profile at the study site, during normal and drought conditions, is presented in Table 3.3 and Figure 3.1. The rain exclusion cover was successful in decreasing VWC throughout the soil profile prior to and during the drought conditions. During the normal conditions the mean VWC of the top ten cm of soil was 0.099 $cm^3 \cdot cm^{-3}$. In comparison, during the drought conditions the mean VWC of the top ten cm of soil was 0.042 $cm^3 \cdot cm^{-3}$. Overall during the normal conditions, the VWCs at depths of 0 cm – 30 cm, 30 cm, 120 cm, and 150 cm, were higher compared to drought conditions. At depths of 60 cm and 90 cm, the differences in VWC between the two periods were below the associated probe error (±2.5%). For both the normal and drought conditions, average VWC was higher at 120 cm, compared to the soil above and below suggesting a supply of water to this depth. Additionally, the soil texture at this depth was consistent with the texture at depths above and below suggesting no increased water holding capacity at this depth (Appendix B). This supply of water could be explained by hydraulic redistribution (HR) of soil water from the soil surface through the jack pine taproot. Hydraulic redistribution is the passive movement of soil water from areas of higher potential to areas of lower potential via the tree roots (Burgess et al., 1998). This concept is further discussed in Section 4.0.

Table 3.3 Descriptive statistics of soil volumetric water content during normal and drought conditions

	Soil Surface[1] ($cm^3 \cdot cm^{-3}$)		30 cm Depth ($cm^3 \cdot cm^{-3}$)		60 cm Depth ($cm^3 \cdot cm^{-3}$)		90 cm Depth ($cm^3 \cdot cm^{-3}$)		120 cm Depth ($cm^3 \cdot cm^{-3}$)		150 cm Depth ($cm^3 \cdot cm^{-3}$)	
	Normal[2]	Drought[3]	Normal	Drought	Normal	Drought	Normal	Drought	Normal	Drought	Normal	Drought
Min	0.080	0.040	0.057	0.035	0.032	0.037	0.039	0.042	0.052	0.049	0.038	0.042
Median[4]	0.099	0.042	0.075	0.037	0.038	0.037	0.045	0.043	0.054	0.050	0.050	0.044
Average	0.099	0.042	0.075	0.038	0.037	0.037	0.044	0.043	0.054	0.050	0.048	0.044
Max	0.122	0.045	0.094	0.044	0.039	0.038	0.046	0.044	0.056	0.051	0.055	0.045

Footnote:
[1] Soil surface measurements represent the average volumetric water content in the top 30 cm of soil.
[2] Top 30 cm of soil had a volumetric water content greater than or equal to 0.080 $cm^3 \cdot cm^{-3}$.
[3] Top 30 cm of soil had a volumetric water content less than or equal to 0.045 $cm^3 \cdot cm^{-3}$.
[4] Median values vary slightly from the medians reported for the Mann-Whitney *U* tests. This discrepancy is due to the Mann-Whitney *U* test being based on daily averages.

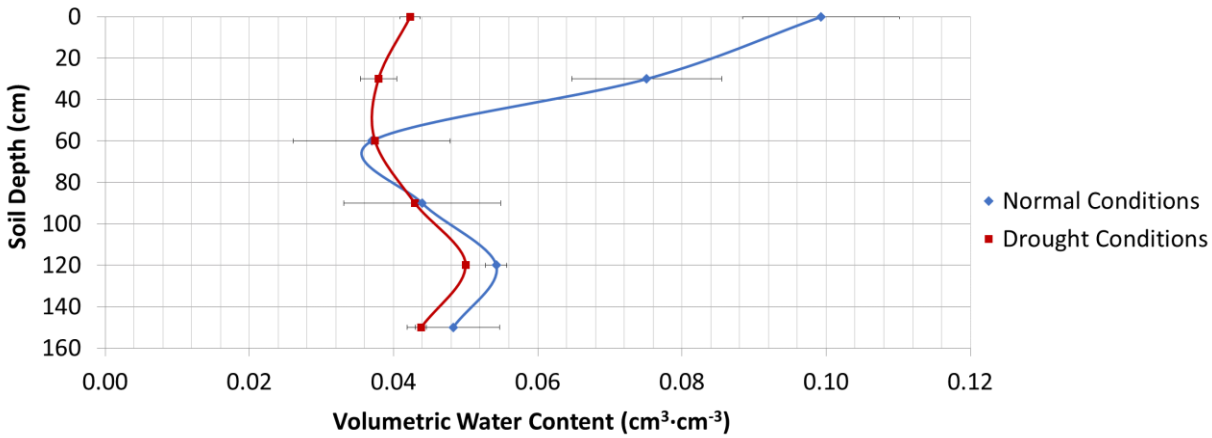

Figure 3.1 Average volumetric water content of soil throughout the soil profile during normal and drought conditions.

To better understand how VWC changed throughout the normal and drought conditions, average daily values were plotted with time (Figure 3.2; Figure 3.3). To examine the daily changes in VWC, no days were excluded for the normal conditions as they were excluded for the sap flow comparisons (Section 3.4.6). During the normal conditions, precipitation events led to rapid increases in surface soil VWC (Figure 3.2). Due to fast draining sandy soil at the study site, the VWC at a depth of 30 cm reflected the increases and decreases of soil surface VWC, only with a lower VWC (Figure 3.2). This depletion of VWC between the soil surface and 30 cm is likely due to uptake of water by jack pine lateral roots, understory vegetation, and evaporation. The VWC at depths of 60 cm, 90 cm, and 120 cm were fairly consistent throughout the normal conditions

(Figure 3.2). Of all the measured depths, VWC at 60 cm was the lowest. The lower VWC at 60 cm depth could be an indication of the jack pine lateral roots and understory vegetation capturing infiltrating water prior to reaching this soil depth and the lack of young non-suberised roots at this soil depth. As these roots are thought to be the roots that release water to the soil through HR (Caldwell et al., 1998). At a depth of 120 cm, the VWC was relatively unchanging throughout the normal conditions and was consistently higher than the VWCs measured at 60 cm and 90 cm. Soil water at a depth of 150 cm increased between July 12th and 15th, 2016 (Figure 3.2). This increase in VWC at 150 cm occurs after a large rainfall event on July 11th, 2016. This increase in VWC is not reflected at the other measured soil depths. During the drought conditions, the rain exclusion cover prevented the infiltration of precipitation (Figure 3.3). The VWC continued to gradually decrease throughout the drought conditions (Figure 3.3). The VWC at 30 cm depth showed the greatest change throughout the drought conditions, decreasing from 0.044 $cm^3 \cdot cm^{-3}$ to 0.035 $cm^3 \cdot cm^{-3}$ (Table 3.3; Figure 3.3).

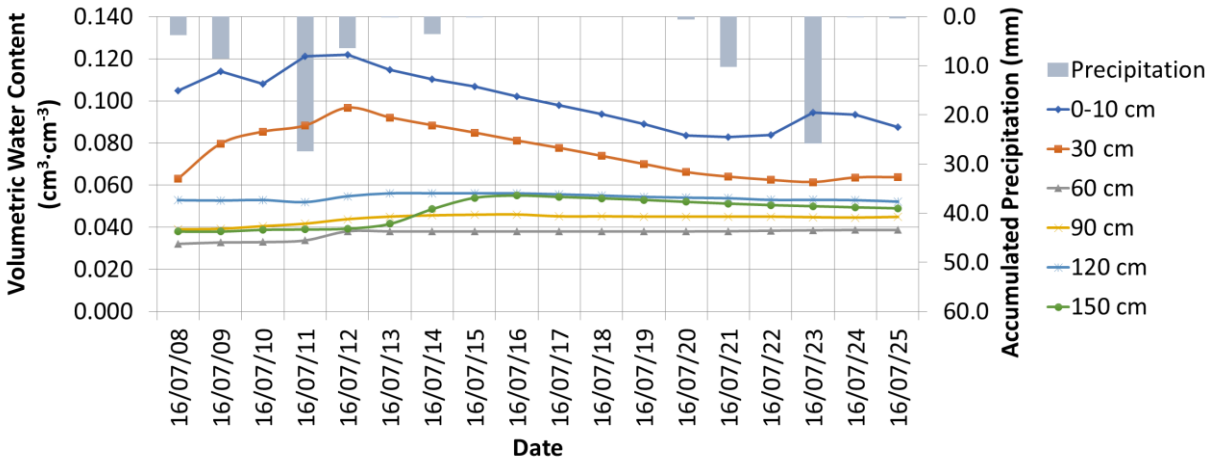

Figure 3.2 Volumetric water content of soil during normal conditions.

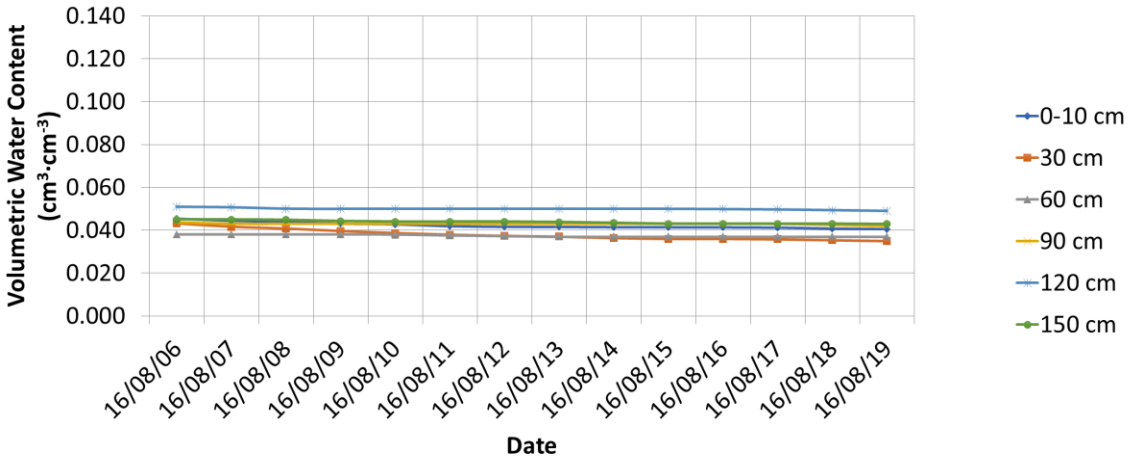

Figure 3.3 Volumetric water content of soil during drought conditions.

3.4.2 Comparing normal and drought conditions

To compare the effects of environmental parameters on sap flow and subsequent changes in tree trunk circumference, we first needed to confirm that environmental parameters were consistent between the normal and drought conditions. The Mann-Whitney *U* test was used to confirm that all environmental parameters, other than soil surface VWC, were statistically not different between the normal and drought conditions. The Mann-Whitney *U* median values vary slightly from the medians reported in Table 3.2 and Table 3.3. This discrepancy is due to the Mann-Whitney *U* test being based on daily averages instead of the measured hourly values. Mann-Whitney *U* test sample sets and complete results can be found in Appendix I. The differences for the environmental parameters between the normal and drought conditions are listed as follows:

- Median VWC in the top ten cm of soil during the normal and drought conditions were 0.100 $cm^3 \cdot cm^{-3}$ and 0.042 $cm^3 \cdot cm^{-3}$, respectively; distributions in the two groups were statistically different (Mann-Whitney $U = 0$, $n_1 = n_2 = 14$, $P < 0.05$ two-tailed, z-score = 55).
- Median net radiation during the normal and drought conditions were 173.30 $W \cdot m^{-2}$ and 151.31 $W \cdot m^{-2}$, respectively; distributions in the two groups were statistically not different (Mann-Whitney $U = 36$, $n_1 = 11$, $n_2 = 12$, $P < 0.05$ two-tailed, z-score = 24).
- Median air humidity during the normal and drought conditions were 73.09% and 74.09%, respectively; distributions in the two groups were statistically not different (Mann-Whitney $U = 96$, $n_1 = n_2 = 14$, $P < 0.05$ two-tailed, z-score = 55).

- Median air temperature during the normal and drought conditions were 17.53°C and 17.08°C, respectively; distributions in the two groups were statistically not different (Mann-Whitney $U = 69$, $n_1 = n_2 = 14$, $P < 0.05$ two-tailed, z-score = 55).
- Median wind speed during the normal and drought conditions were 0.33 $km \cdot h^{-1}$ and 0.27 $km \cdot h^{-1}$, respectively; distributions in the two groups were statistically not different (Mann-Whitney $U = 50$, $n_1 = 14$, $n_2 = 13$, $P < 0.05$ two-tailed, z-score = 50).

3.4.3 Hysteretic relationship between sap flow and environmental parameters

Diurnal hysteretic relationships were found between sap flow and all the environmental parameters, except VWC, during both normal and drought conditions (Figure 3.4). Sap flow hysteresis may be caused by environmental factors or internal water storage, which makes explaining the cause of this pattern difficult due to the complex interactions between trees and their environment (Tuzet et al., 2003; Zhang et al., 2014; Bai et at, 2017). Diurnal hysteretic loops of sap flow (or transpiration) in response to environmental parameters have been found across ecosystems and species (Lu et al., 2003; Tuzet et al., 2003; Unsworth et al., 2004; Zhang et al., 2014; Li et al., 2016b; Bai et at., 2017). According to Granier et al., (2000) a time lag of canopy conductance, the driving mechanism of sap flow, was due to internal water storage in coniferous species, therefore a hysteretic response is caused by this delay. Additionally, the stomatal aperture of some species has been found to be narrower prior to the decline of environmental parameters that drive transpiration, causing the hysteretic pattern between sap flow and environmental parameters (Lu et al., 2003; Unsworth et al., 2004). Observationally, this study found the overall hysteresis loop between sap flow and environmental parameters to be consistent between normal and drought conditions, but the peak of sap flow achieved during normal conditions was greater. The relationships between sap flow and environmental parameters are further discussed in Section 3.4.6.

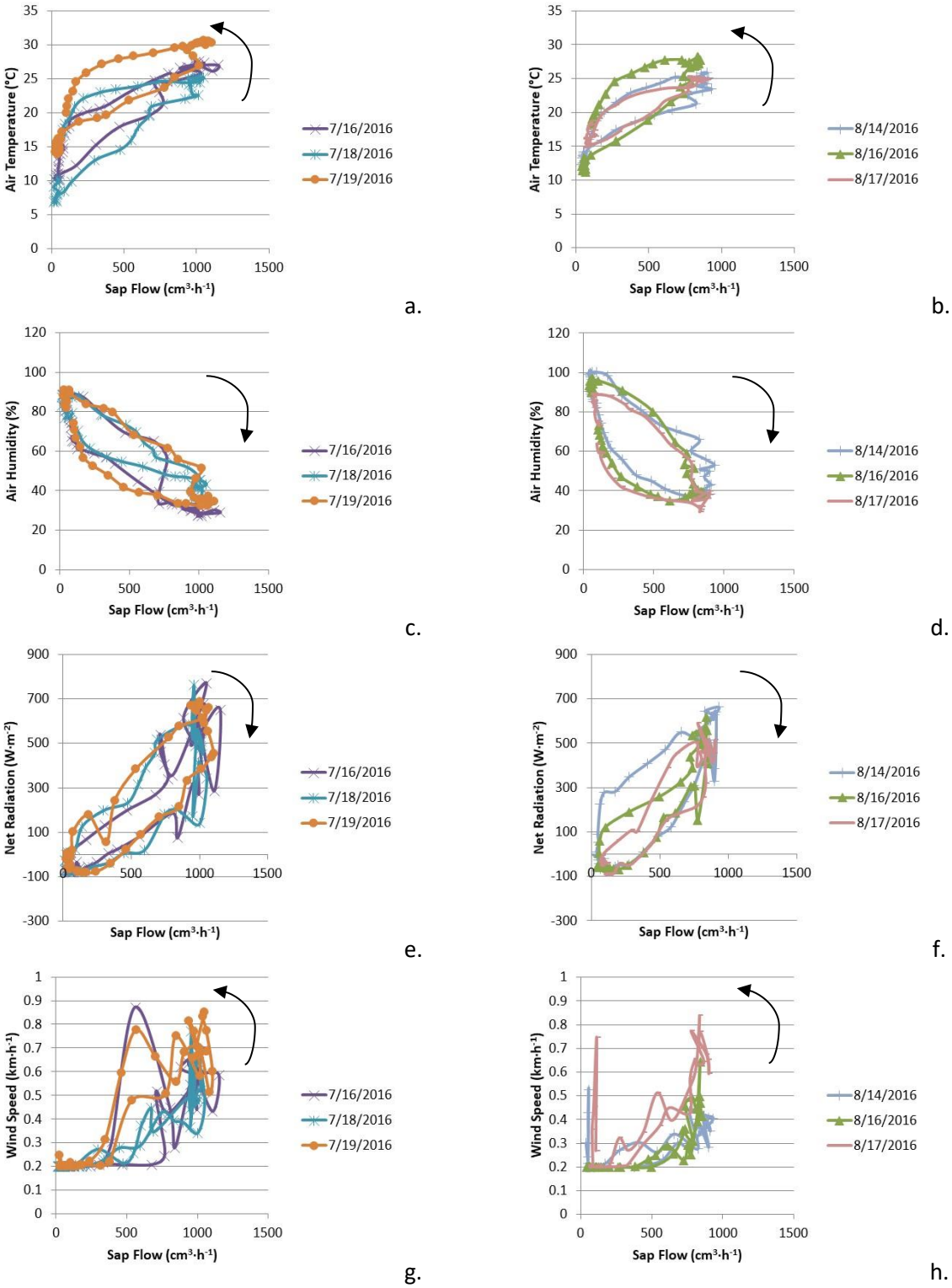

Figure 3.4 Showing variations in hysteretic response of sap flow to air temperature (a, b), air humidity (c, d), net radiation (e, f), and wind speed (g, h). Hysteresis loops during normal conditions are on the left and hysteresis loops during drought conditions are on shown on the right. Arrow indicates direction of hysteretic loop.

3.4.4 Hysteretic relationship between sap flow and tree trunk circumference

During both the normal and drought conditions, the relationship between sap flow and trunk circumference was hysteretic, with a clear clockwise and negative relationship between sap flow and tree trunk circumference (Figure 3.5). However, during the two periods the hysteresis loop followed different paths. During normal conditions the hysteretic relationship between sap flow and tree trunk circumference was circular. In the morning there was a gradual decrease in tree trunk circumference as there was ample water supply in the xylem (capillary storage) and phloem (elastic storage) to supply evapotranspiration, in the afternoon and evening there was a rapid increase in tree trunk circumference as elastic water storage within the phloem was recharged with water from the xylem and the radial tension due to suction subsided. During drought conditions the hysteretic relationship between sap flow and tree trunk circumference was quite linear. In the morning the tree trunk circumference decreased rapidly due to limited capillary and elastic water storage, in the afternoon the tree trunk circumference increased but did not reach the same extent as the day previous as the tree contracted due to decreasing water storage. The relationship between sap flow and tree trunk circumference is further discussed in Section 3.4.7.

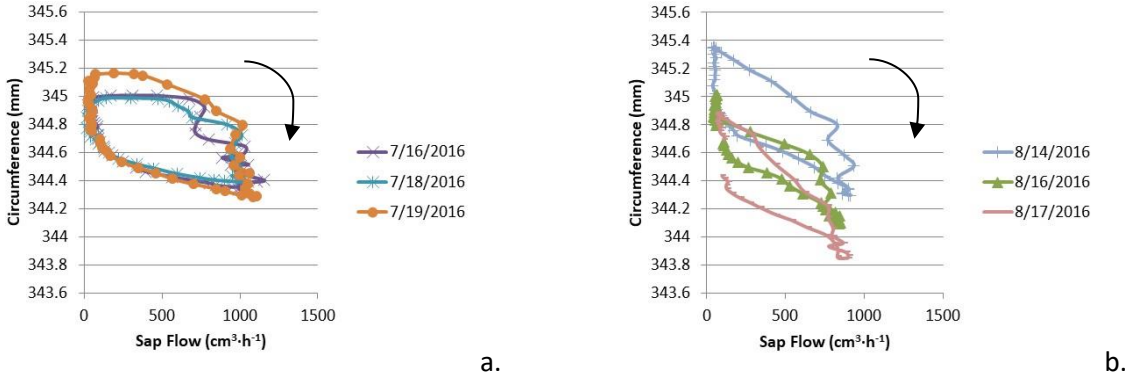

Figure 3.5 Showing variations in hysteretic response of sap flow to tree trunk circumference (a, b). Hysteresis loops during normal conditions are on the left and hysteresis loops during drought conditions are on the right. Arrow indicates direction of hysteretic loop.

3.4.5 Linear relationships

The hysteretic relationships between sap flow and environmental parameters, and between sap flow and tree trunk circumference were demonstrated in Section 3.4.3 (Figure 3.4) and Section 3.4.4 (Figure 3.5). Therefore, sap flow was linearly correlated with environmental parameters during two periods of the day: as sap flow increased in the morning and as sap flow decreased in the evening (Figure 3.6). The daily maximums and minimums of sap flow cannot be compared linearly to environmental parameters or tree trunk circumference.

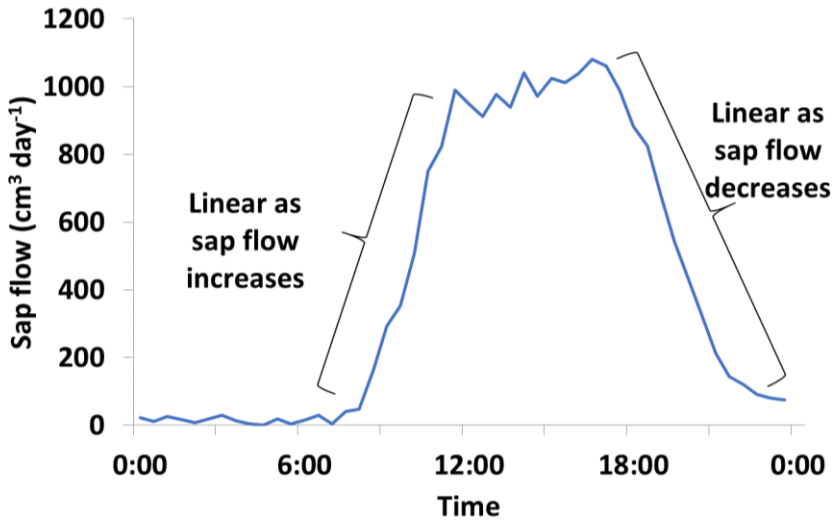

Figure 3.6 Demonstrating two periods of the day where parameters linearly compare with sap flow.

3.4.6 Sap flow and environmental parameters

Data collected during the normal and drought conditions is presented comparing sap flow to VWC (Figure 3.7), net radiation (Figure 3.8; Figure 3.9), air humidity (Figure 3.10; Figure 3.11), air temperature (Figure 3.12; Figure 3.13), and wind speed (Figure 3.14; Figure 3.15). To eliminate confounding data, days where sap flow did not occur were excluded from the dataset; these disruptions are indicated in the figures by vertical dashed lines. The solid vertical line indicates the 12 day gap between normal and drought conditions. The period of normal conditions is to the left of the solid vertical line and the period of drought conditions is to the right. Simple linear regression was performed on the measured sap flow and environmental parameters, as sap flow

increased in the morning and decreased in the afternoon, for both normal and drought conditions (Section 3.4.5).

During normal conditions, VWC of the surface soil remained at or above 0.080 $cm^3 \cdot cm^{-3}$ and the average sap flow was 404.51 $cm^3 \cdot hr^{-1}$ (Figure 3.7; Table 3.1). While, during drought conditions VWC of the surface soil remained at or below 0.045 $cm^3 \cdot cm^{-3}$ and the average sap flow was 342.36 $cm^3 \cdot hr^{-1}$ (Figure 3.7; Table 3.1). Other than VWC, all other environmental parameters were consistent between the normal and drought conditions. Therefore, when soil water was limited during the drought conditions, the rate of sap flow supporting transpiration was reduced (Figure 3.7; Table 3.1). Reduced tree transpiration during periods of limited soil water is consistent with other research (Butt et al., 2014; Wang et al., 2017; Tian et al., 2018). MacKay et al., (2012) found soil moisture had a significant limiting impact on transpiration of white pine (*Pinus strobus* L.) when a site specific threshold for soil moisture of approximately 0.068 $cm^3 \cdot cm^{-3}$ was reached. Under drought conditions sap flow has been shown to have a strong relationship with VWC (Bernier et al., 2002). Li et al., (2016a) found that sap flow velocity, which is indicative of plant water use, was primarily controlled by vapour pressure deficit, then solar radiation, and finally by soil water content, at both hourly and daily scales. However, a stand of *P. euphratica* studied by Li et al., (2016a) was not limited by drought or even extended dry conditions. This suggests that the VWC is only limiting on sap flow when tree water demand exceeds soil water supply. As the VWC decreases, the hydraulic conductivity between roots and soil could also decrease. This decrease in hydraulic conductivity between the tree roots and soil could limit the movement of water from the soil to the tree, triggering stomatal closure, and subsequently reducing transpiration (Tognetti et al., 2009).

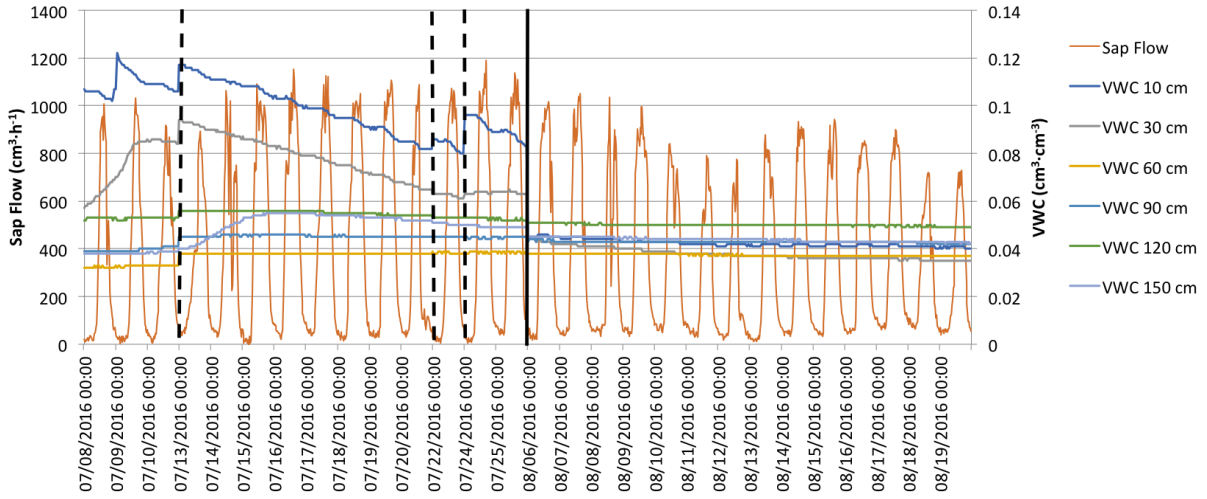

Figure 3.7 Volumetric water content throughout the soil profile and temperature plotted against time. Sap flow ($cm^3 \cdot h^{-1}$) is on the left axis and volumetric water content ($cm^3 \cdot cm^{-3}$) is on the right axis. The vertical dashed lines indicate a disruption in time, due to days where sap flow did not occur. The vertical solid line indicates the 12 day gap between the normal and drought conditions. Data to the left of the vertical solid line is from the normal conditions, while data to the right is from the drought conditions.

Net radiation and sap flow followed similar diurnal patterns (Figure 3.8; Figure 3.9). As net radiation increased, sap flow increased; as net radiation decreased, sap flow decreased. On a daily scale, net radiation was skewed to the left in relation to sap flow, therefore net radiation increased prior to sap flow in the morning and declined before sap flow in the afternoon. Furthermore, on some days (e.g., July 8th, July 18th, July 19th, and August 8th) sap flow continued to increase after net radiation decreased (Figure 3.9). The relationship between sap flow and net radiation was inconsistent with the other environmental parameters (air temperature and air humidity), where sap flow decreased prior to the environmental parameters changing in the afternoon. As sap flow increased in the morning and decreased in the afternoon, there was a very strong positive correlation between sap flow and net radiation during both normal and drought conditions. In the morning during the normal conditions r (n=27) = 0.94, r^2 = 0.88, $p < 0.0001$; in the morning during the drought conditions r (n=26) = 0.84, r^2 = 0.70, $p < 0.0001$; in the afternoon during the normal conditions r (n=25) = 0.91, r^2 = 0.83, $p < 0.0001$; and in the afternoon during the drought conditions r (n=24) = 0.97, r^2 = 0.94, $p < 0.0001$ (Figure 3.8). Other studies have also demonstrated a strong relationship between solar radiation and sap flow for different

species (David et al., 2004; Tognetti et al., 2009; Li et al., 2016a; Li et al., 2016b; Ma et al., 2017; Wang et al., 2017). During both the normal and drought conditions there was a clear clockwise, positive hysteretic relationship between net radiation and sap flow (Section 3.4.3; Figure 3.4e; Figure 3.4f), indicating higher sap flow rates in the morning compared to the afternoon and early evening, independent of net radiation. However, peak net radiation values and corresponding sap flow values were quite variable (Figure 3.4e; Figure 3.4f; Figure 3.9). David et al., (2004) reported that solar radiation became progressively less influential on sap flow in the afternoon.

In the morning, as net radiation increased there was often a lag before sap started to flow (July 8th, July 18th, August 12th, and August 14th), indicating that other environmental changes or physiological changes within the tree were required to initiate sap flow in the morning. Li et al., (2016b) also found that sap velocity lagged behind solar radiation. Considering the very strong, almost perfect, correlation between sap flow and air humidity in the morning, changes in air humidity may be vital to initiate sap flow in the morning. A decrease in air humidity in the morning increased the potential gradient between the atmosphere and the tree, triggering sap flow. Which is consistent with data collected (but not presented for this study), where sap did not flow on days with near 100% air humidity.

Ma et al., (2017) found that net solar radiation was the primary environmental parameter driving sap flow, followed be vapour pressure deficit, and then by temperature. Wang et al., (2017) also found that variations in daily transpiration were driven by net radiation and atmospheric vapour pressure deficits. In comparison, Li et al., (2016a) found that vapour pressure deficit was more influential on sap velocity but solar radiation was also significant for sap velocity. Li et al., (2016a) argued that low solar radiation levels limited evaporation, while at high solar radiation levels the VWC and the hydraulic resistance between soil and roots limited evaporation.

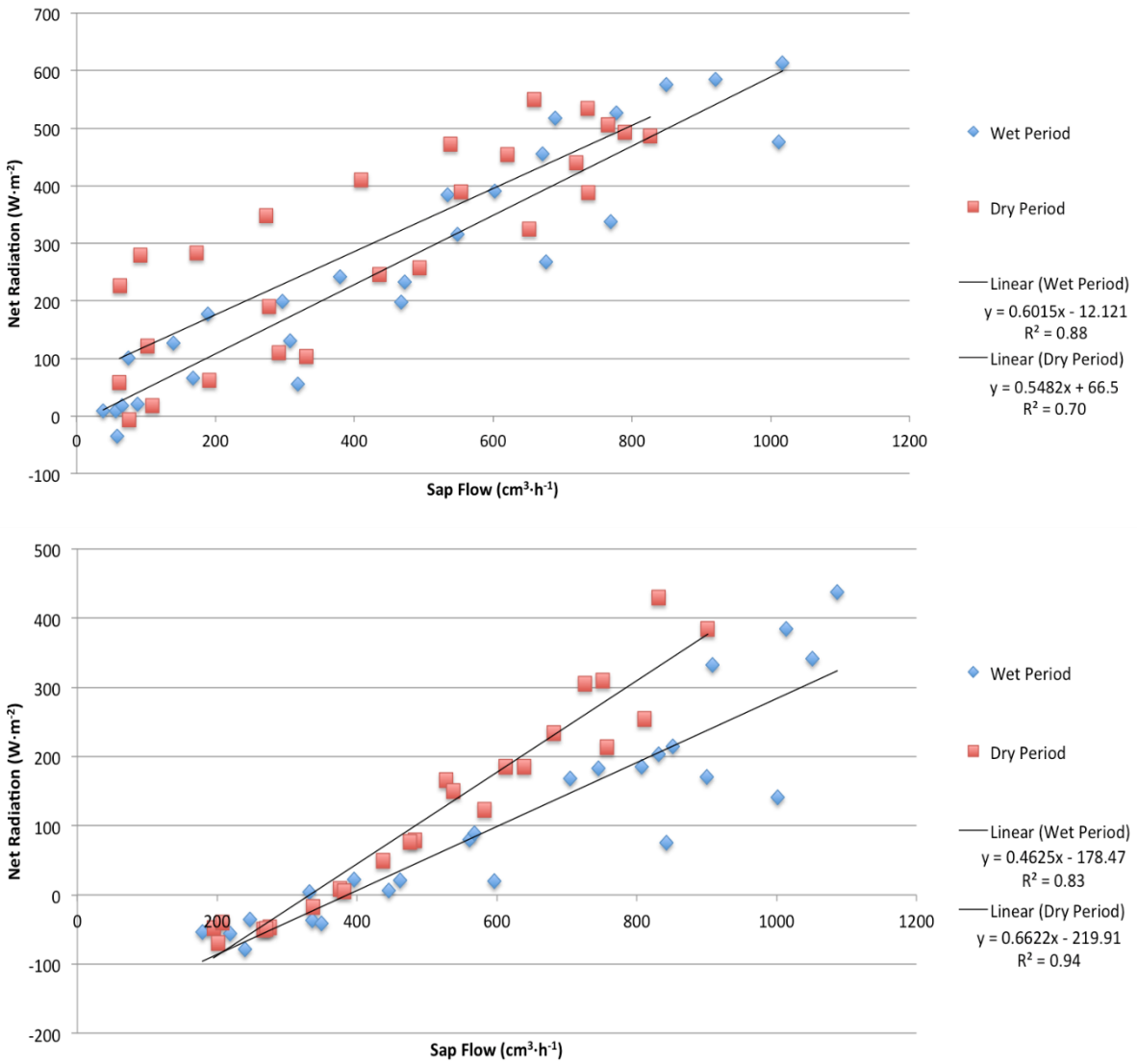

Figure 3.8 Net radiation compared with sap flow as flow increased in the morning (top) and decreased in the evening (bottom) for both normal and drought conditions.

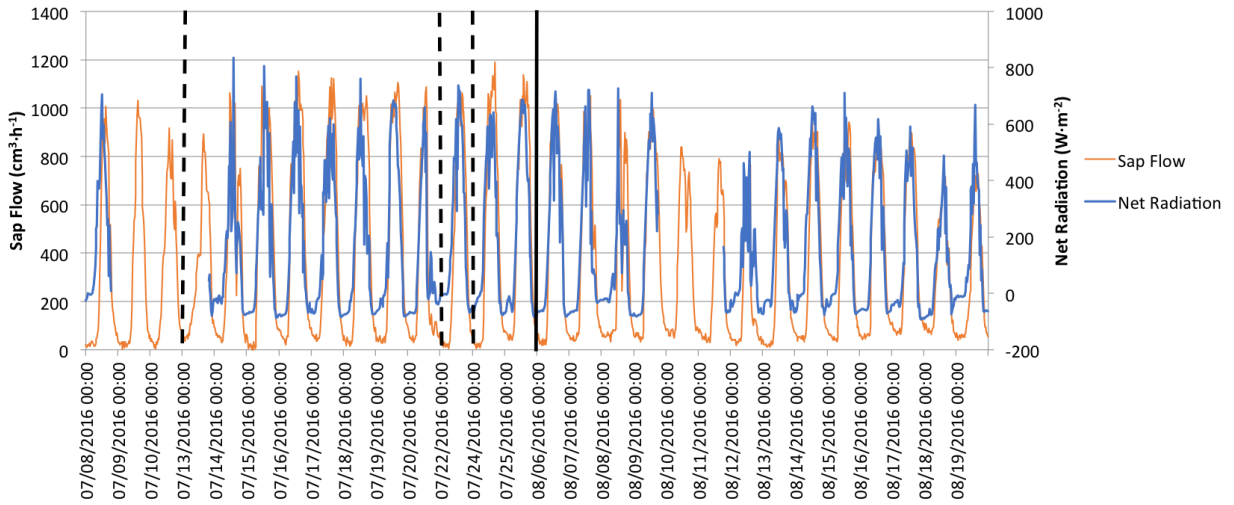

Figure 3.9 Sap flow and net radiation plotted against time. Sap flow ($cm^3 \cdot h^{-1}$) is on the left axis and net radiation ($W \cdot m^{-2}$) is on the right axis. Vertical dashed lines indicate a disruption is time, due to days where sap flow did not occur. Vertical solid line indicates the 12 day gap between the normal and drought conditions. Data to the left of the vertical solid line is from the normal conditions, while data to the right is from the drought conditions. Due to instrument failure, net radiation data is missing from July 8th - 10th, July 13th, and August 9th - 11th.

Air humidity and sap flow followed divergent diurnal patterns (Figure 3.10; Figure 3.11). As humidity decreased, sap flow increased; as humidity increased, sap flow decreased. On a daily scale, air humidity was skewed to the left in relation to sap flow, therefore sap flow decreased in the afternoon prior to air humidity increasing. As sap flow increased in the morning, there was a very strong, almost perfect, negative correlation between sap flow and air humidity during both normal and drought conditions, r (n=27) = -0.99, r^2 = 0.97, $p < 0.0001$ and r (n=26) = -0.95, r^2 = 0.90, $p < 0.0001$, respectively (Figure 3.11). However, as sap flow decreased in the afternoon, there was only a strong negative correlation between sap flow and air humidity during both the normal and drought conditions, r (n=25) = -0.79, r^2 = 0.62, $p < 0.0001$ and r (n=24) = -0.75, r^2 = 0.56, $p < 0.0001$, respectively (Figure 3.11).

During both the normal and drought conditions there was a clear clockwise, negative hysteretic relationship between air humidity and sap flow (Section 3.4.3; Figure 3.4.c; Figure 3.4d), further indicating higher sap flow rates in the morning versus the afternoon and early evening, independent of air humidity. As with air temperature, changes in air humidity throughout the diurnal cycle can correspond with interruptions in sap flow. However, these

events are confounded by other environmental parameters (i.e., decreases in air temperature and net radiation).

A vapour pressure deficit represents the difference between the water vapour in the air and the amount of water vapour the air could potentially hold, whereas air humidity refers to the amount of water vapour in the air. Therefore, both air humidity and vapour pressure deficit can be related to the evaporative potential that drives transpiration (and sap flow). Other studies have also found the response of sap flow to be coupled with increasing vapour pressure deficits (or decreasing humidity) (Kumagai et al., 2005; Ewers et al., 2008; Li et al., 2016b; Ma et al., 2017). Li et al., (2016a) found that vapour pressure deficit was the primary environmental parameter driving sap flow and found a significant clockwise hysteretic relationship between sap velocity and vapour pressure deficit, at both hourly and daily scales. Li et al., (2016a) argues that the phased behaviour of sap velocity in relation to vapour pressure deficiency is due to biophysical feedbacks within the tree. Effectively, the increased water demand at the needles and declining supply of water results in a stomatal response limits sap flow. This biophysical change results in the tree responding differently to environmental conditions at different parts of the day, resulting in the hysteresis pattern (Li et al., 2016b).

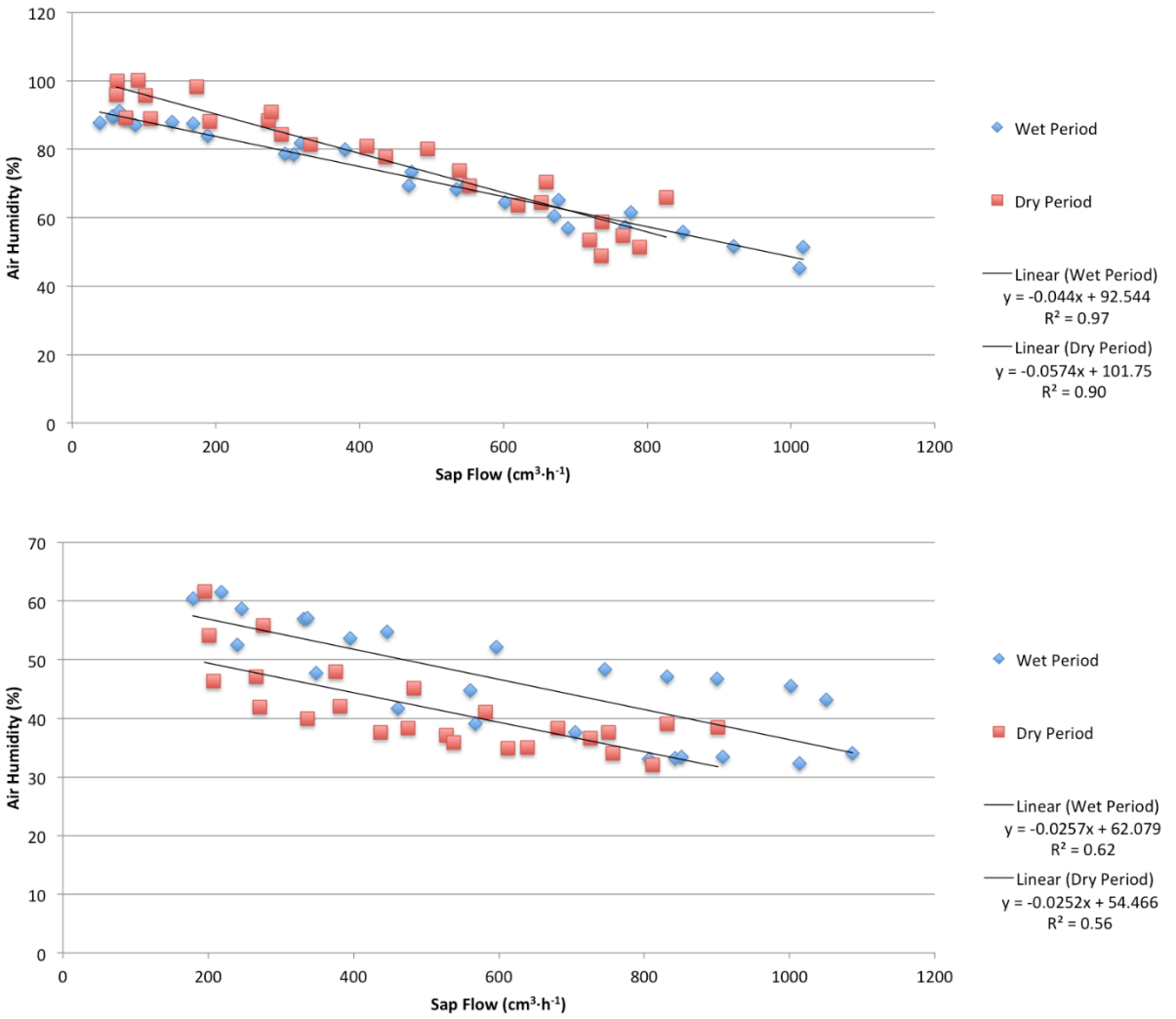

Figure 3.10 Air Humidity compared with sap flow as flow increased in the morning (top) and decreased in the evening (bottom) for both normal and drought conditions.

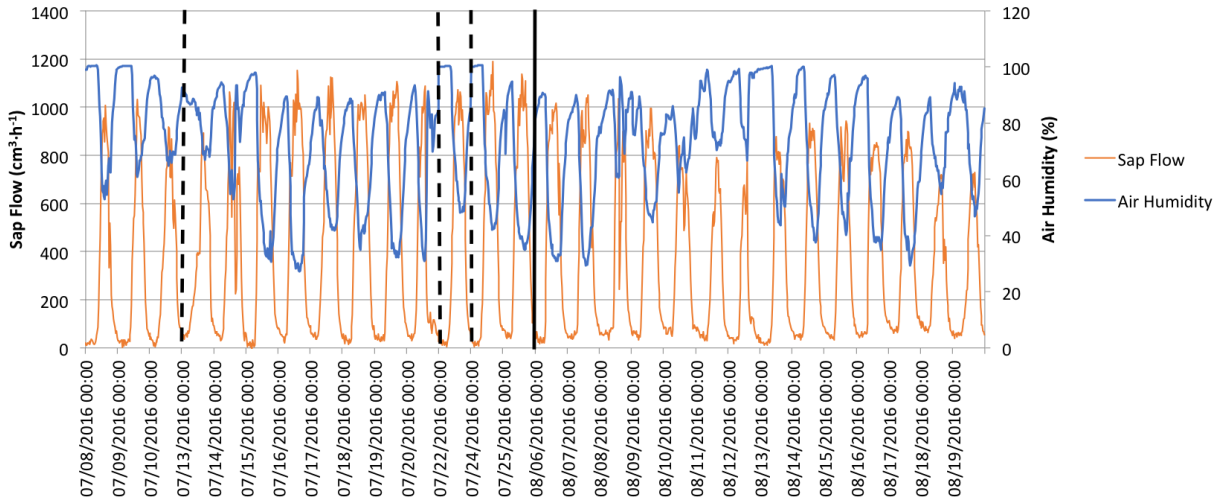

Figure 3.11 Sap flow and air humidity plotted against time. Sap flow ($cm^3 \cdot h^{-1}$) is on the left axis and air humidity (%) is on the right axis. The vertical dashed lines indicate a disruption is time, due to days where sap flow did not occur. The vertical solid line indicates the 12 day gap between the normal and drought conditions. Data to the left of the vertical solid line is from the normal conditions, while data to the right is from the drought conditions.

Air temperature and sap flow followed similar diurnal patterns (Figure 3.12; Figure 3.13). As air temperature increased, sap flow increased; as air temperature decreased, sap flow decreased. On a daily scale, air temperature was skewed to the right in relation to sap flow, therefore sap flow decreased in the afternoon prior to air temperature decreasing. As sap flow increased in the morning, there was a strong positive correlation between sap flow and air temperature during the normal conditions, r ($n=24$) = 0.85, $r^2 = 0.72$, $p < 0.0001$ and a very strong positive relationship during the drought conditions, r ($n=26$) = 0.96, $r^2 = 0.92$, $p < 0.0001$ (Figure 3.12). However, as sap flow decreased in the afternoon, there was only a moderate positive correlation between sap flow and air temperature during both normal and drought conditions, r ($n=25$) = 0.63, $r^2 = 0.39$, $p < 0.001$ and r ($n=24$) = 0.63, $r^2 = 0.39$, $p < 0.001$, respectively (Figure 3.12). Sap flow and air temperature are likely spuriously correlated as both are correlated with net radiation. During both the normal and drought conditions there was a clear anticlockwise, positive hysteretic relationship between air temperature and sap flow (Section 3.4.3; Figure 3.4a; Figure 3.4b), indicating higher sap flow rates in the morning compared to the afternoon and early evening, independent of air temperature. Daily peak air temperatures did not correspond with peak sap flow. For example, the air temperature reached 20°C on July 14th and 26°C on July 15th,

however sap flow was higher on July 14th. Furthermore, sap flow generally had a period of inactivity between 00:00 and 03:00 am, whereas air temperature often reached a lowest point and then began to increase during this time. Diurnal discrepancies in air temperature often correspond with decreases in sap flow, such as the dips in air temperature on July 14th and August 8th. However, these events are confounded by changes in other environmental parameters (i.e., increased in relative humidity or decreased in net radiation).

Wang et al., (2017) found that air temperature did not have direct effects on transpiration in a Scottish boreal forest. However, the relationship between air temperature and sap flow is rather ambiguous. Air temperature may not have direct impacts on sap flow (Oberhuber and Gruber, 2010; Wang et al., 2017), however temperature is a major factor in the forest water cycle (Waring et al., 1979) and environmental conditions (Rossi et al., 2007; Deslauriers et al., 2008; Zweifer et al., 2006; Oberhuber and Gruber, 2010; MacKay et al., 2012; Butt et al., 2014; Li et al., 2016a; Li et al., 2016b; Ma et al., 2017; Wang et al., 2017; Tian et al., 2018), both of which influence sap flow.

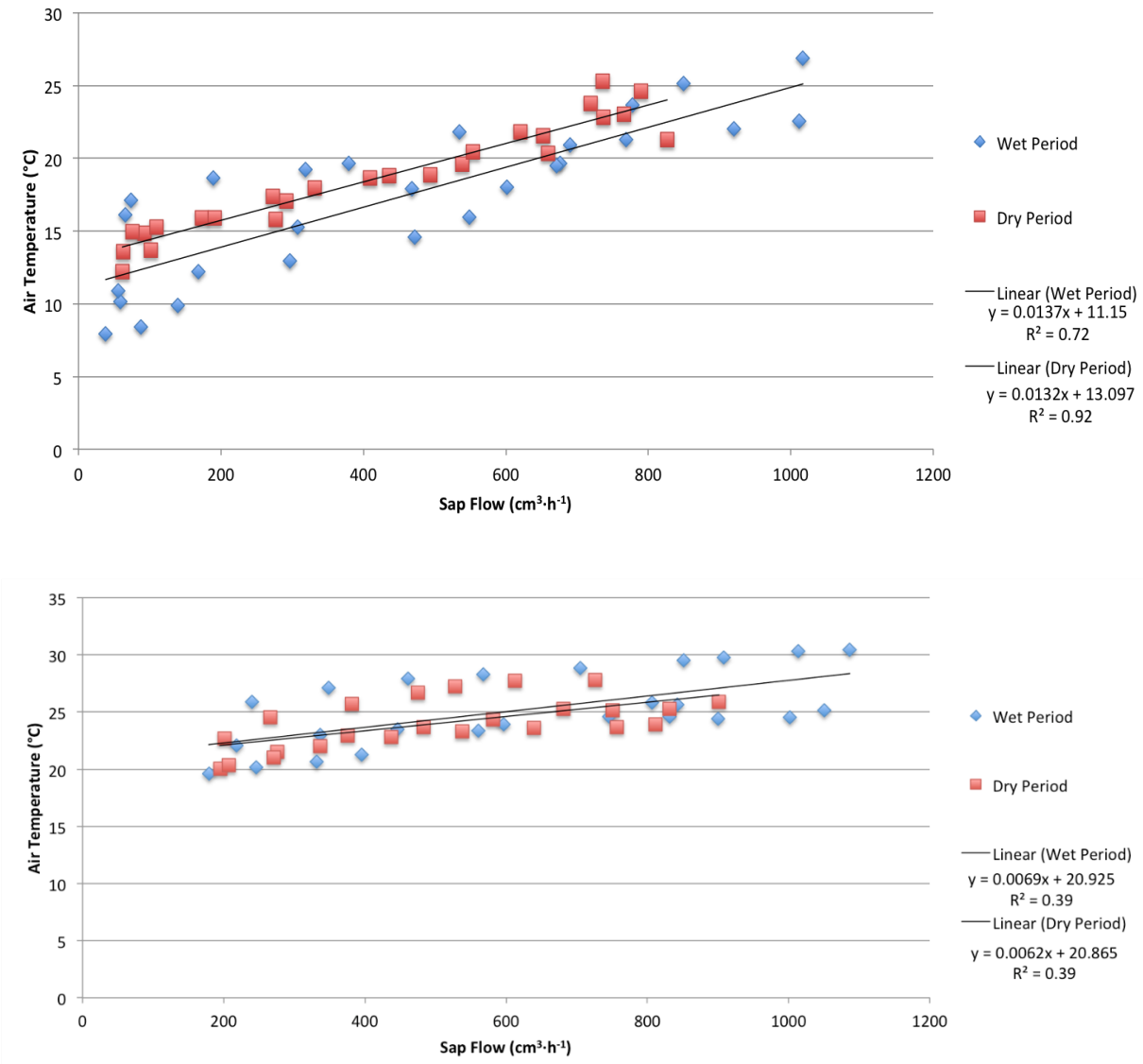

Figure 3.12 Air temperature compared with sap flow as flow increased in the morning (top) and decreased in the evening (bottom) for both normal and drought conditions.

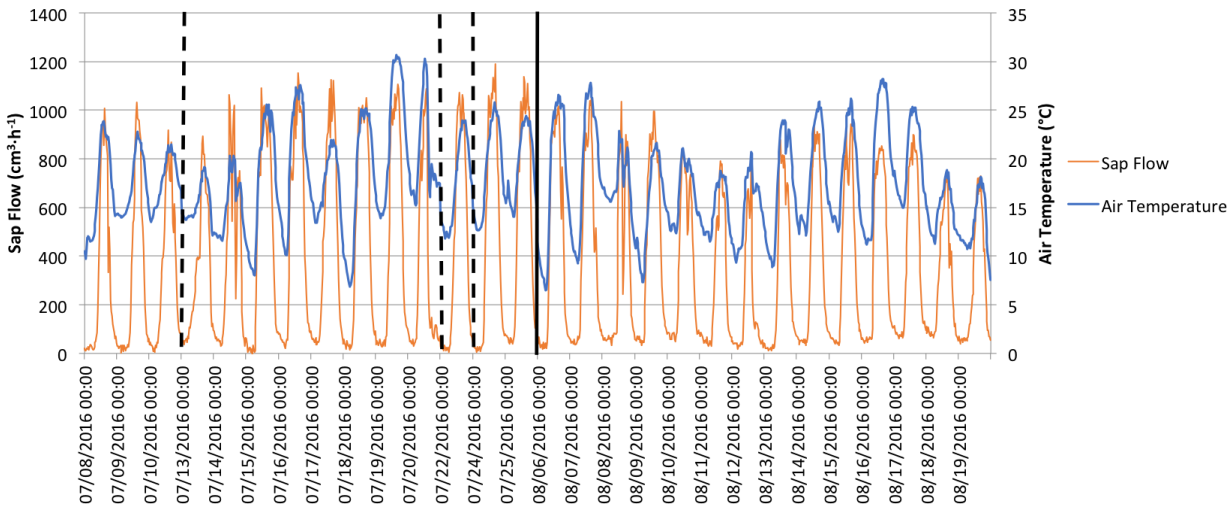

Figure 3.13 Sap flow and air temperature plotted against time. Sap flow ($cm^3 \cdot h^{-1}$) is on the left axis and air temperature (°C) is on the right axis. Vertical dashed lines indicate a disruption is time, due to days where sap flow did not occur. Vertical solid line indicates the 12 day gap between the normal and drought conditions. Data to the left of the vertical solid line is from the normal conditions, while data to the right is from the drought conditions.

Wind speed and sap flow followed similar diurnal cycles (Figure 3.14; Figure 3.15). As wind speed increased, sap flow increased; as wind speed decreased, sap flow decreased. On a daily scale, wind speed was highly variable compared to sap flow. As sap flow increased in the morning, there was a strong positive correlation between sap flow and wind speed during both the normal and drought conditions, $r\ (n=27) = 0.77$, $r^2 = 0.60$, $p < 0.0001$ and $r\ (n=26) = 0.77$, $r^2 = 0.60$, $p < 0.0001$, respectively (Figure 3.14). However, as sap flow decreased in the afternoon, there was only a weak positive correlation between sap flow and wind speed during the normal conditions $r\ (n=25) = 0.50$, $r^2 = 0.25$, $p < 0.0001$, and a moderate positive correlation during the drought conditions $r\ (n=24) = 0.56$, $r^2 = 0.31$, $p < 0.0001$ (Figure 3.14). During both the normal and drought conditions there was a weak anticlockwise, positive hysteretic relationship between wind speed and sap flow (Section 3.4.3; Figure 3.4g; Figure 3.4h). Wind speed is driven by changes in temperature, air pressure, earth's rotation, and centripetal force (Makarieva et al., 2013). Therefore, the effects of wind speed on sap flow were confounded in this study by the effects of air temperature and air humidity on wind speed.

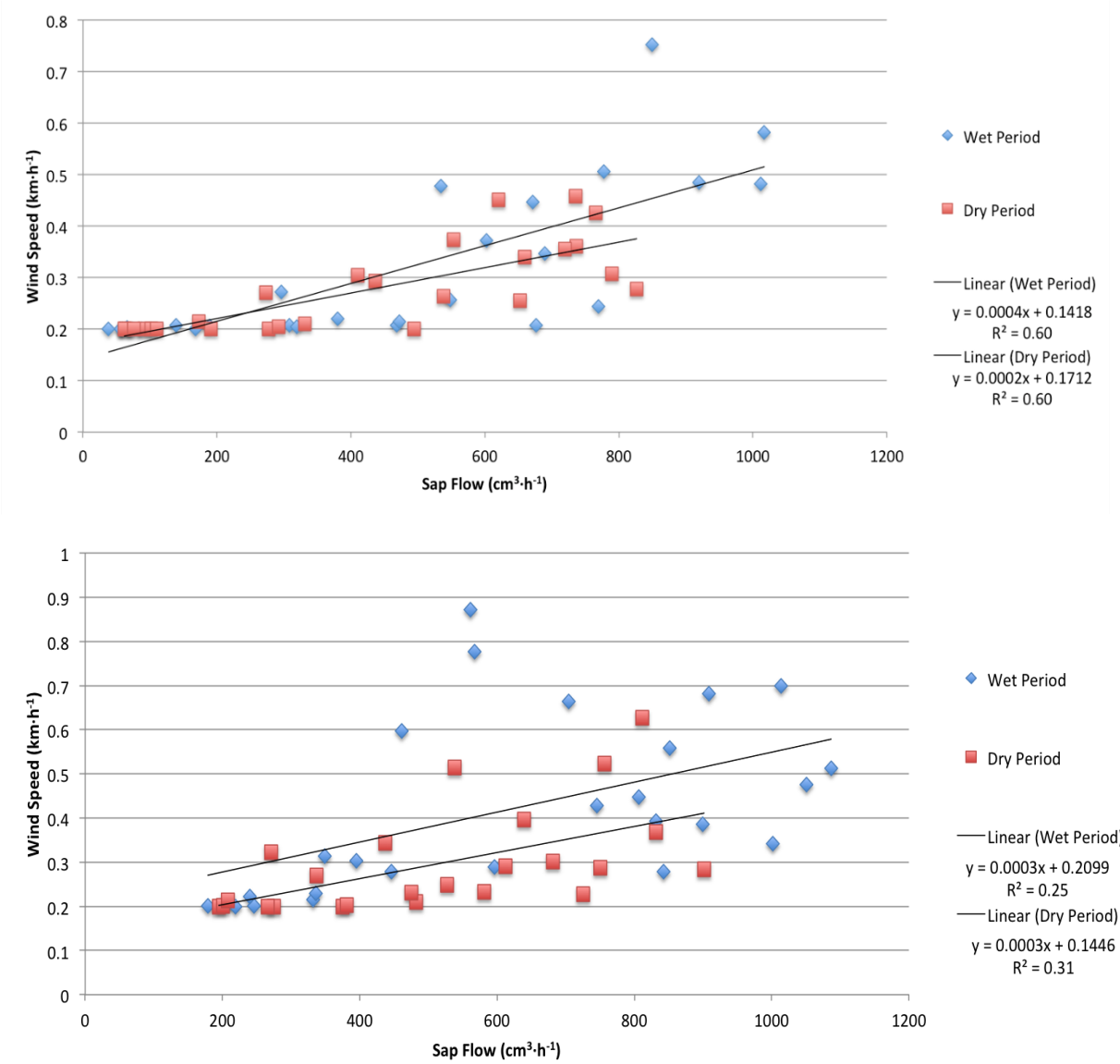

Figure 3.14 Wind Speed compared with sap flow as flow increased in the morning (top) and decreased in the evening (bottom) for both normal and drought conditions.

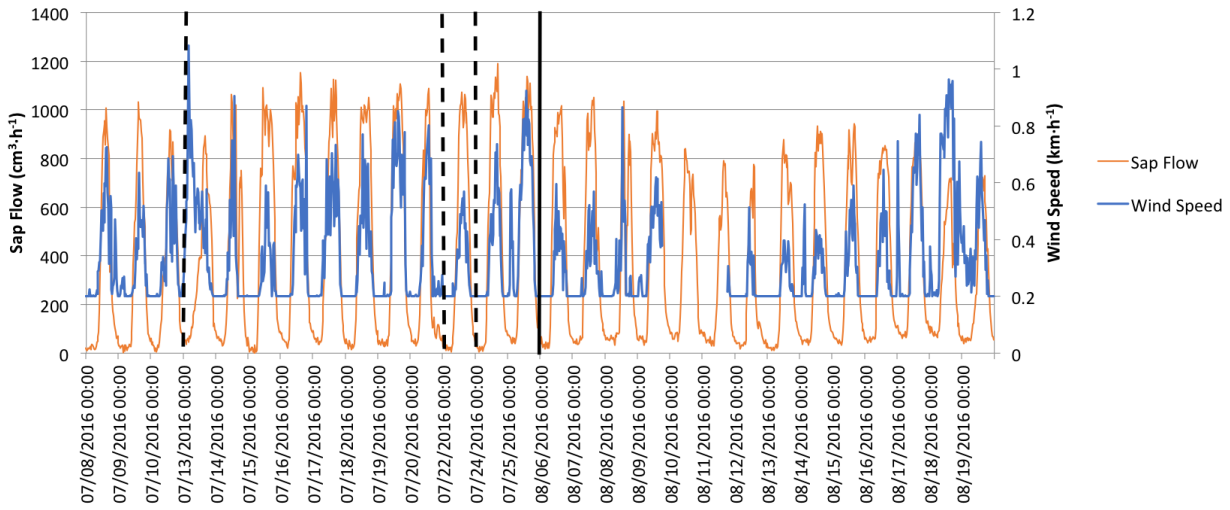

Figure 3.15 Sap flow and wind speed plotted against time. Sap flow ($cm^3 \cdot h^{-1}$) is on the left axis and wind speed ($km \cdot h^{-1}$) is on the right axis. Vertical dashed lines indicate a disruption is time, due to days where sap flow did not occur. Vertical solid line indicates the 12 day gap between the normal and drought conditions. Data to the left of the vertical solid line is from the normal conditions, while data to the right is from the drought conditions. Due to instrument failure, wind speed data is missing from August 9th - 11th.

3.4.7 Sap flow and tree trunk circumference

In addition to examining how environmental parameters influenced jack pine sap flow, this study measured the diurnal effects of jack pine sap flow on tree trunk circumference during both normal and drought conditions. Diurnal cycles of tree trunk expansion and contraction compared to sap flow were interpreted using two methods: overall change in the tree circumference (Figure 3.17) and diurnal change in the tree circumference (Figure 3.18). Sap flow as it increased in the morning and decreased in the afternoon was compared with diurnal changes in tree trunk circumference, for both normal and drought conditions (Figure 3.16).

Sap flow and tree trunk circumference followed divergent patterns (Figure 3.16; Figure 3.17; Figure 3.18). As sap flow increased, the tree trunk circumference contracted; as sap flow decreased, the tree trunk circumference expanded. At night when sap was not flowing the tree trunk circumference expanded, and in the morning when sap flow began the tree trunk circumference began to contract. The diurnal curve of the tree trunk's circumference expansion was skewed to the left, as tree trunk circumference contracted readily once sap flow commenced (Figure 3.17; Figure 3.18). This contraction upon sap flow initiating suggests that tree trunk

circumference would have continued to expand if sap flow had not started. Furthermore, under normal conditions, after periods of no sap flow the average tree trunk circumference was greater than it had been in the days prior (days of no sap flow indicated by the dashed lines, Figure 3.17; Figure 3.18). During drought conditions, the daily minimum of tree trunk circumference decreased with time (Figure 3.17). The diurnal change in tree trunk circumference increased dramatically after August 12th, 2016, which is likely due to water stress caused by low VWC culminated with increased demands for transpiration (Figure 3.7; Figure 3.17; Figure 3.18).

During normal conditions, as sap flow increased in the morning there was moderate negative correlation between sap flow and trunk circumference, r (n=27) = -0.55, r^2 = 0.31, p = 0.003. However, during drought conditions, as sap flow increased in the morning there was a strong negative correlation between sap flow and trunk circumference, r (n=26) = -0.90, r^2 = 0.82, p < 0.001. The higher correlation during the drought conditions may be an indication that the tree trunk circumference is responding primarily to tension due to transpiration and not to lateral movement of water into storage. Indicating that during the normal conditions fluctuating internal water storage and sap flow are both contributing to the tree trunk circumference. While, during drought conditions when the internal water storage has been depleted, sap flow is the main driver of tree trunk circumference expansion and contraction. As sap flow decreased in the afternoon during both normal and drought conditions, there was a very strong, almost perfect, negative correlation between sap flow and tree trunk circumference, r (n=25) = -0.93, r^2 = 0.87 p < 0.001 and r (n=24) = -0.99, r^2 = 0.99 p < 0.001, respectively. The regression slopes between normal and drought conditions are quite different (Figure 3.16). As sap flow decreased in the evening, the highly linear correlation between tree trunk circumference and sap flow suggests very little water moved laterally at this time. This is likely because internal water storage had likely been depleted throughout the day. During both normal and drought conditions there was a clear clockwise, negative hysteretic relationship between overall tree trunk circumference and sap flow (Section 3.4.3; Figure 3.5a; Figure 3.5b). This hysteretic relationship indicates that on a diurnal scale, jack pine trees contract and expand at different rates. These observations of trunk expansion and contraction compared to sap flow are consistent with other research (Goldstein

et al., 1998; Deslauriers et al., 2003; McLaughlin et al., 2003; Drew and Downes, 2009; Miralles-Crespo et al., 2010; Siegmund et al., 2016; Tian et al., 2018).

Diurnal changes in tree trunk circumference were similar during the normal and drought conditions (Figure 3.18). This was confirmed by a Mann-Whitney U statistical test. The median average diurnal change in tree trunk circumference during the normal and drought conditions were 0.38 mm and 0.47 mm, respectively; distributions in the two groups were statistically not different (Mann-Whitney $U = 77$, $n_1 = n_2 = 14$, $P < 0.05$ two-tailed, z-score = 55). However, the daily minimum tree trunk circumferences were statistically different during the normal and drought conditions (Figure 3.17). The median minimum tree trunk circumference during the normal and drought conditions were 344.59 mm and 344.30 mm, respectively; distributions in the two groups were statistically different (Mann-Whitney $U = 34$, $n_1 = n_2 = 14$, $P < 0.05$ two-tailed, z-score = 55). Indicating, the daily amplitude of change was primarily driven by sap flow, while the overall tree trunk circumference was affected by soil moisture and the associated internal water storage of the tree.

Cell growth in the cambium, leading to the growth of bark and wood is irreversible. At the same time, expansions and contractions of the tree trunk due to changes in osmotic water potentials within the tree are reversible (Zweifel et al., 2005). Therefore, radial shrinkage of the tree trunk is always associated with decreasing water potentials and radial expansion of the tree trunk is either associated with increasing water potential or tree growth. Consequently, using band dendrometers does not allow us to simply differentiate between the expansion of tree growth and the increase in tree trunk water potential. Zweifer (2016) argues, “Stem radii below a precedent maximum indicate a complete inhibition of any cell division and cell elongation in the cambium. Or in other words, as soon as the conditions in a stem induce a shrinkage in radius – measured over (inner) bark – the turgor and water potential conditions in the cambium are assumed to cross a threshold which do not enable [tree growth]”. Therefore, band dendrometer measurement could be broken into irreversible growth (i.e., tree trunk circumference peaks that are higher than previous days) and reversible expansion and contraction (i.e., daily expansion and contraction that does not exceed the peak tree trunk circumference previously reached). With this assumption, we can say that the trees experienced growth during the normal conditions

on the days where sap did not flow (represented by vertical dashed lines in Figure 3.17), and this growth was evident on July 13th, July 22nd, and July 24th (Figure 3.17). Furthermore, the trees experienced no growth under drought conditions. The jack pine trees were more productive under normal conditions than drought conditions; productivity was indicated by higher sap flow rates to support transpiration (hydrological cycle), tree growth (carbon sequestration), and increased internal water storage (hydrological cycle).

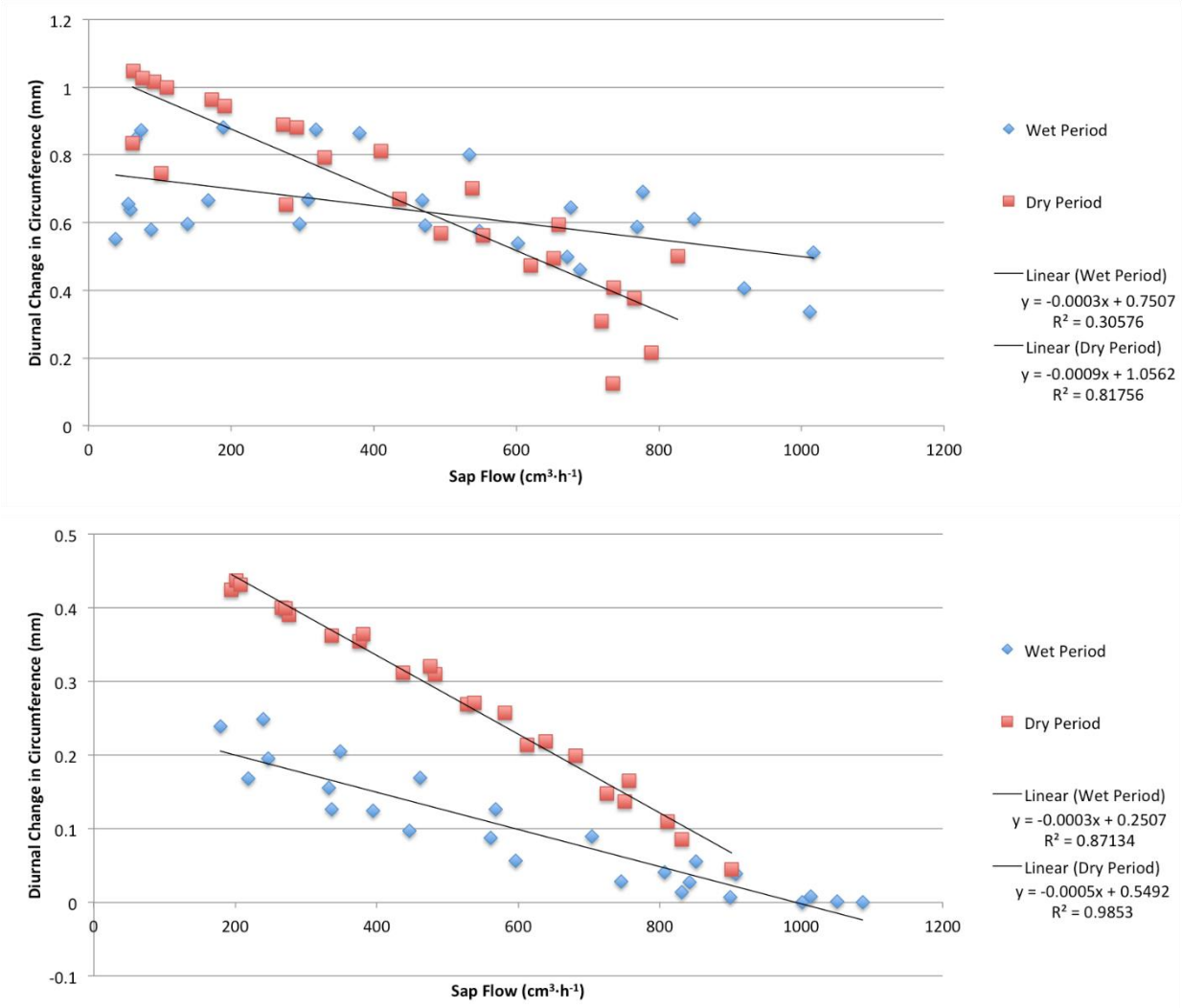

Figure 3.16 Diurnal change in tree trunk circumference compared with sap flow as flow increased in the morning (top) and decreased in the evening (bottom) for both normal and drought conditions.

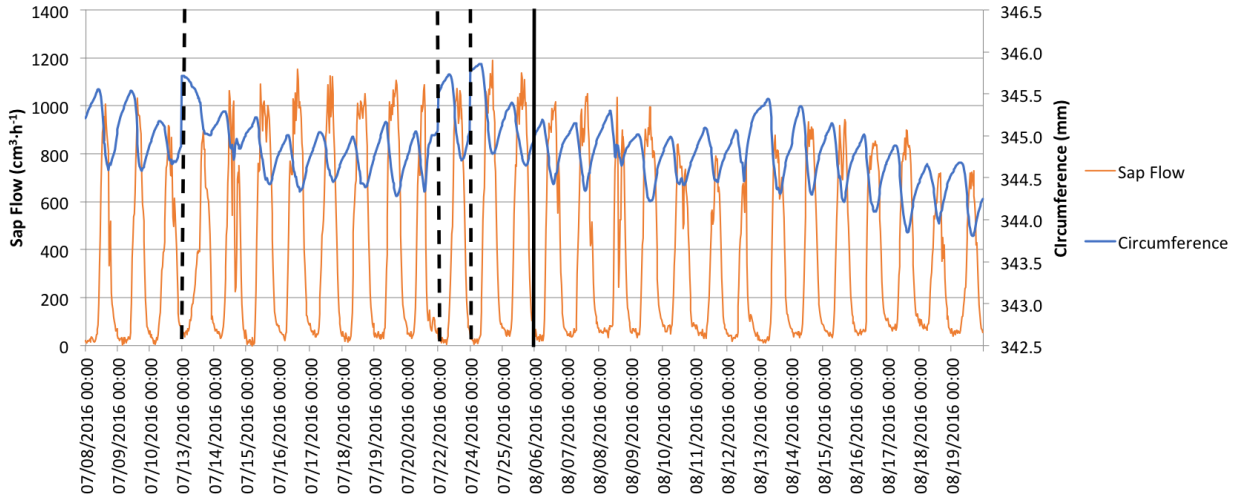

Figure 3.17 Sap flow and tree trunk circumference. Sap flow ($cm^3 \cdot h^{-1}$) is on the left axis and tree trunk circumference (mm) is on the right axis. Vertical dashed lines indicate a disruption is time, due to days where sap flow did not occur. Vertical solid line indicates the 12 day gap between the normal and drought conditions. Data to the left of the vertical solid line is from the normal conditions, while data to the right is from the drought conditions.

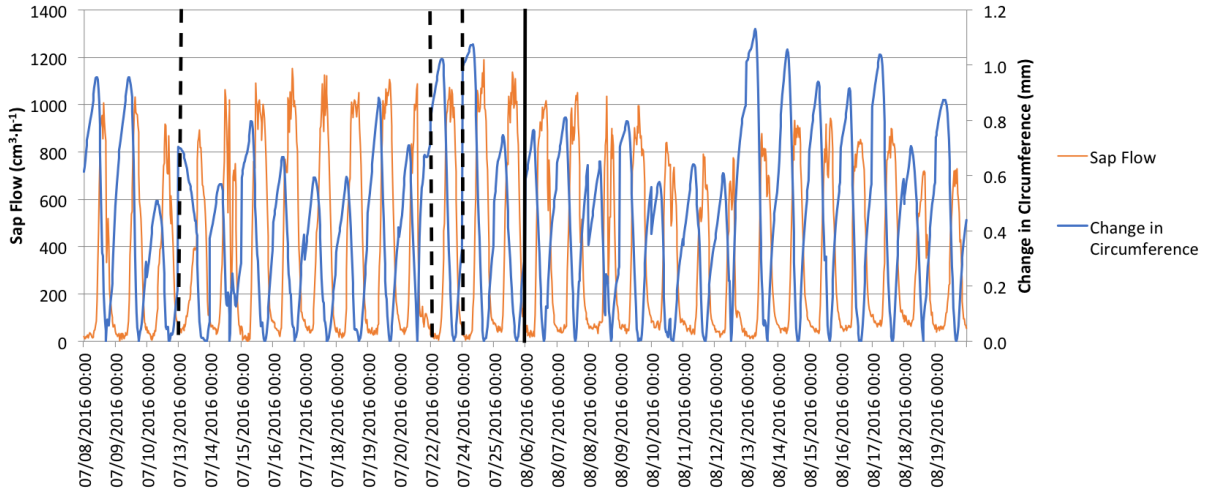

Figure 3.18 Sap flow and change in tree trunk circumference. Sap flow ($cm^3 \cdot h^{-1}$) is on the left axis and tree trunk circumference (mm) is on the right axis. Vertical dashed lines indicate a disruption is time, due to days where sap flow did not occur. Vertical solid line indicates the 12 day gap between the normal and drought conditions. Data to the left of the vertical solid line is from the normal conditions, while data to the right is from the drought conditions.

3.5 Conclusions

This study found that on a diurnal scale, sap flow of jack pine trees was primarily driven by net radiation, air humidity, and VWC. Air humidity was found to be important to induce sap flow in the morning. On days where air humidity did not decrease sufficiently, sap flow did not occur. While air humidity was the primary inducer of sap flow in the morning, net radiation was found to be the primary driver of sap flow throughout the day under normal and drought conditions. VWC was not influential on the timing of sap flow but regulated the volume of water being moved up the tree. The volume of water being moved up the tree to support transpiration decreased under drought conditions. Diurnal hysteretic relationships were found between sap flow and all the environmental parameters except for VWC. Therefore, changes in environmental parameters did not yield consistent changes in sap flow throughout the day. These diurnal hysteretic loops suggest that sap flow rates are affected by physiological variables within the tree, which may help jack pine trees mediate high transpiration rates in stressful environments.

On a diurnal scale the relationship between sap flow and tree trunk circumference was found to be divergent and hysteretic. Therefore, trees expanded and contracted at different rates throughout the day in response to sap flow. Radial shrinkage of the tree trunk was due to decreasing water storage within the tree, while radial expansion of the tree trunk was due to increasing water storage within the tree or growth. Jack pine trees only demonstrated tree growth under normal conditions, and these periods of growth were associated with days where sap did not flow (i.e., high humidity all day). While, under drought conditions the tree trunk circumference decreased over time as the tree utilized internal water storage to support transpiration. Daily amplitude of changes in tree trunk circumference was primarily driven by sap flow, but the overall tree trunk circumference was driven by VWC and the associated internal water storage within the tree.

Climate change may induce changes to environmental cycles, such as the carbon sequestration cycle or the hydrological cycle. This study found that jack pine trees under drought stress are not as productive at generating growth, and therefore are sequestering less carbon from the atmosphere. Additionally, these trees have less internal water storage making them drier and potentially more prone to fire. Under drought conditions the volume of sap flowing up

the tree to support transpiration was lower, which ultimately means less water was being contributed to the atmosphere, via evapotranspiration, to support the hydrological cycle. Climate change induced droughts will change the carbon sequestration cycle and hydrological cycle of jack pine stands in the boreal forest.

4. JACK PINE TREES: HYDRAULIC REDISTRIBUTION OF SOIL WATER

4.1 Preface

Reclamation of sites after open pit oil sands mining in the Athabasca oil sands region (AOSR) of northern Alberta, Canada requires building fully functional ecosystems with the biodiversity and land use that reflects the environment prior to mining. Approximately 20% of final reclaimed landscapes in the AOSR consists of coarse textured aeolian deposits and fluvial till (Zettl et al., 2011). A major problem for re-establishing vegetation on these coarse textured soils is the low retention of soil water, leading to low plant available water (PAW). Establishing vegetation requires adequate water in the active rooting zone. However, under dry conditions established trees and saplings with taproots may be able to access water from soil depths greater than 1.0 m. Understanding how trees utilize limited PAW in sandy soils with low water holding capabilities will help with future reclamation. Hydraulic redistribution (HR) is the process in which soil water moves from areas of low matric potential to areas of high matric potential in the soil profile using the tree roots as conduits. Hydraulic redistribution is one process that might mitigate PAW deficits at coarse textured sites with low water holding capacity. This empirical study used deuterium (^2H) isotopes to track the movement of soil water in coarse sandy soil at a stand of native *Pinus banksiana* (jack pine trees). Deuterium was injected 100 cm below the soil surface and its movement was monitored via soil and tree sampling over the course of the study (35 days).

4.2 Abstract

Hydraulic redistribution of soil water via plant roots has been observed for many different species; however, the ability of jack pine trees to facilitate HR has not been documented. If jack pine trees can facilitate HR, this could mean the jack pine taproot may be able to access soil water from greater depths (e.g., >100 cm) resulting in increased PAW at the soil surface. This mechanism of soil water transport could provide additional PAW to jack pine trees and understory vegetation which could contribute to transpiration and photosynthesis. Additionally, HR may help maintain hydraulic conductance between soil and roots, sustain roots in dry soil,

and provide access to nutrients. The objective of this study was to determine if jack pine trees facilitate HR at a dry sandy site under drought conditions.

This research was conducted by imposing drought conditions on a stand of jack pine trees within an c*: bearberry/lichen (subxeric/poor)* ecosite. An isotopically labelled solution consisting of local water enriched with ^{2}H was injected into the soil profile at a depth of 100 cm at dusk in August 11th, 2016. The $\delta^{2}H$ and $\delta^{18}O$ signatures of water throughout the soil profile and the jack pine xylem water were collected prior to the introduction of the isotopically labelled solution and during four subsequent sampling campaigns after introducing the isotope solution. To track the movement of the isotopically labelled solution throughout the soil profile, the $\delta^{2}H$ values of each sampling location during each sampling campaign were compared to the $\delta^{2}H$ values that were measured prior to introducing the isotopic solution.

The average $\delta^{2}H$ value of soil water collected from 0 cm – 20 cm prior to injecting the isotopically labelled solution was -103.77‰ (SD = 1.37). In comparison, soil water collected from this depth 1 day after injecting the isotopically labelled solution had an average $\delta^{2}H$ value of -98.51‰ (SD = 5.50), 11 days after injecting the isotopically labelled solution had an average $\delta^{2}H$ value of -56.88‰ (SD = 46.42), and 35 days after injecting the isotopically labelled solution had an average $\delta^{2}H$ value of -46.58‰ (SD = 39.79). After injecting the isotopically labelled solution, soil water collected from 0 cm – 20 cm had statistically significantly higher $\delta^{2}H$ values compared to prior to introducing the isotopically labelled solution ($\alpha = 0.05$). The average $\delta^{2}H$ value of soil water collected from 20 cm – 40 cm and 40 cm – 80 cm prior to injecting the isotopically labelled solution was -106.33‰ (SD = 1.51) and -108.92‰ (SD = 2.04), respectively. There was no statistically significant change in ^{2}H in the soil water between 20 cm – 40 cm or 40 cm – 80 cm at any point during this study ($\alpha = 0.05$). The average $\delta^{2}H$ value of soil water collected from 80 cm – 120 cm prior to injecting the isotopically labelled solution was -113.47‰ (SD = 1.11). As expected, considering the injection depth of the isotopically labelled solution at 100 cm, soil water collected from 80 cm – 120 cm was enriched in ^{2}H throughout the study ($\alpha = 0.001$). The presence of the isotopically labelled solution at the soil surface and absence of it between 20 cm – 80 cm indicated jack pine trees facilitated HR using their taproot and lateral roots. Therefore, jack pine trees can contribute to PAW at the soil surface through HR. When designing soil

prescriptions for reclamation of sandy c*: bearberry/lichen (subxeric/poor)* ecosites in the AOSR, we should account for soil water storage and associated PAW at depths greater than 100 cm.

4.3 Introduction

Mining in the AOSR requires removing vegetation, surficial organic matter, mineral soil, and overburden. To understand the scale of this mining: in 2013, 121 million m^3 of raw crude bitumen were mined from the AOSR, all of which was located in the boreal forest (Alberta Energy Regulators, 2015). Within the boreal forest in the AOSR there are many different ecosites, resulting from intricate environmental relationships (Beckingham and Archibald, 1996). Factors that determine these ecosites are soil (geology, geomorphology, topography, available water holding capacity, and nutrient regime), climate (solar radiation, precipitation, and permafrost), and external factors (forest fires, human activity, and pest infestations) (Sojo et al., 2007). Successful reclamation after oil sands mining requires building fully functional, self-sustaining ecosystems with the biodiversity and land use that reflects the site's pre-disturbance conditions (Alberta Environmental Protection, 1998). Therefore, successful reclamation requires understanding the intricate relationships between water, nutrients, and energy that create ecosites. A growing body of literature is being developed on the critical establishment of vegetation on reclaimed oil sands landscapes (Mackenzie and Naeth, 2009; Rowland et al., 2009; Hemstock et al., 2010; Larney and Angers, 2012; Leatherdale et al., 2012; Hahn and Quideau, 2012; Farnden et al., 2013).

Hydraulic redistribution (HR) is the passive movement of soil water via roots due to soil water potential gradients, essentially water from areas of low matric potential (wet soil) moves to areas of higher matric potential (dry soil) due to the soil water potential gradient (Burgess et al., 1998). Theoretically, HR has multiple benefits for tree survival and success on dry sites. These benefits include maintaining hydraulic conductance with the soil (Domec et al., 2004; Irvine et al., 2008), sustaining roots in dry soil (Bauerle et al., 2008), obtaining nutrients from dry soils (Querejeta et al., 2008), and ultimately increasing water supply for transpiration and photosynthesis (Brooks et al., 2002). Hydraulic redistribution depends on the potential gradient and pathway resistance through the roots; in multiple species it has been shown that soil water can be moved upwards (Caldwell and Richards, 1989; Burgess et al., 1998; Moreira et al., 2003;

Bleby et al., 2010), downwards (Smith et al., 1999; Burgess et al., 2001; Bleby et al., 2010), and laterally (Smart et al., 2005; Burgess and Bleby, 2006; Bleby et al., 2010). The soil water potential gradient theoretically moves water along the shortest pathway of least resistance. However, the hydraulic architecture of the rooting system may hinder HR. In individual roots the resistance of water flow is thought to be the same in either directions but within rooting networks resistance might be greater when water is moving away from the trunk towards the soil (Burgess and Bleby, 2006). This increased resistance is due to the hydraulic architecture of the xylem conduits, which makes it more advantageous for water to move towards the tree (Burgess and Bleby, 2006). Bleby et al., (2010) suggests all woody roots are capable of HR but the hydraulic architecture of the xylem conduits determine which roots in the network actually play a roll in HR. It is believed that the young non-suberised roots release the HR soil water (Caldwell et al., 1998). Hydraulic redistribution typically occurs at night when the soil water matric potential gradient exceeds that of the plant water potential gradient. However, HR can also occur during the day when the soil water potential gradient becomes greater than that of plant water potential gradient created by evapo-transpiration (Caldwell and Richards, 1989; Caldwell et al., 1998; Bleby et al., 2010). It has been shown that HR can induce sap flow in roots greater than that induced by transpiration (Burgess and Bleby, 2006).

Hydraulic redistribution has been observed in many ecosystems: amazon (Oliveira et al., 2005; Wang et al., 2011; Stahl et al., 2012; Yan and Dickinson, 2014), desert (Hultine et al., 2003; Hao et al., 2013; Yu et al., 2013), savannas (Scott et al., 2008; Yu and D'Odorico, 2015; Priyadarchini et al., 2016), and mixed forests (Brooks et al., 2002; Warren et al., 2007; Zapater et al., 2011). Many different plant species have demonstrated HR but trees appear to be the leading proponent for HR (Jackson et al., 2000). In a semi-arid woodland environment, HR was observed in every tree species within the study stand, deciduous and evergreen (Bleby et al., 2010). For Bleby et al.'s (2010) study, HR was observed in all species and types of woody roots: 80% of the surface roots (structural and shallow) and every deep root. Additionally, the symbiotic mycorrhizal fungi often associated with fine roots have been found to hydraulically redistribute soil water (Querejeta et al., 2003). If consistently dry soils can maintain roots, instead of roots dying off, HR is likely allowing the fine roots and aquoporins to stay hydrated (Bleby et al., 2010).

Jack pine trees are a drought tolerant species that grow throughout the boreal forest, especially in areas with dry sterile soils such as on glacial and fluvial deposits (Preston and Braham, 2002). Jack pine stands are typically even-aged due to regeneration after forest fires; heat from fire releases the resinous bond of the serotinous cone that houses the seeds (Alexander and Cruz, 2012). Jack pine trees have a dimorphic rooting structure, which is fundamental for the trees success on dry sterile soils. The majority of their rooting biomass is in the upper 20 cm of soil as lateral roots that extend out radially at a 90° angle from the base of the tree, additionally jack pine trees typically have a taproot that extends down from the base of the tree (Plourde et al., 2009). Taproots are able to access soil water and nutrients from soil deeper in the soil profile, especially during times of drought at the soil surface (Bleby et al., 2010). Rudolp and Laidly (1990) found jack pine taproots that extended vertically in the soil profile past 270 cm, which potentially extends the soil water storage available to the jack pine tree. Access to deep soil water via the taproot, when the surface soil is under dry or drought conditions, may be crucial for sustaining the tree's water and nutrient supply. The jack pine taproot and lateral roots sit in multiple soil depths with different volumes of PAW. There is likely a soil water potential gradient that can facilitate HR between the lateral roots in the surface soil and the taproot extending down through the soil profile. Therefore, jack pine trees expansive and dimorphic root structure may be highly effective at redistributing soil water via HR. Determining if jack pine trees facilitate HR is important in the context of reclamation, as HR can potentially increase the PAW in the top 30 cm of the soil profile.

Monitoring changes in volumetric water content of the soil, soil water potentials, and volumetric humidity to measure HR all yield ambiguous results (Milikin-Ishikawa and Bledsoe, 2000; Domec et al., 2004; Warren et al., 2005; Meinzer et al., 2007; Bauerle et al., 2008). Studies that measure sap flow using heat pulse probes (Smith et al., 1999; Burgess et al., 1998; Hultine et al., 2003; Oliveira et al., 2005; Burgess and Bleby, 2006; Bleby et al., 2010; Yu et al., 2013) or water movement using stable isotopic studies (Dawson, 1993; Moreira et al., 2003; Zapater et al., 2011; Stahl et al., 2012; Hao et al., 2013) have uncovered valuable knowledge about HR. Installing heat pulse probes to roots below ground requires excavating the roots or in isolated scenarios using karst systems (Bleby et al., 2010). Root excavation is damaging to the roots and

mycorrhizal fungi and karst systems are unique scenarios that are not present in most ecosystems. Using naturally occurring isotopic fractionation patterns may be possible in some scenarios but the difference in isotopic signature throughout the soil profile is likely not great enough to confirm HR. This study builds upon the exploratory experiment conducted by Zapater et al., (2011) and further developments by Stahl et al., (2013) of injecting a strong isotopically labelled solution to a given depth of soil. While isotopic studies do not allow us to know the exact rate of HR or the volume of water expressed they do shed light on the existence and approximate locations of HR.

To the best of the author's knowledge, HR has not been extensively observed for jack pine trees, a species often planted during site reclamation. The purpose of this study is to detect the contributions of HR to PAW in the top 20 cm of soil for a jack pine stand in Narrow Hills Provincial Park, Saskatchewan, Canada. The canopy cover at the research site was exclusively jack pine, the understory was characteristic of jack pine forests with low brush and moss. The objective for this research were twofold (1) define the transfer of soil water at a jack pine stand using an isotopically labelled solution, and (2) determine if jack pine roots facilitate HR.

4.4 Methods

4.4.1 Study site

This research was intended to be conducted within the AOSR, however the 2016 wildfires in the AOSR resulted in the relocation of this study. This research was conducted in the summer of 2016 in Narrow Hills Provincial Park, Saskatchewan, Canada (53°59'59"N, -104°39'30"W). A 10 m by 10 m study site was delineated and all work was conducted within this site. A control site was located 20 m south of the study site and all control samples were collected from this site. The study site and control site consisted of jack pine trees, a low brush and moss understory, homogeneous sandy soil, and xeric conditions. The study site consisted of 28 jack pine trees, with a mean diameter of 27.17 cm. These jack pine trees are an even-aged stand (21 years old), regenerated after a wildfire in 1995. The majority of the lateral roots were within 0 cm – 15 cm of the soil surface (observational data confirmed by Stamatinos [2019]). To confirm taproots for this jack pine tree stand were around 100 cm, a taproot was excavated from a jack pine tree just

outside of the study site. This tap root was found to extend down 112 cm from the base of the tree. The understory consisted of blueberry (*Vaccinium angustifolium*), cranberry (*Vaccinium oxycoccos*), lily-of-the-valley (*Convallaria majalis*), prickly rose (*Rosa acicularis*), moss (*Pleurozium schreberi* and *Polytrichum commune)*, and reindeer lichen (*Cladonia rangiferina*). Within Saskatchewan, the ecosite classification for this site is designated as *TS2: Jack Pine – Black Spruce/ Lichen* (M.S. McLaughlan et al., 2010). For consistency with literature pertaining to the AOSR, within Alberta the ecosite classification for this site is designated as *c: bearberry/lichen (subxeric/poor)* (Willoughby et al., 2017).

Soil at the study site is part of the Pine Association and consists of Degraded Eutric Brunisolic soils (AAFC, 2009). The study site has a gently undulating topography. These soils developed from sandy glaciofluvial material, deposited during the recession of the Wisconsin Glaciation (Steele et al., 1997). Soils at the study site have a surface texture of loamy sand (0 cm – 15 cm) and then consist of homogeneous sandy soil with no finer textured lenses or confining layers (15 cm – 300 cm) (Appendix B; observational data confirmed by Stamatinos [2019]). This homogenous sandy soil results in low available water holding capacity. A shallow piezometer installed at the study site confirmed that the groundwater table never reached a depth of 250 cm.

4.4.2 Water content of soil

Soil water content was monitored directly (gravimetric water content) by soil sampling and indirectly (volumetric water content) using *in-situ* CS616: Water Content Reflectometers (Campbell Scientific, USA). Gravimetric water content of the soil (GWC) is the mass of water stored within a mass of soil. To determine GWC: soil samples were collected, the weight of wet soil was recorded, samples were dried in the oven at 105° C for 24 hours, and then the weight of the dry soil was recorded. The following equation yields GWC:

$$\theta_g = \frac{m_{wet} - m_{dry}}{m_{dry}} \quad \textbf{(4.1)}$$

where, θ_g is GWC, m_{wet} is the wet soil mass, and m_{dry} is the dry soil mass.

Volumetric water content of the soil (VWC) is the volume of water within a volume of soil. Volumetric water content was measured every 60 minutes using CS616: Water Content Reflectometers. The VWC was measured at six soil depths: surface (0 cm – 10), 30 cm, 60 cm, 90 cm, 120 cm, and 150 cm. CS616: Water Content Reflectometers rely on the dielectric permittivity of soil to utilize the time-domain measurement method. An electromagnetic pulse is released down the two 30 cm stainless steel rods of the reflectometer, the travel time of this pulse depends on the dielectric permittivity of the soil. Liquid (water) has a higher dielectric constant than the solid and gas fractions of the soil. Therefore, as VWC increases and decreases, the dielectric permittivity of the soil changes. The VWC is then calculated based on the travel time of the electromagnetic pulse.

The net travel time of the electromagnetic pulse (output period) was recorded in a CR1000 data logger (Campbell Scientific, USA). CS616: Water Content Reflectometers have a temperature dependence that when uncalibrated will result in fluctuating VWC. The following equation corrects for temperature dependence (CS616 and CS625 Water Content Reflectometers, 2016):

$$\tau_{\text{corrected}}\,(\mathrm{T}_{\text{soil}}) = \tau_{\text{uncorrected}} + (20 - \mathrm{T}_{\text{soil}}) \times (0.526 - 0.052 \times \tau_{\text{uncorrected}} + 0.00136 \times \tau_{\text{uncorrected}}{}^{2})$$

(4.2)

where, $\tau_{\text{corrected}}$ is the corrected output period in microseconds, T_{soil} is the measured temperature of the soil, and $\tau_{\text{uncorrected}}$ is the uncorrected output period in microseconds. A fixed temperature and water content along the length of the rods was assumed.

The following quadratic calibration equation was used to calculate θ_v from the temperature corrected output period. For a mineral soil with bulk density less than 1.55 g cm^{-3}, bulk electrical conductivity less than 0.5 dS m^{-1}, and clay content less than 30% the following equations yields a θ_v accuracy of ± 2.5% (CS616 and CS625 Water Content Reflectometers 2016):

$$\theta_v = -0.0663 - 0.0063 \times \tau_{\text{corrected}} + 0.0007 \times \tau_{\text{corrected}}{}^{2}$$

(4.3)

where, $\tau_{\text{corrected}}$ is the corrected output period in microseconds, θ_v is fractional and can be expressed as a percentage by multiplying by 100. VWC data is presented in Appendix C.

4.4.3 Rain exclusion cover

To induce drought conditions, a rain exclusion cover was constructed below the tree canopy between 1.4 m and 2.4 m from the ground on July 26, 2016. The rain exclusion cover was constructed of heavy-duty tarps that overlapped at all seams. The rain exclusion cover extended 2 m – 4 m past the edge of the study site and allowed for air movement. A second rain exclusion cover was installed over the control site. To insure the integrity of the rain exclusion covers, bi-weekly inspections were conducted with additional inspections during bad weather. Photos of the rain exclusion cover over the study site are in Appendix D.

4.4.4 Isotopically labelled solution

The 10 m by 10 m study site was delineated into 1 m subplots (n = 100). PVC pipes with a 4.5 cm diameter were installed vertically into the center of each of the subplots, or as close to the center as possible without disturbing woody tree roots. A one-person auger (BT 130, STIHL, USA) was used to bore 100 cm deep holes and PVC pipes were installed into these holes. A depth of 100 cm was chosen due to the absence of all roots except jack pine taproots at this depth. The PVC pipes were capped at the surface to deter pests.

^{2}H enriched water (99.95% ^{2}H Oxide, Cambridge Isotopes Laboratories, Inc, MA, USA) was mixed with local tap water (δ^2H = -115‰) to prepare the isotopically labelled solution. The isotopically labelled solution consisted of 1.5 liters of ^{2}H enriched water in 25 liters of local water, for a final signature of δ^2H = 380000‰. It was estimated that there was 7500 liters of soil water storage within 1 m of the 10 m by 10 m plot prior to labelling. Injecting the isotopically labelled solution into the soil occurred after sundown on August 11th, 2016 (DOY 224). Each PVC pipe received 0.25 liters of labelled water for a total of 25 liters for the study site.

4.4.5 Soil sampling

Soil sampling was conducted with a one-person hand auger built for excavating dry unconsolidated sand (Signature Sand Auger, AMS, USA). Soil sampling occurred predawn, prior to tree transpiration and sap flow. Five sampling campaigns were conducted:

- Campaign 1: prior to isotopic labelling, August 11th, 2016 (DOY 224);
- Campaign 2: 1 day after isotopic labelling, August 12th, 2016 (DOY 225);
- Campaign 3: 11 days after isotopic labelling, August 22nd, 2016 (DOY 235);
- Campaign 4: 29 days after isotopic labelling, September 9th, 2016 (DOY 253); and
- Campaign 5: 35 days after isotopic labelling, September 15th, 2016 (DOY 259).

During each campaign six sample and three control sample soil cores were collected. Soil cores were separated into four sections by depth (0 cm – 20 cm, 20 cm – 40 cm, 40 cm – 80 cm, and 80 cm – 120 cm). Soil samples were stored in double-bagged large Ziplock^{TM} bags as per the standard method described by Wassenaar et al., (2008). If any roots were present in the soil, they were removed before bagging to avoid root water contamination. The soil auger was rinsed with local water and dried between each core section increment. Bagged soil was transported in coolers and refrigerated at a temperature of 2°C. To reduce isotopic fractionation of soil water within the samples, soil samples were refrigerated until isotopic analysis was conducted. Isotopic analysis of the soil water occurred within two days of sampling.

Prior to Campaign 4, wildlife (coyotes) destroyed a storage box kept onsite and removed the towels used to clean the hand auger. During Campaign 4 efforts were made to clean the hand auger between samples using spare cloth but resulted in cross-contaminated samples. Therefore, no results for Campaign 4 are presented.

4.4.6 Tree sampling

Tree sampling campaigns were conducted at the same time as soil sampling campaigns (Section 4.4.5). Tree sampling consisted of collecting xylem water using two different methods. Method 1, referred to as branch xylem water samples, consisted of collecting branch cuttings from the crown of the trees using extendable tree clippers and Method 2, referred to as ABH xylem water samples, consisted of collecting xylem water from the tree trunk at breast height

(ABH) (1.4 m) using a 5 mm increment borer. During each campaign three branch and five ABH xylem water samples were collected from the study site and three branch and three ABH xylem water samples were collected from the control site. Bark was removed from all tree samples to limit contaminating xylem water. All tree tissue samples were stored in eight milliliter glass vials. To ensure no evaporation occurred, vial opening were sealed with Parafilm M® and closed with polyvinyl-faced pulp lined septa lids. To reduce physiological processes and fractionation, glass vials were transported to the laboratory in chilled coolers and then stored in -80°C freezers until analysis.

4.4.7 Isotopic analysis of soil water

Soil samples were analyzed on a Picarro L2130-*i* Analyzer (Picarro Inc., Santa Clara, USA), at the University of Saskatchewan, in Saskatoon, Canada. δ^2H and $\delta^{18}O$ assays were conducted following the $H_2O_{(liquid)}$- $H_2O_{(vapour)}$ pore water equilibrium and laser spectroscopy method (Wassenaar et al., 2008; Hendry et al., 2015). 100 g soil samples were collected in one litre Ziplock™ bags. To conduct the analysis, the head space of Ziplock™ sample bags were filled with dry air until they reached liquid-vapour equilibrium between the soil sample and headspace. Therefore, the isotopic composition of the vapour in the headspace was in equilibrium with the water in the soil. These dry air filled samples were left for 48-60 hours (depending on order of analyses) to reach equilibrium before analysis. To analyze the vapour on the Picarro L2130-*i* Analyzer (Picarro), a sterile 21G stainless steel disposable syringe tip was inserted into the headspace of the Ziplock™ bag and a female Luer-lok adapter connected the syringe tip to a stainless steel tube, which drew vapour into the ring down cavity of the Picarro. The vapour's δ^2H and $\delta^{18}O$ composition were measured concurrently. Isotopic compositions were calibrated against an isotopically enriched standard from Fiji (δ^2H = -41.50‰ and $\delta^{18}O$ = -6.50‰) and an isotopically depleted standard from Birsay, Saskatchewan (δ^2H = -175.40‰ and $\delta^{18}O$ = - 22.85‰). Calibration standards were run initially and after every fourth sample, calibration checks and random sample duplicates were run after every tenth sample. Error associated with this technique and instrumentation is δ^2H = ±0.8‰ and $\delta^{18}O$ = ±0.3‰ (Wassenaar et al., 2008). The Picarro L2130-*i* cannot report values above zero parts per mille for δ^2H or $\delta^{18}O$. Therefore,

soil samples enriched above zero parts per mille for δ^2H due to the isotopically labelled solution were reported as δ^2H = 0.0‰.

4.4.8 Isotopic analysis of xylem water

Tree water was extracted from the xylem tissue through cryogenic extraction and cold trapping at the University of Saskatchewan following the Koeniger et al., (2011) method. Due to the small volume of xylem water collected from the branch and ABH samples, some composite samples needed to be analyzed. Composite samples were made up of xylem water from the same campaign and sampling location (i.e., branch xylem water and ABH xylem water samples were not combined). Tree water was then shipped to Alberta Innovates Technology Futures in Alberta, Canada. Isotopic compositions were then analyzed on a Delta V Advantage mass spectrometer and HDevice peripheral, following Nelson (2000) methodology. Error associated with this technique and instrumentation is δ^2H = ±0.1‰ and $\delta^{18}O$ = ±0.1‰ (Nelson, 2000).

4.4.9 Reporting isotopic ratios

Isotopic compositions for both soil and xylem water are reported in units of parts per mille (‰) and expressed relative to Vienna Standard Mean Ocean Water (VSMOW) reference standards:

$$\delta = \left(\frac{R}{R_{std}} - 1\right) \times 1000\ ‰ \quad \textbf{(4.4)}$$

where, δ is the isotopic composition (‰), R is the measured isotopic ratio of the sample, and R_{std} is the VSMOW δ^2H or $\delta^{18}O$ reference standard.

4.4.10 Statistical analysis to compare samples

Independent samples t-tests were performed to determine if there were statistically significant differences in δ^2H between Campaign 1 and subsequent Campaigns. Samples collected during Campaign 1 represent the baseline prior to introducing the isotopically labelled solution. For each comparison, samples were compared with samples from the same sampling

location. For the tree xylem water samples, the sampling locations were grouped together as "Tree Tissue" due to the small sample population resulting from composite samples.

Independent samples *t*-test allows us to determine if two campaigns are statistically significantly different by comparing the means of the two independent campaigns. To conduct *t*-tests, data must be sufficiently normal (i.e, kurtosis < |2.0| and skew < |2.0|) (Schmider et al., 2010).

$$K = \frac{\sum_{i=1}^{n} (x_i - \bar{x})^4 / n}{s^4}$$

(4.5)

where, *K* is kurtosis, x is the sample value, $\bar{x}$ is the mean of the sample set, n is the number of observations for the sample set, and s_2 is the standard deviation of the set of samples.

$$g = \frac{\sum_{i=1}^{n} (x_i - \bar{x})^3 / n}{s^3}$$

(4.6)

where, g is skew, x is the sample value, $\bar{x}$ is the mean of the sample set, n is the number of observations for the sample set, and s_2 is the standard deviation of the set of samples.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s_p \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

(4.7)

where, *t* is the test statistic, $\bar{x}_1$ is the mean of the first sample set, $\bar{x}_2$ is the mean of the second sample set, s_p is the pooled standard deviation, s_1 is the standard deviation of the first set of samples, s_2 is the standard deviation of the second set of samples, n_1 is the number of observations for the first sample set, and n_2 is the number of observations for the second sample set.

$$df = (n_1 + n_2) - 2$$

(4.8)

where, df is degrees of freedom, n_1 is the number of observations for the first sample set and n_2 is the number of observations for the second sample set. The calculated t values were then compared to a t distribution table, using the corresponding degrees of freedom and chosen significance level (α = 0.05).

4.5 Results and discussion

4.5.1 Volumetric water content of soil

The VWC at the study site prior to inducing drought conditions and for each sampling campaign are presented in Table 4.1 and Figure 4.1. The VWCs presented are averages from the time of 00:00 to 04:00 from the day in question. The VWC prior to inducing drought conditions was collected the morning prior to installing the rain exclusion cover (July 26, 2016, 11 days prior to Campaign 1). Presenting the VWC prior to inducing drought conditions is informative when considering the isotopic composition of the tree tissue during Campaign 1 (discussed in Section 4.5.5). The average VWC in the top 30 cm of the soil profile prior to installing the rain exclusion cover was 0.083 $cm^3 \cdot cm^{-3}$, which was highest VWC of all depths sampled from the soil profile (Table 4.1). The surface VWC found at the study site prior to installing the rain exclusion cover was consistent with VWCs found at other jack pine stands with similar textured, sandy soils in the region (Elliott et al., 1998; Iwashita et al., 2005; Zha et al., 2010). Prior to installing the rain exclusion cover and during each campaign, the VWC decreased through the soil profile to 60 cm and then increased to 120 cm, followed by a decrease at the last measured depth of 150 cm (Figure 4.1). The increased VWC at 120 cm suggests a hydraulic connection between this depth and a source of water (i.e., the soil surface).

The rain exclusion cover was successful in creating drought conditions at the soil surface that may be conducive to vertical HR. Prior to Campaign 1, VWC decreased throughout the soil profile. Notably, the VWC at the surface soil and 30 cm locations decreased by almost half after installing the rain exclusion cover and before Campaign 1 (Table 4.1). During the sampling campaigns the VWC in the top 30 cm was always lower than the VWC found at 120 cm. The VWC decreased incrementally between each campaign. The introduction of the isotopically labelled

solution to a depth of 100 cm after Campaign 1 was not captured by the CS616: Water Content Reflectometers because these probes were installed at the control site.

Table 4.1 Volumetric water content of the soil

Depth (cm)	Prior to Rain Exclusion[1] ($cm^3 \cdot cm^{-3}$)	Campaign 1 VWC ($cm^3 \cdot cm^{-3}$)	Campaign 2 VWC ($cm^3 \cdot cm^{-3}$)	Campaign 3 VWC ($cm^3 \cdot cm^{-3}$)	Campaign 5 VWC ($cm^3 \cdot cm^{-3}$)
Soil Surface[2]	0.083	0.042	0.041	0.039	0.038
30	0.063	0.038	0.038	0.034	0.032
60	0.039	0.038	0.037	0.036	0.034
90	0.045	0.043	0.043	0.042	0.041
120	0.052	0.050	0.050	0.049	0.048
150	0.049	0.044	0.044	0.042	0.040

Footnote:
[1] Data from the morning of July 26, 2016, prior to installing the rain exclusion cover (11 days prior to Campaign 1).
[2] Soil surface measurements represent the average volumetric water content in the top ten cm of soil.

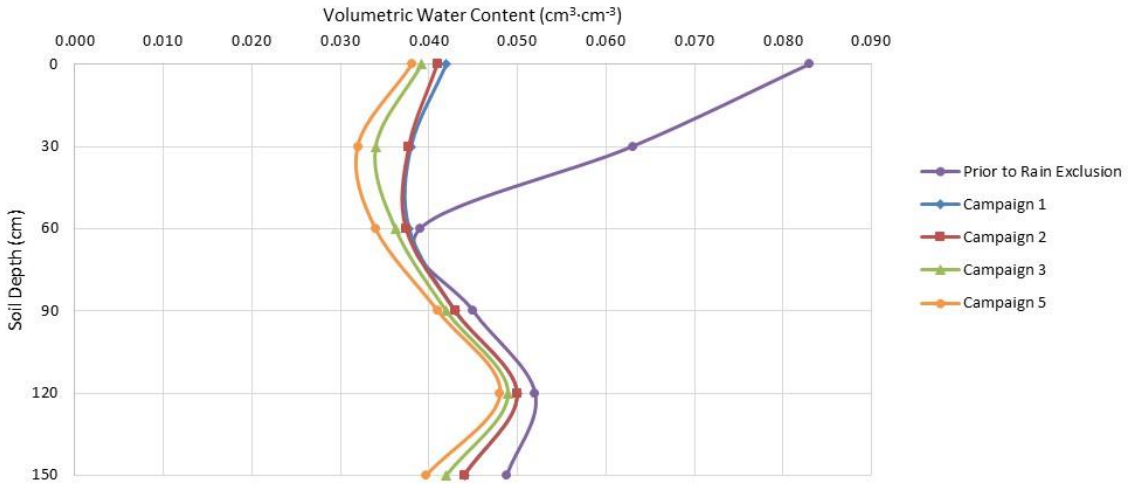

Figure 4.1 Average volumetric water content of soil throughout the soil profile prior to installing the rain exclusion cover and during each sampling campaign.

4.5.2 Gravimetric water content of soil

The GWC was measured from sub-samples of the soil samples collected for isotopic analysis. Measured GWC from the soil sampling campaigns are presented in Table 4.1 and Figure 4.2. The measured GWC throughout the soil profile were consistent with the VWC measurements. The GWC was higher for soils collected from depths of 0 cm – 20 cm, 40 cm – 80 cm, and 80 cm – 120 cm than samples collected from 20 cm – 40 cm. GWC decreased with each

sampling campaign, with the exception of Campaign 2. Campaign 2 saw an increase in GWC between 40 cm – 80 cm and 80 cm – 120 cm, which is likely attributed to the addition of the isotopically labelled solution at 100 cm that occurred between Campaign 1 and Campaign 2.

Table 4.2 Gravimetric water content of the soil samples

Depth (cm)	Campaign 1 GWC ($g \cdot g^{-1}$)	Campaign 2 GWC ($g \cdot g^{-1}$)	Campaign 3 GWC ($g \cdot g^{-1}$)	Campaign 5 GWC ($g \cdot g^{-1}$)
0-20	0.029	0.028	0.026	0.025
20-40	0.022	0.021	0.019	0.018
40-80	0.027	0.028	0.028	0.026
80-120	0.029	0.031	0.027	0.026

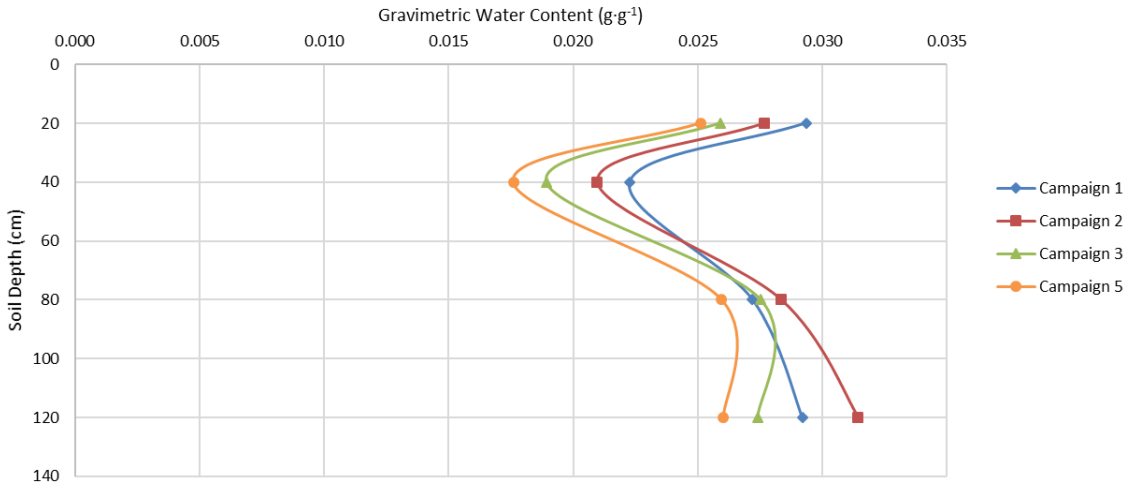

Figure 4.2 Average gravimetric water content of soil throughout the soil during each sampling campaign. Gravimetric water contents were measured from composite depths but are demonstrated at the bottom of the depth interval for this figure.

4.5.3 Descriptive statistics

During each sampling campaign, soil samples were collected from 0 cm – 20 cm, 20 cm – 40 cm, 40 cm – 80 cm, and 80 cm – 120 cm. Descriptive statistics of the soil samples δ^2H value for each campaign and sampling depth are presented in Table 4.3. Soils collected from 0 cm – 20 cm had an average δ^2H value of -103.77‰ during Campaign 1 and then increased with each sampling campaign to -98.51‰, -6.88‰, and -46.58‰ for Campaign 2, 3, and 5, respectively. This indicates the isotopically labelled solution added at 100 cm in the soil profile has been distributed to the top of the soil profile. Soils collected from 20 cm – 40 cm had an average δ^2H

value of -106.33‰ during Campaign 1 and the average δ^2H value fluctuated between -105.71‰, -84.72‰, and -101.19‰ for Campaigns 2, 3, and 5, respectively. For soils collected from 20 cm – 40 cm during Campaign 3, where the average δ^2H value was -84.72‰, the minimum δ^2H value was -103.94‰ but the maximum δ^2H value was 0‰. Therefore, some of the samples at this depth have been enriched in ^2H by the isotopically labelled solution, while others did not appear to be enriched. Soils collected from 40 cm – 80 cm had an average δ^2H value of -108.92‰ during Campaign 1, the average δ^2H value at this depth fluctuated between -109.24‰, -99.84‰, and -110.07‰ for every subsequent campaign, respectively. The soils collected from 40 cm – 80 cm during Campaign 3, are consistent with the soils collected from 20 cm – 40 cm. The minimum δ^2H value was -120.12‰ but the maximum δ^2H value was 0‰, suggesting the isotopically labelled solution enriched some of the soils with ^2H at this depth. Soils collected from 80 cm – 120 cm had an average δ^2H value of -113.47‰ during Campaign 1, the average δ^2H value at this depth increased to -0.45‰, -18.84‰, and -26.64‰ for each subsequent campaign, respectively. Therefore, the isotopically labelled solution that was delivered to 100 cm depth enriched the soil water in ^2H at this depth.

During each sampling campaign, branch xylem water and ABH xylem water samples were collected. Descriptive statistics of the branch xylem water and ABH xylem water samples δ^2H value for each campaign are presented in Table 4.3. The δ^2H value of ABH xylem water collected were consistent between Campaign 1 (-120.01‰) and Campaign 2 (-120.12‰). However, by Campaign 3 the ABH xylem water sample was enriched in ^2H from the isotopically labelled solution and had a δ^2H value of 48.95‰. Surprisingly the ABH xylem water collected during Campaign 5 had a δ^2H value of 106.12‰, which suggests a source of soil water that has not been affected by the isotopically labelled solution. Like the ABH xylem water samples, the average δ^2H value of branch xylem water was consistent between Campaign 1 (-112.72‰) and Campaign 2 (-108.49‰). However, by Campaign 3 the branch xylem water samples were enriched in ^2H from the isotopically labelled solution and had a δ^2H value of -72.67‰. The branch xylem water collected during Campaign 5 had an average δ^2H value of -90.25‰, suggesting the isotopically labelled solution was still present in the branch xylem water.

Table 4.3 Descriptive statistics of δ^2H values for each campaign

δ^2H of Soil Samples Collected from 0 cm – 20 cm (‰)				
	Campaign 1	Campaign 2	Campaign 3	Campaign 5
Min	-105.65	-105.44	-103.94	-92.26
Median	-104.11	-96.64	-73.44	-28.02
Average	-103.77	-98.51	-56.88	-46.58
Max	-101.82	-92.32	0.00	-19.46
δ^2H of Soil Samples Collected from 20 cm – 40 cm (‰)				
	Campaign 1	Campaign 2	Campaign 3	Campaign 5
Min	-108.78	-113.22	-120.12	-107.28
Median	-106.08	-104.97	-96.73	-104.21
Average	-106.33	-105.71	-84.72	-101.19
Max	-104.17	-101.64	0.00	-92.10
δ^2H of Soil Samples Collected from 40 cm – 80 cm (‰)				
	Campaign 1	Campaign 2	Campaign 3	Campaign 5
Min	-111.42	-111.71	-126.84	-116.00
Median	-109.18	-108.48	-121.05	-109.13
Average	-108.92	-109.24	-99.84	-110.07
Max	-105.42	-107.73	0.00	-105.07
δ^2H of Soil Samples Collected from 80 cm – 120 cm (‰)				
	Campaign 1	Campaign 2	Campaign 3	Campaign 5
Min	-115.21	-0.90	-111.19	-79.91
Median	-113.27	-0.50	-0.50	0.00
Average	-113.47	-0.45	-18.84	-26.64
Max	-112.11	0.00	0.00	0.00
δ^2H Signature of ABH Xylem Water[1] (‰)				
	Campaign 1	Campaign 2	Campaign 3	Campaign 5
Min	-120.01	-120.12	48.95	-106.12
Median	-120.01	-120.12	48.95	-106.12
Average	-120.01	-120.12	48.95	-106.12
Max	-120.01	-120.12	48.95	-106.12
δ^2H Signature of Branch Xylem water (‰)				
	Campaign 1	Campaign 2	Campaign 3	Campaign 5
Min	-116.71	-110.70	-95.59	-113.56
Median	-113.00	-107.82	-89.86	-112.48
Average	-112.72	-108.49	-72.67	-90.25
Max	-105.55	-106.95	-32.55	-44.70
δ^2H Signature of Tree Tissue[2] (‰)				
	Campaign 1	Campaign 2	Campaign 3	Campaign 5
Min	-120.01	-120.12	-95.59	-113.56
Median	-114.73	-109.26	-61.21	-109.30
Average	-113.93	-111.40	-42.26	-94.22
Max	-105.55	-106.95	48.95	-44.70

Footnote:

[1] One composite sample collected during each Campaign.

[2] Tree tissue includes branch xylem water, composite branch xylem water, and composite ABH xylem water.

4.5.4 Comparing δ^2H values between campaigns

To compare if the δ^2H value of soil samples and tree tissue samples from Campaign 1 and subsequent Campaigns were statistically significantly different, independent samples t-tests were performed. Data collected during the campaigns were sufficiently normal for the purpose of conducting t-tests (i.e, kurtosis < |2.0| and skew < |2.0|) (Schmider et al., 2010). The results of the t-tests are presented in Table 4.4.

Soil water collected from 0 cm – 20 cm during Campaign 1 (n = 6) had an average δ^2H value of -103.77‰ (SD = 1.37), while Campaign 2 (n = 6), Campaign 3 (n = 6), and Campaign 5 (n = 6) had average δ^2H values of -98.51‰ (SD = 5.50), -56.88‰ (SD = 46.42), and -46.58‰ (SD = 39.79), respectively. The independent samples t-tests indicated the δ^2H value of soil water from 0 cm – 20 cm collected during Campaign 1 were statistically significantly different than Campaigns 2 $t(10) = -2.24$, $p = 0.046$, Campaign 3 $t(10) = -2.47$, $p = 0.033$, and Campaign 5 $t(7) = -2.49$, $p = 0.007$. Therefore, the soil water collected from 0 cm – 20 cm after Campaign 1 was associated with a statistically higher mean δ^2H value than the soil water collected from 0 cm – 20 cm during Campaign 1.

Soil water collected from 20 cm – 40 cm during Campaign 1 (n = 6) had an average δ^2H value of -106.33‰ (SD = 1.51), while Campaign 2 (n = 6), Campaign 3 (n = 6), and Campaign 5 (n = 6) had average δ^2H values of -105.71‰ (SD = 3.99), -84.72‰ (SD = 43.41), and -101.19‰ (SD = 8.03), respectively. The independent samples t-tests indicated the δ^2H value of soil water from 20 cm – 40 cm collected during Campaign 1 were statistically significantly similar to soil water collected during Campaigns 2 $t(10) = -0.36$, $p = 0.729$, Campaign 3 $t(10) = -1.22$, $p = 0.251$, and Campaign 5 $t(7) = -1.10$, $p = 0.149$. Therefore, the soil water collected from 20 cm – 40 cm after Campaign 1 was associated with a statistically similar mean δ^2H value as the soil water collected from 20 cm – 40 cm during Campaign 1.

Soil water collected from 40 cm – 80 cm during Campaign 1 (n = 6) had an average δ^2H value of -108.92‰ (SD = 2.04), while Campaign 2 (n = 6), Campaign 3 (n = 6), and Campaign 5 (n = 6) had average δ^2H values of -109.24‰ (SD = 1.69), -99.84‰ (SD = 49.64), and -110.07‰ (SD = 5.52), respectively. The independent samples t-tests indicated soil water from 40 cm – 80 cm collected during Campaign 1 were statistically significantly similar to soil water collected during

Campaigns 2 t(10) = -0.29, p = 0.774, Campaign 3 t(10) = -0.45, p = 0.664, and Campaign 5 t(7) = 0.35, p = 0.651. Therefore, the soil water collected from 40 cm – 80 cm after Campaign 1 was associated with a statistically similar mean δ^2H value as the soil water collected from 40 cm – 80 cm during Campaign 1.

Soil water collected from 80 cm – 120 cm during Campaign 1 (n = 6) had an average δ^2H value of -113.47‰ (SD = 1.11), while the soil water collected from this depth during Campaign 2 (n = 6), Campaign 3 (n = 6), and Campaign 5 (n = 6) had average δ^2H values of -0.45‰ (SD = 0.38), -18.84‰ (SD = 45.25), and -26.64‰ (SD = 46.13), respectively. The independent samples t-tests indicated the δ^2H value of soil water from 80 cm – 120 cm collected during Campaign 1 were statistically significantly different from soil water collected during Campaigns 2 t(10) = -235.22, p < 0.001, Campaign 3 t(10) = -5.12, p < 0.001, and Campaign 5 t(7) = -3.26, p < 0.001. Therefore, the soil water collected from 80 cm – 120 cm after Campaign 1 was associated with a statistically higher mean δ^2H value than the soil water collected from 80 cm – 120 cm during Campaign 1.

Tree tissue collected during Campaign 1 (n = 6) had an average δ^2H value of -113.93‰ (SD = 5.03), while the tree tissue collected during Campaign 2 (n = 4), Campaign 3 (n = 4), and Campaign 5 (n =4) had average δ^2H values of -111.40‰ (SD = 6.03), -42.26‰ (SD = 67.14), and -94.22‰ (SD = 33.17), respectively. The independent samples t-tests indicated tree tissue collected during Campaign 1 was statistically significantly different from tree tissue collected during Campaigns 3 t(8) = -2.13, p = 0.028. The independent samples t-tests indicated tree tissue collected during Campaign 1 were statistically significantly similar to tree tissue collected during Campaigns 2 t(8) = -0.70, p = 0.489 and Campaign 5 t(8) = -1.18, p = 0.178. Therefore, the tree tissue collected from during Campaign 3 was associated with a statistically higher mean δ^2H value than the tree tissue collected during Campaign 1.

The soil water collected from 0 cm – 20 cm and 80 cm – 120 cm during Campaign 2, Campaign 3, and Campaign 5 were statistically significantly different from the soil water collected from these depths during Campaign 1. While soil water collected from 20 cm – 40 cm and 40 cm – 80 cm during Campaign 2, Campaign 3, and Campaign 5 were statistically not different to the soil water collected from these depths during Campaign 1. Therefore, we are seeing an increase in δ^2H at the soil surface (0 cm – 20 cm) and at the injection location (80 cm – 120 cm), from the

day after injecting the isotopically labelled solution through to the last campaign. Furthermore, we are not seeing a statistically significant increase in δ^2H between 20 cm – 80 cm. For tree tissue samples, only the samples collected during Campaign 3 were statistically significantly different from Campaign 1. Tree tissue samples collected during Campaign 5 were statistically significantly similar to Campaign 1. However, it is evident that the isotopically labelled solution did increase the δ^2H signature in some tree tissue samples for Campaign 5 (Table 4.3; Table 4.4).

Table 4.4 Comparing δ^2H values using t-tests

	n[1]	M[2]	SD[3]	Skew[4]	Kurtosis[5]	t-value[6]	p-value[7]
Campaign 1 (0-20 cm)	6	-103.77	1.37	0.27	-0.49		
Campaign 2 (0-20 cm)	6	-98.51	5.50	-0.54	-1.80	-2.27	0.046*
Campaign 3 (0-20 cm)	6	-56.88	46.42	0.59	-2.02	-2.47	0.033*
Campaign 5 (0-20 cm)	6	-46.58	35.59	-0.92	-1.88	-3.93	0.003*
Campaign 1 (20-40 cm)	6	-106.33	1.51	-0.42	1.66		
Campaign 2 (20-40 cm)	6	-105.71	3.99	-1.62	3.36	-0.36	0.729
Campaign 3 (20-40 cm)	6	-84.72	43.41	1.99	4.32	-1.22	0.251
Campaign 5 (20-40 cm)	6	-101.19	7.18	0.81	-1.88	-1.71	0.117
Campaign 1 (40-80 cm)	6	-108.92	2.04	0.91	1.47		
Campaign 2 (40-80 cm)	6	-109.24	1.69	-0.86	-1.49	0.29	0.774
Campaign 3 (40-80 cm)	6	-99.84	49.64	2.30	5.38	-0.45	0.664
Campaign 5 (40-80 cm)	6	-110.07	4.94	-0.41	-1.88	0.52	0.612
Campaign 1 (80-120 cm)	6	-113.47	1.11	-0.57	-0.24		
Campaign 2 (80-120 cm)	6	-0.45	0.38	0.22	-1.99	-235.22	0.000**
Campaign 3 (80-120 cm)	6	-18.84	45.25	-2.45	6.00	-5.12	0.000**
Campaign 5 (80-120 cm)	6	-26.64	41.26	-0.97	-1.88	-5.15	0.000**
Campaign 1 (tree tissue)[8]	6	-113.93	5.03	0.79	0.78		
Campaign 2 (tree tissue)	4	-111.40	6.03	-1.61	2.48	-0.70	0.489
Campaign 3 (tree tissue)	4	-42.26	67.14	1.10	0.03	-2.13	0.028*
Campaign 5 (tree tissue)	4	-94.22	33.17	1.94	3.79	-1.18	0.178

Footnote:

[1] Sample size of the campaign represented by n.

[2] Mean δ^2H of the samples collected during the campaign is represented by M.

[3] Standard deviation of the δ^2H of the samples collected during the campaign is represented by SD.

[4] Skew of the samples collected during the campaign is represented by Skew.

[5] Kurtosis of the samples collected during the campaign is represented by Kurtosis.

[6] t-value of the campaign compared to similar samples from Campaign 1.

[7] p-value of the campaign compared to similar samples from Campaign 1.

[8] Tree tissue includes branch xylem water, composite branch xylem water, and composite ABH xylem water.

* P-value less than 0.05.

** P-value less than 0.01.

4.5.5 Movement of deuterium at the study site

The average δ^2H value for each sampling depth are presented for each campaign (Table 4.3; Figure 4.3). In Figure 4.3, error bars represent the standard deviation of the dataset (separated by sampling depth and Campaign). Measured δ^2H values can be found in Appendix J. Samples collected during Campaign 1, prior to isotopic labelling (August 11, 2016) demonstrate that δ^2H values become increasingly lower with depth, decreasing from -103.77‰ in samples collected from 0 cm – 20 cm to -113.47‰ in samples collected from 80 cm – 120 cm (Figure 4.3; Table 4.3). Local water at the study site was depleted in ^2H and ^{18}O, which is expected given the high continentality, high latitude, and relatively high altitude of the site (Kendall et al., 1995). The isotopic signature of snowmelt is more depleted in ^2H and ^{18}O than the isotopic composition of summer precipitation due to processes that drive fractionation (Clark and Fritz, 1997; Gibson et al., 2011; Baer et al., 2016). In the spring, ^2H and ^{18}O depleted snowmelt water recharges deeper soil water (Gazisa and Feng, 2004). The isotopically enriched summer rains recharge the surface soil water throughout the growing season, and the soil surface water becomes further enriched due to evaporative processes driving fractionation (Clark and Fritz, 1997; Gazisa and Feng, 2004). Therefore, δ^2H values become increasing lower moving down the soil profile due to the infiltration of ^2H depleted snowmelt, while δ^2H values at the soil surface are higher due to ^2H enriched summer precipitation and preferential evaporation of the lighter ^1H water molecules at the soil surface. During Campaign 1, the δ^2H value of the ABH xylem water and branch xylem water were -120.01‰ and -112.72‰, respectively. The δ^2H value of the branch xylem water reflects the δ^2H value of the soil water from 80 cm – 120 cm (e.g., δ^2H = -113.47‰), while the δ^2H value of the ABH xylem water suggests a more ^2H depleted (potentially deeper) source of water. The rain exclusion cover was installed 11 days prior to Campaign 1, creating drought conditions at the study site during Campaign 1. Changing δ^2H values at the soil surface due to HR, was not apparent during Campaign 1 because the isotopic signature of the site prior to inducing drought conditions was not known.

Samples collected during Campaigns 2 (August 12, 2016; 1 day after isotopic labelling), demonstrate that the isotopically labelled solution statistically significantly increased the δ^2H values of the soil water collected from 80 cm – 120 cm and 0 cm – 20 cm, compared to Campaign

1 (Section 4.5.4; Table 4.4; Figure 4.3). However, the δ^2H values of soil samples collected from 20 cm – 80 cm and tree tissue samples were not significantly different from Campaign 1 (Section 4.5.4; Table 4.4; Figure 4.3). This enrichment of ^2H at the soil surface and not between 20 cm – 80 cm suggests soil water transport occurred from 80 cm - 120 cm to the surface 0 cm - 20 cm, but it occurred without having to move through the soil from 20 cm - 80 cm. The lack of enrichment of ^2H within 20 cm – 80 cm, indicates water was not moved from 80 cm – 120 cm to the surface soil through evaporation or diffusion over the timeframe of this study. Therefore, the ^2H at the soil surface provides evidence that jack pine trees may have performed HR of soil water from below 80 cm to the soil surface via their taproot and lateral roots.

Samples collected during Campaign 3 (August 22, 2016; 11 days after isotopic labelling), demonstrate that the isotopically labelled solution statistically significantly increased the δ^2H value of the water in samples collected from 0 cm – 20 cm, 80 cm – 120 cm, and the tree tissue, compared to Campaign 1 (Section 4.5.4; Table 4.4; Figure 4.3). The average δ^2H value of the tree tissue samples was -42.26‰, which suggests the trees were acquiring water that was originally sourced from 100 cm below the soil surface. The presence of the isotopically labelled solution in the tree tissue and at 0 cm – 20 cm indicates that the tree is utilizing water from 80 cm – 120 cm and that HR is providing labelled water to the surface soil. Despite only the 0 cm – 20 cm and 80 cm – 120 cm soil water being statistically significantly different to Campaign 1, it is apparent that the isotopically labelled solution increased the δ^2H value of some of the soil water collected from 20 cm – 80 cm. For instance, during Campaign 3 the average δ^2H value of samples collected between 40 cm – 80 was -84.72‰, which indicates some of the samples collected from this depth had been exposed to the isotopically labelled solution. This increased δ^2H value could be due to fine roots from the lateral roots or the taproot spreading into these depths in the pursuit of soil water.

Samples collected during Campaign 5 (September 15, 2016; 35 days after isotopic labelling), were consistent with Campaign 3, with the exception of the ABH xylem water which had a δ^2H value of -106.12‰ (Section 4.5.4; Table 4.4; Figure 4.3). The δ^2H value of ABH xylem water during Campaign 5 is surprizing as soil water at the lateral roots and taproot has a much higher δ^2H value. Campaign 5 was 46 days after the rain exclusion cover was installed and 35 days

after the isotopically labelled solution had been introduced. Therefore, PAW around the taproots may have been depleted and the taproots may be relying on accessing water from below 120 cm, as was likely evident in Campaign 1 when the ABH xylem water sample had an isotopic signature of -120.01‰.

The enrichment of ^{2}H at 0 cm – 20 cm and within the tree tissue indicates that the jack pine trees are likely responsible for HR of soil water from 100 cm, which is consistent with Bleby et al.'s (2010) study, where HR was observed in all species and types of woody roots. This is the first study to document the HR of soil water at a jack pine stand in the boreal forest. This study does not quantify the volume of soil water HR within the soil profile but demonstrates the existence of the HR water at a jack pine stand in the boreal forest.

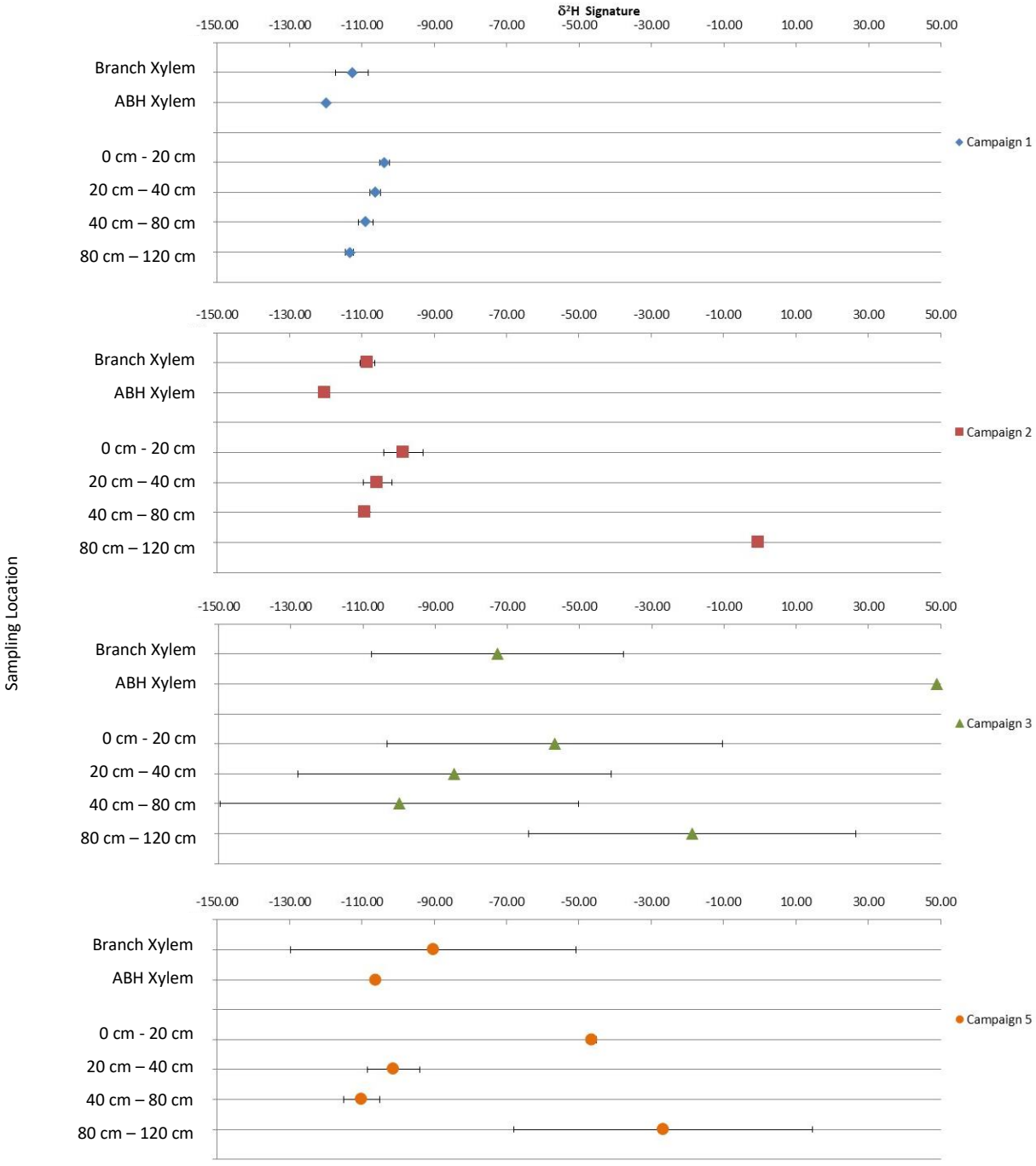

Figure 4.3 Jack pine xylem water and soil water δ^2H value at the sampling locations for each campaign.

4.6 Conclusions

In this study, the use of ^{2}H enriched water as an isotopically labelled solution was informative about the movement of soil water throughout the soil profile and the uptake of soil water in jack pine trees. The ^{2}H enriched isotopically labelled solution was injected to a soil depth of 100 cm and the morning after injecting the isotopic tracer, ^{2}H enriched water was present in the top 0 cm – 20 cm of the soil profile and at the injection location between 80 cm – 120 cm. Furthermore, there was no ^{2}H enriched water in the soil between 20 cm – 80 cm at this time, which indicated the ^{2}H at the soil surface was not from diffusion or evaporation. ^{2}H enriched water was found throughout the soil profile 11 days after injecting the tracer. However, this change in $\delta^{2}H$ signature between 20 cm – 80 cm was not statistically significant at any point during this study. ^{2}H enrichment of the tree xylem water was not detected until 11 days after the introduction of the isotopic tracer. Xylem water was first enriched ABH and then in the branches, as water moved up the tree. The jack pine trees ability to move soil water to the soil surface via the taproot through periods of drought may be beneficial to the lateral roots and understory. Furthermore, this stand of jack pine trees utilized soil water from at least a depth of 100 cm, which suggests if a reclamation prescription limits the soil depth to 100 cm the PAW jack pine trees can provide to the soil surface through HR will also be limited.

5. SUMMARY AND CONCLUSIONS

Climate change is resulting in shifting precipitation patterns and increased average temperature, which is resulting in consequences for the boreal forest. Furthermore, these changes may result in change to other environmental cycles, such as the carbon sequestration cycle or the hydrological cycle. The AOSR of northern Alberta, Canada, is located entirely within the boreal forest. Mining in the AOSR requires the dismantling of ecosites and ecosystems. Therefore, reclamation of these sites means rebuilding fully functional ecosystems that have the biodiversity and land use of the site prior to mining. To build fully functional ecosystems at these sites, we need to understand how these sites respond to drought stress.

In Chapter 3, I evaluated how jack pine trees will respond to volumetric water content of the soil (VWC), air temperature, air humidity, net radiation, and wind speed (environmental parameters). This empirical study measured how jack pine trees utilized internal water storage on a diurnal scale under both normal conditions and drought conditions, to better understand how jack pine trees respond to drought conditions. Heat pulse probes and circumference dendrometers were used to measure water movement within jack pine trees. To interpret the internal movement of tree water within jack pine trees, sap flow was compared with environmental parameters and water storage within the tree trunk, under both normal conditions and drought conditions. On a diurnal scale, sap flow of jack pine trees was found to be primarily driven by net radiation, air humidity, and VWC. In the morning, air humidity was found to be important in inducing sap flow. Sap flow did not initiate when the air humidity was too high, likely because air humidity causes the evaporative potential difference that initiates transpiration. Net radiation was the primary driver of sap flow throughout the day under normal and drought conditions. VWC regulated the volume of water moving up the tree, not the timing of the sap flow. Under drought conditions the volume of water moving up the tree (sap flow) decreased. Sap flow was found to have hysteretic relationships with all measured environmental parameters except for VWC. Therefore, changes in environmental parameters did not result in consistent changes in sap flow throughout the day. Jack pine trees might mediate high transpiration rates in stressful environments by slowing sap flow rates by changing physiological

variables within the tree, which would explain the hysteretic relationships. Sap flow was found to have a hysteretic and divergent relationship with tree trunk circumference. Therefore, changes in sap flow rates did not result in consistent changes in tree trunk circumference throughout the day. For the duration of this study, tree growth only occurred under normal conditions, on days where sap did not flow. While, the tree trunk circumference shrunk under drought conditions due to internal water storage being utilized to support transpiration. The daily amplitude of the tree trunk circumference was primarily driven by sap flow but the overall circumference of the tree trunk circumference was primarily driven by VWC.

In Chapter 4, we confirmed that jack pine trees hydraulically redistribute soil water. This empirical study used ^{2}H isotopes to track the movement of soil water in coarse sandy soil at a stand of established jack pine trees. ^{2}H was injected 100 cm below the soil surface and the movement of ^{2}H was monitored via soil and tree sampling over the course of the study. To determine if jack pine trees perform HR, an isotopically labelled solution was used to monitor the movement of labelled soil water within the soil profile and xylem. After injecting the isotopically labelled solution to a depth of 100 cm, $\delta^{2}H$ values were statistically significantly higher for soil water collected from 0 cm – 20 cm ($\alpha = 0.05$) and 80 cm – 120 cm ($\alpha = 0.001$), however $\delta^{2}H$ values were statistically similar for the soil water collected from 0 cm – 40 cm ($\alpha = 0.05$) and 40 cm – 80 cm ($\alpha = 0.05$). The dispersal of the isotopically labelled solution at 0 cm – 20 cm and 80 cm – 120 cm indicates that jack pine trees facilitate HR.

Jack pine trees under drought stress sequester less carbon from the atmosphere than trees under normal conditions, because trees under drought stress are not as productive at generating growth. Additionally, jack pine trees under drought stress contribute less water to the hydrological cycle compared to trees under normal conditions, as trees under drought stress have lower volumes of sap flowing up the tree to support transpiration. Furthermore, trees under drought conditions have less internal water storage making them more prone to the risks of forest fires. Induced drought from climate change will result in changes to the carbon sequestration cycle and hydrological cycle in the boreal forest. To account for drought conditions, we should consider soil water storage and associated PAW of deep soil water (i.e., depth > 100 cm) when designing soil prescriptions for reclamation of *c: bearberry/lichen (subxeric/poor)*

ecosites in the AOSR. This study suggests that deep soil water may play an important role during drought conditions, as the taproot of the jack pine tree allows the tree to access deep soil water through uptake and hydraulic redistribution. The jack pine trees ability to supply water to lateral roots and the soil surface via HR from depths below 100 cm may be crucial in hydrating young lateral fine roots, maintaining hydraulic conductance between roots and soil, and providing water to the understory during periods of drought. Therefore, in reclaiming coarse textured soil in the boreal forest, the soil profile should be thick enough to provide trees with ample depth for soil water storage, so that trees can take advantage of shallow soil water reserve recharged from frequent small rainfall events, and also deep soil water reserve recharged from snowmelt and infrequent but large rainfall events.

When designing soil prescriptions for reclamation in the AOSR, typically only soil water in the placed soil cover is considered available and soil water storage in the overburden is neglected. If roots can penetrate the overburden, water from the overburden may help plants combat drought stress through direct water uptake and/or indirectly through hydraulic redistribution. Therefore, the role of soil water storage within overburden in contributing to transpiration should be reexamined.

5.1.1 Future work

This research was the first of its kind for our laboratory group. There were many lessons learned from this research but also a lot of questions generated for future work. The following is a list of considerations future work may way to consider:

(1) Jack pine trees: diurnal fluctuations of sap flow and tree trunk circumference

- Compare sap flow and tree trunk circumference with evapotranspiration.
- Compare non-augmented and induced drought conditions concurrently.
- Longer term, seasonal, or multi-year comparisons of tree growth and water storage.
- Measure leaf water potential.

(2) Jack pine trees: hydraulic redistribution of soil water

- Study sites with multiple tree species that have different rooting morphologies.

- Trench around the study site to confirm no lateral HR of soil water from outside of the study site.
- Use *in situ* methods to measures the isotopic signature of soil water, as soil sampling may sever fine roots resulting in the release of xylem water.
- Using the natural isotopic composition of the study site to track the movement of soil water.
- Planted jack pine trees often have spiraling roots and no taproot (Plourde et al., 2009). Consider the effects of planted jack pine trees root morphology on HR, in the context of reclamation.
- Use targeted soil sampling depths based on VWC. For instance, using sampling depths of 0 cm – 30 cm, 30 cm – 50 cm, 50 cm – 70 cm, 70 cm – 90 cm, and 90 cm – 120 cm for this research may have resulted in a higher resolution of the distribution of ^{2}H labelled water throughout the soil profile.
- Sample the understory to determine if these species are benefiting from hydraulically redistributed soil water.
- Measure the root distribution at the study site.

REFERENCES

AAFC (Agriculture and Agri-food Canada). 2009. Saskatchewan Land Resource Unit. Saskatchewan Soil Resource spatial database. https://open.canada.ca/data/en/dataset/3734623c-25c5-4e69-936d-26f764a2807f (Accessed March 3, 2019)

Acton, D.F., G.A. Padbury, and C.T Stushnof. 1998. The ecoregions of Saskatchewan. Canadian Plains Research Center, University of Regina, Regina, Canada.

Alberta Energy Regulator. 2015. Alberta Energy Regulator annual report. Alberta, Canada.

Alberta Environmental Protection. 1998. Guidelines for reclamation to forest vegetation in the Athabasca oil sands region. Prepared by the Alberta Environmental Protection, Edmonton, AB.

Alberta Queen's Printer. 2000. Environmental Protection and Enhancement Act. Statues of Alberta, Chapter E-12.

Alexander, M., and M. Cruz. 2012. Modelling the effects of surface and crown fire behaviour on serotinous cone opening in jack pine and lodgepole pine forests. International Journal of Wildland Fire. 21(6): 709-721.

Allen, C. D., A. K. Macalady, H. Chenchouni, D. Bachelet, N. Mcdowell, M. Vennetier, T. Kitzberger, A. Rigling, D.D. Breshears, E.H. Hogg, P. Gonzalez, R. Fensham, Z. Zhang, J. Castro, N. Demidova, J. Lim, G. Allard, S.W. Running, A. Semerci, and N. Cobb. 2010. A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests. Forest Ecology and Management. 259(4): 660-684.

Amiro, B., B. Stocks, M.E. Alexander, M.D. Flannigan, and B. Wotton. 2001. Fire, climate change, carbon and fuel management in the Canadian boreal forest. International Journal of Wildland Fire. 10(3): 405-413.

Angeles, G., B. Bond, J.S. Boyer, T. Brodribb, J.R. Brooks, M.J. Burns, J. Cavender-Bares, M. Clearwater, H. Cochard, J. Comstock, S.D. Davis, J.C. Domec, L. Donovan, F. Ewers, B. Gartner, U. Hacke, T. Hinckley, N.M. Holbrook, H.G. Jones, K. Kavanagh, B. Law, J. López-Portillo, C. Lovisolo, T. Martin, J. Martínez-Vilalta, S. Mayr, F.C. Meinzer, P. Melcher, M. Mencuccini, S. Mulkey, A. Nardini, H.S. Neufeld, J. Passioura, W.T. Pockman, R.B. Pratt, S. Rambal, H. Richter, L. Sack, S. Salleo, A. Schubert, P. Schulte, J.P. Sparks, J. Sperry, R. Teskey, and M. Tyree. 2004. The Cohesion-Tension Theory. New Phytologist. 163(3): 451-452.

Baer, T., S. L. Barbour, and J. J. Gibson. 2016. The stable isotopes of site wide waters at an oil sands mine in northern Alberta, Canada. Journal of Hydrology. 541(PB): 1155-1164.

Baertschi, P. 1976. Absolute 18O content of standard mean ocean water. Earth and Planetary Science Letters. 31(3): 341-344.

Bai, Y., X. Li, S. Liu., and P. Wang. 2017. Modelling diurnal and seasonal hysteresis phenomena of canopy conductance in an oasis forest ecosystem. Agricultural and Forest Meteorology. 246: 98-110.

Balshi, M., A. McGuire, P. Duffy, M. Flannigan, J. Walsh, and J. Melillo. 2009. Assessing the response of area burned to changing climate in western boreal North America using a Multivariate Adaptive Regression Splines (MARS) approach. Global Change Biology. 15(3): 578-600.

Barber, V.A., G.P. Juday, and B.P. Finney. 2000. Reduced growth of Alaskan white spruce in the twentieth century from temperature-induced drought stress. Nature. 405(6787): 668-673.

Barrett, D.J., T.J. Hatton, J.E. Ash, and M.C. Ball. 1995. Evaluation of the heat pulse velocity technique for measurement of sap flow in rainforest and eucalypt forest species of south-eastern Australia. Plant, Cell and Environment. (4): 463-469.

Bauerle, T., J. Richards, D. Smart, and D. Eissenstat. 2008. Importance of internal hydraulic redistribution for prolonging the lifespan of roots in dry soil. Plant, Cell and Environment. 31(2): 177-186.

Beaumont, L. J., A. Pitman, S. Perkins, N.E. Zimmermann, N.G. Yoccoz, and W. Thuiller. 2011. Impacts of climate change on the world's most exceptional ecoregions. Proceedings of the National Academy of Sciences of the United States of America. 108(6): 2306-11.

Becker, P., and W. Edwards. 1999. Corrected heat capacity of wood for sap flow calculations. Tree Physiology. 19(11): 767-768.

Beckingham, J., and J. H. Archibald. 1996. Natural Resources Canada. 1996. *Field Guide to Ecosites of Northern Alberta.*

Bernier, P.Y., N. Bréda, A. Granier, F. Raulier, and F. Mathieu. 2002. Validation of a canopy gas exchange model and derivation of a soil water modifier for transpiration for sugar maple (Acer saccharum Marsh.) using sap flow density measurements. Forest Ecology and Management. 163(1-3): 185-196.

Bleby, T., A. Mcelrone, and R. Jackson. 2010. Water uptake and hydraulic redistribution across large woody root systems to 20 m depth. Plant, Cell and Environment. 33(12): 2132-2148.

Boehm, J. 1893. Capillarität und Saftsteigen. Berichte Der Deutschen Botanischen Gesellschaft. 11(3): 203-212.

Bouriaud, O., J. Leban, D. Bert, and C. Deleuze. 2005. Intra-annual variations in climate influence growth and wood density of Norway spruce. Tree Physiology. 25(6): 651-660.

Brandt, J., M. Flannigan, D. Maynard, I. Thompson, and W. Volney. 2013. An introduction to Canada's boreal zone: Ecosystem processes, health, sustainability, and environmental issues. Environmental Reviews. 21(4): 207-226.

Brooks, J., F. Meinzer, R. Coulombe, and J. Gregg. 2002. Hydraulic redistribution of soil water during summer drought in two contrasting Pacific Northwest coniferous forests. Tree Physiology. 22(15-16): 1107-1117.

Burgess, S., and T. Bleby. 2006. Redistribution of soil water by lateral roots mediated by stem tissues. Journal of Experimental Botany. 57(12): 3283-3291.

Burgess, S., M. Adams, N. Turner, and C. Ong. 1998. The redistribution of soil water by tree root systems. Oecologia. 115(3): 306-311.

Burgess, S., M. Adams, N. Turner, C. Beverly, C. Ong, A. Khan, and T. Bleby. 2001. An improved heat pulse method to measure low and reverse rates of sap flow in woody plants. Tree Physiology. 21(9): 589-598.

Burns, R.M., and B.H. Honkala. 199*0. Silvics of North America. Agriculture Handbook / United States, Dept. of Agriculture.* 654.

Burton, P.J., Y. Bergeron, B.E.C. Bogdanski, G.P. Juday, T. Kuuluvainen, B.J. McAfee, A.E. Ogden, V.K. Teplyakov, R.I. Alfaro, D.A. Francis, S. Gauthier, and, J. Hantula. 2010. Sustainability of boreal forests and forestry in a changing environment. Forests and Society - Responding to Global Drivers of Change. International Union of Forest Research Organizations, Vienna, Austria, IUFRO World Series. (14): 249-282.

Butt, N., D.P. Bebber, T. Riutta, M. Crockatt, M.D. Morecroft, and Y. Malhi. 2014. Relationships between tree growth and weather extremes: Spatial and interspecific comparisons in a temperate broadleaf forest. Forest Ecology and Management. 334: 209-216.

Caldwell, M., and J. Richards. 1989. Hydraulic lift: Water efflux from upper roots improves effectiveness of water uptake by deep roots. Oecologia. 79(1): 1-5.

Caldwell, M., T. Dawson, and J. Richards. 1998. Hydraulic lift: Consequences of water efflux from the roots of plants. Oecologia. 113(2): 151-161.

Carnicer, J., M. Coll, M. Ninyerola, X. Pons, G. Sánchez, and J. Peñuelas. 2011. Widespread crown condition decline, food web disruption, and amplified tree mortality with increased climate change-type drought. Proceedings of the National Academy of Sciences of the United States of America. 108(4): 1474-1478.

Clark, I.D., and P. Fritz. 1997. Environmental isotopes in hydrogeology. CRC Press/Lewis Publishers. FL, US.

CS616 and CS625 Water Content Reflectometers. 2016. *CS616 and CS625 Water Content Reflectometers User Manual*. Campbell Scientific, USA.

Danielson, R.M., and S. Visser. 1989. Host response to inoculation and behaviour of introduced and indigenous ectomycorrhizal fungi of jack pine grown on oil-sands tailings. Canadian Journal of Forest Research. 19(11): 1412-1421.

Danielson, R.M. 1991. Temporal changes and effects of amendments on the occurrence of sheathing (ecto) mycorrhizas of conifers growing in oil sands tailings and coal spoil. Agriculture, Ecosystems and Environment. 35:261–281.

Daudet, F., T. Améglio, H. Cochard, O. Archilla, and A. Lacointe. 2005. Experimental analysis of the role of water and carbon in tree stem diameter variations. Journal of Experimental Botany. 56(409): 135-144.

David, T.S., M.I. Ferreira, S. Cohen, J.S. Pereira, and J.S. David. 2004. Constraints on transpiration from an evergreen oak tree in southern Portugal. Agricultural and Forest Meteorology. 122(3): 193-205.

David, T.S., C.A. Pinto, N. Nadezhdina, C. Kurz-Besson, M.O. Henriques, T. Quilhó, J. Cermak, M.M. Chaves, J.S. Pereira, and J.S. David. 2013. Root functioning, tree water use and hydraulic redistribution in Quercus suber trees: A modeling approach based on root sap flow. Forest Ecology and Management. 307(C): 136-146.

Dawson, T.E. 1993. Hydraulic lift and water-use by plants—implications for water-balance, performance and plant-plant interactions. Oecologia. (95): 565–574.

de Wit, J., C. Straaten, and W. Mook. 1980. Determination of the Absolute Hydrogen Isotopic Ratio of V-SMOW and SLAP. Geostandards Newsletter. 4(1): 33-36.

Denneler B., Y. Bergeron, and Y. Begin. 2010. Flooding Effects on Tree-Ring Formation of Riparian Eastern White-Cedar (Thuja occidentalis L.) Northwestern Quebec, Canada. Tree-Ring Research. *66*(1): 3-17.

Deslauriers, A., H. Morin, C. Urbinati, and M. Carrer. 2003. Daily weather response of balsam fir (Abies balsamea (L.) Mill.) stem radius increment from dendrometer analysis in the boreal forests of Québec, Canada. Trees. *17*(6): 477-484.

Deslauriers, A., S. Rossi, T. Anfodillo, and A. Saracino. 2008. Cambial phenology, wood formation and temperature thresholds in two contrasting years at high altitude in southern Italy. Tree Physiology. *28*(6): 863-871.

Domec, J., J. Warren, M. Meinzer, F. Brooks, and C. Coulombe. 2004. Native root xylem embolism and stomatal closure in stands of Douglas-fir and ponderosa pine: Mitigation by hydraulic redistribution. Oecologia. *141*(1): 7-16.

Drew, D.M., and G.M. Downes. 2009. The use of precision dendrometers in research on daily stem size and wood property variation: A review. Dendrochronologia. *27*(2): 159-172.

Ecomatik User Manual. 2014. *Circumference Dendrometer 2 (DC2) User Manual*, Ecomatik, Germany.

Edwards, W.R.N., and N.W.M. Warwick. 1984. Transpiration from a kiwifruit vine as estimated by the heat pulse technique and the Penman-Monteith equation. New Zealand Journal of Agricultural Research. 27:537–543.

Elliott, J. A., B.M. Toth, R.J. Granger, J.W. Pomeroy, G.K.M. Smith, N.W. Foster, M.K. Mahendrappa, and B.D. Titus. 1998. Soil moisture storage in mature and replanted sub-humid boreal forest stands. Canadian Journal of Soil Science. *78*(1): 17-27.

Ewers, B.E., D.S. Mackay, J. Tang, P.V. Bolstad, and S. Samanta. 2008. Intercomparison of sugar maple (Acer saccharum Marsh.) stand transpiration responses to environmental conditions from the Western Great Lakes Region of the United States. Agricultural and Forest Meteorology. *148*(2): 231-246.

Ewers, B., B. Bond-Lamberty, and D. Mackay. 2011. *Consequences of stand age and species' functional trait changes on ecosystem water use of forests*. Springer, New York, United States.

Farnden, C., R. Vassov, M. Yarmuch, and B. Larson. 2013. Soil reclamation amendments affect long term growth of jack pine following oil sands mining. New Forests. 44(5): 799-810.

Gartner, B. L., and F.C. Meinzer. 2005. Structure-Function Relationships In Sapwood Water Transport And Storage. Vascular Transport in Plants. Elsevier/Academic Press, Oxford. 307-331.

Gauthier, S., P. Bernier, T. Kuuluvainen, A. Shvidenko, and D. Schepaschenko. 2015. Boreal forest health and global change. Science. *349*(6250): 819-822.

Gazis, C., and X. Feng. 2004. A stable isotope study of soil water: Evidence for mixing and preferential flow paths. Geoderma. *119*(1-2): 97-111.

Gibson, J.J., S.J. Birks, M. Moncur, Y. Yi, K. Tattrie, S. Jasechko, K. Richardson, and P. Eby. 2011. Isotopic and Geochemical Tracers for Fingerprinting Process-Affected Waters in the Oil Sands Industry: A Pilot Study. Oil Sands Research and Information Network, University of Alberta, School of Energy and the Environment, Edmonton, Alberta. OSRIN Report No. TR-12.

Gillett, N., A. Weaver, F. Zwiers, and M. Flannigan. 2004. Detecting the effect of climate change on Canadian forest fires. Geophysical Research Letters. 31(18).

Goldstein, G., J. Andrade, F. Meinzer, N. Holbrook, J. Cavelier, P. Jackson, and A. Celis. 1998. Stem water storage and diurnal patterns of water use in tropical forest canopy trees. Plant, Cell and Environment. 21(4): 397-406.

Granier, A., P. Biron, and D. Lemoine. 2000. Water balance, transpiration and canopy conductance in two beech stands. Agricultural and Forest Meteorology. 100(4): 291-308.

Grimm W.C. 1983. *The illustrated book of trees: With keys for summer and winter identification.* AGRIS, Canada.

Hahn, A., and S. Quideau. 2013. Long-term effects of organic amendments on the recovery of plant and soil microbial communities following disturbance in the Canadian boreal forest. Plant and Soil. 363(1-2): 331-344.

Hao, X., Y. Li, and H. Deng. 2013. Assessment of hydraulic redistribution on desert riparian forests in an extremely arid area. Environmental Monitoring and Assessment. 185(12): 10027-10038.

Hemstock, S.S., S.A. Quideau, and D.S. Chanasyk. 2010. Nitrogen availability from peat amendments used in boreal oil sands reclamation. Canadian Journal of Soil Science. 90(1): 165-175.

Hendry, M., E. Schmeling, L. Wassenaar, S. Barbour, and D. Pratt. 2015. Determining the stable isotope composition of pore water from saturated and unsaturated zone core: Improvements to the direct vapor equilibration laser spectroscopy method. Hydrology and Earth System Sciences Discussions. 12(6): 6241-6274.

Huang, M., S.L. Barbour, A. Elshorbagy, J. Zettl, and B.C. Si. 2013. Effects of Variably Layered Coarse Textured Soils on Plant Available Water and Forest Productivity. Procedia Enviro. Sciences. 19: 148-157.

Hultine, K., W. Cable, S. Burgess, and D. Williams. 2003. Hydraulic redistribution by deep roots of a Chihuahuan Desert phreatophyte. Tree Physiology. 23(5): 353-360.

IPCC. 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK and New York, USA.

IPCC. 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge, United Kingdom and New York, USA.

IPCC. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Geneva, Switzerland.

Ireson, A.M., A.G. Barr, J.F. Johnstone, S.D. Mamet, G. Van Der Kamp, C.J. Whitfield, N.L. Michel, R.L. North, C.J. Westbrook, C. Debeer, K.P. Chun, A. Nazemi, and J. Sagin. 2015. The changing water cycle: The Boreal Plains ecozone of Western Canada. Wiley Interdisciplinary Reviews. Water. *2*(5): 505-521.

Irvine J., and J. Grace. 1997. Continuous measurement of water tensions in the xylem of trees based on the elastic properties of wood. Planta. 202: 455–461.

Irvine, J., M.P. Perks, F. Magnani, and J. Grace. 1998. Response of Pinus sylvestris to drought: Stomatal control of transpiration and hydraulic conductance. Tree Physiology. 18(6): 393-402.

Iwashita, H., N. Saigusa, S. Murayama, H. Mccaughey, A. Black, A. Barr, K. Higuchi, S. Yamamoto. 2005. Effect of Soil Water Content on Carbon Dioxide Flux at a Sparse-Canopy Forest in the Canadian Boreal Ecosystem. Nogyo Kisho*.* 61(3): 131-141.

Jackson, R.B., J.S. Sperry, and T.E. Dawson. 2000. Root water uptake and transport: using physiological processes in global predictions. Trends in Plant Science*.* 5: 482– 488.

James, S., F. Meinzer, G. Goldstein, D. Woodruff, T. Jones, T. Restom, M. Mejia, M. Clearwater, and P. Campanello. 2003. Axial and radial water transport and internal water storage in tropical forest canopy trees. Oecologia. 134(1): 37-45.

Ježík, M., M. Blaženec, K. Střelcová, and Ľ. Ditmarová. 2011. The impact of the 2003–2008 weather variability on intra-annual stem diameter changes of beech trees at a submontane site in central Slovakia. Dendrochronologia. 29(4): 227-235.

Jupa, R., L. Plavcová, V. Gloser, S. Jansen, and F. Meinzer. 2016. Linking xylem water storage with anatomical parameters in five temperate tree species. Tree Physiology. 36(6): 756-769.

Kendall, C., M. Sklash, and T. Bullen. 1995. Isotope tracers of water and solute sources in catchments. *Trudgill, Stephen T. (ed.): Solute Modelling in Catchment Systems.* John Wiley and Sons, Inc., Chichester, England. 261-303.

Köcher, P., V. Horna, C. Leuschner, and F. Meinzer. 2013. Stem water storage in five coexisting temperate broad-leaved tree species: Significance, temporal dynamics and dependence on tree functional traits. Tree Physiology. 33(8): 817-832.

Koeniger, P., J. Marshall, T. Link, and A. Mulch. 2011. An inexpensive, fast, and reliable method for vacuum extraction of soil and plant water for stable isotope analyses by mass spectrometry. Rapid Communications in Mass Spectrometry*. 25*20: 3041-3048.

Kozlowski, T. 1962. Tree Growth. Soil Science. 93(6): 440.

Koeniger, P., J. Marshall, T. Link, and A. Mulch. 2011. An inexpensive, fast, and reliable method for vacuum extraction of soil and plant water for stable isotope analyses by mass spectrometry. Rapid Communications in Mass Spectrometry. 2520: 3041-3048.

Lambers, H., and F.S. Chapin. 1998. Plant physiological ecology. Springer, New York, USA.

Larney, F.J., and D.A. Angers. 2012. The role of organic amendments in soil reclamation: A review. Canadian Journal of Soil Science. 92(1): 19-38.

Leatherdale, J., D.S. Chanasyk, and S. Quideau. 2012. Soil water regimes of reclaimed upland slopes in the oil sands region of Alberta. Canadian Journal of Plant Science, 92(1): 117-129.

Li, W., J. Si, T. Yu, and X. Li. 2016a. Response of Populus euphratica Oliv. sap flow to environmental variables for a desert riparian forest in the Heihe River Basin, Northwest China. Journal of Arid Land. 8(4): 591-603.

Li, W., T. Yu, X. Li, and C. Zhao. 2016b. Sap flow characteristics and their response to environmental variables in a desert riparian forest along lower Heihe River Basin, Northwest China. Environmental Monitoring and Assessment. 188(10): 1-14.

Lide, D.R. 1996. *CRC handbook of chemistry and physics, 77th Edn*. CRC Press, Boca Raton, LA.

Lindner, M., J. Garcia-Gonzalo, M. Kolström, T. Green, R. Reguera, M. Maroschek, R. Seidl, M.J. Lexer, S. Netherer, A. Schopf, A. Kremer, S. Delzon, A. Barbati, M. Marchetti, and P. Corona. 2008. Impacts of climate change on european forests and options for adaptation. Impacts of Climate Change on European Forests and Options for Adaptation. AGRI-2007-G4-06.

Loustau D., P. Berbigier, P. Roumagnac, C. Arruda-Pacheco, J.S. David, M.I. Ferreira, J.S. Pereira, and R. Tavares. 1996. Transpiration of a 64-year-old maritime pine stand in Portugal. 1. Seasonal course of water flux through maritime pine. Oecologia. (107): 33–42.

Lu, P., I. Yunusa, R. Walker, and W. Müller. 2003. Regulation of canopy conductance and transpiration and their modelling in irrigated grapevines. Functional Plant Biology. 30(6): 689-698.

Ma, Z., C. Peng, Q. Zhu, H. Chen, G. Yu, W. Li, X. Zhou, W. Wang, and W. Zhang. 2012. Regional drought-induced reduction in the biomass carbon sink of Canada's boreal forests. Proceedings of the National Academy of Sciences of the United States of America. 109(7): 2423-2427.

Ma, C., Y. Luo, M. Shao, X. Li, L. Sun, and X. Jia. 2017. Environmental controls on sap flow in black locust forest in Loess Plateau, China. Scientific Reports. 7(1): 13160.

MacKay, S., M. Arain, M. Khomik, J. Brodeur, J. Schumacher, H. Hartmann, and M. Peichl. 2012. The impact of induced drought on transpiration and growth in a temperate pine plantation forest. Hydrological Processes. 18(1): 1779-1791.

Mackenzie, D., and M. Naeth. 2010. The Role of the Forest Soil Propagule Bank in Assisted Natural Recovery after Oil Sands Mining. Restoration Ecology. 18(4): 418-427.

Makarieva, A., V. Gorshkov, D. Sheil, A. Nobre, and B.L. Li. 2013. Where do winds come from? A new theory on how water vapor condensation influences atmospheric pressure and dynamics. Atmospheric Chemistry and Physics. 13(2): 1039-1056.

Marshall, D. 1958. Measurement of Sap Flow in Conifers by Heat Transport. Plant Physiology. 33(6): 385-396.

McDowell, N., S. White, and W. Pockman. 2008. Transpiration and stomatal conductance across a steep climate gradient in the southern Rocky Mountains. Ecohydrology. 1(3): 193-204.

McLaughlan, M., R.A. Wright, and R.D. Jiricka. 2010. Saskatchewan Forest Service, and Saskatchewan. Ministry of Environment. *Field guide to the ecosites of Saskatchewan's provincial forests* (Saskatchewan Government Digital Collection. Ministry of Environment, Regina, Canada.

Mclaughlin, S., S. Wullschleger, and M. Nosal. 2003. Diurnal and seasonal changes in stem increment and water use by yellow poplar trees in response to environmental stress. Tree Physiology. 23(16): 1125-1136.

Meinzer, F., J. Warren, and J. Brooks. 2007. Species-specific partitioning of soil water resources in an old-growth Douglas-fir-western hemlock forest. Tree Physiology. 27(6): 871-880.

Meinzer, F., D. Johnson, B. Lachenbruch, K. McCulloh, and D. Woodruff. 2009. Xylem hydraulic safety margins in woody plants: Coordination of stomatal control of xylem tension with hydraulic capacitance. Functional Ecology. 23(5): 922-930.

Milikin-Ishikawa, C., and C. Bledsoe. 2000. Seasonal and diurnal patterns of soil water potential in the rhizosphere of blue oaks: Evidence for hydraulic lift. Oecologia. 125(4): 459-465.

Miralles-Crespo, J., M.J. Sanchez-Blanco, G.A. Navarro, J.J. Martinez-Sanchez, L.J. Franco, and A.S. Banon. 2010. Comparison of Stem Diameter Variations in Three Small Ornamental Shrubs under Water Stress. HortScience: A Publication of the American Society for Horticultural Science. 45(11): 1681-1689.

Moreira, M., F. Scholz, S. Bucci, L. Sternberg, G. Goldstein, F. Meinzer, and A. Franco. 2003. Hydraulic lift in a neotropical savanna. Functional Ecology. 17(5): 573-581.

Nelson, S. 2000. A simple, practical methodology for routine VSMOW/SLAP normalization of water samples analyzed by continuous flow methods. Rapid Communications in Mass Spectrometry. 14(12): 1044-1046.

Oberhuber, W., and A. Gruber. 2010. Climatic influences on intra-annual stem radial increment of Pinus sylvestris (L.) exposed to drought. Trees. *24*(5): 887-898.

Oliveira, R., S. Dawson, T. Burgess, and E. Nepstad. 2005. Hydraulic redistribution in three Amazonian trees. Oecologia. 145(3): 354-363.

Plourde, A., C. Krause, and D. Lord. 2009. Spatial distribution, architecture, and development of the root system of Pinus banksiana Lamb. in natural and planted stands. Forest Ecology and Management. 258(9): 2143-2152.

Preston, R.J, and R.R. Braham. 2002. *North American Trees*. Wiley-Blackwell*,* Canada.

Priyadarshini, K.V.R., H.H.T. Prins, S. Bie, I.M.A. Heitkönig, S. Woodborne, G. Gort, K. Kirkman, F. Ludwig, T.E. Dawson, and H. Kroon. 2016. Seasonality of hydraulic redistribution by trees to grasses and changes in their water-source use that change tree–grass interactions. Ecohydrology. 9(2): 218-228.

Querejeta, J., L. Egerton-Warburton, and M. Allen. 2003. Direct nocturnal water transfer from oaks to their mycorrhizal symbionts during severe soil drying. Oecologia. 134(1): 65.

Randerson, J.T., H. Liu, M.G. Flanner, S.D. Chambers, Y. Jin, P.G. Hess, G. Pfister, M.C. Mack, K.K. Treseder, L.R. Welp, F.S. Chapin, J.W. Harden, M.L. Goulden, E. Lyons, J.C. Neff, E.A.G. Schuur, and C.S. Zender. 2006. The Impact of Boreal Forest Fire on Climate Warming. Science. 314(5802): 1130-1132.

Richards, J.H., and M.M. Caldwell. 1987. Hydraulic lift: Substantial nocturnal water transport between soil layers by Artemisia tridentata roots. Oecologia. 73:486–489.

Rossi, S., A. Deslauriers, T. Anfodillo, and V. Carraro. 2007. Evidence of threshold temperatures for xylogenesis in conifers at high altitudes. Oecologia. 152(1): 1-12.

Rowland, S., C. Prescott., S. Grayston, S. Quideau, and G. Bradfield. 2009. Recreating a Functioning Forest Soil in Reclaimed Oil Sands in Northern Alberta: An Approach for Measuring Success in Ecological Restoration. Journal of Environmental Quality. 38(4): 1580-90.

Rudolp, T.D. and P.R. Laidly. 1990. *Pinus banksiana. Silvics of North America, Agri. Handbook*, Washington, USA. 654(1) 280-293.

Salama, R.B., G.A. Bartle, and P. Farrington. 1994. Water use of plantation Eucalyptus camaldulensis estimated by groundwater hydrograph separation techniques and heat pulse method. Journal of Hydrology. 156:163–180.

Sambaraju, K., A. Carroll, J. Zhu, K. Stahl, R. Moore, and B. Aukema. 2012. Climate change could alter the distribution of mountain pine beetle outbreaks in western Canada. Ecography. 35(3): 211-223.

Scholz, F., S. Bucci, G. Goldstein, F. Meinzer, A. Franco, and F. Miralles-Wilhelm. 2007. Biophysical properties and functional significance of stem water storage tissues in Neotropical savanna trees. Plant, Cell and Environment. 30(2): 236-248.

SCL (Shell Canada Limited) 2009. Vegetation Appendix 3A: Ecological Land Classification, Ecosite Phase and Land Label Description. Volume IIC, Section 3.

Scott, H.D. 2000. *Soil Physics Agricultural and Environmental Applications*. Iowa State University Press, Ames, Iowa.

Scott, R., W. Cable, and K. Hultine. 2008. The ecohydrologic significance of hydraulic redistribution in a semiarid savanna. Water Resources Research. *44*(2).

Sevanto, S., T. Holtta, and N.M. Holbrook. 2011. Effects of the hydraulic coupling between xylem and phloem on diurnal phloem diameter variation. Plant, Cell and Environment. 34(4): 690-703.

Siegmund, J., T. Sanders, I. Heinrich, E. Van der Maaten, S. Simard, G. Helle, and R. Donner. 2016. Meteorological Drivers of Extremes in Daily Stem Radius Variations of Beech, Oak, and Pine in Northeastern Germany: An Event Coincidence Analysis. *Frontiers in Plant* Science. 7(2016): 733.

Smart, D., E. Carlisle, M. Goebel, and B. Núñez. 2005. Transverse hydraulic redistribution by a grapevine. Plant, Cell and Environment. 28(2): 157-166.

Smith, D., N. Jackson, J. Roberts, and C. Ong. 1999. Reverse flow of sap in tree roots and downward siphoning of water by Grevillea robusta. Functional Ecology. 13(2): 256-264.

Soja, A.J., N.M. Tchebakova, N.H.F. French, M.D. Flannigan, H.H. Shugart, B.J. Stocks, A.I. Sukhinin, E.I. Parfenova, F.S. Chapin, and P.W. Stackhouse. 2007. Climate-induced boreal forest change: Predictions versus current observations. Global and Planetary Change. 56(3-4): 274-296.

Stahl, C., B. Herault, V. Rossi, B. Burban, C. Brechet, and D. Bonal. 2013. Depth of soil water uptake by tropical rainforest trees during dry periods: Does tree dimension matter? Oecologia. 173(4): 1191-1201.

Stamatinos, M. 2019. Varying Root Distributions Between Jack Pine, Aspen, and Mixed-Wood Stands in Sandy Boreal Soils. Thesis Submitted to the Department of Geography, Environmental Earth Sciences, University of Saskatchewan, Saskatoon, Saskatchewan.

Steele, S., S. Gower, J. Vogel, and J. Norman. 1997. Root mass, net primary production and turnover in aspen, jack pine and black spruce forests in Saskatchewan and Manitoba, Canada. Tree Physiology. 17(8-9): 577-587.

Stephens, S.L., N. Burrows, A. Buyantuyev, R.W. Gray, R.E. Keane, R. Kubian, S. Liu, F. Seijo, L. Shu, K.G. Tolhurst, and J.M. Van Wagtendonk. 2014. Temperate and boreal forest mega-fires: Characteristics and challenges. Frontiers in Ecology and the Environment. 12(2): 115-122.

Stephenson, N.L., A.J. Das, R. Condit, S.E. Russo, P.J. Baker, N.G. Beckman, D.A. Coomes, E.R. Lines, W.K. Morris, N. Rüger, E. Álvarez, C. Blundo, S. Bunyavejchewin, G. Chuyong, S.J. Davies, Á. Duque, C.N. Ewango, O. Flores, J.F. Franklin, H.R. Grau, Z. Hao, M.E. Harmon, S.P. Hubbell, D. Kenfack, Y. Lin, J.R. Makana, A. Malizia, L.R. Malizia, R.J. Pabst, N. Pongpattananurak, S.H. Su, I.F. Sun, S. Tan, D. Thomas, P.J. Van Mantgem, X. Wang, S.K. Wiser, and M.A. Zavala. 2014. Rate of tree carbon accumulation increases continuously with tree size. Nature. 507(7490): 90-3.

Steppe, K., and R. Lemeur. 2004. An experimental system for analysis of the dynamic sap-flow characteristics in young trees: Results of a beech tree. Functional Plant Biology. 31(1): 83-92.

Steppe, K., F. Sterck, and A. Deslauriers. 2015. Diel growth dynamics in tree stems: Linking anatomy and ecophysiology. Trends in Plant Science. 20(6): 335-343.

Swanson, R., and D. Whitfield. 1981. A numerical analysis of heat pulse velocity theory and practice. Journal of Experimental Botany. 32(1): 221-239.

Swanson, R.H. 1983. Numerical and experimental analyses of implanted-probe heat pulse velocity theory. Ph.D. Thesis, University of Alberta, Edmonton, Canada.

Thomas, P. 2014. *Trees: Their natural history* (2nd ed.). Cambridge University Press, Cambridge, U.K.

Tian, Q., Z. He, S. Xiao, J. Du, X. Peng, L. Chen, P. Lin, X. Zhu, and A. Ding. 2017. Growing season stemwater status assessment of Qinghai spruce through the sap flow and stem radial variations in the Qilian Mountains of China. Forests. 9(1).

Tognetti, R., A. Giovannelli, A. Lavini, G. Morelli, F. Fragnito, and R. D'Andria. 2009. Assessing environmental controls over conductances through the soil-plant-atmosphere continuum in an experimental olive tree plantation of southern Italy. Agricultural and Forest Meteorology. 149(8): 1229-1243.

Tuzet, A., A. Perrier, and R. Leuning. 2003. A coupled model of stomatal conductance, photosynthesis and transpiration. Plant, Cell and Environment. 26(7): 1097-1116.

Tyree, M., and T. Yang. 1990. Water-storage capacity of Thuja, Tsuga and Acer stems measured by dehydration isotherms. Planta. 182(3): 420-426.

Unsworth, M., N. Phillips, T. Link, B. Bond, M. Falk, M. Harmon, T. Hinckley, D. Marks, and K. Paw. 2004. Components and Controls of Water Flux in an Old-growth Douglas-fir? Western Hemlock Ecosystem. Ecosystems. 7(5).

Vieira J., S. Rossi, F. Campelo, H. Freitas, and C. Nabais. 2013. Seasonal and daily cycles of stem radial variation of Pinus pinaster in a drought-prone environment. Agricultural and Forest Meteorology. 180, 173-181.

Visser, S. 1995. Ectomycorrhizal fungal succession in jack pine stands following wildfire. New Phytologist. 129(3): 389-401.

Wang, G., C. Alo, R. Mei, and S. Sun. 2011. Droughts, hydraulic redistribution, and their impact on vegetation composition in the Amazon forest. Plant Ecology. 212(4): 663-673.

Wang, H., D. Tetzlaff, J.J. Dick, and C. Soulsby. 2017. Assessing the environmental controls on Scots pine transpiration and the implications for water partitioning in a boreal headwater catchment. Agricultural and Forest Meteorology. 240-241, 58-66.

Waring, R., and S. Running. 1978. Sapwood water storage: Its contribution to transpiration and effect upon water conductance through the stems of old-growth Douglas-fir. Plant, Cell and Environment. 1(2): 131-140.

Waring, R., D. Whitehead, and P. Jarvis. 1979. The contribution of stored water to transpiration in Scots pine. Plant, Cell and Environment. 2(4): 309-317.

Warren, J.M., F.C. Meinzer, J.R. Brooks, and J.C. Domec. 2005. Vertical stratification of soil water storage and release dynamics in Pacific Northwest coniferous forests. Agricultural and Forest Meteorology. 130(1-2): 39-58.

Warren, J.M., F.C. Meinzer, J.R. Brooks, J.C. Domec, and R. Coulombe. 2007. Hydraulic redistribution of soil water in two old-growth coniferous forests: Quantifying patterns and controls. New Phytologist. 173(4): 753-765.

Wassenaar, L., M. Hendry, V. Chostner, and G. Lis. 2008. High resolution pore water delta2H and delta18O measurements by H2O(liquid)-H2O(vapor) equilibration laser spectroscopy. Environmental Science and Technology. 42(24): 9262-9267.

Walker, X., M. Mack, and J. Johnstone. 2015. Stable carbon isotope analysis reveals widespread drought stress in boreal black spruce forests. Global Change Biology. 21(8): 3102-3113.

Weber, M., and B. Stocks. 1998. Forest Fires and Sustainability in the Boreal Forests of Canada. Ambio. 27(7): 545.

Willoughby, M.G, M. Meijer, and D. Downing. 2017. Government of Alberta. *Guide to Ecological Sites of the Athabasca Plain Subregion.* Environment and Parks Land Policy, Edmonton, Canada.

Yan, B., and R. Dickinson. 2014. Modeling hydraulic redistribution and ecosystem response to droughts over the Amazon basin using Community Land Model 4.0 (CLM4). Journal of Geophysical Research: Biogeosciences. 119(11): 2130-2143.

Yu, K., and P. D'Odorico. 2015. Hydraulic lift as a determinant of tree–grass coexistence on savannas. New Phytologist. 207(4): 1038-1051.

Yu, T., Q. Feng, J. Si, H. Xi, Z. Li, and A. Chen. 2013. Hydraulic redistribution of soil water by roots of two desert riparian phreatophytes in northwest China's extremely arid region. Plant and Soil. 372(1-2): 1-12.

Zapater, M., C. Hossann, N. Bréda, C. Bréchet, D. Bonal, and A. Granier. 2011. Evidence of hydraulic lift in a young beech and oak mixed forest using 18O soil water labelling. Trees. 25(5): 885-894.

Zettl, J.D., S.L. Barbour, M. Haung, B.C. Si, and L.A. Leskiw. 2011. Influence of textural layering on field capacity of coarse soils. Canadian Journal of Soil Science. 91(2): 133-147.

Zha, T., A.G. Barr, G. van Der Kamp, T.A. Black, J.H. Mccaughey, and L.B. Flanagan. 2010. Interannual variation of evapotranspiration from forest and grassland ecosystems in western Canada in relation to drought. Agricultural and Forest Meteorology. 150(11): 1476-1484.

Zhang, Q., S. Manzoni, G. Katul, A. Porporato, and D. Yang. 2014. The hysteretic evapotranspiration—Vapor pressure deficit relation. Journal of Geophysical Research: Biogeosciences. 119(2): 125-140.

Zimmerman, U., H. Schneider, L.H. Wegner, and A. Haase. 2004. Water ascent in tall trees: does evolution of land plants rely on a highly metastable state? New Phytologist. 162, 575-615.

Zimmermann, M. 1983. *Xylem structure and the ascent of sap*. Springer series in wood science. Springer-Verlag. Berlin, New York.

Zotz, G., S. Patino, and M. Tyree. 1997. Water relations and hydraulic architecture of woody hemiepiphytes. Journal of Experimental Botany. 48(315): 1825-1833.

Zweifel, R., and R. Häsler. 2001. Dynamics of water storage in mature subalpine Picea abies: Temporal and spatial patterns of change in stem radius. Tree Physiology. 21(9): 561-569.

Zweifel R., L. Zimmermann, and D.M. Newbery. 2005. Modeling tree water deficit from microclimate: an approach to quantifying drought stress. Tree Physiology. 25, 147–156.

Zweifel, R. 2016. Radial stem variations – a source of tree physiological information not fully exploited yet. Plant, Cell and Environment. 39(2): 231-232.

Zweifel, R., L. Zimmermann, F. Zeugin, and D. Newbery. 2006. Intra-annual radial growth and water relations of trees: Implications towards a growth mechanism. Journal of Experimental Botany. 57(6): 1445-1459.

APPENDICES

APPENDIX A. CORRECTION COEFFICIENTS TO CALCULATE HEAT PULSE VELOCITY

Table A.1: Correction coefficients to correct for wounding of sapwood

Wound (cm)	b	c	d	r^2	B	r^2
0.17	1.6565	–0.0014	0.0002	1.0000	1.7023	0.9993
0.18	1.7077	–0.0014	0.0002	1.0000	1.7585	0.9992
0.19	1.7701	–0.0017	0.0002	1.0000	1.8265	0.9991
0.20	1.8292	–0.0019	0.0003	1.0000	1.8905	0.9990
0.21	1.8909	–0.0022	0.0003	1.0000	1.9572	0.9989
0.22	1.9554	–0.0025	0.0004	1.0000	2.0267	0.9988
0.23	2.0226	–0.0029	0.0004	1.0000	2.0991	0.9987
0.24	2.0685	–0.0031	0.0005	1.0000	2.1482	0.9987
0.26	2.1932	–0.0038	0.0006	1.0000	2.2817	0.9985
0.28	2.3448	–0.0047	0.0008	1.0000	2.4467	0.9984
0.30	2.4908	–0.0057	0.0010	1.0000	2.5985	0.9983

Footnote:

[1] Correction coefficients provided by Burgess et al., 2001. Correction coefficients were derived to be used with heat pulse probes with a -0.6 cm, 0 cm, 0.6 cm spacing configuration and a 1.3 mm diameter stainless steel probe needle.

APPENDIX B. SOIL TEXTURE

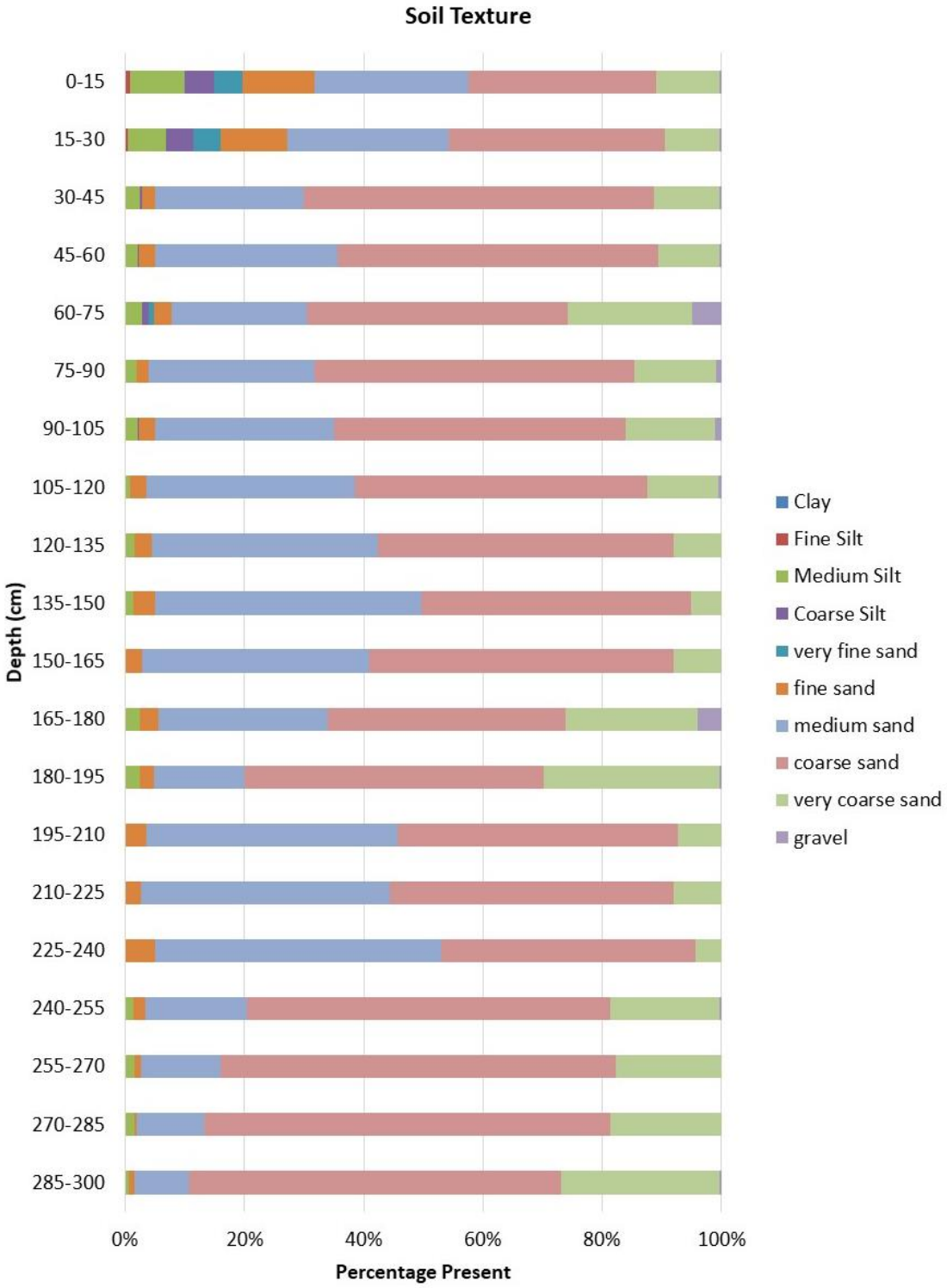

Figure B1: Soil texture data collected from the study site for further research by Stamatinos (2019).

Table B1: Soil texture data collected from the study site

Depth (cm)	Clay	Fine Silt	Medium Silt	Coarse Silt	Very Fine Sand	Fine Sand	Medium Sand	Coarse Sand	Very Coarse Sand	Gravel
0-15	0.0	0.8	9.1	4.9	4.9	12.0	25.9	31.4	10.6	0.4
15-30	0.0	0.5	6.4	4.5	4.7	11.1	27.1	36.1	9.2	0.3
30-45	0.0	0.0	2.5	0.3	0.0	2.2	24.9	58.7	11.1	0.3
45-60	0.0	0.0	2.1	0.3	0.0	2.7	30.5	53.8	10.3	0.4
60-75	0.0	0.0	2.8	1.1	0.9	3.0	22.7	43.7	21.0	4.9
75-90	0.0	0.0	1.8	0.0	0.0	2.2	27.8	53.5	13.8	0.9
90-105	0.0	0.0	2.2	0.1	0.0	2.7	30.1	48.8	15.0	1.1
105-120	0.0	0.0	0.7	0.0	0.0	2.9	35.0	49.0	12.0	0.5
120-135	0.0	0.0	1.5	0.0	0.0	2.9	37.9	49.6	8.0	0.0
135-150	0.0	0.0	1.4	0.0	0.0	3.7	44.6	45.3	5.1	0.0
150-165	0.0	0.0	0.0	0.0	0.0	2.8	38.1	51.0	8.1	0.0
165-180	0.0	0.0	2.5	0.0	0.0	3.1	28.3	39.9	22.2	4.0
180-195	0.0	0.0	2.5	0.0	0.0	2.3	15.1	50.1	29.5	0.4
195-210	0.0	0.0	0.0	0.0	0.0	3.6	42.0	47.2	7.2	0.0
210-225	0.0	0.0	0.0	0.0	0.0	2.6	41.6	47.7	8.0	0.0
225-240	0.0	0.0	0.0	0.0	0.0	4.9	48.0	42.8	4.3	0.0
240-255	0.0	0.0	1.4	0.0	0.0	2.0	16.9	61.0	18.3	0.4
255-270	0.0	0.0	1.5	0.1	0.0	1.1	13.3	66.3	17.7	0.0
270-285	0.0	0.0	1.5	0.0	0.0	0.5	11.3	68.1	18.7	0.0
285-300	0.0	0.0	0.6	0.0	0.0	0.8	9.2	62.4	26.5	0.4

Data collected by Stamatinos, M. (2019). Varying Root Distributions Between Jack Pine, Aspen, and Mixed-Wood Stands in Sandy Boreal Soils. Thesis Submitted to the Department of Geography, Environmental Earth Sciences, University of Saskatchewan, Saskatoon, Saskatchewan.

APPENDIX C. VOLUMETRIC WATER CONTENT OF SOIL

	SoilMoist Surface	SoilMoist30	SoilMoist60	SoilMoist90	SoilMoist120	SoilMoist150
7/8/16 12:00 AM	0.107	0.057	0.032	0.039	0.052	0.038
7/8/16 12:30 AM	0.107	0.057	0.032	0.039	0.052	0.038
7/8/16 1:00 AM	0.106	0.058	0.032	0.039	0.052	0.038
7/8/16 1:30 AM	0.106	0.058	0.032	0.039	0.052	0.038
7/8/16 2:00 AM	0.106	0.058	0.032	0.039	0.053	0.038
7/8/16 2:30 AM	0.106	0.058	0.032	0.039	0.053	0.038
7/8/16 3:00 AM	0.106	0.059	0.032	0.039	0.053	0.038
7/8/16 3:30 AM	0.106	0.059	0.032	0.039	0.053	0.038
7/8/16 4:00 AM	0.106	0.059	0.032	0.039	0.053	0.038
7/8/16 4:30 AM	0.106	0.059	0.032	0.039	0.053	0.038
7/8/16 5:00 AM	0.106	0.059	0.032	0.039	0.053	0.038
7/8/16 5:30 AM	0.106	0.059	0.032	0.039	0.053	0.038
7/8/16 6:00 AM	0.106	0.06	0.032	0.039	0.053	0.038
7/8/16 6:30 AM	0.106	0.06	0.032	0.039	0.053	0.038
7/8/16 7:00 AM	0.106	0.06	0.032	0.039	0.053	0.038
7/8/16 7:30 AM	0.106	0.06	0.032	0.039	0.053	0.038
7/8/16 8:00 AM	0.106	0.061	0.033	0.039	0.053	0.038
7/8/16 8:30 AM	0.106	0.061	0.033	0.039	0.053	0.038
7/8/16 9:00 AM	0.106	0.062	0.032	0.039	0.053	0.038
7/8/16 9:30 AM	0.106	0.062	0.032	0.039	0.053	0.038
7/8/16 10:00 AM	0.106	0.062	0.033	0.039	0.053	0.038
7/8/16 10:30 AM	0.106	0.062	0.033	0.039	0.053	0.038
7/8/16 11:00 AM	0.106	0.062	0.033	0.039	0.053	0.038
7/8/16 11:30 AM	0.106	0.062	0.033	0.039	0.053	0.038
7/8/16 12:00 PM	0.105	0.063	0.032	0.039	0.053	0.038
7/8/16 12:30 PM	0.105	0.063	0.032	0.039	0.053	0.038
7/8/16 1:00 PM	0.105	0.064	0.032	0.039	0.053	0.038
7/8/16 1:30 PM	0.105	0.064	0.032	0.039	0.053	0.038
7/8/16 2:00 PM	0.104	0.064	0.033	0.039	0.053	0.038
7/8/16 2:30 PM	0.104	0.064	0.033	0.039	0.053	0.038
7/8/16 3:00 PM	0.104	0.065	0.032	0.039	0.053	0.038
7/8/16 3:30 PM	0.104	0.065	0.032	0.039	0.053	0.038
7/8/16 4:00 PM	0.103	0.065	0.032	0.039	0.053	0.038
7/8/16 4:30 PM	0.103	0.065	0.032	0.039	0.053	0.038
7/8/16 5:00 PM	0.103	0.066	0.032	0.039	0.053	0.038
7/8/16 5:30 PM	0.103	0.066	0.032	0.039	0.053	0.038
7/8/16 6:00 PM	0.103	0.066	0.032	0.039	0.053	0.038
7/8/16 6:30 PM	0.103	0.066	0.032	0.039	0.053	0.038
7/8/16 7:00 PM	0.103	0.067	0.032	0.039	0.053	0.038
7/8/16 7:30 PM	0.103	0.067	0.032	0.039	0.053	0.038
7/8/16 8:00 PM	0.103	0.068	0.032	0.039	0.053	0.038
7/8/16 8:30 PM	0.103	0.068	0.032	0.039	0.053	0.038
7/8/16 9:00 PM	0.102	0.068	0.032	0.039	0.053	0.038
7/8/16 9:30 PM	0.102	0.068	0.032	0.039	0.053	0.038
7/8/16 10:00 PM	0.103	0.069	0.032	0.039	0.052	0.038
7/8/16 10:30 PM	0.103	0.069	0.032	0.039	0.052	0.038
7/8/16 11:00 PM	0.107	0.069	0.032	0.039	0.053	0.038

7/8/16 11:30 PM	0.107	0.069	0.032	0.039	0.053	0.038
7/9/16 12:00 AM	0.107	0.07	0.033	0.039	0.053	0.038
7/9/16 12:30 AM	0.107	0.07	0.033	0.039	0.053	0.038
7/9/16 1:00 AM	0.122	0.07	0.032	0.039	0.052	0.038
7/9/16 1:30 AM	0.122	0.07	0.032	0.039	0.052	0.038
7/9/16 2:00 AM	0.12	0.071	0.033	0.039	0.052	0.038
7/9/16 2:30 AM	0.12	0.071	0.033	0.039	0.052	0.038
7/9/16 3:00 AM	0.119	0.072	0.033	0.039	0.052	0.038
7/9/16 3:30 AM	0.119	0.072	0.033	0.039	0.052	0.038
7/9/16 4:00 AM	0.118	0.073	0.032	0.039	0.052	0.038
7/9/16 4:30 AM	0.118	0.073	0.032	0.039	0.052	0.038
7/9/16 5:00 AM	0.117	0.073	0.032	0.039	0.052	0.038
7/9/16 5:30 AM	0.117	0.073	0.032	0.039	0.052	0.038
7/9/16 6:00 AM	0.117	0.075	0.032	0.039	0.052	0.038
7/9/16 6:30 AM	0.117	0.075	0.032	0.039	0.052	0.038
7/9/16 7:00 AM	0.116	0.076	0.033	0.039	0.053	0.038
7/9/16 7:30 AM	0.116	0.076	0.033	0.039	0.053	0.038
7/9/16 8:00 AM	0.116	0.077	0.033	0.039	0.052	0.038
7/9/16 8:30 AM	0.116	0.077	0.033	0.039	0.052	0.038
7/9/16 9:00 AM	0.116	0.079	0.033	0.039	0.053	0.038
7/9/16 9:30 AM	0.116	0.079	0.033	0.039	0.053	0.038
7/9/16 10:00 AM	0.115	0.08	0.033	0.039	0.053	0.038
7/9/16 10:30 AM	0.115	0.08	0.033	0.039	0.053	0.038
7/9/16 11:00 AM	0.115	0.081	0.033	0.039	0.053	0.038
7/9/16 11:30 AM	0.115	0.081	0.033	0.039	0.053	0.038
7/9/16 12:00 PM	0.114	0.082	0.033	0.039	0.053	0.038
7/9/16 12:30 PM	0.114	0.082	0.033	0.039	0.053	0.038
7/9/16 1:00 PM	0.114	0.083	0.033	0.039	0.053	0.038
7/9/16 1:30 PM	0.114	0.083	0.033	0.039	0.053	0.038
7/9/16 2:00 PM	0.113	0.084	0.033	0.039	0.053	0.038
7/9/16 2:30 PM	0.113	0.084	0.033	0.039	0.053	0.038
7/9/16 3:00 PM	0.113	0.084	0.033	0.039	0.053	0.038
7/9/16 3:30 PM	0.113	0.084	0.033	0.039	0.053	0.038
7/9/16 4:00 PM	0.112	0.084	0.033	0.039	0.053	0.038
7/9/16 4:30 PM	0.112	0.084	0.033	0.039	0.053	0.038
7/9/16 5:00 PM	0.111	0.085	0.033	0.039	0.053	0.038
7/9/16 5:30 PM	0.111	0.085	0.033	0.039	0.053	0.038
7/9/16 6:00 PM	0.111	0.085	0.033	0.04	0.053	0.038
7/9/16 6:30 PM	0.111	0.085	0.033	0.04	0.053	0.038
7/9/16 7:00 PM	0.11	0.085	0.033	0.04	0.053	0.038
7/9/16 7:30 PM	0.11	0.085	0.033	0.04	0.053	0.038
7/9/16 8:00 PM	0.11	0.085	0.033	0.04	0.053	0.038
7/9/16 8:30 PM	0.11	0.085	0.033	0.04	0.053	0.038
7/9/16 9:00 PM	0.11	0.085	0.033	0.04	0.053	0.038
7/9/16 9:30 PM	0.11	0.085	0.033	0.04	0.053	0.038
7/9/16 10:00 PM	0.109	0.085	0.033	0.04	0.053	0.038
7/9/16 10:30 PM	0.109	0.085	0.033	0.04	0.053	0.038
7/9/16 11:00 PM	0.109	0.085	0.033	0.04	0.053	0.038
7/9/16 11:30 PM	0.109	0.085	0.033	0.04	0.053	0.038
7/10/16 12:00 AM	0.109	0.086	0.033	0.04	0.053	0.039
7/10/16 12:30 AM	0.109	0.086	0.033	0.04	0.053	0.039
7/10/16 1:00 AM	0.109	0.085	0.033	0.04	0.053	0.038
7/10/16 1:30 AM	0.109	0.085	0.033	0.04	0.053	0.038

7/10/16 2:00 AM	0.109	0.085	0.033	0.04	0.053	0.039
7/10/16 2:30 AM	0.109	0.085	0.033	0.04	0.053	0.039
7/10/16 3:00 AM	0.109	0.086	0.033	0.04	0.053	0.039
7/10/16 3:30 AM	0.109	0.086	0.033	0.04	0.053	0.039
7/10/16 4:00 AM	0.109	0.086	0.033	0.04	0.053	0.039
7/10/16 4:30 AM	0.109	0.086	0.033	0.04	0.053	0.039
7/10/16 5:00 AM	0.109	0.086	0.033	0.04	0.053	0.038
7/10/16 5:30 AM	0.109	0.086	0.033	0.04	0.053	0.038
7/10/16 6:00 AM	0.109	0.086	0.033	0.04	0.053	0.038
7/10/16 6:30 AM	0.109	0.086	0.033	0.04	0.053	0.038
7/10/16 7:00 AM	0.109	0.086	0.033	0.04	0.053	0.038
7/10/16 7:30 AM	0.109	0.086	0.033	0.04	0.053	0.038
7/10/16 8:00 AM	0.109	0.086	0.033	0.04	0.053	0.039
7/10/16 8:30 AM	0.109	0.086	0.033	0.04	0.053	0.039
7/10/16 9:00 AM	0.109	0.086	0.033	0.04	0.053	0.039
7/10/16 9:30 AM	0.109	0.086	0.033	0.04	0.053	0.039
7/10/16 10:00 AM	0.109	0.086	0.033	0.04	0.053	0.039
7/10/16 10:30 AM	0.109	0.086	0.033	0.04	0.053	0.039
7/10/16 11:00 AM	0.109	0.085	0.033	0.04	0.053	0.039
7/10/16 11:30 AM	0.109	0.085	0.033	0.04	0.053	0.039
7/10/16 12:00 PM	0.109	0.085	0.033	0.041	0.053	0.039
7/10/16 12:30 PM	0.109	0.085	0.033	0.041	0.053	0.039
7/10/16 1:00 PM	0.108	0.085	0.033	0.041	0.053	0.039
7/10/16 1:30 PM	0.108	0.085	0.033	0.041	0.053	0.039
7/10/16 2:00 PM	0.108	0.085	0.033	0.041	0.053	0.039
7/10/16 2:30 PM	0.108	0.085	0.033	0.041	0.053	0.039
7/10/16 3:00 PM	0.108	0.085	0.033	0.041	0.053	0.039
7/10/16 3:30 PM	0.108	0.085	0.033	0.041	0.053	0.039
7/10/16 4:00 PM	0.107	0.085	0.033	0.041	0.053	0.039
7/10/16 4:30 PM	0.107	0.085	0.033	0.041	0.053	0.039
7/10/16 5:00 PM	0.107	0.085	0.033	0.041	0.053	0.039
7/10/16 5:30 PM	0.107	0.085	0.033	0.041	0.053	0.039
7/10/16 6:00 PM	0.107	0.085	0.033	0.041	0.053	0.039
7/10/16 6:30 PM	0.107	0.085	0.033	0.041	0.053	0.039
7/10/16 7:00 PM	0.107	0.085	0.033	0.041	0.053	0.039
7/10/16 7:30 PM	0.107	0.085	0.033	0.041	0.053	0.039
7/10/16 8:00 PM	0.106	0.085	0.033	0.041	0.052	0.039
7/10/16 8:30 PM	0.106	0.085	0.033	0.041	0.052	0.039
7/10/16 9:00 PM	0.106	0.085	0.033	0.041	0.053	0.039
7/10/16 9:30 PM	0.106	0.085	0.033	0.041	0.053	0.039
7/10/16 10:00 PM	0.106	0.084	0.033	0.041	0.053	0.039
7/10/16 10:30 PM	0.106	0.084	0.033	0.041	0.053	0.039
7/10/16 11:00 PM	0.106	0.084	0.033	0.041	0.053	0.039
7/10/16 11:30 PM	0.106	0.084	0.033	0.041	0.053	0.039
7/11/16 12:00 AM	0.106	0.084	0.033	0.041	0.052	0.039
7/11/16 12:30 AM	0.106	0.084	0.033	0.041	0.052	0.039
7/11/16 1:00 AM	0.106	0.084	0.033	0.041	0.052	0.039
7/11/16 1:30 AM	0.106	0.084	0.033	0.041	0.052	0.039
7/11/16 2:00 AM	0.106	0.084	0.033	0.041	0.052	0.039
7/11/16 2:30 AM	0.106	0.084	0.033	0.041	0.052	0.039
7/11/16 3:00 AM	0.11	0.084	0.033	0.041	0.052	0.039
7/11/16 3:30 AM	0.11	0.084	0.033	0.041	0.052	0.039
7/11/16 4:00 AM	0.11	0.084	0.033	0.041	0.052	0.039

7/11/16 4:30 AM	0.11	0.084	0.033	0.041	0.052	0.039
7/11/16 5:00 AM	0.11	0.084	0.033	0.041	0.052	0.039
7/11/16 5:30 AM	0.11	0.084	0.033	0.041	0.052	0.039
7/11/16 6:00 AM	0.113	0.084	0.033	0.041	0.052	0.039
7/11/16 6:30 AM	0.113	0.084	0.033	0.041	0.052	0.039
7/11/16 7:00 AM	0.113	0.084	0.033	0.041	0.052	0.039
7/11/16 7:30 AM	0.113	0.084	0.033	0.041	0.052	0.039
7/11/16 8:00 AM	0.113	0.084	0.033	0.042	0.052	0.039
7/11/16 8:30 AM	0.113	0.084	0.033	0.042	0.052	0.039
7/11/16 9:00 AM	0.113	0.084	0.033	0.042	0.052	0.039
7/11/16 9:30 AM	0.113	0.084	0.033	0.042	0.052	0.039
7/11/16 10:00 AM	0.113	0.084	0.033	0.042	0.052	0.039
7/11/16 10:30 AM	0.113	0.084	0.033	0.042	0.052	0.039
7/11/16 11:00 AM	0.116	0.085	0.033	0.042	0.052	0.039
7/11/16 11:30 AM	0.116	0.085	0.033	0.042	0.052	0.039
7/11/16 12:00 PM	0.119	0.085	0.033	0.042	0.052	0.039
7/11/16 12:30 PM	0.119	0.085	0.033	0.042	0.052	0.039
7/11/16 1:00 PM	0.119	0.085	0.033	0.042	0.052	0.039
7/11/16 1:30 PM	0.119	0.085	0.033	0.042	0.052	0.039
7/11/16 2:00 PM	0.121	0.085	0.033	0.041	0.052	0.039
7/11/16 2:30 PM	0.121	0.085	0.033	0.041	0.052	0.039
7/11/16 3:00 PM	0.126	0.086	0.033	0.042	0.052	0.039
7/11/16 3:30 PM	0.126	0.086	0.033	0.042	0.052	0.039
7/11/16 4:00 PM	0.14	0.088	0.033	0.042	0.052	0.039
7/11/16 4:30 PM	0.14	0.088	0.033	0.042	0.052	0.039
7/11/16 5:00 PM	0.144	0.089	0.033	0.042	0.052	0.039
7/11/16 5:30 PM	0.144	0.089	0.033	0.042	0.052	0.039
7/11/16 6:00 PM	0.141	0.093	0.034	0.042	0.052	0.039
7/11/16 6:30 PM	0.141	0.093	0.034	0.042	0.052	0.039
7/11/16 7:00 PM	0.138	0.097	0.035	0.042	0.052	0.039
7/11/16 7:30 PM	0.138	0.097	0.035	0.042	0.052	0.039
7/11/16 8:00 PM	0.135	0.1	0.036	0.042	0.052	0.039
7/11/16 8:30 PM	0.135	0.1	0.036	0.042	0.052	0.039
7/11/16 9:00 PM	0.133	0.1	0.037	0.042	0.052	0.039
7/11/16 9:30 PM	0.133	0.1	0.037	0.042	0.052	0.039
7/11/16 10:00 PM	0.131	0.1	0.037	0.042	0.052	0.039
7/11/16 10:30 PM	0.131	0.1	0.037	0.042	0.052	0.039
7/11/16 11:00 PM	0.129	0.1	0.038	0.043	0.052	0.039
7/11/16 11:30 PM	0.129	0.1	0.038	0.043	0.052	0.039
7/12/16 12:00 AM	0.128	0.1	0.038	0.043	0.052	0.039
7/12/16 12:30 AM	0.128	0.1	0.038	0.043	0.052	0.039
7/12/16 1:00 AM	0.127	0.1	0.038	0.043	0.052	0.039
7/12/16 1:30 AM	0.127	0.1	0.038	0.043	0.052	0.039
7/12/16 2:00 AM	0.126	0.1	0.038	0.043	0.053	0.039
7/12/16 2:30 AM	0.126	0.1	0.038	0.043	0.053	0.039
7/12/16 3:00 AM	0.125	0.099	0.038	0.043	0.053	0.039
7/12/16 3:30 AM	0.125	0.099	0.038	0.043	0.053	0.039
7/12/16 4:00 AM	0.124	0.099	0.038	0.043	0.053	0.039
7/12/16 4:30 AM	0.124	0.099	0.038	0.043	0.053	0.039
7/12/16 5:00 AM	0.124	0.098	0.038	0.043	0.054	0.039
7/12/16 5:30 AM	0.124	0.098	0.038	0.043	0.054	0.039
7/12/16 6:00 AM	0.123	0.098	0.038	0.043	0.054	0.039
7/12/16 6:30 AM	0.123	0.098	0.038	0.043	0.054	0.039

7/12/16 7:00 AM	0.123	0.098	0.038	0.043	0.054	0.039
7/12/16 7:30 AM	0.123	0.098	0.038	0.043	0.054	0.039
7/12/16 8:00 AM	0.122	0.097	0.038	0.043	0.054	0.039
7/12/16 8:30 AM	0.122	0.097	0.038	0.043	0.054	0.039
7/12/16 9:00 AM	0.122	0.097	0.039	0.044	0.055	0.039
7/12/16 9:30 AM	0.122	0.097	0.039	0.044	0.055	0.039
7/12/16 10:00 AM	0.122	0.097	0.038	0.044	0.055	0.039
7/12/16 10:30 AM	0.122	0.097	0.038	0.044	0.055	0.039
7/12/16 11:00 AM	0.122	0.096	0.038	0.044	0.055	0.039
7/12/16 11:30 AM	0.122	0.096	0.038	0.044	0.055	0.039
7/12/16 12:00 PM	0.121	0.096	0.038	0.044	0.055	0.039
7/12/16 12:30 PM	0.121	0.096	0.038	0.044	0.055	0.039
7/12/16 1:00 PM	0.121	0.096	0.038	0.044	0.055	0.039
7/12/16 1:30 PM	0.121	0.096	0.038	0.044	0.055	0.039
7/12/16 2:00 PM	0.121	0.096	0.038	0.044	0.055	0.039
7/12/16 2:30 PM	0.121	0.096	0.038	0.044	0.055	0.039
7/12/16 3:00 PM	0.121	0.096	0.038	0.044	0.055	0.04
7/12/16 3:30 PM	0.121	0.096	0.038	0.044	0.055	0.04
7/12/16 4:00 PM	0.121	0.095	0.038	0.044	0.056	0.04
7/12/16 4:30 PM	0.121	0.095	0.038	0.044	0.056	0.04
7/12/16 5:00 PM	0.12	0.095	0.038	0.044	0.056	0.04
7/12/16 5:30 PM	0.12	0.095	0.038	0.044	0.056	0.04
7/12/16 6:00 PM	0.12	0.095	0.038	0.044	0.056	0.04
7/12/16 6:30 PM	0.12	0.095	0.038	0.044	0.056	0.04
7/12/16 7:00 PM	0.12	0.095	0.038	0.044	0.056	0.04
7/12/16 7:30 PM	0.12	0.095	0.038	0.044	0.056	0.04
7/12/16 8:00 PM	0.119	0.095	0.038	0.045	0.056	0.04
7/12/16 8:30 PM	0.119	0.095	0.038	0.045	0.056	0.04
7/12/16 9:00 PM	0.119	0.094	0.038	0.045	0.056	0.04
7/12/16 9:30 PM	0.119	0.094	0.038	0.045	0.056	0.04
7/12/16 10:00 PM	0.118	0.094	0.038	0.045	0.056	0.04
7/12/16 10:30 PM	0.118	0.094	0.038	0.045	0.056	0.04
7/12/16 11:00 PM	0.118	0.094	0.038	0.045	0.056	0.04
7/12/16 11:30 PM	0.118	0.094	0.038	0.045	0.056	0.04
7/13/16 12:00 AM	0.117	0.094	0.038	0.045	0.056	0.04
7/13/16 12:30 AM	0.117	0.094	0.038	0.045	0.056	0.04
7/13/16 1:00 AM	0.117	0.094	0.038	0.045	0.056	0.04
7/13/16 1:30 AM	0.117	0.094	0.038	0.045	0.056	0.04
7/13/16 2:00 AM	0.117	0.094	0.038	0.045	0.056	0.04
7/13/16 2:30 AM	0.117	0.094	0.038	0.045	0.056	0.04
7/13/16 3:00 AM	0.117	0.093	0.038	0.045	0.056	0.04
7/13/16 3:30 AM	0.117	0.093	0.038	0.045	0.056	0.04
7/13/16 4:00 AM	0.117	0.093	0.038	0.045	0.056	0.04
7/13/16 4:30 AM	0.117	0.093	0.038	0.045	0.056	0.04
7/13/16 5:00 AM	0.116	0.093	0.038	0.045	0.056	0.04
7/13/16 5:30 AM	0.116	0.093	0.038	0.045	0.056	0.04
7/13/16 6:00 AM	0.116	0.093	0.038	0.045	0.056	0.04
7/13/16 6:30 AM	0.116	0.093	0.038	0.045	0.056	0.04
7/13/16 7:00 AM	0.116	0.093	0.038	0.045	0.056	0.04
7/13/16 7:30 AM	0.116	0.093	0.038	0.045	0.056	0.04
7/13/16 8:00 AM	0.116	0.093	0.038	0.045	0.056	0.041
7/13/16 8:30 AM	0.116	0.093	0.038	0.045	0.056	0.041
7/13/16 9:00 AM	0.116	0.093	0.038	0.045	0.056	0.041

7/13/16 9:30 AM	0.116	0.093	0.038	0.045	0.056	0.041
7/13/16 10:00 AM	0.115	0.093	0.038	0.045	0.056	0.041
7/13/16 10:30 AM	0.115	0.093	0.038	0.045	0.056	0.041
7/13/16 11:00 AM	0.115	0.092	0.038	0.045	0.056	0.041
7/13/16 11:30 AM	0.115	0.092	0.038	0.045	0.056	0.041
7/13/16 12:00 PM	0.115	0.092	0.038	0.045	0.056	0.041
7/13/16 12:30 PM	0.115	0.092	0.038	0.045	0.056	0.041
7/13/16 1:00 PM	0.115	0.092	0.038	0.045	0.056	0.042
7/13/16 1:30 PM	0.115	0.092	0.038	0.045	0.056	0.042
7/13/16 2:00 PM	0.115	0.092	0.038	0.045	0.056	0.042
7/13/16 2:30 PM	0.115	0.092	0.038	0.045	0.056	0.042
7/13/16 3:00 PM	0.114	0.092	0.038	0.045	0.056	0.042
7/13/16 3:30 PM	0.114	0.092	0.038	0.045	0.056	0.042
7/13/16 4:00 PM	0.114	0.091	0.038	0.045	0.056	0.042
7/13/16 4:30 PM	0.114	0.091	0.038	0.045	0.056	0.042
7/13/16 5:00 PM	0.113	0.091	0.038	0.045	0.056	0.043
7/13/16 5:30 PM	0.113	0.091	0.038	0.045	0.056	0.043
7/13/16 6:00 PM	0.113	0.091	0.038	0.045	0.056	0.043
7/13/16 6:30 PM	0.113	0.091	0.038	0.045	0.056	0.043
7/13/16 7:00 PM	0.113	0.091	0.038	0.045	0.056	0.043
7/13/16 7:30 PM	0.113	0.091	0.038	0.045	0.056	0.043
7/13/16 8:00 PM	0.112	0.09	0.038	0.045	0.056	0.044
7/13/16 8:30 PM	0.112	0.09	0.038	0.045	0.056	0.044
7/13/16 9:00 PM	0.112	0.09	0.038	0.045	0.056	0.044
7/13/16 9:30 PM	0.112	0.09	0.038	0.045	0.056	0.044
7/13/16 10:00 PM	0.112	0.09	0.038	0.045	0.056	0.044
7/13/16 10:30 PM	0.112	0.09	0.038	0.045	0.056	0.044
7/13/16 11:00 PM	0.112	0.09	0.038	0.045	0.056	0.045
7/13/16 11:30 PM	0.112	0.09	0.038	0.045	0.056	0.045
7/14/16 12:00 AM	0.111	0.09	0.038	0.045	0.056	0.045
7/14/16 12:30 AM	0.111	0.09	0.038	0.045	0.056	0.045
7/14/16 1:00 AM	0.111	0.09	0.038	0.045	0.056	0.045
7/14/16 1:30 AM	0.111	0.09	0.038	0.045	0.056	0.045
7/14/16 2:00 AM	0.111	0.09	0.038	0.045	0.056	0.046
7/14/16 2:30 AM	0.111	0.09	0.038	0.045	0.056	0.046
7/14/16 3:00 AM	0.111	0.09	0.038	0.046	0.056	0.046
7/14/16 3:30 AM	0.111	0.09	0.038	0.046	0.056	0.046
7/14/16 4:00 AM	0.111	0.089	0.038	0.045	0.056	0.046
7/14/16 4:30 AM	0.111	0.089	0.038	0.045	0.056	0.046
7/14/16 5:00 AM	0.111	0.09	0.038	0.045	0.056	0.047
7/14/16 5:30 AM	0.111	0.09	0.038	0.045	0.056	0.047
7/14/16 6:00 AM	0.111	0.089	0.038	0.045	0.056	0.047
7/14/16 6:30 AM	0.111	0.089	0.038	0.045	0.056	0.047
7/14/16 7:00 AM	0.111	0.089	0.038	0.045	0.056	0.047
7/14/16 7:30 AM	0.111	0.089	0.038	0.045	0.056	0.047
7/14/16 8:00 AM	0.111	0.089	0.038	0.046	0.056	0.048
7/14/16 8:30 AM	0.111	0.089	0.038	0.046	0.056	0.048
7/14/16 9:00 AM	0.111	0.089	0.038	0.046	0.056	0.048
7/14/16 9:30 AM	0.111	0.089	0.038	0.046	0.056	0.048
7/14/16 10:00 AM	0.111	0.089	0.038	0.046	0.056	0.048
7/14/16 10:30 AM	0.111	0.089	0.038	0.046	0.056	0.048
7/14/16 11:00 AM	0.111	0.089	0.038	0.046	0.056	0.049
7/14/16 11:30 AM	0.111	0.089	0.038	0.046	0.056	0.049

7/14/16 12:00 PM	0.11	0.088	0.038	0.046	0.056	0.049
7/14/16 12:30 PM	0.11	0.088	0.038	0.046	0.056	0.049
7/14/16 1:00 PM	0.11	0.088	0.038	0.046	0.056	0.049
7/14/16 1:30 PM	0.11	0.088	0.038	0.046	0.056	0.049
7/14/16 2:00 PM	0.11	0.088	0.038	0.046	0.056	0.049
7/14/16 2:30 PM	0.11	0.088	0.038	0.046	0.056	0.049
7/14/16 3:00 PM	0.109	0.088	0.038	0.045	0.056	0.05
7/14/16 3:30 PM	0.109	0.088	0.038	0.045	0.056	0.05
7/14/16 4:00 PM	0.11	0.087	0.038	0.046	0.056	0.05
7/14/16 4:30 PM	0.11	0.087	0.038	0.046	0.056	0.05
7/14/16 5:00 PM	0.11	0.088	0.038	0.046	0.056	0.05
7/14/16 5:30 PM	0.11	0.088	0.038	0.046	0.056	0.05
7/14/16 6:00 PM	0.11	0.087	0.038	0.046	0.056	0.051
7/14/16 6:30 PM	0.11	0.087	0.038	0.046	0.056	0.051
7/14/16 7:00 PM	0.109	0.087	0.038	0.046	0.056	0.051
7/14/16 7:30 PM	0.109	0.087	0.038	0.046	0.056	0.051
7/14/16 8:00 PM	0.109	0.087	0.038	0.046	0.056	0.051
7/14/16 8:30 PM	0.109	0.087	0.038	0.046	0.056	0.051
7/14/16 9:00 PM	0.109	0.087	0.038	0.046	0.056	0.051
7/14/16 9:30 PM	0.109	0.087	0.038	0.046	0.056	0.051
7/14/16 10:00 PM	0.109	0.087	0.038	0.045	0.056	0.051
7/14/16 10:30 PM	0.109	0.087	0.038	0.045	0.056	0.051
7/14/16 11:00 PM	0.108	0.086	0.038	0.045	0.056	0.052
7/14/16 11:30 PM	0.108	0.086	0.038	0.045	0.056	0.052
7/15/16 12:00 AM	0.108	0.087	0.038	0.046	0.056	0.052
7/15/16 12:30 AM	0.108	0.087	0.038	0.046	0.056	0.052
7/15/16 1:00 AM	0.108	0.086	0.038	0.046	0.056	0.053
7/15/16 1:30 AM	0.108	0.086	0.038	0.046	0.056	0.053
7/15/16 2:00 AM	0.108	0.086	0.038	0.046	0.056	0.053
7/15/16 2:30 AM	0.108	0.086	0.038	0.046	0.056	0.053
7/15/16 3:00 AM	0.108	0.086	0.038	0.046	0.056	0.053
7/15/16 3:30 AM	0.108	0.086	0.038	0.046	0.056	0.053
7/15/16 4:00 AM	0.108	0.086	0.038	0.045	0.056	0.053
7/15/16 4:30 AM	0.108	0.086	0.038	0.045	0.056	0.053
7/15/16 5:00 AM	0.108	0.086	0.038	0.046	0.056	0.053
7/15/16 5:30 AM	0.108	0.086	0.038	0.046	0.056	0.053
7/15/16 6:00 AM	0.108	0.086	0.038	0.046	0.056	0.053
7/15/16 6:30 AM	0.108	0.086	0.038	0.046	0.056	0.053
7/15/16 7:00 AM	0.108	0.086	0.038	0.045	0.056	0.053
7/15/16 7:30 AM	0.108	0.086	0.038	0.045	0.056	0.053
7/15/16 8:00 AM	0.108	0.086	0.038	0.046	0.056	0.054
7/15/16 8:30 AM	0.108	0.086	0.038	0.046	0.056	0.054
7/15/16 9:00 AM	0.108	0.085	0.038	0.046	0.056	0.054
7/15/16 9:30 AM	0.108	0.085	0.038	0.046	0.056	0.054
7/15/16 10:00 AM	0.108	0.086	0.038	0.046	0.056	0.054
7/15/16 10:30 AM	0.108	0.086	0.038	0.046	0.056	0.054
7/15/16 11:00 AM	0.108	0.085	0.038	0.046	0.056	0.054
7/15/16 11:30 AM	0.108	0.085	0.038	0.046	0.056	0.054
7/15/16 12:00 PM	0.108	0.085	0.038	0.046	0.056	0.054
7/15/16 12:30 PM	0.108	0.085	0.038	0.046	0.056	0.054
7/15/16 1:00 PM	0.107	0.085	0.038	0.045	0.056	0.054
7/15/16 1:30 PM	0.107	0.085	0.038	0.045	0.056	0.054
7/15/16 2:00 PM	0.107	0.085	0.038	0.046	0.056	0.054

7/15/16 2:30 PM	0.107	0.085	0.038	0.046	0.056	0.054
7/15/16 3:00 PM	0.107	0.084	0.038	0.046	0.056	0.054
7/15/16 3:30 PM	0.107	0.084	0.038	0.046	0.056	0.054
7/15/16 4:00 PM	0.106	0.084	0.038	0.046	0.056	0.055
7/15/16 4:30 PM	0.106	0.084	0.038	0.046	0.056	0.055
7/15/16 5:00 PM	0.105	0.084	0.038	0.046	0.056	0.054
7/15/16 5:30 PM	0.105	0.084	0.038	0.046	0.056	0.054
7/15/16 6:00 PM	0.105	0.084	0.038	0.046	0.056	0.055
7/15/16 6:30 PM	0.105	0.084	0.038	0.046	0.056	0.055
7/15/16 7:00 PM	0.105	0.083	0.038	0.046	0.056	0.055
7/15/16 7:30 PM	0.105	0.083	0.038	0.046	0.056	0.055
7/15/16 8:00 PM	0.104	0.083	0.038	0.046	0.056	0.055
7/15/16 8:30 PM	0.104	0.083	0.038	0.046	0.056	0.055
7/15/16 9:00 PM	0.104	0.083	0.038	0.046	0.056	0.055
7/15/16 9:30 PM	0.104	0.083	0.038	0.046	0.056	0.055
7/15/16 10:00 PM	0.104	0.083	0.038	0.046	0.056	0.055
7/15/16 10:30 PM	0.104	0.083	0.038	0.046	0.056	0.055
7/15/16 11:00 PM	0.103	0.083	0.038	0.046	0.056	0.055
7/15/16 11:30 PM	0.103	0.083	0.038	0.046	0.056	0.055
7/16/16 12:00 AM	0.104	0.083	0.038	0.046	0.056	0.055
7/16/16 12:30 AM	0.104	0.083	0.038	0.046	0.056	0.055
7/16/16 1:00 AM	0.104	0.083	0.038	0.046	0.056	0.055
7/16/16 1:30 AM	0.104	0.083	0.038	0.046	0.056	0.055
7/16/16 2:00 AM	0.103	0.082	0.038	0.046	0.056	0.055
7/16/16 2:30 AM	0.103	0.082	0.038	0.046	0.056	0.055
7/16/16 3:00 AM	0.103	0.083	0.038	0.046	0.056	0.055
7/16/16 3:30 AM	0.103	0.083	0.038	0.046	0.056	0.055
7/16/16 4:00 AM	0.103	0.083	0.038	0.046	0.056	0.055
7/16/16 4:30 AM	0.103	0.083	0.038	0.046	0.056	0.055
7/16/16 5:00 AM	0.103	0.082	0.038	0.046	0.056	0.055
7/16/16 5:30 AM	0.103	0.082	0.038	0.046	0.056	0.055
7/16/16 6:00 AM	0.103	0.082	0.038	0.046	0.056	0.055
7/16/16 6:30 AM	0.103	0.082	0.038	0.046	0.056	0.055
7/16/16 7:00 AM	0.103	0.082	0.038	0.046	0.056	0.055
7/16/16 7:30 AM	0.103	0.082	0.038	0.046	0.056	0.055
7/16/16 8:00 AM	0.103	0.082	0.038	0.046	0.056	0.055
7/16/16 8:30 AM	0.103	0.082	0.038	0.046	0.056	0.055
7/16/16 9:00 AM	0.104	0.082	0.038	0.046	0.056	0.055
7/16/16 9:30 AM	0.104	0.082	0.038	0.046	0.056	0.055
7/16/16 10:00 AM	0.103	0.082	0.038	0.046	0.056	0.055
7/16/16 10:30 AM	0.103	0.082	0.038	0.046	0.056	0.055
7/16/16 11:00 AM	0.103	0.081	0.038	0.046	0.056	0.055
7/16/16 11:30 AM	0.103	0.081	0.038	0.046	0.056	0.055
7/16/16 12:00 PM	0.103	0.081	0.038	0.046	0.056	0.055
7/16/16 12:30 PM	0.103	0.081	0.038	0.046	0.056	0.055
7/16/16 1:00 PM	0.103	0.081	0.038	0.046	0.056	0.055
7/16/16 1:30 PM	0.103	0.081	0.038	0.046	0.056	0.055
7/16/16 2:00 PM	0.102	0.081	0.038	0.046	0.056	0.055
7/16/16 2:30 PM	0.102	0.081	0.038	0.046	0.056	0.055
7/16/16 3:00 PM	0.102	0.08	0.038	0.046	0.056	0.055
7/16/16 3:30 PM	0.102	0.08	0.038	0.046	0.056	0.055
7/16/16 4:00 PM	0.101	0.08	0.038	0.046	0.056	0.055
7/16/16 4:30 PM	0.101	0.08	0.038	0.046	0.056	0.055

7/16/16 5:00 PM	0.101	0.08	0.038	0.046	0.056	0.055
7/16/16 5:30 PM	0.101	0.08	0.038	0.046	0.056	0.055
7/16/16 6:00 PM	0.1	0.08	0.038	0.046	0.056	0.055
7/16/16 6:30 PM	0.1	0.08	0.038	0.046	0.056	0.055
7/16/16 7:00 PM	0.1	0.08	0.038	0.046	0.056	0.055
7/16/16 7:30 PM	0.1	0.08	0.038	0.046	0.056	0.055
7/16/16 8:00 PM	0.1	0.079	0.038	0.046	0.056	0.055
7/16/16 8:30 PM	0.1	0.079	0.038	0.046	0.056	0.055
7/16/16 9:00 PM	0.1	0.079	0.038	0.046	0.056	0.055
7/16/16 9:30 PM	0.1	0.079	0.038	0.046	0.056	0.055
7/16/16 10:00 PM	0.099	0.079	0.038	0.046	0.056	0.055
7/16/16 10:30 PM	0.099	0.079	0.038	0.046	0.056	0.055
7/16/16 11:00 PM	0.099	0.079	0.038	0.046	0.056	0.055
7/16/16 11:30 PM	0.099	0.079	0.038	0.046	0.056	0.055
7/17/16 12:00 AM	0.1	0.079	0.038	0.045	0.056	0.055
7/17/16 12:30 AM	0.1	0.079	0.038	0.045	0.056	0.055
7/17/16 1:00 AM	0.099	0.079	0.038	0.045	0.056	0.055
7/17/16 1:30 AM	0.099	0.079	0.038	0.045	0.056	0.055
7/17/16 2:00 AM	0.099	0.079	0.038	0.046	0.056	0.055
7/17/16 2:30 AM	0.099	0.079	0.038	0.046	0.056	0.055
7/17/16 3:00 AM	0.099	0.079	0.038	0.046	0.056	0.055
7/17/16 3:30 AM	0.099	0.079	0.038	0.046	0.056	0.055
7/17/16 4:00 AM	0.099	0.079	0.038	0.045	0.056	0.055
7/17/16 4:30 AM	0.099	0.079	0.038	0.045	0.056	0.055
7/17/16 5:00 AM	0.099	0.079	0.038	0.045	0.056	0.055
7/17/16 5:30 AM	0.099	0.079	0.038	0.045	0.056	0.055
7/17/16 6:00 AM	0.099	0.079	0.038	0.045	0.056	0.055
7/17/16 6:30 AM	0.099	0.079	0.038	0.045	0.056	0.055
7/17/16 7:00 AM	0.099	0.079	0.038	0.045	0.055	0.055
7/17/16 7:30 AM	0.099	0.079	0.038	0.045	0.055	0.055
7/17/16 8:00 AM	0.099	0.078	0.038	0.045	0.056	0.054
7/17/16 8:30 AM	0.099	0.078	0.038	0.045	0.056	0.054
7/17/16 9:00 AM	0.099	0.078	0.038	0.045	0.056	0.054
7/17/16 9:30 AM	0.099	0.078	0.038	0.045	0.056	0.054
7/17/16 10:00 AM	0.099	0.078	0.038	0.045	0.056	0.054
7/17/16 10:30 AM	0.099	0.078	0.038	0.045	0.056	0.054
7/17/16 11:00 AM	0.099	0.078	0.038	0.045	0.056	0.054
7/17/16 11:30 AM	0.099	0.078	0.038	0.045	0.056	0.054
7/17/16 12:00 PM	0.099	0.078	0.038	0.045	0.056	0.055
7/17/16 12:30 PM	0.099	0.078	0.038	0.045	0.056	0.055
7/17/16 1:00 PM	0.099	0.078	0.038	0.045	0.056	0.054
7/17/16 1:30 PM	0.099	0.078	0.038	0.045	0.056	0.054
7/17/16 2:00 PM	0.098	0.077	0.038	0.045	0.055	0.054
7/17/16 2:30 PM	0.098	0.077	0.038	0.045	0.055	0.054
7/17/16 3:00 PM	0.098	0.077	0.038	0.045	0.055	0.054
7/17/16 3:30 PM	0.098	0.077	0.038	0.045	0.055	0.054
7/17/16 4:00 PM	0.098	0.077	0.038	0.045	0.055	0.054
7/17/16 4:30 PM	0.098	0.077	0.038	0.045	0.055	0.054
7/17/16 5:00 PM	0.097	0.077	0.038	0.045	0.055	0.054
7/17/16 5:30 PM	0.097	0.077	0.038	0.045	0.055	0.054
7/17/16 6:00 PM	0.096	0.076	0.038	0.045	0.055	0.054
7/17/16 6:30 PM	0.096	0.076	0.038	0.045	0.055	0.054
7/17/16 7:00 PM	0.096	0.076	0.038	0.045	0.055	0.054

7/17/16 7:30 PM	0.096	0.076	0.038	0.045	0.055	0.054
7/17/16 8:00 PM	0.096	0.076	0.038	0.045	0.055	0.054
7/17/16 8:30 PM	0.096	0.076	0.038	0.045	0.055	0.054
7/17/16 9:00 PM	0.096	0.076	0.038	0.045	0.055	0.054
7/17/16 9:30 PM	0.096	0.076	0.038	0.045	0.055	0.054
7/17/16 10:00 PM	0.095	0.076	0.038	0.046	0.055	0.054
7/17/16 10:30 PM	0.095	0.076	0.038	0.046	0.055	0.054
7/17/16 11:00 PM	0.095	0.075	0.038	0.045	0.055	0.054
7/17/16 11:30 PM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 12:00 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 12:30 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 1:00 AM	0.095	0.075	0.038	0.046	0.055	0.054
7/18/16 1:30 AM	0.095	0.075	0.038	0.046	0.055	0.054
7/18/16 2:00 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 2:30 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 3:00 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 3:30 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 4:00 AM	0.095	0.075	0.038	0.046	0.055	0.054
7/18/16 4:30 AM	0.095	0.075	0.038	0.046	0.055	0.054
7/18/16 5:00 AM	0.095	0.075	0.038	0.046	0.055	0.054
7/18/16 5:30 AM	0.095	0.075	0.038	0.046	0.055	0.054
7/18/16 6:00 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 6:30 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 7:00 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 7:30 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 8:00 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 8:30 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 9:00 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 9:30 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 10:00 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 10:30 AM	0.095	0.075	0.038	0.045	0.055	0.054
7/18/16 11:00 AM	0.095	0.074	0.038	0.045	0.055	0.054
7/18/16 11:30 AM	0.095	0.074	0.038	0.045	0.055	0.054
7/18/16 12:00 PM	0.095	0.074	0.038	0.045	0.055	0.054
7/18/16 12:30 PM	0.095	0.074	0.038	0.045	0.055	0.054
7/18/16 1:00 PM	0.094	0.074	0.038	0.045	0.055	0.054
7/18/16 1:30 PM	0.094	0.074	0.038	0.045	0.055	0.054
7/18/16 2:00 PM	0.094	0.073	0.038	0.045	0.055	0.053
7/18/16 2:30 PM	0.094	0.073	0.038	0.045	0.055	0.053
7/18/16 3:00 PM	0.094	0.073	0.038	0.045	0.055	0.054
7/18/16 3:30 PM	0.094	0.073	0.038	0.045	0.055	0.054
7/18/16 4:00 PM	0.093	0.073	0.038	0.045	0.055	0.054
7/18/16 4:30 PM	0.093	0.073	0.038	0.045	0.055	0.054
7/18/16 5:00 PM	0.093	0.073	0.038	0.045	0.055	0.053
7/18/16 5:30 PM	0.093	0.073	0.038	0.045	0.055	0.053
7/18/16 6:00 PM	0.092	0.072	0.038	0.045	0.055	0.054
7/18/16 6:30 PM	0.092	0.072	0.038	0.045	0.055	0.054
7/18/16 7:00 PM	0.092	0.072	0.038	0.045	0.055	0.053
7/18/16 7:30 PM	0.092	0.072	0.038	0.045	0.055	0.053
7/18/16 8:00 PM	0.091	0.072	0.038	0.045	0.055	0.053
7/18/16 8:30 PM	0.091	0.072	0.038	0.045	0.055	0.053
7/18/16 9:00 PM	0.091	0.072	0.038	0.045	0.055	0.053
7/18/16 9:30 PM	0.091	0.072	0.038	0.045	0.055	0.053

7/18/16 10:00 PM	0.091	0.072	0.038	0.045	0.055	0.053
7/18/16 10:30 PM	0.091	0.072	0.038	0.045	0.055	0.053
7/18/16 11:00 PM	0.091	0.072	0.038	0.045	0.055	0.053
7/18/16 11:30 PM	0.091	0.072	0.038	0.045	0.055	0.053
7/19/16 12:00 AM	0.091	0.071	0.038	0.045	0.055	0.053
7/19/16 12:30 AM	0.091	0.071	0.038	0.045	0.055	0.053
7/19/16 1:00 AM	0.09	0.072	0.038	0.045	0.055	0.053
7/19/16 1:30 AM	0.09	0.072	0.038	0.045	0.055	0.053
7/19/16 2:00 AM	0.091	0.071	0.038	0.045	0.055	0.053
7/19/16 2:30 AM	0.091	0.071	0.038	0.045	0.055	0.053
7/19/16 3:00 AM	0.09	0.071	0.038	0.045	0.055	0.053
7/19/16 3:30 AM	0.09	0.071	0.038	0.045	0.055	0.053
7/19/16 4:00 AM	0.091	0.071	0.038	0.045	0.055	0.053
7/19/16 4:30 AM	0.091	0.071	0.038	0.045	0.055	0.053
7/19/16 5:00 AM	0.09	0.071	0.038	0.045	0.055	0.053
7/19/16 5:30 AM	0.09	0.071	0.038	0.045	0.055	0.053
7/19/16 6:00 AM	0.091	0.071	0.038	0.045	0.054	0.053
7/19/16 6:30 AM	0.091	0.071	0.038	0.045	0.054	0.053
7/19/16 7:00 AM	0.091	0.071	0.038	0.045	0.055	0.053
7/19/16 7:30 AM	0.091	0.071	0.038	0.045	0.055	0.053
7/19/16 8:00 AM	0.091	0.071	0.038	0.045	0.054	0.053
7/19/16 8:30 AM	0.091	0.071	0.038	0.045	0.054	0.053
7/19/16 9:00 AM	0.091	0.071	0.038	0.045	0.055	0.053
7/19/16 9:30 AM	0.091	0.071	0.038	0.045	0.055	0.053
7/19/16 10:00 AM	0.091	0.071	0.038	0.045	0.054	0.053
7/19/16 10:30 AM	0.091	0.071	0.038	0.045	0.054	0.053
7/19/16 11:00 AM	0.091	0.071	0.038	0.045	0.054	0.053
7/19/16 11:30 AM	0.091	0.071	0.038	0.045	0.054	0.053
7/19/16 12:00 PM	0.09	0.07	0.038	0.045	0.054	0.053
7/19/16 12:30 PM	0.09	0.07	0.038	0.045	0.054	0.053
7/19/16 1:00 PM	0.09	0.07	0.038	0.045	0.054	0.053
7/19/16 1:30 PM	0.09	0.07	0.038	0.045	0.054	0.053
7/19/16 2:00 PM	0.089	0.07	0.038	0.045	0.055	0.053
7/19/16 2:30 PM	0.089	0.07	0.038	0.045	0.055	0.053
7/19/16 3:00 PM	0.089	0.07	0.038	0.045	0.054	0.053
7/19/16 3:30 PM	0.089	0.07	0.038	0.045	0.054	0.053
7/19/16 4:00 PM	0.088	0.069	0.038	0.045	0.054	0.053
7/19/16 4:30 PM	0.088	0.069	0.038	0.045	0.054	0.053
7/19/16 5:00 PM	0.087	0.069	0.038	0.045	0.054	0.053
7/19/16 5:30 PM	0.087	0.069	0.038	0.045	0.054	0.053
7/19/16 6:00 PM	0.087	0.068	0.038	0.045	0.054	0.053
7/19/16 6:30 PM	0.087	0.068	0.038	0.045	0.054	0.053
7/19/16 7:00 PM	0.086	0.068	0.038	0.045	0.054	0.053
7/19/16 7:30 PM	0.086	0.068	0.038	0.045	0.054	0.053
7/19/16 8:00 PM	0.086	0.068	0.038	0.045	0.054	0.052
7/19/16 8:30 PM	0.086	0.068	0.038	0.045	0.054	0.052
7/19/16 9:00 PM	0.086	0.068	0.038	0.045	0.054	0.053
7/19/16 9:30 PM	0.086	0.068	0.038	0.045	0.054	0.053
7/19/16 10:00 PM	0.085	0.068	0.038	0.045	0.054	0.053
7/19/16 10:30 PM	0.085	0.068	0.038	0.045	0.054	0.053
7/19/16 11:00 PM	0.085	0.068	0.038	0.045	0.054	0.053
7/19/16 11:30 PM	0.085	0.068	0.038	0.045	0.054	0.053
7/20/16 12:00 AM	0.085	0.068	0.038	0.045	0.054	0.053

7/20/16 12:30 AM	0.085	0.068	0.038	0.045	0.054	0.053
7/20/16 1:00 AM	0.085	0.068	0.038	0.045	0.054	0.052
7/20/16 1:30 AM	0.085	0.068	0.038	0.045	0.054	0.052
7/20/16 2:00 AM	0.085	0.068	0.038	0.045	0.054	0.052
7/20/16 2:30 AM	0.085	0.068	0.038	0.045	0.054	0.052
7/20/16 3:00 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 3:30 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 4:00 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 4:30 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 5:00 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 5:30 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 6:00 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 6:30 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 7:00 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 7:30 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 8:00 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 8:30 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 9:00 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 9:30 AM	0.085	0.067	0.038	0.045	0.054	0.052
7/20/16 10:00 AM	0.085	0.066	0.038	0.045	0.054	0.052
7/20/16 10:30 AM	0.085	0.066	0.038	0.045	0.054	0.052
7/20/16 11:00 AM	0.084	0.066	0.038	0.045	0.054	0.052
7/20/16 11:30 AM	0.084	0.066	0.038	0.045	0.054	0.052
7/20/16 12:00 PM	0.084	0.066	0.038	0.045	0.054	0.052
7/20/16 12:30 PM	0.084	0.066	0.038	0.045	0.054	0.052
7/20/16 1:00 PM	0.083	0.066	0.038	0.045	0.054	0.052
7/20/16 1:30 PM	0.083	0.066	0.038	0.045	0.054	0.052
7/20/16 2:00 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 2:30 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 3:00 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 3:30 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 4:00 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 4:30 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 5:00 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 5:30 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 6:00 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 6:30 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 7:00 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 7:30 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 8:00 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 8:30 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 9:00 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 9:30 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 10:00 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 10:30 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 11:00 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/20/16 11:30 PM	0.082	0.065	0.038	0.045	0.054	0.052
7/21/16 12:00 AM	0.082	0.065	0.038	0.045	0.054	0.052
7/21/16 12:30 AM	0.082	0.065	0.038	0.045	0.054	0.052
7/21/16 1:00 AM	0.082	0.064	0.038	0.045	0.054	0.052
7/21/16 1:30 AM	0.082	0.064	0.038	0.045	0.054	0.052
7/21/16 2:00 AM	0.082	0.065	0.038	0.045	0.054	0.052
7/21/16 2:30 AM	0.082	0.065	0.038	0.045	0.054	0.052

7/21/16 3:00 AM	0.082	0.064	0.038	0.045	0.054	0.052
7/21/16 3:30 AM	0.082	0.064	0.038	0.045	0.054	0.052
7/21/16 4:00 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 4:30 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 5:00 AM	0.082	0.064	0.038	0.045	0.054	0.052
7/21/16 5:30 AM	0.082	0.064	0.038	0.045	0.054	0.052
7/21/16 6:00 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 6:30 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 7:00 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 7:30 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 8:00 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 8:30 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 9:00 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 9:30 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 10:00 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 10:30 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 11:00 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 11:30 AM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 12:00 PM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 12:30 PM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 1:00 PM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 1:30 PM	0.082	0.064	0.038	0.045	0.054	0.051
7/21/16 2:00 PM	0.082	0.064	0.038	0.045	0.053	0.051
7/21/16 2:30 PM	0.082	0.064	0.038	0.045	0.053	0.051
7/21/16 3:00 PM	0.083	0.064	0.038	0.045	0.054	0.051
7/21/16 3:30 PM	0.083	0.064	0.038	0.045	0.054	0.051
7/21/16 4:00 PM	0.083	0.064	0.038	0.045	0.054	0.051
7/21/16 4:30 PM	0.083	0.064	0.038	0.045	0.054	0.051
7/21/16 5:00 PM	0.083	0.064	0.038	0.045	0.054	0.051
7/21/16 5:30 PM	0.083	0.064	0.038	0.045	0.054	0.051
7/21/16 6:00 PM	0.083	0.063	0.038	0.045	0.054	0.051
7/21/16 6:30 PM	0.083	0.063	0.038	0.045	0.054	0.051
7/21/16 7:00 PM	0.083	0.063	0.038	0.045	0.053	0.051
7/21/16 7:30 PM	0.083	0.063	0.038	0.045	0.053	0.051
7/21/16 8:00 PM	0.085	0.063	0.038	0.045	0.053	0.051
7/21/16 8:30 PM	0.085	0.063	0.038	0.045	0.053	0.051
7/21/16 9:00 PM	0.086	0.064	0.039	0.045	0.053	0.051
7/21/16 9:30 PM	0.086	0.064	0.039	0.045	0.053	0.051
7/21/16 10:00 PM	0.086	0.064	0.039	0.045	0.053	0.051
7/21/16 10:30 PM	0.086	0.064	0.039	0.045	0.053	0.051
7/21/16 11:00 PM	0.086	0.063	0.038	0.045	0.053	0.051
7/21/16 11:30 PM	0.086	0.063	0.038	0.045	0.053	0.051
7/22/16 12:00 AM	0.086	0.063	0.039	0.045	0.053	0.051
7/22/16 12:30 AM	0.086	0.063	0.039	0.045	0.053	0.051
7/22/16 1:00 AM	0.086	0.063	0.038	0.045	0.053	0.051
7/22/16 1:30 AM	0.086	0.063	0.038	0.045	0.053	0.051
7/22/16 2:00 AM	0.086	0.063	0.038	0.045	0.053	0.051
7/22/16 2:30 AM	0.086	0.063	0.038	0.045	0.053	0.051
7/22/16 3:00 AM	0.086	0.063	0.038	0.045	0.053	0.051
7/22/16 3:30 AM	0.086	0.063	0.038	0.045	0.053	0.051
7/22/16 4:00 AM	0.085	0.063	0.039	0.045	0.053	0.051
7/22/16 4:30 AM	0.085	0.063	0.039	0.045	0.053	0.051
7/22/16 5:00 AM	0.085	0.063	0.039	0.045	0.053	0.051

7/22/16 5:30 AM	0.085	0.063	0.039	0.045	0.053	0.051
7/22/16 6:00 AM	0.085	0.063	0.039	0.045	0.053	0.051
7/22/16 6:30 AM	0.085	0.063	0.039	0.045	0.053	0.051
7/22/16 7:00 AM	0.085	0.063	0.038	0.045	0.053	0.051
7/22/16 7:30 AM	0.085	0.063	0.038	0.045	0.053	0.051
7/22/16 8:00 AM	0.085	0.063	0.039	0.045	0.053	0.051
7/22/16 8:30 AM	0.085	0.063	0.039	0.045	0.053	0.051
7/22/16 9:00 AM	0.086	0.063	0.039	0.045	0.053	0.051
7/22/16 9:30 AM	0.086	0.063	0.039	0.045	0.053	0.051
7/22/16 10:00 AM	0.086	0.063	0.038	0.045	0.053	0.051
7/22/16 10:30 AM	0.086	0.063	0.038	0.045	0.053	0.051
7/22/16 11:00 AM	0.085	0.063	0.039	0.045	0.053	0.051
7/22/16 11:30 AM	0.085	0.063	0.039	0.045	0.053	0.051
7/22/16 12:00 PM	0.085	0.063	0.039	0.045	0.053	0.05
7/22/16 12:30 PM	0.085	0.063	0.039	0.045	0.053	0.05
7/22/16 1:00 PM	0.085	0.063	0.038	0.045	0.053	0.05
7/22/16 1:30 PM	0.085	0.063	0.038	0.045	0.053	0.05
7/22/16 2:00 PM	0.084	0.063	0.038	0.045	0.053	0.05
7/22/16 2:30 PM	0.084	0.063	0.038	0.045	0.053	0.05
7/22/16 3:00 PM	0.083	0.062	0.038	0.045	0.053	0.05
7/22/16 3:30 PM	0.083	0.062	0.038	0.045	0.053	0.05
7/22/16 4:00 PM	0.083	0.062	0.038	0.045	0.053	0.05
7/22/16 4:30 PM	0.083	0.062	0.038	0.045	0.053	0.05
7/22/16 5:00 PM	0.082	0.062	0.038	0.045	0.053	0.05
7/22/16 5:30 PM	0.082	0.062	0.038	0.045	0.053	0.05
7/22/16 6:00 PM	0.081	0.062	0.038	0.045	0.053	0.05
7/22/16 6:30 PM	0.081	0.062	0.038	0.045	0.053	0.05
7/22/16 7:00 PM	0.081	0.061	0.038	0.045	0.053	0.05
7/22/16 7:30 PM	0.081	0.061	0.038	0.045	0.053	0.05
7/22/16 8:00 PM	0.081	0.061	0.038	0.045	0.053	0.05
7/22/16 8:30 PM	0.081	0.061	0.038	0.045	0.053	0.05
7/22/16 9:00 PM	0.08	0.061	0.038	0.045	0.053	0.05
7/22/16 9:30 PM	0.08	0.061	0.038	0.045	0.053	0.05
7/22/16 10:00 PM	0.08	0.061	0.038	0.045	0.053	0.05
7/22/16 10:30 PM	0.08	0.061	0.038	0.045	0.053	0.05
7/22/16 11:00 PM	0.08	0.061	0.038	0.045	0.053	0.05
7/22/16 11:30 PM	0.08	0.061	0.038	0.045	0.053	0.05
7/23/16 12:00 AM	0.08	0.061	0.038	0.045	0.053	0.05
7/23/16 12:30 AM	0.08	0.061	0.038	0.045	0.053	0.05
7/23/16 1:00 AM	0.08	0.061	0.038	0.045	0.053	0.05
7/23/16 1:30 AM	0.08	0.061	0.038	0.045	0.053	0.05
7/23/16 2:00 AM	0.08	0.061	0.038	0.045	0.053	0.05
7/23/16 2:30 AM	0.08	0.061	0.038	0.045	0.053	0.05
7/23/16 3:00 AM	0.09	0.061	0.038	0.044	0.053	0.05
7/23/16 3:30 AM	0.09	0.061	0.038	0.044	0.053	0.05
7/23/16 4:00 AM	0.1	0.061	0.039	0.045	0.053	0.05
7/23/16 4:30 AM	0.1	0.061	0.039	0.045	0.053	0.05
7/23/16 5:00 AM	0.104	0.061	0.039	0.045	0.053	0.05
7/23/16 5:30 AM	0.104	0.061	0.039	0.045	0.053	0.05
7/23/16 6:00 AM	0.1	0.061	0.038	0.045	0.053	0.05
7/23/16 6:30 AM	0.1	0.061	0.038	0.045	0.053	0.05
7/23/16 7:00 AM	0.098	0.061	0.038	0.045	0.053	0.05
7/23/16 7:30 AM	0.098	0.061	0.038	0.045	0.053	0.05

7/23/16 8:00 AM	0.097	0.061	0.039	0.044	0.053	0.05
7/23/16 8:30 AM	0.097	0.061	0.039	0.044	0.053	0.05
7/23/16 9:00 AM	0.096	0.061	0.039	0.045	0.053	0.05
7/23/16 9:30 AM	0.096	0.061	0.039	0.045	0.053	0.05
7/23/16 10:00 AM	0.095	0.061	0.038	0.045	0.053	0.05
7/23/16 10:30 AM	0.095	0.061	0.038	0.045	0.053	0.05
7/23/16 11:00 AM	0.095	0.061	0.039	0.045	0.053	0.05
7/23/16 11:30 AM	0.095	0.061	0.039	0.045	0.053	0.05
7/23/16 12:00 PM	0.094	0.061	0.038	0.045	0.053	0.05
7/23/16 12:30 PM	0.094	0.061	0.038	0.045	0.053	0.05
7/23/16 1:00 PM	0.094	0.061	0.039	0.044	0.053	0.05
7/23/16 1:30 PM	0.094	0.061	0.039	0.044	0.053	0.05
7/23/16 2:00 PM	0.093	0.061	0.038	0.044	0.053	0.05
7/23/16 2:30 PM	0.093	0.061	0.038	0.044	0.053	0.05
7/23/16 3:00 PM	0.096	0.062	0.039	0.045	0.053	0.05
7/23/16 3:30 PM	0.096	0.062	0.039	0.045	0.053	0.05
7/23/16 4:00 PM	0.097	0.062	0.039	0.045	0.053	0.05
7/23/16 4:30 PM	0.097	0.062	0.039	0.045	0.053	0.05
7/23/16 5:00 PM	0.098	0.062	0.038	0.045	0.053	0.05
7/23/16 5:30 PM	0.098	0.062	0.038	0.045	0.053	0.05
7/23/16 6:00 PM	0.098	0.062	0.039	0.045	0.053	0.05
7/23/16 6:30 PM	0.098	0.062	0.039	0.045	0.053	0.05
7/23/16 7:00 PM	0.097	0.062	0.039	0.045	0.053	0.05
7/23/16 7:30 PM	0.097	0.062	0.039	0.045	0.053	0.05
7/23/16 8:00 PM	0.097	0.062	0.038	0.045	0.053	0.05
7/23/16 8:30 PM	0.097	0.062	0.038	0.045	0.053	0.05
7/23/16 9:00 PM	0.097	0.062	0.039	0.044	0.053	0.05
7/23/16 9:30 PM	0.097	0.062	0.039	0.044	0.053	0.05
7/23/16 10:00 PM	0.096	0.062	0.039	0.044	0.053	0.05
7/23/16 10:30 PM	0.096	0.062	0.039	0.044	0.053	0.05
7/23/16 11:00 PM	0.096	0.062	0.039	0.044	0.053	0.05
7/23/16 11:30 PM	0.096	0.062	0.039	0.044	0.053	0.05
7/24/16 12:00 AM	0.096	0.063	0.039	0.044	0.053	0.05
7/24/16 12:30 AM	0.096	0.063	0.039	0.044	0.053	0.05
7/24/16 1:00 AM	0.096	0.063	0.038	0.045	0.053	0.05
7/24/16 1:30 AM	0.096	0.063	0.038	0.045	0.053	0.05
7/24/16 2:00 AM	0.096	0.063	0.038	0.045	0.053	0.05
7/24/16 2:30 AM	0.096	0.063	0.038	0.045	0.053	0.05
7/24/16 3:00 AM	0.096	0.063	0.038	0.044	0.053	0.05
7/24/16 3:30 AM	0.096	0.063	0.038	0.044	0.053	0.05
7/24/16 4:00 AM	0.096	0.063	0.039	0.044	0.053	0.05
7/24/16 4:30 AM	0.096	0.063	0.039	0.044	0.053	0.05
7/24/16 5:00 AM	0.096	0.063	0.039	0.045	0.053	0.05
7/24/16 5:30 AM	0.096	0.063	0.039	0.045	0.053	0.05
7/24/16 6:00 AM	0.096	0.063	0.039	0.045	0.053	0.05
7/24/16 6:30 AM	0.096	0.063	0.039	0.045	0.053	0.05
7/24/16 7:00 AM	0.096	0.063	0.039	0.045	0.053	0.05
7/24/16 7:30 AM	0.096	0.063	0.039	0.045	0.053	0.05
7/24/16 8:00 AM	0.096	0.064	0.039	0.045	0.053	0.05
7/24/16 8:30 AM	0.096	0.064	0.039	0.045	0.053	0.05
7/24/16 9:00 AM	0.096	0.064	0.039	0.045	0.053	0.05
7/24/16 9:30 AM	0.096	0.064	0.039	0.045	0.053	0.05
7/24/16 10:00 AM	0.095	0.064	0.039	0.045	0.053	0.049

7/24/16 10:30 AM	0.095	0.064	0.039	0.045	0.053	0.049
7/24/16 11:00 AM	0.095	0.064	0.038	0.044	0.053	0.05
7/24/16 11:30 AM	0.095	0.064	0.038	0.044	0.053	0.05
7/24/16 12:00 PM	0.095	0.064	0.039	0.044	0.053	0.049
7/24/16 12:30 PM	0.095	0.064	0.039	0.044	0.053	0.049
7/24/16 1:00 PM	0.094	0.064	0.039	0.044	0.053	0.049
7/24/16 1:30 PM	0.094	0.064	0.039	0.044	0.053	0.049
7/24/16 2:00 PM	0.093	0.064	0.038	0.045	0.053	0.049
7/24/16 2:30 PM	0.093	0.064	0.038	0.045	0.053	0.049
7/24/16 3:00 PM	0.093	0.064	0.039	0.045	0.053	0.049
7/24/16 3:30 PM	0.093	0.064	0.039	0.045	0.053	0.049
7/24/16 4:00 PM	0.092	0.064	0.038	0.044	0.053	0.049
7/24/16 4:30 PM	0.092	0.064	0.038	0.044	0.053	0.049
7/24/16 5:00 PM	0.091	0.064	0.039	0.044	0.053	0.049
7/24/16 5:30 PM	0.091	0.064	0.039	0.044	0.053	0.049
7/24/16 6:00 PM	0.09	0.063	0.038	0.044	0.052	0.049
7/24/16 6:30 PM	0.09	0.063	0.038	0.044	0.052	0.049
7/24/16 7:00 PM	0.09	0.063	0.038	0.044	0.053	0.049
7/24/16 7:30 PM	0.09	0.063	0.038	0.044	0.053	0.049
7/24/16 8:00 PM	0.09	0.063	0.039	0.044	0.052	0.049
7/24/16 8:30 PM	0.09	0.063	0.039	0.044	0.052	0.049
7/24/16 9:00 PM	0.089	0.064	0.039	0.045	0.053	0.049
7/24/16 9:30 PM	0.089	0.064	0.039	0.045	0.053	0.049
7/24/16 10:00 PM	0.089	0.064	0.039	0.045	0.053	0.049
7/24/16 10:30 PM	0.089	0.064	0.039	0.045	0.053	0.049
7/24/16 11:00 PM	0.089	0.064	0.039	0.045	0.052	0.049
7/24/16 11:30 PM	0.089	0.064	0.039	0.045	0.052	0.049
7/25/16 12:00 AM	0.089	0.064	0.039	0.045	0.053	0.049
7/25/16 12:30 AM	0.089	0.064	0.039	0.045	0.053	0.049
7/25/16 1:00 AM	0.089	0.064	0.038	0.045	0.052	0.049
7/25/16 1:30 AM	0.089	0.064	0.038	0.045	0.052	0.049
7/25/16 2:00 AM	0.089	0.064	0.039	0.044	0.053	0.049
7/25/16 2:30 AM	0.089	0.064	0.039	0.044	0.053	0.049
7/25/16 3:00 AM	0.089	0.064	0.039	0.045	0.053	0.049
7/25/16 3:30 AM	0.089	0.064	0.039	0.045	0.053	0.049
7/25/16 4:00 AM	0.09	0.064	0.038	0.044	0.052	0.049
7/25/16 4:30 AM	0.09	0.064	0.038	0.044	0.052	0.049
7/25/16 5:00 AM	0.089	0.064	0.039	0.044	0.052	0.049
7/25/16 5:30 AM	0.089	0.064	0.039	0.044	0.052	0.049
7/25/16 6:00 AM	0.09	0.064	0.039	0.045	0.052	0.049
7/25/16 6:30 AM	0.09	0.064	0.039	0.045	0.052	0.049
7/25/16 7:00 AM	0.09	0.064	0.038	0.045	0.052	0.049
7/25/16 7:30 AM	0.09	0.064	0.038	0.045	0.052	0.049
7/25/16 8:00 AM	0.09	0.064	0.039	0.045	0.052	0.049
7/25/16 8:30 AM	0.09	0.064	0.039	0.045	0.052	0.049
7/25/16 9:00 AM	0.089	0.064	0.039	0.045	0.052	0.049
7/25/16 9:30 AM	0.089	0.064	0.039	0.045	0.052	0.049
7/25/16 10:00 AM	0.089	0.065	0.039	0.045	0.052	0.049
7/25/16 10:30 AM	0.089	0.065	0.039	0.045	0.052	0.049
7/25/16 11:00 AM	0.089	0.064	0.038	0.045	0.052	0.049
7/25/16 11:30 AM	0.089	0.064	0.038	0.045	0.052	0.049
7/25/16 12:00 PM	0.088	0.064	0.039	0.045	0.052	0.049
7/25/16 12:30 PM	0.088	0.064	0.039	0.045	0.052	0.049

7/25/16 1:00 PM	0.088	0.064	0.039	0.045	0.052	0.049
7/25/16 1:30 PM	0.088	0.064	0.039	0.045	0.052	0.049
7/25/16 2:00 PM	0.088	0.064	0.038	0.045	0.052	0.049
7/25/16 2:30 PM	0.088	0.064	0.038	0.045	0.052	0.049
7/25/16 3:00 PM	0.087	0.064	0.038	0.045	0.053	0.049
7/25/16 3:30 PM	0.087	0.064	0.038	0.045	0.053	0.049
7/25/16 4:00 PM	0.086	0.063	0.039	0.045	0.052	0.049
7/25/16 4:30 PM	0.086	0.063	0.039	0.045	0.052	0.049
7/25/16 5:00 PM	0.085	0.063	0.039	0.045	0.052	0.049
7/25/16 5:30 PM	0.085	0.063	0.039	0.045	0.052	0.049
7/25/16 6:00 PM	0.085	0.063	0.039	0.045	0.052	0.049
7/25/16 6:30 PM	0.085	0.063	0.039	0.045	0.052	0.049
7/25/16 7:00 PM	0.085	0.063	0.038	0.045	0.053	0.049
7/25/16 7:30 PM	0.085	0.063	0.038	0.045	0.053	0.049
7/25/16 8:00 PM	0.084	0.063	0.039	0.045	0.052	0.049
7/25/16 8:30 PM	0.084	0.063	0.039	0.045	0.052	0.049
7/25/16 9:00 PM	0.084	0.063	0.039	0.045	0.052	0.049
7/25/16 9:30 PM	0.084	0.063	0.039	0.045	0.052	0.049
7/25/16 10:00 PM	0.083	0.063	0.038	0.045	0.052	0.049
7/25/16 10:30 PM	0.083	0.063	0.038	0.045	0.052	0.049
7/25/16 11:00 PM	0.083	0.063	0.039	0.045	0.052	0.049
7/25/16 11:30 PM	0.083	0.063	0.039	0.045	0.052	0.049
06-Aug-16 00:00:00	0.045	0.044	0.038	0.043	0.051	0.045
06-Aug-16 00:30:00	0.045	0.044	0.038	0.043	0.051	0.045
06-Aug-16 01:00:00	0.045	0.044	0.038	0.044	0.051	0.045
06-Aug-16 01:30:00	0.045	0.044	0.038	0.044	0.051	0.045
06-Aug-16 02:00:00	0.045	0.044	0.038	0.044	0.051	0.045
06-Aug-16 02:30:00	0.045	0.044	0.038	0.044	0.051	0.045
06-Aug-16 03:00:00	0.045	0.044	0.038	0.044	0.051	0.045
06-Aug-16 03:30:00	0.045	0.044	0.038	0.044	0.051	0.045
06-Aug-16 04:00:00	0.045	0.044	0.038	0.044	0.051	0.045
06-Aug-16 04:30:00	0.045	0.044	0.038	0.044	0.051	0.045
06-Aug-16 05:00:00	0.045	0.044	0.038	0.044	0.051	0.045
06-Aug-16 05:30:00	0.045	0.044	0.038	0.044	0.051	0.045
06-Aug-16 06:00:00	0.045	0.043	0.038	0.043	0.051	0.045
06-Aug-16 06:30:00	0.045	0.043	0.038	0.043	0.051	0.045
06-Aug-16 07:00:00	0.045	0.044	0.038	0.044	0.051	0.045
06-Aug-16 07:30:00	0.045	0.044	0.038	0.044	0.051	0.045
06-Aug-16 08:00:00	0.046	0.043	0.038	0.044	0.051	0.045
06-Aug-16 08:30:00	0.046	0.043	0.038	0.044	0.051	0.045
06-Aug-16 09:00:00	0.046	0.044	0.038	0.044	0.051	0.045
06-Aug-16 09:30:00	0.046	0.044	0.038	0.044	0.051	0.045
06-Aug-16 10:00:00	0.046	0.043	0.038	0.044	0.051	0.045
06-Aug-16 10:30:00	0.046	0.043	0.038	0.044	0.051	0.045
06-Aug-16 11:00:00	0.046	0.043	0.038	0.044	0.051	0.045
06-Aug-16 11:30:00	0.046	0.043	0.038	0.044	0.051	0.045
06-Aug-16 12:00:00	0.046	0.043	0.038	0.043	0.051	0.045
06-Aug-16 12:30:00	0.046	0.043	0.038	0.043	0.051	0.045
06-Aug-16 13:00:00	0.046	0.043	0.038	0.043	0.051	0.045
06-Aug-16 13:30:00	0.046	0.043	0.038	0.043	0.051	0.045
06-Aug-16 14:00:00	0.046	0.043	0.038	0.043	0.051	0.045
06-Aug-16 14:30:00	0.046	0.043	0.038	0.043	0.051	0.045
06-Aug-16 15:00:00	0.046	0.043	0.038	0.044	0.051	0.045

06-Aug-16 15:30:00	0.046	0.043	0.038	0.044	0.051	0.045
06-Aug-16 16:00:00	0.045	0.043	0.038	0.044	0.051	0.045
06-Aug-16 16:30:00	0.045	0.043	0.038	0.044	0.051	0.045
06-Aug-16 17:00:00	0.045	0.043	0.038	0.044	0.051	0.045
06-Aug-16 17:30:00	0.045	0.043	0.038	0.044	0.051	0.045
06-Aug-16 18:00:00	0.045	0.042	0.038	0.043	0.051	0.045
06-Aug-16 18:30:00	0.045	0.042	0.038	0.043	0.051	0.045
06-Aug-16 19:00:00	0.045	0.042	0.038	0.044	0.051	0.045
06-Aug-16 19:30:00	0.045	0.042	0.038	0.044	0.051	0.045
06-Aug-16 20:00:00	0.045	0.042	0.038	0.043	0.051	0.045
06-Aug-16 20:30:00	0.045	0.042	0.038	0.043	0.051	0.045
06-Aug-16 21:00:00	0.045	0.042	0.038	0.043	0.051	0.045
06-Aug-16 21:30:00	0.045	0.042	0.038	0.043	0.051	0.045
06-Aug-16 22:00:00	0.045	0.042	0.038	0.043	0.051	0.045
06-Aug-16 22:30:00	0.045	0.042	0.038	0.043	0.051	0.045
06-Aug-16 23:00:00	0.045	0.042	0.038	0.043	0.051	0.045
06-Aug-16 23:30:00	0.045	0.042	0.038	0.043	0.051	0.045
07-Aug-16 00:00:00	0.045	0.042	0.038	0.043	0.051	0.045
07-Aug-16 00:30:00	0.045	0.042	0.038	0.043	0.051	0.045
07-Aug-16 01:00:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 01:30:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 02:00:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 02:30:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 03:00:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 03:30:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 04:00:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 04:30:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 05:00:00	0.044	0.042	0.038	0.043	0.05	0.045
07-Aug-16 05:30:00	0.044	0.042	0.038	0.043	0.05	0.045
07-Aug-16 06:00:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 06:30:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 07:00:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 07:30:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 08:00:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 08:30:00	0.044	0.042	0.038	0.043	0.051	0.045
07-Aug-16 09:00:00	0.045	0.042	0.038	0.043	0.051	0.045
07-Aug-16 09:30:00	0.045	0.042	0.038	0.043	0.051	0.045
07-Aug-16 10:00:00	0.045	0.042	0.038	0.043	0.051	0.045
07-Aug-16 10:30:00	0.045	0.042	0.038	0.043	0.051	0.045
07-Aug-16 11:00:00	0.045	0.042	0.038	0.043	0.051	0.045
07-Aug-16 11:30:00	0.045	0.042	0.038	0.043	0.051	0.045
07-Aug-16 12:00:00	0.045	0.042	0.038	0.043	0.05	0.045
07-Aug-16 12:30:00	0.045	0.042	0.038	0.043	0.05	0.045
07-Aug-16 13:00:00	0.045	0.042	0.038	0.043	0.051	0.045
07-Aug-16 13:30:00	0.045	0.042	0.038	0.043	0.051	0.045
07-Aug-16 14:00:00	0.045	0.041	0.038	0.043	0.051	0.045
07-Aug-16 14:30:00	0.045	0.041	0.038	0.043	0.051	0.045
07-Aug-16 15:00:00	0.045	0.041	0.038	0.043	0.051	0.045
07-Aug-16 15:30:00	0.045	0.041	0.038	0.043	0.051	0.045
07-Aug-16 16:00:00	0.045	0.041	0.038	0.043	0.051	0.045
07-Aug-16 16:30:00	0.045	0.041	0.038	0.043	0.051	0.045
07-Aug-16 17:00:00	0.045	0.041	0.038	0.043	0.051	0.045
07-Aug-16 17:30:00	0.045	0.041	0.038	0.043	0.051	0.045

07-Aug-16 18:00:00	0.044	0.041	0.038	0.043	0.05	0.045
07-Aug-16 18:30:00	0.044	0.041	0.038	0.043	0.05	0.045
07-Aug-16 19:00:00	0.044	0.041	0.038	0.043	0.051	0.045
07-Aug-16 19:30:00	0.044	0.041	0.038	0.043	0.051	0.045
07-Aug-16 20:00:00	0.044	0.041	0.038	0.043	0.05	0.045
07-Aug-16 20:30:00	0.044	0.041	0.038	0.043	0.05	0.045
07-Aug-16 21:00:00	0.044	0.041	0.038	0.043	0.05	0.045
07-Aug-16 21:30:00	0.044	0.041	0.038	0.043	0.05	0.045
07-Aug-16 22:00:00	0.044	0.041	0.038	0.043	0.051	0.045
07-Aug-16 22:30:00	0.044	0.041	0.038	0.043	0.051	0.045
07-Aug-16 23:00:00	0.044	0.041	0.038	0.043	0.05	0.045
07-Aug-16 23:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 00:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 00:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 01:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 01:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 02:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 02:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 03:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 03:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 04:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 04:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 05:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 05:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 06:00:00	0.044	0.041	0.038	0.043	0.051	0.045
08-Aug-16 06:30:00	0.044	0.041	0.038	0.043	0.051	0.045
08-Aug-16 07:00:00	0.044	0.041	0.038	0.043	0.051	0.045
08-Aug-16 07:30:00	0.044	0.041	0.038	0.043	0.051	0.045
08-Aug-16 08:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 08:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 09:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 09:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 10:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 10:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 11:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 11:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 12:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 12:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 13:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 13:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 14:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 14:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 15:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 15:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 16:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 16:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 17:00:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 17:30:00	0.044	0.041	0.038	0.043	0.05	0.045
08-Aug-16 18:00:00	0.044	0.04	0.038	0.043	0.05	0.044
08-Aug-16 18:30:00	0.044	0.04	0.038	0.043	0.05	0.044
08-Aug-16 19:00:00	0.044	0.04	0.038	0.043	0.05	0.044
08-Aug-16 19:30:00	0.044	0.04	0.038	0.043	0.05	0.044
08-Aug-16 20:00:00	0.044	0.04	0.038	0.043	0.05	0.044

08-Aug-16 20:30:00	0.044	0.04	0.038	0.043	0.05	0.044
08-Aug-16 21:00:00	0.044	0.04	0.038	0.043	0.05	0.045
08-Aug-16 21:30:00	0.044	0.04	0.038	0.043	0.05	0.045
08-Aug-16 22:00:00	0.043	0.04	0.038	0.043	0.05	0.044
08-Aug-16 22:30:00	0.043	0.04	0.038	0.043	0.05	0.044
08-Aug-16 23:00:00	0.043	0.04	0.038	0.043	0.05	0.044
08-Aug-16 23:30:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 00:00:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 00:30:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 01:00:00	0.043	0.04	0.038	0.043	0.05	0.045
09-Aug-16 01:30:00	0.043	0.04	0.038	0.043	0.05	0.045
09-Aug-16 02:00:00	0.043	0.04	0.038	0.043	0.05	0.045
09-Aug-16 02:30:00	0.043	0.04	0.038	0.043	0.05	0.045
09-Aug-16 03:00:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 03:30:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 04:00:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 04:30:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 05:00:00	0.043	0.04	0.038	0.043	0.05	0.045
09-Aug-16 05:30:00	0.043	0.04	0.038	0.043	0.05	0.045
09-Aug-16 06:00:00	0.043	0.04	0.038	0.043	0.05	0.045
09-Aug-16 06:30:00	0.043	0.04	0.038	0.043	0.05	0.045
09-Aug-16 07:00:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 07:30:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 08:00:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 08:30:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 09:00:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 09:30:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 10:00:00	0.043	0.04	0.038	0.043	0.05	0.045
09-Aug-16 10:30:00	0.043	0.04	0.038	0.043	0.05	0.045
09-Aug-16 11:00:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 11:30:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 12:00:00	0.044	0.04	0.038	0.043	0.05	0.044
09-Aug-16 12:30:00	0.044	0.04	0.038	0.043	0.05	0.044
09-Aug-16 13:00:00	0.044	0.04	0.038	0.043	0.05	0.044
09-Aug-16 13:30:00	0.044	0.04	0.038	0.043	0.05	0.044
09-Aug-16 14:00:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 14:30:00	0.043	0.04	0.038	0.043	0.05	0.044
09-Aug-16 15:00:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 15:30:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 16:00:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 16:30:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 17:00:00	0.043	0.039	0.038	0.043	0.05	0.045
09-Aug-16 17:30:00	0.043	0.039	0.038	0.043	0.05	0.045
09-Aug-16 18:00:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 18:30:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 19:00:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 19:30:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 20:00:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 20:30:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 21:00:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 21:30:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 22:00:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 22:30:00	0.043	0.039	0.038	0.043	0.05	0.044

09-Aug-16 23:00:00	0.043	0.039	0.038	0.043	0.05	0.044
09-Aug-16 23:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 00:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 00:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 01:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 01:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 02:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 02:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 03:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 03:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 04:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 04:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 05:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 05:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 06:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 06:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 07:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 07:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 08:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 08:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 09:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 09:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 10:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 10:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 11:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 11:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 12:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 12:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 13:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 13:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 14:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 14:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 15:00:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 15:30:00	0.043	0.039	0.038	0.043	0.05	0.044
10-Aug-16 16:00:00	0.043	0.038	0.038	0.043	0.05	0.044
10-Aug-16 16:30:00	0.043	0.038	0.038	0.043	0.05	0.044
10-Aug-16 17:00:00	0.043	0.038	0.038	0.043	0.05	0.044
10-Aug-16 17:30:00	0.043	0.038	0.038	0.043	0.05	0.044
10-Aug-16 18:00:00	0.043	0.038	0.038	0.043	0.05	0.044
10-Aug-16 18:30:00	0.043	0.038	0.038	0.043	0.05	0.044
10-Aug-16 19:00:00	0.042	0.038	0.037	0.043	0.05	0.044
10-Aug-16 19:30:00	0.042	0.038	0.037	0.043	0.05	0.044
10-Aug-16 20:00:00	0.042	0.038	0.038	0.043	0.05	0.044
10-Aug-16 20:30:00	0.042	0.038	0.038	0.043	0.05	0.044
10-Aug-16 21:00:00	0.042	0.038	0.038	0.043	0.05	0.044
10-Aug-16 21:30:00	0.042	0.038	0.038	0.043	0.05	0.044
10-Aug-16 22:00:00	0.042	0.038	0.038	0.043	0.05	0.044
10-Aug-16 22:30:00	0.042	0.038	0.038	0.043	0.05	0.044
10-Aug-16 23:00:00	0.042	0.038	0.038	0.043	0.05	0.044
10-Aug-16 23:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 00:00:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 00:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 01:00:00	0.042	0.038	0.038	0.043	0.05	0.044

11-Aug-16 01:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 02:00:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 02:30:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 03:00:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 03:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 04:00:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 04:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 05:00:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 05:30:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 06:00:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 06:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 07:00:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 07:30:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 08:00:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 08:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 09:00:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 09:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 10:00:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 10:30:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 11:00:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 11:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 12:00:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 12:30:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 13:00:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 13:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 14:00:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 14:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 15:00:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 15:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 16:00:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 16:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 17:00:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 17:30:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 18:00:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 18:30:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 19:00:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 19:30:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 20:00:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 20:30:00	0.042	0.038	0.037	0.043	0.05	0.044
11-Aug-16 21:00:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 21:30:00	0.042	0.038	0.038	0.043	0.05	0.044
11-Aug-16 22:00:00	0.042	0.037	0.037	0.043	0.05	0.044
11-Aug-16 22:30:00	0.042	0.037	0.037	0.043	0.05	0.044
11-Aug-16 23:00:00	0.041	0.037	0.038	0.043	0.05	0.044
11-Aug-16 23:30:00	0.041	0.037	0.038	0.043	0.05	0.044
12-Aug-16 00:00:00	0.041	0.038	0.037	0.043	0.05	0.044
12-Aug-16 00:30:00	0.041	0.038	0.037	0.043	0.05	0.044
12-Aug-16 01:00:00	0.041	0.038	0.038	0.043	0.05	0.044
12-Aug-16 01:30:00	0.041	0.038	0.038	0.043	0.05	0.044
12-Aug-16 02:00:00	0.041	0.038	0.038	0.043	0.05	0.044
12-Aug-16 02:30:00	0.041	0.038	0.038	0.043	0.05	0.044
12-Aug-16 03:00:00	0.041	0.037	0.037	0.043	0.05	0.044
12-Aug-16 03:30:00	0.041	0.037	0.037	0.043	0.05	0.044

12-Aug-16 04:00:00	0.041	0.038	0.037	0.043	0.05	0.044
12-Aug-16 04:30:00	0.041	0.038	0.037	0.043	0.05	0.044
12-Aug-16 05:00:00	0.041	0.038	0.037	0.043	0.05	0.044
12-Aug-16 05:30:00	0.041	0.038	0.037	0.043	0.05	0.044
12-Aug-16 06:00:00	0.041	0.038	0.038	0.043	0.05	0.044
12-Aug-16 06:30:00	0.041	0.038	0.038	0.043	0.05	0.044
12-Aug-16 07:00:00	0.042	0.038	0.037	0.043	0.05	0.044
12-Aug-16 07:30:00	0.042	0.038	0.037	0.043	0.05	0.044
12-Aug-16 08:00:00	0.042	0.038	0.038	0.043	0.05	0.044
12-Aug-16 08:30:00	0.042	0.038	0.038	0.043	0.05	0.044
12-Aug-16 09:00:00	0.042	0.038	0.037	0.043	0.05	0.044
12-Aug-16 09:30:00	0.042	0.038	0.037	0.043	0.05	0.044
12-Aug-16 10:00:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 10:30:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 11:00:00	0.042	0.037	0.038	0.043	0.05	0.044
12-Aug-16 11:30:00	0.042	0.037	0.038	0.043	0.05	0.044
12-Aug-16 12:00:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 12:30:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 13:00:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 13:30:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 14:00:00	0.042	0.037	0.038	0.043	0.05	0.044
12-Aug-16 14:30:00	0.042	0.037	0.038	0.043	0.05	0.044
12-Aug-16 15:00:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 15:30:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 16:00:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 16:30:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 17:00:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 17:30:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 18:00:00	0.042	0.037	0.038	0.043	0.05	0.044
12-Aug-16 18:30:00	0.042	0.037	0.038	0.043	0.05	0.044
12-Aug-16 19:00:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 19:30:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 20:00:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 20:30:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 21:00:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 21:30:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 22:00:00	0.041	0.037	0.037	0.043	0.05	0.044
12-Aug-16 22:30:00	0.041	0.037	0.037	0.043	0.05	0.044
12-Aug-16 23:00:00	0.042	0.037	0.037	0.043	0.05	0.044
12-Aug-16 23:30:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 00:00:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 00:30:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 01:00:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 01:30:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 02:00:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 02:30:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 03:00:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 03:30:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 04:00:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 04:30:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 05:00:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 05:30:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 06:00:00	0.041	0.037	0.037	0.043	0.05	0.044

13-Aug-16 06:30:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 07:00:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 07:30:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 08:00:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 08:30:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 09:00:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 09:30:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 10:00:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 10:30:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 11:00:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 11:30:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 12:00:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 12:30:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 13:00:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 13:30:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 14:00:00	0.042	0.037	0.037	0.043	0.05	0.043
13-Aug-16 14:30:00	0.042	0.037	0.037	0.043	0.05	0.043
13-Aug-16 15:00:00	0.042	0.037	0.037	0.043	0.05	0.043
13-Aug-16 15:30:00	0.042	0.037	0.037	0.043	0.05	0.043
13-Aug-16 16:00:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 16:30:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 17:00:00	0.042	0.037	0.037	0.043	0.05	0.043
13-Aug-16 17:30:00	0.042	0.037	0.037	0.043	0.05	0.043
13-Aug-16 18:00:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 18:30:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 19:00:00	0.042	0.037	0.037	0.043	0.05	0.043
13-Aug-16 19:30:00	0.042	0.037	0.037	0.043	0.05	0.043
13-Aug-16 20:00:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 20:30:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 21:00:00	0.042	0.037	0.037	0.043	0.05	0.043
13-Aug-16 21:30:00	0.042	0.037	0.037	0.043	0.05	0.043
13-Aug-16 22:00:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 22:30:00	0.042	0.037	0.037	0.043	0.05	0.044
13-Aug-16 23:00:00	0.041	0.037	0.037	0.043	0.05	0.044
13-Aug-16 23:30:00	0.041	0.037	0.037	0.043	0.05	0.044
14-Aug-16 00:00:00	0.041	0.037	0.037	0.043	0.05	0.043
14-Aug-16 00:30:00	0.041	0.037	0.037	0.043	0.05	0.043
14-Aug-16 01:00:00	0.041	0.037	0.037	0.043	0.05	0.044
14-Aug-16 01:30:00	0.041	0.037	0.037	0.043	0.05	0.044
14-Aug-16 02:00:00	0.041	0.037	0.037	0.043	0.05	0.044
14-Aug-16 02:30:00	0.041	0.037	0.037	0.043	0.05	0.044
14-Aug-16 03:00:00	0.041	0.037	0.037	0.043	0.05	0.044
14-Aug-16 03:30:00	0.041	0.037	0.037	0.043	0.05	0.044
14-Aug-16 04:00:00	0.041	0.037	0.037	0.043	0.05	0.044
14-Aug-16 04:30:00	0.041	0.037	0.037	0.043	0.05	0.044
14-Aug-16 05:00:00	0.041	0.036	0.037	0.043	0.05	0.043
14-Aug-16 05:30:00	0.041	0.036	0.037	0.043	0.05	0.043
14-Aug-16 06:00:00	0.041	0.036	0.037	0.043	0.05	0.044
14-Aug-16 06:30:00	0.041	0.036	0.037	0.043	0.05	0.044
14-Aug-16 07:00:00	0.041	0.036	0.037	0.043	0.05	0.043
14-Aug-16 07:30:00	0.041	0.036	0.037	0.043	0.05	0.043
14-Aug-16 08:00:00	0.041	0.036	0.037	0.043	0.05	0.044
14-Aug-16 08:30:00	0.041	0.036	0.037	0.043	0.05	0.044

14-Aug-16 09:00:00	0.042	0.037	0.037	0.043	0.05	0.044
14-Aug-16 09:30:00	0.042	0.037	0.037	0.043	0.05	0.044
14-Aug-16 10:00:00	0.042	0.037	0.037	0.043	0.05	0.043
14-Aug-16 10:30:00	0.042	0.037	0.037	0.043	0.05	0.043
14-Aug-16 11:00:00	0.042	0.037	0.037	0.043	0.05	0.043
14-Aug-16 11:30:00	0.042	0.037	0.037	0.043	0.05	0.043
14-Aug-16 12:00:00	0.042	0.037	0.037	0.043	0.05	0.044
14-Aug-16 12:30:00	0.042	0.037	0.037	0.043	0.05	0.044
14-Aug-16 13:00:00	0.042	0.036	0.037	0.043	0.05	0.044
14-Aug-16 13:30:00	0.042	0.036	0.037	0.043	0.05	0.044
14-Aug-16 14:00:00	0.042	0.036	0.037	0.043	0.05	0.044
14-Aug-16 14:30:00	0.042	0.036	0.037	0.043	0.05	0.044
14-Aug-16 15:00:00	0.042	0.036	0.037	0.043	0.05	0.043
14-Aug-16 15:30:00	0.042	0.036	0.037	0.043	0.05	0.043
14-Aug-16 16:00:00	0.042	0.036	0.037	0.043	0.05	0.043
14-Aug-16 16:30:00	0.042	0.036	0.037	0.043	0.05	0.043
14-Aug-16 17:00:00	0.042	0.036	0.037	0.043	0.05	0.043
14-Aug-16 17:30:00	0.042	0.036	0.037	0.043	0.05	0.043
14-Aug-16 18:00:00	0.042	0.036	0.037	0.043	0.05	0.043
14-Aug-16 18:30:00	0.042	0.036	0.037	0.043	0.05	0.043
14-Aug-16 19:00:00	0.042	0.036	0.037	0.043	0.05	0.043
14-Aug-16 19:30:00	0.042	0.036	0.037	0.043	0.05	0.043
14-Aug-16 20:00:00	0.042	0.036	0.037	0.043	0.05	0.043
14-Aug-16 20:30:00	0.042	0.036	0.037	0.043	0.05	0.043
14-Aug-16 21:00:00	0.041	0.036	0.037	0.043	0.05	0.043
14-Aug-16 21:30:00	0.041	0.036	0.037	0.043	0.05	0.043
14-Aug-16 22:00:00	0.041	0.036	0.037	0.043	0.05	0.043
14-Aug-16 22:30:00	0.041	0.036	0.037	0.043	0.05	0.043
14-Aug-16 23:00:00	0.041	0.036	0.037	0.043	0.05	0.043
14-Aug-16 23:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 00:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 00:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 01:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 01:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 02:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 02:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 03:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 03:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 04:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 04:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 05:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 05:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 06:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 06:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 07:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 07:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 08:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 08:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 09:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 09:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 10:00:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 10:30:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 11:00:00	0.042	0.036	0.037	0.043	0.05	0.043

15-Aug-16 11:30:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 12:00:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 12:30:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 13:00:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 13:30:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 14:00:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 14:30:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 15:00:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 15:30:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 16:00:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 16:30:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 17:00:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 17:30:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 18:00:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 18:30:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 19:00:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 19:30:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 20:00:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 20:30:00	0.042	0.036	0.037	0.043	0.05	0.043
15-Aug-16 21:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 21:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 22:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 22:30:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 23:00:00	0.041	0.036	0.037	0.043	0.05	0.043
15-Aug-16 23:30:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 00:00:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 00:30:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 01:00:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 01:30:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 02:00:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 02:30:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 03:00:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 03:30:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 04:00:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 04:30:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 05:00:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 05:30:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 06:00:00	0.041	0.036	0.037	0.043	0.049	0.043
16-Aug-16 06:30:00	0.041	0.036	0.037	0.043	0.049	0.043
16-Aug-16 07:00:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 07:30:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 08:00:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 08:30:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 09:00:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 09:30:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 10:00:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 10:30:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 11:00:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 11:30:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 12:00:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 12:30:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 13:00:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 13:30:00	0.042	0.036	0.037	0.043	0.05	0.043

16-Aug-16 14:00:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 14:30:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 15:00:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 15:30:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 16:00:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 16:30:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 17:00:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 17:30:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 18:00:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 18:30:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 19:00:00	0.041	0.036	0.037	0.043	0.049	0.043
16-Aug-16 19:30:00	0.041	0.036	0.037	0.043	0.049	0.043
16-Aug-16 20:00:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 20:30:00	0.042	0.036	0.037	0.043	0.05	0.043
16-Aug-16 21:00:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 21:30:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 22:00:00	0.041	0.036	0.037	0.043	0.049	0.043
16-Aug-16 22:30:00	0.041	0.036	0.037	0.043	0.049	0.043
16-Aug-16 23:00:00	0.041	0.036	0.037	0.043	0.05	0.043
16-Aug-16 23:30:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 00:00:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 00:30:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 01:00:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 01:30:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 02:00:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 02:30:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 03:00:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 03:30:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 04:00:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 04:30:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 05:00:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 05:30:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 06:00:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 06:30:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 07:00:00	0.041	0.036	0.037	0.043	0.049	0.043
17-Aug-16 07:30:00	0.041	0.036	0.037	0.043	0.049	0.043
17-Aug-16 08:00:00	0.041	0.036	0.037	0.043	0.049	0.043
17-Aug-16 08:30:00	0.041	0.036	0.037	0.043	0.049	0.043
17-Aug-16 09:00:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 09:30:00	0.041	0.036	0.037	0.043	0.05	0.043
17-Aug-16 10:00:00	0.042	0.036	0.037	0.043	0.05	0.043
17-Aug-16 10:30:00	0.042	0.036	0.037	0.043	0.05	0.043
17-Aug-16 11:00:00	0.042	0.036	0.037	0.043	0.05	0.043
17-Aug-16 11:30:00	0.042	0.036	0.037	0.043	0.05	0.043
17-Aug-16 12:00:00	0.042	0.036	0.037	0.043	0.05	0.043
17-Aug-16 12:30:00	0.042	0.036	0.037	0.043	0.05	0.043
17-Aug-16 13:00:00	0.042	0.036	0.037	0.043	0.05	0.043
17-Aug-16 13:30:00	0.042	0.036	0.037	0.043	0.05	0.043
17-Aug-16 14:00:00	0.042	0.036	0.037	0.043	0.049	0.043
17-Aug-16 14:30:00	0.042	0.036	0.037	0.043	0.049	0.043
17-Aug-16 15:00:00	0.042	0.036	0.037	0.043	0.05	0.043
17-Aug-16 15:30:00	0.042	0.036	0.037	0.043	0.05	0.043
17-Aug-16 16:00:00	0.042	0.036	0.037	0.042	0.05	0.043

17-Aug-16 16:30:00	0.042	0.036	0.037	0.042	0.05	0.043
17-Aug-16 17:00:00	0.041	0.035	0.037	0.043	0.05	0.043
17-Aug-16 17:30:00	0.041	0.035	0.037	0.043	0.05	0.043
17-Aug-16 18:00:00	0.041	0.035	0.037	0.043	0.05	0.043
17-Aug-16 18:30:00	0.041	0.035	0.037	0.043	0.05	0.043
17-Aug-16 19:00:00	0.041	0.035	0.037	0.043	0.049	0.043
17-Aug-16 19:30:00	0.041	0.035	0.037	0.043	0.049	0.043
17-Aug-16 20:00:00	0.041	0.035	0.037	0.043	0.049	0.043
17-Aug-16 20:30:00	0.041	0.035	0.037	0.043	0.049	0.043
17-Aug-16 21:00:00	0.041	0.036	0.037	0.043	0.049	0.043
17-Aug-16 21:30:00	0.041	0.036	0.037	0.043	0.049	0.043
17-Aug-16 22:00:00	0.041	0.036	0.037	0.043	0.049	0.043
17-Aug-16 22:30:00	0.041	0.036	0.037	0.043	0.049	0.043
17-Aug-16 23:00:00	0.041	0.035	0.037	0.043	0.05	0.043
17-Aug-16 23:30:00	0.041	0.035	0.037	0.043	0.05	0.043
18-Aug-16 00:00:00	0.041	0.036	0.037	0.043	0.05	0.043
18-Aug-16 00:30:00	0.041	0.036	0.037	0.043	0.05	0.043
18-Aug-16 01:00:00	0.041	0.036	0.037	0.043	0.049	0.043
18-Aug-16 01:30:00	0.041	0.036	0.037	0.043	0.049	0.043
18-Aug-16 02:00:00	0.041	0.036	0.037	0.043	0.049	0.043
18-Aug-16 02:30:00	0.041	0.036	0.037	0.043	0.049	0.043
18-Aug-16 03:00:00	0.041	0.036	0.037	0.043	0.049	0.043
18-Aug-16 03:30:00	0.041	0.036	0.037	0.043	0.049	0.043
18-Aug-16 04:00:00	0.041	0.036	0.037	0.043	0.049	0.043
18-Aug-16 04:30:00	0.041	0.036	0.037	0.043	0.049	0.043
18-Aug-16 05:00:00	0.041	0.036	0.037	0.043	0.05	0.043
18-Aug-16 05:30:00	0.041	0.036	0.037	0.043	0.05	0.043
18-Aug-16 06:00:00	0.041	0.036	0.037	0.043	0.05	0.043
18-Aug-16 06:30:00	0.041	0.036	0.037	0.043	0.05	0.043
18-Aug-16 07:00:00	0.041	0.036	0.037	0.042	0.049	0.043
18-Aug-16 07:30:00	0.041	0.036	0.037	0.042	0.049	0.043
18-Aug-16 08:00:00	0.041	0.036	0.037	0.043	0.05	0.043
18-Aug-16 08:30:00	0.041	0.036	0.037	0.043	0.05	0.043
18-Aug-16 09:00:00	0.041	0.035	0.037	0.042	0.05	0.043
18-Aug-16 09:30:00	0.041	0.035	0.037	0.042	0.05	0.043
18-Aug-16 10:00:00	0.041	0.035	0.037	0.043	0.049	0.043
18-Aug-16 10:30:00	0.041	0.035	0.037	0.043	0.049	0.043
18-Aug-16 11:00:00	0.041	0.035	0.037	0.042	0.049	0.043
18-Aug-16 11:30:00	0.041	0.035	0.037	0.042	0.049	0.043
18-Aug-16 12:00:00	0.041	0.035	0.037	0.043	0.049	0.043
18-Aug-16 12:30:00	0.041	0.035	0.037	0.043	0.049	0.043
18-Aug-16 13:00:00	0.041	0.035	0.037	0.042	0.049	0.043
18-Aug-16 13:30:00	0.041	0.035	0.037	0.042	0.049	0.043
18-Aug-16 14:00:00	0.041	0.035	0.037	0.042	0.05	0.043
18-Aug-16 14:30:00	0.041	0.035	0.037	0.042	0.05	0.043
18-Aug-16 15:00:00	0.041	0.035	0.037	0.042	0.049	0.043
18-Aug-16 15:30:00	0.041	0.035	0.037	0.042	0.049	0.043
18-Aug-16 16:00:00	0.041	0.035	0.037	0.043	0.05	0.043
18-Aug-16 16:30:00	0.041	0.035	0.037	0.043	0.05	0.043
18-Aug-16 17:00:00	0.041	0.035	0.037	0.042	0.05	0.043
18-Aug-16 17:30:00	0.041	0.035	0.037	0.042	0.05	0.043
18-Aug-16 18:00:00	0.041	0.035	0.037	0.042	0.049	0.043
18-Aug-16 18:30:00	0.041	0.035	0.037	0.042	0.049	0.043

18-Aug-16 19:00:00	0.041	0.035	0.037	0.042	0.049	0.043
18-Aug-16 19:30:00	0.041	0.035	0.037	0.042	0.049	0.043
18-Aug-16 20:00:00	0.041	0.035	0.037	0.042	0.05	0.043
18-Aug-16 20:30:00	0.041	0.035	0.037	0.042	0.05	0.043
18-Aug-16 21:00:00	0.04	0.035	0.037	0.043	0.049	0.043
18-Aug-16 21:30:00	0.04	0.035	0.037	0.043	0.049	0.043
18-Aug-16 22:00:00	0.04	0.035	0.037	0.042	0.049	0.043
18-Aug-16 22:30:00	0.04	0.035	0.037	0.042	0.049	0.043
18-Aug-16 23:00:00	0.04	0.035	0.037	0.042	0.049	0.043
18-Aug-16 23:30:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 00:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 00:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 01:00:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 01:30:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 02:00:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 02:30:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 03:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 03:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 04:00:00	0.041	0.035	0.037	0.042	0.049	0.042
19-Aug-16 04:30:00	0.041	0.035	0.037	0.042	0.049	0.042
19-Aug-16 05:00:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 05:30:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 06:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 06:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 07:00:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 07:30:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 08:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 08:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 09:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 09:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 10:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 10:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 11:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 11:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 12:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 12:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 13:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 13:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 14:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 14:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 15:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 15:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 16:00:00	0.041	0.035	0.037	0.042	0.049	0.042
19-Aug-16 16:30:00	0.041	0.035	0.037	0.042	0.049	0.042
19-Aug-16 17:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 17:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 18:00:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 18:30:00	0.041	0.035	0.037	0.042	0.049	0.043
19-Aug-16 19:00:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 19:30:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 20:00:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 20:30:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 21:00:00	0.04	0.035	0.037	0.042	0.049	0.042

19-Aug-16 21:30:00	0.04	0.035	0.037	0.042	0.049	0.042
19-Aug-16 22:00:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 22:30:00	0.04	0.035	0.037	0.042	0.049	0.043
19-Aug-16 23:00:00	0.04	0.035	0.037	0.042	0.049	0.042
19-Aug-16 23:30:00	0.04	0.035	0.037	0.042	0.049	0.042

APPENDIX D. RAIN EXCLUSION COVER

Photo C.1. Looking east into the rain exclusion cover.

Photo C.2. Looking south at the rain exclusion cover.

APPENDIX E. CONSTRUCTING HEAT PULSE PROBES

1. Use a Dremel to cut 18-gauge needle into three 35 mm strips.
2. To construct the heater needle, insert a loop of 66.8 Ω ft^{-1} wire inside the 35 mm needle. The tip of wire loop corresponds with the needle tip and excess wire trails from the back end of the needle. Insert a register wire, so that register is sitting 15 mm from the needle tip. Use tape to secure wires in place.
3. To construct the two thermistor needles, insert a register wire so that register is sitting 15 mm from the needle tip. Use tape to secure wire in place.
4. Use a syringe and hose to inject OMEGABOND™ 101 resin and catalyst into the needles, let dry for 24 hours.
5. Fill the tips of needles with OMEGABOND™ 101 resin and catalyst, ensuring the wire heater is covered.
6. Sauter two 66.8 Ω ft^{-1} wire ends and three register wire to insulated cable.
7. Insert thermistor needle, heater needle, and thermistor needles into a HDPE™ plastic cup with three holes predrilled with 0.6 cm spacing.
8. Shrink wrap all wires, and then fill HDPE™ plastic cup with LePage® Speed Set epoxy.

APPENDIX F. CALCULATED SAP FLOW VARIABLES

Tree	tin wt	tin+wet wood (g)	wet wood (g)	tin+dry wood (g)	dry wood (g)	water (g)	green Volume (m^3)
1	0.98	1.25	0.27	1.12	0.14	0.13	3.65E-07
2	1.06	1.25	0.19	1.19	0.13	0.06	3.33E-07
3	0.97	1.19	0.22	1.12	0.15	0.07	3.33E-07

Tree	fresh wt (Kg)	dry wt (Kg)	Cw	Cs	c (wood and water)
1	0.00027	0.00014	1200	4182	2635.7778
2	0.00019	0.00013			2141.6842
3	0.00022	0.00015			2148.8182

Tree	Pb (kg/m^3)	mc	Fv
1	384.0481	0.9286	0.3924
2	390.0489	0.4615	0.5650
3	450.0564	0.4667	0.4958

Tree	Kw
1	0.5500
2	0.4056
3	0.4635

Tree	Ks	Ps	Kgw
1	0.5984	1000	0.5673
2			0.4403
3			0.4918

Tree	Pf	k	Average k
1	740.6642	0.0029	0.0033267
2	570.0714	0.0036	
3	660.0827	0.0035	

Tree	Cross-sectional area of tube (cm2)
1	48.6554
2	45.2389
3	45.2389

Tree	green Volume (cm^3)
1	0.3645
2	0.3333
3	0.3333

APPENDIX G. SAP FLOW DATA

Date	Time	Temp (*C)	v1	v2	Vh (cm/h)	Vc	Vs (cm/h)	Cali. Vs (cm/h)	Sap Flow (cm3/hr)
7/8/2016	12:00:01 AM	11.6140	0.3671	0.4079	-1.8549	-3.2904	-1.5362	-0.9854	-74.7455
7/8/2016	12:30:00 AM	10.9415	0.3642	0.4087	-2.0289	-3.6000	-1.6807	-1.1299	-81.7771
7/8/2016	1:00:00 AM	10.4221	0.3784	0.4262	-2.0892	-3.7073	-1.7309	-1.1800	-84.2153
7/8/2016	1:30:00 AM	10.3084	0.4067	0.4517	-1.8454	-3.2735	-1.5283	-0.9775	-74.3621
7/8/2016	2:00:00 AM	10.5355	0.4080	0.4546	-1.9013	-3.3729	-1.5747	-1.0239	-76.6198
7/8/2016	2:30:00 AM	10.8377	0.4045	0.4491	-1.8406	-3.2650	-1.5244	-0.9735	-74.1682
7/8/2016	3:00:00 AM	11.0296	0.4043	0.4452	-1.6925	-3.0018	-1.4015	-0.8506	-68.1891
7/8/2016	3:30:00 AM	11.1484	0.3964	0.4439	-1.9936	-3.5372	-1.6515	-1.1006	-80.3522
7/8/2016	4:00:00 AM	11.2239	0.3981	0.4385	-1.7013	-3.0174	-1.4088	-0.8579	-68.5442
7/8/2016	4:30:00 AM	11.2668	0.4006	0.4357	-1.4762	-2.6173	-1.2220	-0.6711	-59.4553
7/8/2016	5:00:00 AM	11.3047	0.4021	0.4376	-1.4885	-2.6393	-1.2322	-0.6814	-59.9541
7/8/2016	5:30:00 AM	11.3714	0.4030	0.4436	-1.6906	-2.9983	-1.3998	-0.8490	-68.1101
7/8/2016	6:00:00 AM	11.4739	0.4038	0.4507	-1.9338	-3.4307	-1.6017	-1.0509	-77.9331
7/8/2016	6:30:00 AM	11.6444	0.4013	0.4487	-1.9644	-3.4852	-1.6272	-1.0763	-79.1697
7/8/2016	7:00:00 AM	11.8784	0.4066	0.4539	-1.9354	-3.4337	-1.6031	-1.0523	-78.0007
7/8/2016	7:30:00 AM	12.3184	0.4138	0.4558	-1.7000	-3.0151	-1.4077	-0.8568	-68.4915
7/8/2016	8:00:00 AM	12.9169	0.4381	0.4686	-1.1817	-2.0945	-0.9779	-0.4270	-47.5792
7/8/2016	8:30:00 AM	13.5901	0.4318	0.4597	-1.1019	-1.9528	-0.9117	-0.3609	-44.3591
7/8/2016	9:00:00 AM	14.2706	0.4565	0.4744	-0.6764	-1.1981	-0.5594	-0.0085	-27.2164
7/8/2016	9:30:00 AM	15.0718	0.4349	0.4394	-0.1826	-0.3233	-0.1510	0.3999	-7.3452
7/8/2016	10:00:00 AM	15.9362	0.4723	0.4220	1.9797	3.4991	1.6337	2.1845	79.4860
7/8/2016	10:30:00 AM	17.0726	0.5932	0.4255	5.8461	10.3301	4.8229	5.3737	234.6587
7/8/2016	11:00:00 AM	18.2658	0.5890	0.3514	9.0895	16.0991	7.5163	8.0671	365.7087
7/8/2016	11:30:00 AM	18.8346	0.5751	0.2607	13.9222	24.8539	11.6037	12.1546	564.5841
7/8/2016	12:00:01 PM	19.2224	0.6365	0.2413	17.0637	30.7031	14.3346	14.8854	697.4548
7/8/2016	12:30:00 PM	19.7686	0.6014	0.2002	19.3535	35.0706	16.3737	16.9245	796.6679

7/8/2016	1:00:00 PM	20.2961	0.6449	0.2094	19.7888	35.9123	16.7666	17.3175	815.7878
7/8/2016	1:30:00 PM	20.7448	0.6456	0.2014	20.4932	37.2824	17.4063	17.9572	846.9109
7/8/2016	2:00:00 PM	21.0938	0.5961	0.1827	20.8065	37.8952	17.6924	18.2432	860.8302
7/8/2016	2:30:00 PM	21.1395	0.6323	0.2202	18.5569	33.5401	15.6591	16.2100	761.9004
7/8/2016	3:00:00 PM	21.6433	0.5886	0.1687	21.9860	40.2212	18.7784	19.3292	913.6696
7/8/2016	3:30:00 PM	21.9410	0.6299	0.1997	20.2087	36.7278	17.1474	17.6982	834.3118
7/8/2016	4:00:00 PM	21.9360	0.5904	0.1995	19.0924	34.5678	16.1389	16.6897	785.2444
7/8/2016	4:30:00 PM	22.1203	0.6199	0.2187	18.3351	33.1162	15.4612	16.0121	752.2715
7/8/2016	5:00:00 PM	22.5064	0.5704	0.2102	17.5679	31.6566	14.7798	15.3306	719.1149
7/8/2016	5:30:00 PM	22.0988	0.4503	0.3206	5.9752	10.5587	4.9296	5.4805	239.8521
7/8/2016	6:00:00 PM	21.8448	0.4873	0.3050	8.2459	14.5927	6.8130	7.3638	331.4891
7/8/2016	6:30:00 PM	21.7009	0.5076	0.2785	10.5649	18.7470	8.7526	9.3034	425.8591
7/8/2016	7:00:00 PM	21.3133	0.4620	0.2889	8.2584	14.6149	6.8234	7.3742	331.9936
7/8/2016	7:30:00 PM	20.4550	0.3979	0.3338	3.0896	5.4586	2.5485	3.0994	123.9986
7/8/2016	8:00:00 PM	19.7137	0.4049	0.3629	1.9283	3.4083	1.5913	2.1421	77.4241
7/8/2016	8:30:00 PM	19.1629	0.4013	0.3692	1.4674	2.5944	1.2113	1.7621	58.9340
7/8/2016	9:00:00 PM	18.6064	0.3919	0.3788	0.5976	1.0573	0.4936	1.0445	24.0174
7/8/2016	9:30:00 PM	18.0583	0.3861	0.3825	0.1660	0.2937	0.1371	0.6880	6.6721
7/8/2016	10:00:00 PM	17.4327	0.3806	0.3856	-0.2278	-0.4032	-0.1883	0.3626	-9.1599
7/8/2016	10:30:00 PM	16.6834	0.3778	0.3956	-0.8101	-1.4352	-0.6701	-0.1192	-32.6020
7/8/2016	11:00:00 PM	16.1863	0.3895	0.4064	-0.7476	-1.3244	-0.6183	-0.0675	-30.0855
7/8/2016	11:30:00 PM	15.8107	0.3916	0.4059	-0.6309	-1.1174	-0.5217	0.0291	-25.3837
7/9/2016	12:00:01 AM	15.5136	0.3924	0.4215	-1.2614	-2.2359	-1.0439	-0.4931	-50.7919
7/9/2016	12:30:00 AM	15.3061	0.3892	0.4258	-1.5816	-2.8047	-1.3094	-0.7586	-63.7116
7/9/2016	1:00:00 AM	15.1097	0.3842	0.4207	-1.5996	-2.8366	-1.3243	-0.7735	-64.4358
7/9/2016	1:30:00 AM	14.9106	0.3833	0.4251	-1.8215	-3.2311	-1.5085	-0.9577	-73.3987
7/9/2016	2:00:00 AM	14.7329	0.3858	0.4249	-1.6967	-3.0092	-1.4049	-0.8541	-68.3567
7/9/2016	2:30:00 AM	14.6047	0.3867	0.4231	-1.5812	-2.8039	-1.3091	-0.7582	-63.6928
7/9/2016	3:00:00 AM	14.4782	0.3932	0.4295	-1.5546	-2.7567	-1.2870	-0.7362	-62.6216

7/9/2016	3:30:00 AM	14.3797	0.3811	0.4341	-2.2884	-4.0620	-1.8964	-1.3456	-92.2719
7/9/2016	4:00:00 AM	14.2644	0.3897	0.4306	-1.7547	-3.1124	-1.4531	-0.9022	-70.7005
7/9/2016	4:30:00 AM	14.1917	0.3898	0.4258	-1.5550	-2.7574	-1.2874	-0.7365	-62.6381
7/9/2016	5:00:00 AM	14.1413	0.3866	0.4360	-2.1127	-3.7491	-1.7504	-1.1995	-85.1656
7/9/2016	5:30:00 AM	14.1270	0.3954	0.4318	-1.5472	-2.7436	-1.2809	-0.7301	-62.3230
7/9/2016	6:00:00 AM	14.1575	0.3976	0.4385	-1.7269	-3.0630	-1.4300	-0.8792	-69.5786
7/9/2016	6:30:00 AM	14.2507	0.3923	0.4414	-2.0743	-3.6808	-1.7185	-1.1676	-83.6139
7/9/2016	7:00:00 AM	14.3977	0.3967	0.4379	-1.7400	-3.0861	-1.4408	-0.8900	-70.1043
7/9/2016	7:30:00 AM	14.5986	0.4027	0.4444	-1.7351	-3.0775	-1.4368	-0.8860	-69.9080
7/9/2016	8:00:00 AM	14.8487	0.4028	0.4368	-1.4255	-2.5273	-1.1799	-0.6291	-57.4093
7/9/2016	8:30:00 AM	14.9744	0.4010	0.4387	-1.5820	-2.8053	-1.3097	-0.7589	-63.7256
7/9/2016	9:00:00 AM	15.1792	0.3997	0.4389	-1.6449	-2.9171	-1.3619	-0.8111	-66.2648
7/9/2016	9:30:00 AM	15.5097	0.4418	0.4673	-0.9867	-1.7484	-0.8163	-0.2655	-39.7175
7/9/2016	10:00:00 AM	16.2175	0.4345	0.4407	-0.2475	-0.4382	-0.2046	0.3462	-9.9547
7/9/2016	10:30:00 AM	16.8608	0.4613	0.4116	2.0051	3.5440	1.6546	2.2054	80.5052
7/9/2016	11:00:00 AM	18.0411	0.5459	0.3727	6.7125	11.8656	5.5398	6.0906	269.5404
7/9/2016	11:30:00 AM	18.4370	0.5100	0.3144	8.5114	15.0663	7.0341	7.5849	342.2469
7/9/2016	12:00:01 PM	18.6827	0.5457	0.2928	10.9532	19.4471	9.0794	9.6302	441.7618
7/9/2016	12:30:00 PM	18.7577	0.5532	0.2915	11.2711	20.0214	9.3475	9.8984	454.8087
7/9/2016	1:00:00 PM	19.3372	0.5889	0.2750	13.3992	23.8939	11.1555	11.7064	542.7764
7/9/2016	1:30:00 PM	19.8235	0.6076	0.2344	16.7571	30.1255	14.0649	14.6157	684.3330
7/9/2016	2:00:00 PM	20.1525	0.6188	0.2097	19.0395	34.4659	16.0913	16.6422	782.9297
7/9/2016	2:30:00 PM	20.6866	0.6607	0.1969	21.2979	38.8605	18.1431	18.6939	882.7588
7/9/2016	3:00:00 PM	21.4304	0.6423	0.1783	22.5453	41.3352	19.2984	19.8493	938.9736
7/9/2016	3:30:00 PM	21.9825	0.6422	0.1935	21.1039	38.4787	17.9648	18.5157	874.0850
7/9/2016	4:00:00 PM	22.6997	0.6429	0.1953	20.9664	38.2086	17.8387	18.3896	867.9512
7/9/2016	4:30:00 PM	23.0264	0.6354	0.1940	20.8787	38.0365	17.7584	18.3092	864.0417
7/9/2016	5:00:00 PM	23.1562	0.5744	0.1859	19.8476	36.0264	16.8199	17.3707	818.3780
7/9/2016	5:30:00 PM	23.4978	0.6260	0.2104	19.1870	34.7499	16.2239	16.7748	789.3812

7/9/2016	6:00:00 PM	23.4577	0.5175	0.2202	15.0353	26.9094	12.5634	13.1142	611.2757
7/9/2016	6:30:00 PM	23.1841	0.5253	0.2621	12.2338	21.7669	10.1625	10.7133	494.4588
7/9/2016	7:00:00 PM	22.8601	0.5014	0.2595	11.5857	20.5906	9.6133	10.1641	467.7389
7/9/2016	7:30:00 PM	22.4564	0.4967	0.2726	10.5579	18.7345	8.7467	9.2975	425.5736
7/9/2016	8:00:00 PM	22.0508	0.4708	0.2909	8.4730	14.9976	7.0021	7.5529	340.6879
7/9/2016	8:30:00 PM	21.4485	0.4351	0.3226	5.2644	9.3006	4.3422	4.8931	211.2725
7/9/2016	9:00:00 PM	20.8344	0.4023	0.3503	2.4358	4.3044	2.0096	2.5605	97.7802
7/9/2016	9:30:00 PM	20.2081	0.3859	0.3624	1.1077	1.9589	0.9145	1.4654	44.4977
7/9/2016	10:00:00 PM	19.4007	0.3673	0.3750	-0.3653	-0.6469	-0.3020	0.2488	-14.6949
7/9/2016	10:30:00 PM	18.6964	0.3773	0.3878	-0.4859	-0.8606	-0.4018	0.1491	-19.5485
7/9/2016	11:00:00 PM	18.1188	0.3774	0.3961	-0.8509	-1.5075	-0.7038	-0.1530	-34.2442
7/9/2016	11:30:00 PM	17.7245	0.3783	0.4042	-1.1658	-2.0662	-0.9646	-0.4138	-46.9350
7/10/2016	12:00:01 AM	17.3829	0.3840	0.4018	-0.7982	-1.4141	-0.6602	-0.1094	-32.1226
7/10/2016	12:30:00 AM	16.9418	0.3735	0.4054	-1.4419	-2.5564	-1.1935	-0.6427	-58.0717
7/10/2016	1:00:00 AM	16.4529	0.3765	0.4033	-1.2106	-2.1458	-1.0018	-0.4510	-48.7436
7/10/2016	1:30:00 AM	16.0301	0.3711	0.4041	-1.5002	-2.6601	-1.2419	-0.6911	-60.4265
7/10/2016	2:00:00 AM	15.6535	0.3858	0.4214	-1.5522	-2.7523	-1.2850	-0.7341	-62.5218
7/10/2016	2:30:00 AM	15.5097	0.3908	0.4298	-1.6736	-2.9681	-1.3858	-0.8349	-67.4244
7/10/2016	3:00:00 AM	15.4643	0.3854	0.4345	-2.1092	-3.7430	-1.7475	-1.1967	-85.0263
7/10/2016	3:30:00 AM	15.4327	0.3888	0.4309	-1.8065	-3.2044	-1.4961	-0.9452	-72.7920
7/10/2016	4:00:00 AM	15.4070	0.3824	0.4338	-2.2183	-3.9371	-1.8382	-1.2873	-89.4366
7/10/2016	4:30:00 AM	15.3694	0.3843	0.4307	-2.0054	-3.5581	-1.6612	-1.1104	-80.8272
7/10/2016	5:00:00 AM	15.2903	0.3917	0.4278	-1.5519	-2.7518	-1.2847	-0.7339	-62.5097
7/10/2016	5:30:00 AM	15.2348	0.3926	0.4334	-1.7373	-3.0814	-1.4386	-0.8878	-69.9980
7/10/2016	6:00:00 AM	15.2268	0.3981	0.4267	-1.2211	-2.1644	-1.0105	-0.4597	-49.1676
7/10/2016	6:30:00 AM	15.2922	0.4006	0.4305	-1.2679	-2.2475	-1.0493	-0.4985	-51.0550
7/10/2016	7:00:00 AM	15.5097	0.4275	0.4352	-0.3120	-0.5524	-0.2579	0.2929	-12.5484
7/10/2016	7:30:00 AM	15.9048	0.4331	0.4195	0.5647	0.9991	0.4664	1.0173	22.6953
7/10/2016	8:00:00 AM	16.1668	0.4476	0.4202	1.1090	1.9612	0.9156	1.4665	44.5498

7/10/2016	8:30:00 AM	16.6639	0.4740	0.3918	3.3483	5.9152	2.7617	3.3125	134.3708
7/10/2016	9:00:00 AM	17.2415	0.4744	0.3475	5.4760	9.6750	4.5170	5.0679	219.7778
7/10/2016	9:30:00 AM	17.4460	0.5032	0.3608	5.8541	10.3441	4.8294	5.3803	234.9782
7/10/2016	10:00:00 AM	17.8096	0.5179	0.3419	7.3061	12.9197	6.0319	6.5828	293.4853
7/10/2016	10:30:00 AM	18.1052	0.5135	0.3351	7.5065	13.2760	6.1983	6.7491	301.5789
7/10/2016	11:00:00 AM	18.4295	0.5295	0.3289	8.3760	14.8247	6.9213	7.4722	336.7594
7/10/2016	11:30:00 AM	18.9541	0.5511	0.3061	10.3443	18.3499	8.5671	9.1180	416.8372
7/10/2016	12:00:01 PM	19.7518	0.5841	0.2683	13.6873	24.4222	11.4022	11.9530	554.7767
7/10/2016	12:30:00 PM	20.1839	0.5860	0.2373	15.9045	28.5271	13.3186	13.8695	648.0238
7/10/2016	1:00:00 PM	20.8438	0.6546	0.2606	16.2025	29.0845	13.5789	14.1297	660.6858
7/10/2016	1:30:00 PM	21.4413	0.6502	0.2394	17.5783	31.6764	14.7890	15.3398	719.5643
7/10/2016	2:00:00 PM	21.9697	0.6491	0.2091	19.9326	36.1911	16.8968	17.4476	822.1196
7/10/2016	2:30:00 PM	22.4827	0.6021	0.1952	19.8191	35.9710	16.7941	17.3449	817.1214
7/10/2016	3:00:00 PM	22.3300	0.5543	0.2139	16.7555	30.1224	14.0635	14.6143	684.2629
7/10/2016	3:30:00 PM	22.2563	0.5801	0.2449	15.1734	27.1658	12.6831	13.2339	617.1003
7/10/2016	4:00:00 PM	22.3300	0.5806	0.2468	15.0542	26.9444	12.5797	13.1306	612.0720
7/10/2016	4:30:00 PM	22.9830	0.5704	0.1956	18.8281	34.0598	15.9017	16.4526	773.7054
7/10/2016	5:00:00 PM	22.8103	0.5562	0.2309	15.4658	27.7092	12.9368	13.4876	629.4442
7/10/2016	5:30:00 PM	22.4157	0.5041	0.2699	10.9958	19.5240	9.1153	9.6662	443.5098
7/10/2016	6:00:00 PM	22.1869	0.5252	0.2973	10.0096	17.7483	8.2863	8.8371	403.1720
7/10/2016	6:30:00 PM	22.3256	0.5455	0.2632	12.8258	22.8452	10.6659	11.2168	518.9547
7/10/2016	7:00:00 PM	22.0149	0.4987	0.2612	11.3770	20.2129	9.4369	9.9878	459.1570
7/10/2016	7:30:00 PM	21.6310	0.4902	0.2859	9.4871	16.8109	7.8486	8.3995	381.8780
7/10/2016	8:00:00 PM	21.2409	0.4697	0.3045	7.6273	13.4909	6.2986	6.8495	306.4614
7/10/2016	8:30:00 PM	20.8031	0.4334	0.3281	4.8966	8.6502	4.0386	4.5894	196.4995
7/10/2016	9:00:00 PM	20.2668	0.4081	0.3574	2.3366	4.1293	1.9279	2.4787	93.8008
7/10/2016	9:30:00 PM	19.7096	0.3914	0.3699	0.9956	1.7608	0.8221	1.3729	39.9980
7/10/2016	10:00:00 PM	19.1926	0.3883	0.3850	0.1513	0.2677	0.1250	0.6758	6.0821
7/10/2016	10:30:00 PM	18.7318	0.3879	0.3922	-0.1910	-0.3382	-0.1579	0.3930	-7.6817

7/10/2016	11:00:00 PM	18.3261	0.3921	0.3989	-0.3022	-0.5351	-0.2498	0.3010	-12.1551
7/10/2016	11:30:00 PM	17.9957	0.3936	0.4044	-0.4795	-0.8491	-0.3964	0.1544	-19.2882
7/11/2016	12:00:01 AM	17.6880	0.3870	0.4062	-0.8525	-1.5104	-0.7052	-0.1543	-34.3099
7/11/2016	12:30:00 AM	17.4633	0.3913	0.4168	-1.1115	-1.9699	-0.9197	-0.3688	-44.7478
7/11/2016	1:00:00 AM	17.3104	0.3965	0.4221	-1.1013	-1.9517	-0.9112	-0.3604	-44.3349
7/11/2016	1:30:00 AM	17.1744	0.3951	0.4137	-0.8076	-1.4307	-0.6679	-0.1171	-32.4991
7/11/2016	2:00:00 AM	17.0342	0.3929	0.4187	-1.1225	-1.9894	-0.9288	-0.3779	-45.1906
7/11/2016	2:30:00 AM	16.8011	0.3820	0.4182	-1.5902	-2.8200	-1.3166	-0.7657	-64.0586
7/11/2016	3:00:00 AM	16.6020	0.3867	0.4211	-1.4978	-2.6557	-1.2399	-0.6891	-60.3277
7/11/2016	3:30:00 AM	16.3712	0.3874	0.4204	-1.4370	-2.5478	-1.1895	-0.6387	-57.8754
7/11/2016	4:00:00 AM	16.1765	0.3844	0.4173	-1.4446	-2.5612	-1.1958	-0.6449	-58.1810
7/11/2016	4:30:00 AM	16.0594	0.3831	0.4221	-1.7087	-3.0305	-1.4149	-0.8640	-68.8404
7/11/2016	5:00:00 AM	15.9792	0.3927	0.4278	-1.5067	-2.6715	-1.2473	-0.6964	-60.6865
7/11/2016	5:30:00 AM	15.9342	0.3898	0.4252	-1.5317	-2.7159	-1.2680	-0.7171	-61.6945
7/11/2016	6:00:00 AM	15.9048	0.3914	0.4274	-1.5507	-2.7498	-1.2838	-0.7330	-62.4647
7/11/2016	6:30:00 AM	15.9029	0.3930	0.4274	-1.4773	-2.6194	-1.2229	-0.6721	-59.5021
7/11/2016	7:00:00 AM	15.9479	0.3946	0.4373	-1.8089	-3.2087	-1.4981	-0.9472	-72.8885
7/11/2016	7:30:00 AM	16.0418	0.3948	0.4356	-1.7273	-3.0636	-1.4303	-0.8795	-69.5928
7/11/2016	8:00:00 AM	16.1356	0.4015	0.4401	-1.6149	-2.8639	-1.3371	-0.7862	-65.0566
7/11/2016	8:30:00 AM	16.2661	0.4018	0.4424	-1.6903	-2.9979	-1.3997	-0.8488	-68.1007
7/11/2016	9:00:00 AM	16.4625	0.4055	0.4449	-1.6282	-2.8875	-1.3481	-0.7973	-65.5928
7/11/2016	9:30:00 AM	16.7083	0.4050	0.4368	-1.3287	-2.3553	-1.0996	-0.5488	-53.5037
7/11/2016	10:00:00 AM	16.9726	0.3982	0.4378	-1.6687	-2.9594	-1.3817	-0.8308	-67.2254
7/11/2016	10:30:00 AM	16.9398	0.3908	0.4268	-1.5543	-2.7562	-1.2868	-0.7360	-62.6097
7/11/2016	11:00:00 AM	16.9418	0.3895	0.4295	-1.7165	-3.0443	-1.4213	-0.8705	-69.1556
7/11/2016	11:30:00 AM	16.8916	0.3917	0.4362	-1.8914	-3.3553	-1.5665	-1.0157	-76.2202
7/11/2016	12:00:01 PM	16.8299	0.3821	0.4218	-1.7417	-3.0893	-1.4423	-0.8915	-70.1764
7/11/2016	12:30:00 PM	16.5826	0.3719	0.4195	-2.1217	-3.7652	-1.7579	-1.2071	-85.5313
7/11/2016	1:00:00 PM	16.3401	0.3815	0.4222	-1.7834	-3.1633	-1.4769	-0.9260	-71.8568

7/11/2016	1:30:00 PM	16.1433	0.3820	0.4251	-1.8812	-3.3372	-1.5581	-1.0072	-75.8077
7/11/2016	2:00:00 PM	15.9988	0.3899	0.4310	-1.7656	-3.1316	-1.4621	-0.9112	-71.1381
7/11/2016	2:30:00 PM	15.9048	0.3846	0.4299	-1.9567	-3.4715	-1.6208	-1.0699	-78.8597
7/11/2016	3:00:00 PM	15.8244	0.3895	0.4363	-1.9967	-3.5426	-1.6540	-1.1031	-80.4751
7/11/2016	3:30:00 PM	15.7754	0.3811	0.4352	-2.3345	-4.1440	-1.9348	-1.3839	-94.1361
7/11/2016	4:00:00 PM	15.7459	0.3816	0.4356	-2.3276	-4.1318	-1.9290	-1.3782	-93.8578
7/11/2016	4:30:00 PM	15.7322	0.3871	0.4348	-2.0443	-3.6275	-1.6936	-1.1427	-82.4019
7/11/2016	5:00:00 PM	15.7145	0.3813	0.4413	-2.5689	-4.5618	-2.1298	-1.5789	-103.6261
7/11/2016	5:30:00 PM	15.6830	0.3813	0.4326	-2.2188	-3.9380	-1.8386	-1.2877	-89.4555
7/11/2016	6:00:00 PM	15.6220	0.3809	0.4288	-2.0876	-3.7045	-1.7295	-1.1787	-84.1515
7/11/2016	6:30:00 PM	15.5274	0.3891	0.4291	-1.7206	-3.0516	-1.4247	-0.8739	-69.3211
7/11/2016	7:00:00 PM	15.5274	0.3917	0.4385	-1.9844	-3.5208	-1.6438	-1.0929	-79.9793
7/11/2016	7:30:00 PM	15.5078	0.3859	0.4345	-2.0866	-3.7026	-1.7287	-1.1778	-84.1092
7/11/2016	8:00:00 PM	15.4801	0.3911	0.4335	-1.8124	-3.2148	-1.5009	-0.9501	-73.0288
7/11/2016	8:30:00 PM	15.4762	0.3857	0.4342	-2.0837	-3.6976	-1.7263	-1.1755	-83.9941
7/11/2016	9:00:00 PM	15.4485	0.3877	0.4331	-1.9493	-3.4584	-1.6146	-1.0638	-78.5611
7/11/2016	9:30:00 PM	15.4130	0.3747	0.4203	-2.0215	-3.5868	-1.6746	-1.1237	-81.4780
7/11/2016	10:00:00 PM	15.3694	0.3873	0.4283	-1.7689	-3.1376	-1.4649	-0.9140	-71.2731
7/11/2016	10:30:00 PM	15.3615	0.3871	0.4329	-1.9694	-3.4942	-1.6314	-1.0805	-79.3753
7/11/2016	11:00:00 PM	15.3378	0.3823	0.4373	-2.3644	-4.1974	-1.9596	-1.4088	-95.3476
7/11/2016	11:30:00 PM	15.2922	0.3840	0.4303	-2.0029	-3.5538	-1.6592	-1.1083	-80.7275
7/12/2016	12:00:01 AM	15.2427	0.3860	0.4311	-1.9445	-3.4498	-1.6106	-1.0598	-78.3659
7/12/2016	12:30:00 AM	15.2110	0.3880	0.4279	-1.7235	-3.0568	-1.4271	-0.8763	-69.4382
7/12/2016	1:00:00 AM	15.2030	0.3877	0.4365	-2.0855	-3.7008	-1.7278	-1.1770	-84.0684
7/12/2016	1:30:00 AM	15.2110	0.3892	0.4377	-2.0692	-3.6718	-1.7143	-1.1634	-83.4096
7/12/2016	2:00:00 AM	15.2110	0.3793	0.4356	-2.4359	-4.3247	-2.0191	-1.4683	-98.2410
7/12/2016	2:30:00 AM	15.1951	0.3902	0.4358	-1.9452	-3.4512	-1.6113	-1.0604	-78.3970
7/12/2016	3:00:00 AM	15.1970	0.3904	0.4367	-1.9698	-3.4948	-1.6317	-1.0808	-79.3886
7/12/2016	3:30:00 AM	15.1951	0.3904	0.4361	-1.9490	-3.4579	-1.6144	-1.0636	-78.5492

7/12/2016	4:00:00 AM	15.1653	0.3919	0.4329	-1.7508	-3.1054	-1.4498	-0.8990	-70.5429
7/12/2016	4:30:00 AM	15.1354	0.3897	0.4357	-1.9634	-3.4835	-1.6264	-1.0755	-79.1320
7/12/2016	5:00:00 AM	15.1157	0.3957	0.4312	-1.5084	-2.6745	-1.2487	-0.6978	-60.7542
7/12/2016	5:30:00 AM	15.1335	0.3903	0.4352	-1.9158	-3.3987	-1.5868	-1.0359	-77.2059
7/12/2016	6:00:00 AM	15.1335	0.3872	0.4313	-1.9011	-3.3726	-1.5746	-1.0237	-76.6123
7/12/2016	6:30:00 AM	15.1157	0.3813	0.4380	-2.4414	-4.3346	-2.0237	-1.4729	-98.4644
7/12/2016	7:00:00 AM	15.1176	0.3964	0.4358	-1.6669	-2.9562	-1.3802	-0.8293	-67.1537
7/12/2016	7:30:00 AM	15.1354	0.3903	0.4369	-1.9836	-3.5195	-1.6432	-1.0923	-79.9491
7/12/2016	8:00:00 AM	15.1157	0.3796	0.4347	-2.3845	-4.2331	-1.9763	-1.4255	-96.1598
7/12/2016	8:30:00 AM	15.0858	0.3833	0.4380	-2.3466	-4.1657	-1.9449	-1.3940	-94.6279
7/12/2016	9:00:00 AM	15.0521	0.3904	0.4308	-1.7327	-3.0732	-1.4348	-0.8840	-69.8110
7/12/2016	9:30:00 AM	15.0381	0.3877	0.4362	-2.0715	-3.6758	-1.7161	-1.1653	-83.4992
7/12/2016	10:00:00 AM	15.1157	0.3857	0.4389	-2.2761	-4.0400	-1.8862	-1.3354	-91.7741
7/12/2016	10:30:00 AM	15.1951	0.3893	0.4339	-1.9073	-3.3836	-1.5797	-1.0289	-76.8629
7/12/2016	11:00:00 AM	15.2268	0.3936	0.4338	-1.7151	-3.0420	-1.4202	-0.8694	-69.1012
7/12/2016	11:30:00 AM	15.2744	0.3933	0.4380	-1.8930	-3.3582	-1.5679	-1.0170	-76.2856
7/12/2016	12:00:01 PM	15.4149	0.4016	0.4262	-1.0460	-1.8537	-0.8654	-0.3146	-42.1082
7/12/2016	12:30:00 PM	15.4386	0.3948	0.4257	-1.3251	-2.3490	-1.0967	-0.5458	-53.3595
7/12/2016	1:00:00 PM	15.4820	0.3944	0.4409	-1.9618	-3.4806	-1.6250	-1.0742	-79.0653
7/12/2016	1:30:00 PM	15.6712	0.3988	0.4379	-1.6469	-2.9206	-1.3636	-0.8127	-66.3445
7/12/2016	2:00:00 PM	15.8107	0.3978	0.4360	-1.6157	-2.8653	-1.3377	-0.7869	-65.0877
7/12/2016	2:30:00 PM	15.8734	0.4044	0.4346	-1.2665	-2.2449	-1.0481	-0.4973	-50.9962
7/12/2016	3:00:00 PM	16.1512	0.4085	0.4332	-1.0324	-1.8295	-0.8542	-0.3033	-41.5593
7/12/2016	3:30:00 PM	16.2467	0.4198	0.4201	-0.0141	-0.0249	-0.0116	0.5392	-0.5659
7/12/2016	4:00:00 PM	16.4334	0.4174	0.3995	0.7712	1.3642	0.6369	1.1877	30.9882
7/12/2016	4:30:00 PM	16.7258	0.4696	0.3760	3.9119	6.9104	3.2263	3.7771	156.9762
7/12/2016	5:00:00 PM	16.9187	0.5146	0.3600	6.2850	11.1076	5.1859	5.7367	252.3204
7/12/2016	5:30:00 PM	17.2031	0.4836	0.3152	7.5305	13.3187	6.2182	6.7691	302.5499
7/12/2016	6:00:00 PM	17.0399	0.4635	0.3429	5.3021	9.3673	4.3734	4.9242	212.7896

7/12/2016	6:30:00 PM	17.1070	0.5000	0.3352	7.0379	12.4434	5.8095	6.3604	282.6647
7/12/2016	7:00:00 PM	17.3563	0.5238	0.3140	9.0058	15.9494	7.4464	7.9973	362.3090
7/12/2016	7:30:00 PM	17.3543	0.4953	0.3111	8.1803	14.4757	6.7584	7.3092	328.8311
7/12/2016	8:00:00 PM	17.1207	0.4734	0.3300	6.3488	11.2206	5.2387	5.7895	254.8892
7/12/2016	8:30:00 PM	16.9726	0.4680	0.3316	6.0636	10.7152	5.0027	5.5535	243.4085
7/12/2016	9:00:00 PM	16.8050	0.4391	0.3583	3.5772	6.3194	2.9504	3.5012	143.5513
7/12/2016	9:30:00 PM	16.5362	0.4191	0.3792	1.7641	3.1185	1.4559	2.0068	70.8398
7/12/2016	10:00:00 PM	16.2039	0.4016	0.3940	0.3394	0.6006	0.2804	0.8313	13.6434
7/12/2016	10:30:00 PM	15.9068	0.3944	0.3981	-0.1610	-0.2851	-0.1331	0.4178	-6.4757
7/12/2016	11:00:00 PM	15.6633	0.3947	0.4046	-0.4376	-0.7750	-0.3618	0.1890	-17.6054
7/12/2016	11:30:00 PM	15.4327	0.3939	0.4063	-0.5469	-0.9685	-0.4522	0.0987	-22.0012
7/13/2016	12:00:01 AM	15.1929	0.3929	0.4147	-0.9524	-1.6876	-0.7879	-0.2371	-38.3364
7/13/2016	12:30:00 AM	14.9604	0.3878	0.4105	-0.9992	-1.7705	-0.8266	-0.2758	-40.2190
7/13/2016	1:00:00 AM	14.7086	0.3905	0.4124	-0.9611	-1.7029	-0.7950	-0.2442	-38.6833
7/13/2016	1:30:00 AM	14.4720	0.3868	0.4113	-1.0830	-1.9192	-0.8961	-0.3452	-43.5978
7/13/2016	2:00:00 AM	14.2383	0.3883	0.4221	-1.4703	-2.6069	-1.2171	-0.6663	-59.2189
7/13/2016	2:30:00 AM	14.0641	0.3943	0.4195	-1.0937	-1.9382	-0.9049	-0.3541	-44.0291
7/13/2016	3:00:00 AM	13.9992	0.3998	0.4231	-0.9963	-1.7655	-0.8243	-0.2734	-40.1042
7/13/2016	3:30:00 AM	14.0117	0.4063	0.4262	-0.8382	-1.4851	-0.6933	-0.1425	-33.7348
7/13/2016	4:00:00 AM	14.0279	0.3962	0.4250	-1.2347	-2.1885	-1.0217	-0.4709	-49.7136
7/13/2016	4:30:00 AM	14.0055	0.4036	0.4171	-0.5794	-1.0262	-0.4791	0.0717	-23.3114
7/13/2016	5:00:00 AM	14.0217	0.4058	0.4256	-0.8357	-1.4805	-0.6912	-0.1404	-33.6323
7/13/2016	5:30:00 AM	14.0622	0.4086	0.4213	-0.5395	-0.9555	-0.4461	0.1048	-21.7049
7/13/2016	6:00:00 AM	14.0703	0.4138	0.4059	0.3389	0.5997	0.2800	0.8308	13.6219
7/13/2016	6:30:00 AM	14.0927	0.4259	0.4200	0.2439	0.4317	0.2016	0.7524	9.8066
7/13/2016	7:00:00 AM	14.2060	0.4211	0.4035	0.7520	1.3302	0.6210	1.1719	30.2174
7/13/2016	7:30:00 AM	14.2706	0.4277	0.3930	1.4883	2.6313	1.2285	1.7793	59.7721
7/13/2016	8:00:00 AM	14.2582	0.4378	0.3916	1.9630	3.4697	1.6199	2.1708	78.8176
7/13/2016	8:30:00 AM	14.3351	0.4391	0.3911	2.0383	3.6027	1.6820	2.2329	81.8387

7/13/2016	9:00:00 AM	14.4257	0.4527	0.3844	2.8796	5.0879	2.3754	2.9263	115.5764
7/13/2016	9:30:00 AM	14.7009	0.4606	0.3817	3.3056	5.8399	2.7265	3.2774	132.6600
7/13/2016	10:00:00 AM	14.8646	0.4705	0.3742	4.0288	7.1168	3.3227	3.8735	161.6655
7/13/2016	10:30:00 AM	15.0718	0.4838	0.3542	5.4863	9.6931	4.5255	5.0763	220.1888
7/13/2016	11:00:00 AM	15.3694	0.4950	0.3498	6.1113	10.7998	5.0422	5.5930	245.3283
7/13/2016	11:30:00 AM	15.5924	0.4993	0.3292	7.3303	12.9629	6.0521	6.6029	294.4655
7/13/2016	12:00:01 PM	15.8734	0.5277	0.3445	7.5043	13.2722	6.1965	6.7473	301.4926
7/13/2016	12:30:00 PM	16.2330	0.5048	0.3337	7.2836	12.8798	6.0133	6.5641	292.5786
7/13/2016	1:00:00 PM	16.6330	0.5284	0.3455	7.4769	13.2235	6.1737	6.7246	300.3859
7/13/2016	1:30:00 PM	17.2644	0.5189	0.3399	7.4404	13.1585	6.1434	6.6942	298.9093
7/13/2016	2:00:00 PM	17.7052	0.6042	0.3164	11.3826	20.2230	9.4416	9.9925	459.3868
7/13/2016	2:30:00 PM	18.4746	0.6022	0.2363	16.4629	29.5726	13.8067	14.3576	671.7729
7/13/2016	3:00:00 PM	18.8346	0.6238	0.2207	18.2816	33.0141	15.4135	15.9644	749.9514
7/13/2016	3:30:00 PM	19.1926	0.6299	0.2177	18.6899	33.7948	15.7780	16.3289	767.6857
7/13/2016	4:00:00 PM	19.8013	0.6124	0.2031	19.4166	35.1924	16.4305	16.9814	799.4334
7/13/2016	4:30:00 PM	19.9193	0.6000	0.2194	17.7024	31.9119	14.8989	15.4498	724.9128
7/13/2016	5:00:00 PM	20.0171	0.5801	0.2122	17.6971	31.9016	14.8941	15.4450	724.6808
7/13/2016	5:30:00 PM	19.9014	0.5623	0.2252	16.0996	28.8918	13.4889	14.0398	656.3085
7/13/2016	6:00:00 PM	19.7855	0.5576	0.2516	14.0060	25.0081	11.6757	12.2265	568.0854
7/13/2016	6:30:00 PM	19.6282	0.5332	0.2433	13.8047	24.6379	11.5029	12.0537	559.6766
7/13/2016	7:00:00 PM	19.3858	0.5404	0.2475	13.7389	24.5169	11.4464	11.9972	556.9285
7/13/2016	7:30:00 PM	18.9840	0.5213	0.2504	12.9025	22.9852	10.7313	11.2821	522.1350
7/13/2016	8:00:00 PM	18.7448	0.5310	0.2597	12.5842	22.4046	10.4602	11.0111	508.9456
7/13/2016	8:30:00 PM	18.4746	0.4993	0.2663	11.0549	19.6308	9.1652	9.7160	445.9348
7/13/2016	9:00:00 PM	18.0714	0.4824	0.2856	9.2190	16.3308	7.6245	8.1753	370.9723
7/13/2016	9:30:00 PM	17.3603	0.4325	0.3059	6.0899	10.7619	5.0245	5.5753	244.4688
7/13/2016	10:00:00 PM	16.4974	0.3916	0.3522	1.8656	3.2977	1.5396	2.0904	74.9100
7/13/2016	10:30:00 PM	15.6869	0.3868	0.3772	0.4403	0.7791	0.3638	0.9146	17.6985
7/13/2016	11:00:00 PM	15.2881	0.4066	0.3907	0.6983	1.2354	0.5768	1.1276	28.0629

7/13/2016	11:30:00 PM	15.0579	0.4041	0.4042	-0.0071	-0.0125	-0.0059	0.5450	-0.2848
7/14/2016	12:00:01 AM	14.8007	0.4012	0.4034	-0.0960	-0.1699	-0.0793	0.4715	-3.8594
7/14/2016	12:30:00 AM	14.5482	0.3991	0.4087	-0.4143	-0.7336	-0.3425	0.2083	-16.6656
7/14/2016	1:00:00 AM	14.3351	0.3949	0.4131	-0.7938	-1.4063	-0.6566	-0.1057	-31.9462
7/14/2016	1:30:00 AM	14.1270	0.3929	0.4077	-0.6486	-1.1488	-0.5364	0.0145	-26.0971
7/14/2016	2:00:00 AM	13.9343	0.3980	0.4136	-0.6772	-1.1996	-0.5601	-0.0092	-27.2495
7/14/2016	2:30:00 AM	13.7207	0.3893	0.4130	-1.0384	-1.8401	-0.8591	-0.3082	-41.7988
7/14/2016	3:00:00 AM	13.5227	0.3950	0.4163	-0.9221	-1.6339	-0.7628	-0.2120	-37.1151
7/14/2016	3:30:00 AM	13.3871	0.3968	0.4186	-0.9418	-1.6688	-0.7791	-0.2283	-37.9086
7/14/2016	4:00:00 AM	13.1814	0.3858	0.4122	-1.1627	-2.0608	-0.9621	-0.4113	-46.8132
7/14/2016	4:30:00 AM	12.8856	0.3903	0.4151	-1.0852	-1.9232	-0.8979	-0.3470	-43.6872
7/14/2016	5:00:00 AM	12.5379	0.3850	0.4210	-1.5713	-2.7862	-1.3008	-0.7500	-63.2926
7/14/2016	5:30:00 AM	12.3035	0.3901	0.4246	-1.4912	-2.6440	-1.2344	-0.6836	-60.0615
7/14/2016	6:00:00 AM	12.2027	0.3927	0.4223	-1.2790	-2.2671	-1.0585	-0.5076	-51.4997
7/14/2016	6:30:00 AM	12.2363	0.4035	0.4224	-0.8059	-1.4277	-0.6666	-0.1157	-32.4322
7/14/2016	7:00:00 AM	12.4171	0.4185	0.4281	-0.3978	-0.7045	-0.3289	0.2219	-16.0033
7/14/2016	7:30:00 AM	12.6695	0.4323	0.4179	0.5982	1.0583	0.4941	1.0449	24.0407
7/14/2016	8:00:00 AM	13.1072	0.4744	0.4197	2.1536	3.8062	1.7770	2.3279	86.4609
7/14/2016	8:30:00 AM	13.8041	0.4908	0.3763	4.6715	8.2523	3.8528	4.4037	187.4599
7/14/2016	9:00:00 AM	14.2564	0.4988	0.3600	5.7368	10.1366	4.7326	5.2834	230.2641
7/14/2016	9:30:00 AM	15.2941	0.5598	0.3340	9.0835	16.0883	7.5112	8.0621	365.4624
7/14/2016	10:00:00 AM	16.1922	0.6986	0.3951	10.0302	17.7853	8.3036	8.8544	404.0131
7/14/2016	10:30:00 AM	17.4500	0.6587	0.2901	14.4266	25.7831	12.0376	12.5884	585.6920
7/14/2016	11:00:00 AM	19.0010	0.6988	0.2767	16.2980	29.2633	13.6624	14.2132	664.7485
7/14/2016	11:30:00 AM	19.3285	0.6090	0.1628	23.2141	42.6772	19.9250	20.4759	969.4600
7/14/2016	12:00:01 PM	19.9329	0.6379	0.1781	22.4533	41.1515	19.2127	19.7636	934.8018
7/14/2016	12:30:00 PM	19.7686	0.5946	0.1901	20.0626	36.4436	17.0147	17.5655	827.8555
7/14/2016	1:00:00 PM	19.7855	0.5498	0.2057	17.2929	31.1361	14.5367	15.0876	707.2903
7/14/2016	1:30:00 PM	19.4621	0.5474	0.2913	11.0978	19.7081	9.2013	9.7521	447.6917

7/14/2016	2:00:00 PM	20.2102	0.6215	0.2065	19.3841	35.1296	16.4012	16.9521	798.0080
7/14/2016	2:30:00 PM	20.5010	0.6136	0.1814	21.4454	39.1512	18.2788	18.8296	889.3616
7/14/2016	3:00:00 PM	21.5668	0.6227	0.1757	22.2608	40.7676	19.0335	19.5843	926.0812
7/14/2016	3:30:00 PM	21.0626	0.4396	0.2364	10.9197	19.3867	9.0512	9.6021	440.3902
7/14/2016	4:00:00 PM	20.1473	0.4337	0.3612	3.2211	5.6907	2.6569	3.2077	129.2702
7/14/2016	4:30:00 PM	20.1294	0.4270	0.3460	3.7029	6.5413	3.0540	3.6048	148.5935
7/14/2016	5:00:00 PM	20.1074	0.4969	0.3278	7.3222	12.9484	6.0453	6.5962	294.1367
7/14/2016	5:30:00 PM	20.5031	0.5924	0.2557	14.7845	26.4447	12.3464	12.8973	600.7200
7/14/2016	6:00:00 PM	20.4958	0.5610	0.2333	15.4407	27.6625	12.9150	13.4658	628.3840
7/14/2016	6:30:00 PM	20.1976	0.5407	0.2385	14.4016	25.7370	12.0160	12.5669	584.6446
7/14/2016	7:00:00 PM	20.1515	0.5621	0.2251	16.1048	28.9016	13.4935	14.0443	656.5316
7/14/2016	7:30:00 PM	19.9256	0.5349	0.2462	13.6501	24.3540	11.3703	11.9212	553.2283
7/14/2016	8:00:00 PM	19.5658	0.4889	0.2852	9.4825	16.8027	7.8448	8.3956	381.6913
7/14/2016	8:30:00 PM	19.0499	0.4376	0.3301	4.9608	8.7636	4.0915	4.6424	199.0753
7/14/2016	9:00:00 PM	18.5259	0.4009	0.3593	1.9268	3.4057	1.5900	2.1409	77.3643
7/14/2016	9:30:00 PM	17.8481	0.3791	0.3677	0.5368	0.9497	0.4434	0.9943	21.5744
7/14/2016	10:00:00 PM	17.0401	0.3639	0.3760	-0.5734	-1.0156	-0.4742	0.0767	-23.0712
7/14/2016	10:30:00 PM	16.1746	0.3604	0.3773	-0.8077	-1.4310	-0.6681	-0.1172	-32.5061
7/14/2016	11:00:00 PM	15.3138	0.3533	0.3867	-1.5920	-2.8231	-1.3180	-0.7672	-64.1294
7/14/2016	11:30:00 PM	14.4858	0.3674	0.3840	-0.7804	-1.3825	-0.6455	-0.0946	-31.4057
7/15/2016	12:00:01 AM	13.7791	0.3736	0.3909	-0.7983	-1.4143	-0.6603	-0.1095	-32.1280
7/15/2016	12:30:00 AM	13.1044	0.3620	0.3905	-1.3356	-2.3677	-1.1054	-0.5546	-53.7844
7/15/2016	1:00:00 AM	12.3892	0.3527	0.3999	-2.2103	-3.9230	-1.8316	-1.2807	-89.1150
7/15/2016	1:30:00 AM	11.7161	0.3614	0.4031	-1.9218	-3.4095	-1.5918	-1.0410	-77.4509
7/15/2016	2:00:00 AM	11.0849	0.3606	0.4059	-2.0828	-3.6959	-1.7255	-1.1747	-83.9560
7/15/2016	2:30:00 AM	10.4816	0.3725	0.4114	-1.7482	-3.1008	-1.4477	-0.8969	-70.4387
7/15/2016	3:00:00 AM	9.8859	0.3705	0.4101	-1.7831	-3.1629	-1.4767	-0.9258	-71.8477
7/15/2016	3:30:00 AM	9.3305	0.3645	0.4124	-2.1731	-3.8567	-1.8006	-1.2498	-87.6097
7/15/2016	4:00:00 AM	8.8112	0.3685	0.4107	-1.9075	-3.3840	-1.5799	-1.0291	-76.8708

7/15/2016	4:30:00 AM	8.3736	0.3646	0.4211	-2.5348	-4.5009	-2.1014	-1.5505	-102.2439
7/15/2016	5:00:00 AM	8.0423	0.3941	0.4298	-1.5275	-2.7085	-1.2645	-0.7137	-61.5267
7/15/2016	5:30:00 AM	7.9700	0.3922	0.4386	-1.9662	-3.4885	-1.6287	-1.0779	-79.2450
7/15/2016	6:00:00 AM	7.9237	0.3872	0.4383	-2.1808	-3.8704	-1.8070	-1.2562	-87.9203
7/15/2016	6:30:00 AM	8.0423	0.4060	0.4557	-2.0295	-3.6012	-1.6813	-1.1305	-81.8045
7/15/2016	7:00:00 AM	8.8474	0.4675	0.4599	0.2876	0.5089	0.2376	0.7884	11.5599
7/15/2016	7:30:00 AM	9.8841	0.5176	0.4294	3.2901	5.8125	2.7137	3.2646	132.0380
7/15/2016	8:00:00 AM	10.9728	0.5852	0.3567	8.7079	15.4170	7.1978	7.7487	350.2133
7/15/2016	8:30:00 AM	12.2363	0.6096	0.3004	12.4555	22.1702	10.3508	10.9016	503.6214
7/15/2016	9:00:00 AM	13.6736	0.6615	0.2620	16.2954	29.2584	13.6601	14.2109	664.6368
7/15/2016	9:30:00 AM	15.9303	0.7226	0.2989	15.5336	27.8355	12.9957	13.5466	632.3128
7/15/2016	10:00:00 AM	18.3117	0.7191	0.2909	15.9261	28.5675	13.3375	13.8883	648.9411
7/15/2016	10:30:00 AM	19.0031	0.7139	0.2933	15.6493	28.0510	13.0964	13.6472	637.2103
7/15/2016	11:00:00 AM	19.9960	0.6093	0.1576	23.7965	43.8546	20.4747	21.0255	996.2042
7/15/2016	11:30:01 AM	20.7534	0.6471	0.1859	21.9450	40.1399	18.7404	19.2913	911.8222
7/15/2016	12:00:01 PM	21.1749	0.5759	0.1669	21.7943	39.8411	18.6009	19.1517	905.0341
7/15/2016	12:30:00 PM	22.0546	0.6593	0.2178	19.4889	35.3321	16.4957	17.0466	802.6062
7/15/2016	1:00:00 PM	23.1577	0.6500	0.1856	22.0507	40.3496	18.8383	19.3892	916.5862
7/15/2016	1:30:00 PM	23.9480	0.6407	0.1808	22.2587	40.7634	19.0315	19.5823	925.9848
7/15/2016	2:00:00 PM	24.9414	0.6593	0.1983	21.1370	38.5437	17.9952	18.5460	875.5627
7/15/2016	2:30:00 PM	25.4185	0.6547	0.2016	20.7296	37.7445	17.6220	18.1729	857.4077
7/15/2016	3:00:00 PM	25.3468	0.6306	0.2014	20.0774	36.4724	17.0281	17.5790	828.5095
7/15/2016	3:30:00 PM	25.1107	0.5771	0.2026	18.4168	33.2723	15.5341	16.0849	755.8171
7/15/2016	4:00:00 PM	26.1028	0.6335	0.2017	20.1365	36.5873	17.0818	17.6326	831.1194
7/15/2016	4:30:00 PM	26.7404	0.6180	0.1788	21.8262	39.9042	18.6304	19.1812	906.4676
7/15/2016	5:00:00 PM	27.0029	0.6065	0.1809	21.2898	38.8445	18.1356	18.6865	882.3963
7/15/2016	5:30:00 PM	26.9755	0.5897	0.1834	20.5534	37.3999	17.4612	18.0120	849.5804
7/15/2016	6:00:00 PM	26.8413	0.5629	0.1941	18.7343	33.8800	15.8178	16.3686	769.6210
7/15/2016	6:30:00 PM	26.6329	0.5571	0.2146	16.7833	30.1748	14.0879	14.6388	685.4534

7/15/2016	7:00:00 PM	26.4016	0.5244	0.2347	14.1438	25.2617	11.7941	12.3449	573.8465
7/15/2016	7:30:00 PM	26.0272	0.4986	0.2624	11.2917	20.0587	9.3649	9.9158	455.6550
7/15/2016	8:00:00 PM	25.5456	0.4636	0.2831	8.6769	15.3617	7.1720	7.7229	348.9583
7/15/2016	8:30:00 PM	24.9530	0.4291	0.3103	5.7072	10.0841	4.7080	5.2589	229.0704
7/15/2016	9:00:00 PM	24.0042	0.3890	0.3225	3.2968	5.8243	2.7192	3.2701	132.3056
7/15/2016	9:30:00 PM	22.8477	0.3540	0.3313	1.1624	2.0556	0.9597	1.5106	46.6957
7/15/2016	10:00:00 PM	21.4933	0.3493	0.3359	0.6877	1.2165	0.5679	1.1188	27.6337
7/15/2016	10:30:00 PM	20.2312	0.3548	0.3513	0.1751	0.3099	0.1447	0.6955	7.0402
7/15/2016	11:00:00 PM	19.4070	0.3734	0.3773	-0.1843	-0.3264	-0.1524	0.3985	-7.4136
7/15/2016	11:30:00 PM	18.9454	0.3896	0.3934	-0.1705	-0.3018	-0.1409	0.4099	-6.8566
7/16/2016	12:00:01 AM	18.5839	0.3892	0.3980	-0.3893	-0.6893	-0.3218	0.2290	-15.6585
7/16/2016	12:30:00 AM	18.2115	0.3829	0.3895	-0.3010	-0.5329	-0.2488	0.3021	-12.1049
7/16/2016	1:00:00 AM	17.7113	0.3809	0.3914	-0.4818	-0.8532	-0.3983	0.1525	-19.3805
7/16/2016	1:30:00 AM	17.1457	0.3668	0.3838	-0.7995	-1.4163	-0.6613	-0.1104	-32.1737
7/16/2016	2:00:00 AM	16.4859	0.3658	0.3875	-1.0162	-1.8008	-0.8408	-0.2899	-40.9077
7/16/2016	2:30:00 AM	15.6593	0.3636	0.3853	-1.0195	-1.8066	-0.8435	-0.2926	-41.0394
7/16/2016	3:00:00 AM	14.9623	0.3640	0.3890	-1.1665	-2.0674	-0.9652	-0.4144	-46.9633
7/16/2016	3:30:00 AM	14.3873	0.3647	0.3909	-1.2220	-2.1660	-1.0112	-0.4604	-49.2027
7/16/2016	4:00:00 AM	13.6755	0.3676	0.3939	-1.2149	-2.1534	-1.0054	-0.4545	-48.9180
7/16/2016	4:30:00 AM	12.9187	0.3562	0.3895	-1.5737	-2.7907	-1.3029	-0.7520	-63.3927
7/16/2016	5:00:00 AM	12.2027	0.3611	0.4004	-1.8139	-3.2175	-1.5022	-0.9513	-73.0887
7/16/2016	5:30:00 AM	11.6480	0.3840	0.4107	-1.1843	-2.0990	-0.9800	-0.4291	-47.6813
7/16/2016	6:00:00 AM	11.3065	0.3925	0.4129	-0.8894	-1.5757	-0.7357	-0.1848	-35.7946
7/16/2016	6:30:00 AM	11.2225	0.4038	0.4262	-0.9500	-1.6833	-0.7859	-0.2351	-38.2387
7/16/2016	7:00:00 AM	11.5252	0.4615	0.4158	1.8362	3.2458	1.5154	2.0662	73.7315
7/16/2016	7:30:00 AM	12.4562	0.5506	0.4070	5.3192	9.3975	4.3875	4.9383	213.4748
7/16/2016	8:00:00 AM	13.5812	0.5839	0.3445	9.2834	16.4461	7.6783	8.2292	373.5918
7/16/2016	8:30:00 AM	14.8685	0.6370	0.2819	14.3449	25.6324	11.9672	12.5180	582.2682
7/16/2016	9:00:00 AM	16.3538	0.6623	0.2588	16.5351	29.7081	13.8700	14.4209	674.8517

7/16/2016	9:30:00 AM	18.5259	0.7046	0.2843	15.9722	28.6537	13.3778	13.9286	650.9001
7/16/2016	10:00:00 AM	21.1140	0.7152	0.3008	15.2420	27.2930	12.7425	13.2933	619.9913
7/16/2016	10:30:00 AM	22.0645	0.6852	0.2880	15.2524	27.3125	12.7516	13.3024	620.4326
7/16/2016	11:00:00 AM	23.4146	0.6696	0.2509	17.2677	31.0884	14.5145	15.0653	706.2071
7/16/2016	11:30:00 AM	24.0909	0.6296	0.1758	22.4529	41.1506	19.2123	19.7631	934.7811
7/16/2016	12:00:01 PM	24.5741	0.6460	0.1847	22.0271	40.3029	18.8165	19.3673	915.5242
7/16/2016	12:30:00 PM	25.5202	0.7025	0.2359	19.2025	34.7797	16.2378	16.7887	790.0583
7/16/2016	1:00:00 PM	26.0272	0.5938	0.1610	22.9623	42.1706	19.6885	20.2393	957.9513
7/16/2016	1:30:00 PM	26.8981	0.6618	0.2072	20.4298	37.1587	17.3485	17.8994	844.0995
7/16/2016	2:00:00 PM	27.2468	0.5937	0.1689	22.1200	40.4874	18.9026	19.4535	919.7156
7/16/2016	2:30:00 PM	27.8065	0.5616	0.1345	25.1398	46.6032	21.7580	22.3088	1058.6421
7/16/2016	3:00:00 PM	28.3142	0.6105	0.1544	24.1820	44.6386	20.8407	21.3916	1014.0147
7/16/2016	3:30:00 PM	28.4450	0.6508	0.1903	21.6343	39.5244	18.4530	19.0039	897.8396
7/16/2016	4:00:00 PM	28.6799	0.6144	0.1739	22.2042	40.6549	18.9808	19.5317	923.5201
7/16/2016	4:30:00 PM	28.4475	0.5580	0.1630	21.6533	39.5618	18.4705	19.0214	898.6903
7/16/2016	5:00:00 PM	28.3525	0.5620	0.1636	21.7188	39.6915	18.5311	19.0819	901.6369
7/16/2016	5:30:00 PM	28.1375	0.5774	0.1782	20.6871	37.6614	17.5832	18.1341	855.5188
7/16/2016	6:00:00 PM	27.7749	0.5620	0.1994	18.2310	32.9176	15.3685	15.9193	747.7591
7/16/2016	6:30:00 PM	27.4840	0.5130	0.1907	17.4086	31.3549	14.6389	15.1897	712.2605
7/16/2016	7:00:00 PM	26.2130	0.4401	0.2282	11.5610	20.5459	9.5924	10.1432	466.7222
7/16/2016	7:30:00 PM	25.1964	0.4415	0.2885	7.4898	13.2464	6.1845	6.7353	300.9074
7/16/2016	8:00:00 PM	24.4249	0.4265	0.3046	5.9206	10.4620	4.8845	5.4353	237.6553
7/16/2016	8:30:00 PM	23.6360	0.4015	0.3237	3.7889	6.6931	3.1249	3.6757	152.0422
7/16/2016	9:00:00 PM	22.8668	0.3869	0.3433	2.1037	3.7181	1.7359	2.2867	84.4598
7/16/2016	9:30:00 PM	22.0745	0.3729	0.3560	0.8150	1.4416	0.6730	1.2239	32.7468
7/16/2016	10:00:00 PM	21.3205	0.3790	0.3646	0.6811	1.2049	0.5625	1.1134	27.3708
7/16/2016	10:30:00 PM	20.7513	0.3812	0.3769	0.1974	0.3493	0.1631	0.7139	7.9352
7/16/2016	11:00:00 PM	20.1389	0.3779	0.3797	-0.0808	-0.1431	-0.0668	0.4840	-3.2510
7/16/2016	11:30:00 PM	19.5489	0.3761	0.3809	-0.2245	-0.3974	-0.1855	0.3653	-9.0280

7/17/2016	12:00:01 AM	18.9433	0.3828	0.3833	-0.0243	-0.0431	-0.0201	0.5307	-0.9789
7/17/2016	12:30:00 AM	18.4486	0.3806	0.3952	-0.6647	-1.1773	-0.5497	0.0012	-26.7441
7/17/2016	1:00:00 AM	17.9427	0.3746	0.3940	-0.8883	-1.5739	-0.7348	-0.1840	-35.7525
7/17/2016	1:30:00 AM	17.4384	0.3769	0.3948	-0.8174	-1.4481	-0.6761	-0.1253	-32.8959
7/17/2016	2:00:00 AM	16.9920	0.3715	0.3946	-1.0614	-1.8810	-0.8782	-0.3273	-42.7289
7/17/2016	2:30:00 AM	16.4955	0.3647	0.3909	-1.2198	-2.1620	-1.0094	-0.4585	-49.1116
7/17/2016	3:00:00 AM	15.9224	0.3788	0.3980	-0.8721	-1.5452	-0.7214	-0.1706	-35.1003
7/17/2016	3:30:00 AM	15.6850	0.3936	0.4117	-0.7886	-1.3970	-0.6522	-0.1014	-31.7349
7/17/2016	4:00:00 AM	15.4149	0.3777	0.4093	-1.4113	-2.5021	-1.1682	-0.6173	-56.8368
7/17/2016	4:30:00 AM	15.2110	0.3822	0.4150	-1.4485	-2.5683	-1.1991	-0.6482	-58.3407
7/17/2016	5:00:00 AM	15.0521	0.3942	0.4208	-1.1460	-2.0311	-0.9483	-0.3974	-46.1383
7/17/2016	5:30:00 AM	14.9584	0.3930	0.4211	-1.2172	-2.1574	-1.0072	-0.4564	-49.0080
7/17/2016	6:00:00 AM	14.9763	0.4033	0.4274	-1.0234	-1.8136	-0.8467	-0.2959	-41.1969
7/17/2016	6:30:00 AM	15.0461	0.4052	0.4149	-0.4164	-0.7374	-0.3443	0.2066	-16.7514
7/17/2016	7:00:00 AM	15.1990	0.4356	0.4136	0.9124	1.6137	0.7534	1.3043	36.6575
7/17/2016	7:30:00 AM	15.3694	0.4504	0.3894	2.5609	4.5253	2.1127	2.6636	102.7963
7/17/2016	8:00:00 AM	15.6220	0.4646	0.3630	4.3397	7.6660	3.5791	4.1299	174.1411
7/17/2016	8:30:00 AM	15.9734	0.5039	0.3583	6.0039	10.6096	4.9534	5.5042	241.0083
7/17/2016	9:00:00 AM	16.6215	0.5605	0.3341	9.1041	16.1252	7.5285	8.0793	366.3023
7/17/2016	9:30:00 AM	17.2358	0.5453	0.3157	9.6129	17.0364	7.9539	8.5047	386.9995
7/17/2016	10:00:00 AM	18.7747	0.6523	0.3560	10.6561	18.9114	8.8293	9.3802	429.5933
7/17/2016	10:30:00 AM	19.3986	0.5991	0.2893	12.8078	22.8124	10.6506	11.2014	518.2081
7/17/2016	11:00:00 AM	19.7264	0.5972	0.2444	15.7237	28.1898	13.1612	13.7120	640.3615
7/17/2016	11:30:00 AM	20.0192	0.5963	0.2041	18.8600	34.1211	15.9304	16.4812	775.0990
7/17/2016	12:00:01 PM	20.2427	0.6473	0.2131	19.5451	35.4407	16.5464	17.0973	805.0738
7/17/2016	12:30:00 PM	20.9435	0.6453	0.2097	19.7788	35.8930	16.7576	17.3085	815.3485
7/17/2016	1:00:00 PM	22.0171	0.6235	0.1834	21.5314	39.3211	18.3581	18.9090	893.2212
7/17/2016	1:30:00 PM	22.7130	0.6156	0.1600	23.7070	43.6731	20.3900	20.9408	992.0824
7/17/2016	2:00:00 PM	22.8246	0.6106	0.1834	21.1655	38.5997	18.0213	18.5722	876.8351

7/17/2016	2:30:00 PM	22.6440	0.6602	0.2214	19.2237	34.8205	16.2569	16.8077	790.9860
7/17/2016	3:00:00 PM	23.4599	0.5819	0.1443	24.5333	45.3564	21.1759	21.7267	1030.3201
7/17/2016	3:30:00 PM	23.5238	0.6258	0.1923	20.7658	37.8154	17.6552	18.2060	859.0192
7/17/2016	4:00:00 PM	23.9883	0.6212	0.1804	21.7580	39.7691	18.5673	19.1181	903.3982
7/17/2016	4:30:00 PM	24.3854	0.5834	0.1452	24.4677	45.2221	21.1132	21.6640	1027.2698
7/17/2016	5:00:00 PM	24.4111	0.5728	0.1563	22.8517	41.9487	19.5849	20.1357	952.9109
7/17/2016	5:30:00 PM	24.1074	0.5936	0.1767	21.3192	38.9024	18.1626	18.7135	883.7104
7/17/2016	6:00:00 PM	23.6879	0.5646	0.1909	19.0763	34.5367	16.1244	16.6752	784.5388
7/17/2016	6:30:00 PM	23.3253	0.5457	0.2044	17.2778	31.1076	14.5234	15.0743	706.6430
7/17/2016	7:00:00 PM	22.8739	0.5287	0.2328	14.4336	25.7961	12.0436	12.5945	585.9867
7/17/2016	7:30:00 PM	22.3751	0.4926	0.2575	11.4143	20.2804	9.4685	10.0193	460.6925
7/17/2016	8:00:00 PM	21.7628	0.4663	0.2833	8.7657	15.5202	7.2460	7.7969	352.5590
7/17/2016	8:30:00 PM	21.1126	0.4236	0.3137	5.2880	9.3423	4.3617	4.9125	212.2196
7/17/2016	9:00:00 PM	20.1955	0.3804	0.3220	2.9351	5.1859	2.4212	2.9720	117.8031
7/17/2016	9:30:00 PM	19.1480	0.3664	0.3422	1.2023	2.1261	0.9926	1.5435	48.2967
7/17/2016	10:00:00 PM	18.1491	0.3580	0.3487	0.4626	0.8186	0.3822	0.9330	18.5944
7/17/2016	10:30:00 PM	16.9960	0.3594	0.3599	-0.0264	-0.0468	-0.0219	0.5290	-1.0632
7/17/2016	11:00:00 PM	15.8048	0.3515	0.3659	-0.7056	-1.2499	-0.5836	-0.0327	-28.3934
7/17/2016	11:30:00 PM	14.8206	0.3537	0.3765	-1.0972	-1.9445	-0.9078	-0.3570	-44.1705
7/18/2016	12:00:01 AM	13.8874	0.3506	0.3793	-1.3863	-2.4576	-1.1474	-0.5966	-55.8272
7/18/2016	12:30:00 AM	12.9703	0.3637	0.3822	-0.8735	-1.5475	-0.7225	-0.1717	-35.1539
7/18/2016	1:00:00 AM	12.2381	0.3629	0.3925	-1.3797	-2.4460	-1.1420	-0.5911	-55.5637
7/18/2016	1:30:00 AM	11.5117	0.3649	0.3960	-1.4404	-2.5538	-1.1923	-0.6415	-58.0117
7/18/2016	2:00:00 AM	10.7894	0.3589	0.4000	-1.9106	-3.3895	-1.5825	-1.0316	-76.9968
7/18/2016	2:30:00 AM	10.1117	0.3696	0.3921	-1.0384	-1.8401	-0.8591	-0.3083	-41.8003
7/18/2016	3:00:00 AM	9.4021	0.3676	0.3974	-1.3709	-2.4303	-1.1347	-0.5838	-55.2073
7/18/2016	3:30:00 AM	8.7550	0.3681	0.4026	-1.5733	-2.7899	-1.3025	-0.7517	-63.3754
7/18/2016	4:00:00 AM	8.1530	0.3754	0.4103	-1.5630	-2.7716	-1.2940	-0.7432	-62.9603
7/18/2016	4:30:00 AM	7.6728	0.3769	0.4213	-1.9602	-3.4778	-1.6237	-1.0729	-79.0020

7/18/2016	5:00:00 AM	7.4467	0.3960	0.4299	-1.4434	-2.5590	-1.1948	-0.6439	-58.1313
7/18/2016	5:30:00 AM	7.4091	0.3942	0.4376	-1.8357	-3.2564	-1.5203	-0.9695	-73.9722
7/18/2016	6:00:00 AM	7.4279	0.4036	0.4446	-1.7038	-3.0218	-1.4108	-0.8600	-68.6442
7/18/2016	6:30:00 AM	7.6711	0.4070	0.4405	-1.3935	-2.4705	-1.1534	-0.6026	-56.1199
7/18/2016	7:00:00 AM	8.1311	0.4483	0.4524	-0.1607	-0.2846	-0.1329	0.4180	-6.4644
7/18/2016	7:30:00 AM	8.8547	0.4648	0.4362	1.1186	1.9781	0.9235	1.4744	44.9350
7/18/2016	8:00:00 AM	9.7584	0.5398	0.4054	5.0375	8.8993	4.1549	4.7057	202.1562
7/18/2016	8:30:00 AM	11.1347	0.5829	0.3417	9.3961	16.6479	7.7725	8.3234	378.1746
7/18/2016	9:00:00 AM	12.3706	0.6181	0.3260	11.2561	19.9942	9.3348	9.8857	454.1898
7/18/2016	9:30:00 AM	14.2260	0.6927	0.3394	12.5523	22.3465	10.4331	10.9839	507.6255
7/18/2016	10:00:00 AM	17.1343	0.6864	0.3060	14.2121	25.3876	11.8529	12.4037	576.7077
7/18/2016	10:30:00 AM	18.1621	0.7006	0.3045	14.6611	26.2166	12.2399	12.7908	595.5377
7/18/2016	11:00:00 AM	19.5848	0.6064	0.1944	20.0155	36.3522	16.9720	17.5229	825.7798
7/18/2016	11:30:00 AM	20.3736	0.6154	0.1757	22.0607	40.3695	18.8476	19.3985	917.0382
7/18/2016	12:00:01 PM	21.2474	0.6651	0.2002	21.1231	38.5165	17.9825	18.5333	874.9435
7/18/2016	12:30:00 PM	22.6747	0.6435	0.1969	20.8397	37.9603	17.7228	18.2736	862.3087
7/18/2016	1:00:00 PM	23.5677	0.6768	0.2103	20.5660	37.4245	17.4726	18.0235	850.1384
7/18/2016	1:30:00 PM	25.0574	0.6469	0.1863	21.9023	40.0552	18.7009	19.2517	909.8976
7/18/2016	2:00:00 PM	25.8038	0.6450	0.1819	22.2716	40.7891	19.0435	19.5944	926.5701
7/18/2016	2:30:00 PM	25.8844	0.5981	0.1703	22.1027	40.4530	18.8866	19.4374	918.9340
7/18/2016	3:00:00 PM	26.2454	0.5743	0.1710	21.3179	38.8999	18.1615	18.7123	883.6527
7/18/2016	3:30:00 PM	26.7380	0.6288	0.1943	20.6623	37.6128	17.5606	18.1114	854.4167
7/18/2016	4:00:00 PM	26.8179	0.5867	0.1712	21.6708	39.5965	18.4867	19.0375	899.4771
7/18/2016	4:30:00 PM	27.4065	0.6039	0.1740	21.8927	40.0361	18.6919	19.2428	909.4641
7/18/2016	5:00:00 PM	27.5542	0.5989	0.1627	22.9306	42.1071	19.6588	20.2097	956.5085
7/18/2016	5:30:00 PM	27.4177	0.5630	0.1627	21.8420	39.9355	18.6450	19.1958	907.1777
7/18/2016	6:00:00 PM	27.3406	0.5762	0.1896	19.5571	35.4638	16.5572	17.1081	805.5980
7/18/2016	6:30:00 PM	27.3269	0.5607	0.2018	17.9796	32.4386	15.1448	15.6957	736.8778
7/18/2016	7:00:00 PM	27.0919	0.5471	0.2207	15.9769	28.6624	13.3818	13.9327	651.0978

7/18/2016	7:30:00 PM	26.6419	0.4966	0.2451	12.4211	22.1075	10.3215	10.8723	502.1969
7/18/2016	8:00:00 PM	26.0937	0.4623	0.2813	8.7394	15.4732	7.2241	7.7749	351.4905
7/18/2016	8:30:00 PM	25.4901	0.4304	0.3055	6.0318	10.6589	4.9764	5.5272	242.1278
7/18/2016	9:00:00 PM	24.7811	0.3952	0.3315	3.0930	5.4646	2.5513	3.1021	124.1335
7/18/2016	9:30:00 PM	23.9131	0.3685	0.3356	1.6432	2.9050	1.3563	1.9071	65.9901
7/18/2016	10:00:00 PM	22.8881	0.3628	0.3451	0.8808	1.5580	0.7274	1.2782	35.3908
7/18/2016	10:30:00 PM	21.8922	0.3549	0.3562	-0.0677	-0.1199	-0.0560	0.4949	-2.7239
7/18/2016	11:00:00 PM	20.9114	0.3532	0.3629	-0.4764	-0.8437	-0.3939	0.1570	-19.1650
7/18/2016	11:30:00 PM	19.9919	0.3643	0.3657	-0.0675	-0.1196	-0.0558	0.4950	-2.7163
7/19/2016	12:00:01 AM	19.1352	0.3618	0.3861	-1.1452	-2.0296	-0.9476	-0.3967	-46.1046
7/19/2016	12:30:00 AM	18.3583	0.3572	0.3873	-1.4236	-2.5239	-1.1784	-0.6275	-57.3335
7/19/2016	1:00:00 AM	17.6484	0.3641	0.3863	-1.0431	-1.8485	-0.8630	-0.3122	-41.9916
7/19/2016	1:30:00 AM	17.0342	0.3631	0.3901	-1.2632	-2.2391	-1.0454	-0.4945	-50.8634
7/19/2016	2:00:00 AM	16.4218	0.3649	0.3972	-1.4950	-2.6508	-1.2376	-0.6867	-60.2157
7/19/2016	2:30:00 AM	15.9871	0.3740	0.4009	-1.2212	-2.1646	-1.0106	-0.4598	-49.1718
7/19/2016	3:00:00 AM	15.5944	0.3793	0.4002	-0.9422	-1.6694	-0.7794	-0.2286	-37.9220
7/19/2016	3:30:00 AM	15.3397	0.3883	0.4194	-1.3579	-2.4072	-1.1239	-0.5730	-54.6816
7/19/2016	4:00:00 AM	15.2922	0.3876	0.4243	-1.5917	-2.8226	-1.3178	-0.7670	-64.1179
7/19/2016	4:30:00 AM	15.2288	0.3811	0.4197	-1.6973	-3.0103	-1.4055	-0.8546	-68.3830
7/19/2016	5:00:00 AM	15.1354	0.3952	0.4237	-1.2253	-2.1718	-1.0140	-0.4631	-49.3349
7/19/2016	5:30:00 AM	15.1475	0.3929	0.4295	-1.5677	-2.7799	-1.2979	-0.7470	-63.1481
7/19/2016	6:00:00 AM	15.1951	0.3953	0.4259	-1.3102	-2.3225	-1.0843	-0.5335	-52.7575
7/19/2016	6:30:00 AM	15.2110	0.3970	0.4191	-0.9522	-1.6871	-0.7877	-0.2368	-38.3254
7/19/2016	7:00:00 AM	15.3378	0.3959	0.4339	-1.6095	-2.8543	-1.3326	-0.7817	-64.8376
7/19/2016	7:30:00 AM	15.5451	0.4075	0.4242	-0.7081	-1.2543	-0.5856	-0.0348	-28.4937
7/19/2016	8:00:00 AM	15.8421	0.4274	0.4397	-0.5000	-0.8855	-0.4134	0.1374	-20.1161
7/19/2016	8:30:00 AM	16.6195	0.4888	0.4277	2.3524	4.1572	1.9409	2.4918	94.4357
7/19/2016	9:00:00 AM	17.5111	0.5054	0.3679	5.5892	9.8752	4.6105	5.1614	224.3264
7/19/2016	9:30:00 AM	18.2336	0.5588	0.3731	7.1070	12.5660	5.8668	6.4176	285.4502

7/19/2016	10:00:00 AM	20.2521	0.7634	0.4104	10.9195	19.3863	9.0510	9.6019	440.3821
7/19/2016	10:30:00 AM	21.6865	0.6919	0.2674	16.7252	30.0655	14.0369	14.5877	682.9704
7/19/2016	11:00:00 AM	22.8623	0.6735	0.2366	18.4051	33.2500	15.5237	16.0745	755.3105
7/19/2016	11:30:00 AM	23.9108	0.6217	0.1762	22.1844	40.6155	18.9625	19.5133	922.6264
7/19/2016	12:00:01 PM	24.8067	0.6492	0.1940	21.2576	38.7810	18.1060	18.6568	880.9532
7/19/2016	12:30:00 PM	26.4220	0.6680	0.2091	20.4371	37.1730	17.3552	17.9061	844.4246
7/19/2016	1:00:00 PM	27.8610	0.6372	0.1837	21.8838	40.0184	18.6837	19.2345	909.0628
7/19/2016	1:30:00 PM	29.0548	0.6516	0.1972	21.0337	38.3407	17.9004	18.4512	870.9505
7/19/2016	2:00:00 PM	29.7923	0.6023	0.1605	23.2676	42.7850	19.9753	20.5262	971.9076
7/19/2016	2:30:00 PM	30.4157	0.6259	0.1816	21.7739	39.8006	18.5820	19.1328	904.1145
7/19/2016	3:00:00 PM	31.1355	0.6187	0.1680	22.9372	42.1202	19.6650	20.2158	956.8067
7/19/2016	3:30:00 PM	31.7410	0.6149	0.1699	22.6325	41.5096	19.3799	19.9307	942.9366
7/19/2016	4:00:00 PM	32.2319	0.6153	0.1644	23.2255	42.7001	19.9357	20.4865	969.9790
7/19/2016	4:30:00 PM	32.4217	0.5806	0.1471	24.1547	44.5829	20.8147	21.3656	1012.7494
7/19/2016	5:00:00 PM	32.2775	0.5798	0.1507	23.7112	43.6816	20.3940	20.9448	992.2762
7/19/2016	5:30:00 PM	31.8749	0.5426	0.1544	22.1146	40.4767	18.8977	19.4485	919.4728
7/19/2016	6:00:00 PM	31.5389	0.5622	0.1830	19.7444	35.8262	16.7264	17.2773	813.8307
7/19/2016	6:30:00 PM	31.1904	0.5457	0.1912	18.4495	33.3348	15.5633	16.1141	757.2373
7/19/2016	7:00:00 PM	30.7341	0.5211	0.2220	15.0115	26.8653	12.5428	13.0936	610.2739
7/19/2016	7:30:00 PM	30.2259	0.4900	0.2517	11.7243	20.8419	9.7306	10.2815	473.4465
7/19/2016	8:00:00 PM	29.6761	0.4608	0.2744	9.1229	16.1587	7.5442	8.0950	367.0637
7/19/2016	8:30:00 PM	29.1004	0.4327	0.3018	6.3371	11.1999	5.2290	5.7798	254.4178
7/19/2016	9:00:00 PM	28.3525	0.3945	0.3211	3.6186	6.3925	2.9845	3.5353	145.2119
7/19/2016	9:30:00 PM	27.5611	0.3857	0.3463	1.8946	3.3488	1.5635	2.1143	76.0720
7/19/2016	10:00:00 PM	26.8042	0.3706	0.3443	1.2925	2.2855	1.0671	1.6179	51.9182
7/19/2016	10:30:00 PM	25.9143	0.3576	0.3464	0.5601	0.9910	0.4627	1.0135	22.5121
7/19/2016	11:00:00 PM	24.9855	0.3607	0.3546	0.3001	0.5311	0.2479	0.7988	12.0635
7/19/2016	11:30:00 PM	24.0793	0.3700	0.3662	0.1852	0.3277	0.1530	0.7039	7.4446
7/20/2016	12:00:01 AM	23.2241	0.3545	0.3587	-0.2058	-0.3644	-0.1701	0.3807	-8.2768

7/20/2016	12:30:00 AM	22.2178	0.3501	0.3620	-0.5894	-1.0440	-0.4874	0.0634	-23.7150
7/20/2016	1:00:00 AM	21.2554	0.3483	0.3708	-1.1021	-1.9531	-0.9118	-0.3610	-44.3662
7/20/2016	1:30:00 AM	20.2814	0.3470	0.3705	-1.1522	-2.0420	-0.9534	-0.4025	-46.3871
7/20/2016	2:00:00 AM	19.3541	0.3499	0.3722	-1.0871	-1.9266	-0.8995	-0.3486	-43.7646
7/20/2016	2:30:00 AM	18.5067	0.3597	0.3874	-1.3079	-2.3185	-1.0825	-0.5316	-52.6671
7/20/2016	3:00:00 AM	18.2150	0.3937	0.4248	-1.3383	-2.3724	-1.1076	-0.5568	-53.8910
7/20/2016	3:30:00 AM	18.1842	0.3887	0.4088	-0.8895	-1.5761	-0.7358	-0.1850	-35.8023
7/20/2016	4:00:00 AM	17.9917	0.3693	0.4042	-1.5866	-2.8135	-1.3135	-0.7627	-63.9107
7/20/2016	4:30:00 AM	17.6880	0.3766	0.4076	-1.3926	-2.4688	-1.1526	-0.6018	-56.0821
7/20/2016	5:00:00 AM	17.4440	0.3806	0.4082	-1.2323	-2.1843	-1.0198	-0.4690	-49.6188
7/20/2016	5:30:00 AM	17.1264	0.3816	0.4015	-0.8970	-1.5893	-0.7420	-0.1912	-36.1032
7/20/2016	6:00:00 AM	16.9284	0.3953	0.4148	-0.8473	-1.5012	-0.7009	-0.1500	-34.1005
7/20/2016	6:30:00 AM	16.9726	0.4171	0.4150	0.0883	0.1563	0.0730	0.6238	3.5497
7/20/2016	7:00:00 AM	17.2644	0.4452	0.4075	1.5568	2.7523	1.2850	1.8359	62.5225
7/20/2016	7:30:00 AM	18.1430	0.5064	0.3822	4.9502	8.7450	4.0828	4.6337	198.6522
7/20/2016	8:00:00 AM	18.8346	0.5641	0.3223	9.8513	17.4640	8.1535	8.7044	396.7141
7/20/2016	8:30:00 AM	19.5892	0.6013	0.2688	14.1623	25.2958	11.8100	12.3609	574.6214
7/20/2016	9:00:00 AM	20.5427	0.6503	0.2625	15.9649	28.6399	13.3713	13.9222	650.5873
7/20/2016	9:30:00 AM	22.3036	0.6875	0.2462	18.0651	32.6014	15.2209	15.7717	740.5768
7/20/2016	10:00:00 AM	24.5997	0.6977	0.2955	15.1173	27.0616	12.6345	13.1853	614.7345
7/20/2016	10:30:00 AM	25.4392	0.6937	0.2570	17.4707	31.4725	14.6938	15.2446	714.9323
7/20/2016	11:00:00 AM	26.4151	0.6601	0.2319	18.4059	33.2515	15.5244	16.0752	755.3443
7/20/2016	11:30:00 AM	27.0465	0.6098	0.1763	21.8308	39.9133	18.6346	19.1855	906.6752
7/20/2016	12:00:01 PM	27.6906	0.6413	0.1910	21.3102	38.8847	18.1544	18.7052	883.3080
7/20/2016	12:30:00 PM	28.8703	0.6375	0.1861	21.6674	39.5899	18.4836	19.0345	899.3274
7/20/2016	1:00:00 PM	29.8312	0.6236	0.1667	23.2103	42.6694	19.9214	20.4722	969.2825
7/20/2016	1:30:00 PM	30.7878	0.6031	0.1566	23.7225	43.7045	20.4046	20.9555	992.7956
7/20/2016	2:00:00 PM	29.8665	0.4451	0.1322	21.3635	38.9898	18.2034	18.7543	885.6953
7/20/2016	2:30:00 PM	27.6814	0.3670	0.2306	8.1740	14.4644	6.7531	7.3039	328.5749

7/20/2016	3:00:00 PM	25.2520	0.3153	0.2606	3.3514	5.9208	2.7643	3.3151	134.4971
7/20/2016	3:30:00 PM	23.0726	0.3369	0.3137	1.2532	2.2160	1.0346	1.5855	50.3398
7/20/2016	4:00:00 PM	21.7628	0.3427	0.3365	0.3174	0.5617	0.2622	0.8131	12.7590
7/20/2016	4:30:00 PM	20.7585	0.3779	0.3721	0.2765	0.4893	0.2284	0.7793	11.1153
7/20/2016	5:00:00 PM	20.3254	0.3987	0.3917	0.3100	0.5487	0.2562	0.8070	12.4634
7/20/2016	5:30:00 PM	20.2081	0.4002	0.3708	1.3447	2.3776	1.1100	1.6609	54.0095
7/20/2016	6:00:00 PM	19.6726	0.3753	0.3821	-0.3153	-0.5582	-0.2606	0.2902	-12.6802
7/20/2016	6:30:00 PM	19.1161	0.3755	0.3907	-0.6955	-1.2320	-0.5752	-0.0244	-27.9871
7/20/2016	7:00:00 PM	18.8699	0.3916	0.4107	-0.8363	-1.4817	-0.6918	-0.1409	-33.6585
7/20/2016	7:30:00 PM	18.6848	0.3896	0.3886	0.0484	0.0857	0.0400	0.5908	1.9463
7/20/2016	8:00:00 PM	18.4014	0.3955	0.3838	0.5312	0.9399	0.4388	0.9897	21.3509
7/20/2016	8:30:00 PM	18.0391	0.3970	0.3854	0.5238	0.9268	0.4327	0.9835	21.0522
7/20/2016	9:00:00 PM	17.7792	0.3972	0.3915	0.2569	0.4546	0.2123	0.7631	10.3274
7/20/2016	9:30:00 PM	17.6006	0.3989	0.4009	-0.0880	-0.1558	-0.0727	0.4781	-3.5391
7/20/2016	10:00:00 PM	17.5244	0.4012	0.4194	-0.7780	-1.3783	-0.6435	-0.0927	-31.3106
7/20/2016	10:30:00 PM	17.5224	0.3963	0.4186	-0.9656	-1.7110	-0.7988	-0.2480	-38.8679
7/20/2016	11:00:00 PM	17.5529	0.3930	0.4171	-1.0502	-1.8611	-0.8689	-0.3180	-42.2765
7/20/2016	11:30:00 PM	17.5661	0.3992	0.4129	-0.5935	-1.0512	-0.4908	0.0601	-23.8787
7/21/2016	12:00:01 AM	17.5834	0.3986	0.4230	-1.0436	-1.8494	-0.8634	-0.3126	-42.0107
7/21/2016	12:30:00 AM	17.5986	0.3864	0.4138	-1.2053	-2.1364	-0.9974	-0.4466	-48.5296
7/21/2016	1:00:00 AM	17.5834	0.3899	0.4197	-1.2941	-2.2939	-1.0710	-0.5201	-52.1081
7/21/2016	1:30:00 AM	17.5529	0.3892	0.4168	-1.2068	-2.1389	-0.9986	-0.4478	-48.5876
7/21/2016	2:00:00 AM	17.4938	0.3888	0.4176	-1.2597	-2.2329	-1.0425	-0.4916	-50.7225
7/21/2016	2:30:00 AM	17.4022	0.3847	0.4195	-1.5256	-2.7052	-1.2630	-0.7122	-61.4517
7/21/2016	3:00:00 AM	17.2854	0.3830	0.4169	-1.4919	-2.6453	-1.2350	-0.6842	-60.0917
7/21/2016	3:30:00 AM	17.0937	0.3756	0.4173	-1.8536	-3.2882	-1.5352	-0.9843	-74.6955
7/21/2016	4:00:00 AM	16.8339	0.3758	0.4098	-1.5203	-2.6958	-1.2586	-0.7078	-61.2381
7/21/2016	4:30:00 AM	16.5595	0.3787	0.4152	-1.6179	-2.8691	-1.3395	-0.7887	-65.1738
7/21/2016	5:00:00 AM	16.3109	0.3780	0.4153	-1.6584	-2.9411	-1.3731	-0.8223	-66.8099

7/21/2016	5:30:00 AM	16.2135	0.3827	0.4217	-1.7048	-3.0236	-1.4117	-0.8608	-68.6854
7/21/2016	6:00:00 AM	16.2934	0.4012	0.4391	-1.5888	-2.8174	-1.3154	-0.7645	-64.0006
7/21/2016	6:30:00 AM	16.4955	0.3976	0.4345	-1.5625	-2.7706	-1.2935	-0.7427	-62.9381
7/21/2016	7:00:00 AM	16.7432	0.3999	0.4205	-0.8842	-1.5666	-0.7314	-0.1805	-35.5862
7/21/2016	7:30:00 AM	16.9726	0.4084	0.4159	-0.3186	-0.5642	-0.2634	0.2874	-12.8164
7/21/2016	8:00:00 AM	17.2604	0.4212	0.4208	0.0157	0.0278	0.0130	0.5638	0.6304
7/21/2016	8:30:00 AM	17.5661	0.4247	0.4103	0.6069	1.0738	0.5013	1.0522	24.3921
7/21/2016	9:00:00 AM	17.8704	0.4341	0.4000	1.4405	2.5468	1.1891	1.7399	57.8538
7/21/2016	9:30:00 AM	18.3391	0.4865	0.3951	3.6611	6.4675	3.0195	3.5704	146.9172
7/21/2016	10:00:00 AM	19.0735	0.5111	0.3469	6.8191	12.0549	5.6282	6.1790	273.8406
7/21/2016	10:30:00 AM	19.4728	0.5137	0.3253	8.0368	14.2200	6.6390	7.1898	323.0222
7/21/2016	11:00:00 AM	19.7370	0.5005	0.3132	8.2481	14.5964	6.8147	7.3656	331.5742
7/21/2016	11:30:00 AM	19.6040	0.4048	0.3667	1.7379	3.0722			69.7878
7/21/2016	12:00:01 PM	19.3265	0.4003	0.3983	0.0868	0.1536			3.4903
7/21/2016	12:30:00 PM	19.3413	0.4041	0.4170	-0.5560	-0.9848			-22.3697
7/21/2016	1:00:00 PM	19.5341	0.4211	0.4104	0.4509	0.7979			18.1247
7/21/2016	1:30:00 PM	19.6779	0.4144	0.3846	1.3158	2.3266			52.8519
7/21/2016	2:00:00 PM	19.4876	0.3949	0.3897	0.2315	0.4097			9.3057
7/21/2016	2:30:00 PM	19.1331	0.3744	0.3978	-1.0672	-1.8912			-42.9602
7/21/2016	3:00:00 PM	18.9243	0.3924	0.4165	-1.0500	-1.8607			-42.2668
7/21/2016	3:30:00 PM	18.8944	0.3904	0.4105	-0.8849	-1.5679			-35.6158
7/21/2016	4:00:00 PM	18.6889	0.3929	0.4124	-0.8509	-1.5075			-34.2439
7/21/2016	4:30:00 PM	18.6869	0.4094	0.4116	-0.0957	-0.1694			-3.8477
7/21/2016	5:00:00 PM	18.9861	0.4424	0.3882	2.2995	4.0638			92.3137
7/21/2016	5:30:00 PM	19.3413	0.5120	0.3245	8.0260	14.2007			322.5839
7/21/2016	6:00:00 PM	19.6948	0.5498	0.2951	10.9475	19.4369			441.5303
7/21/2016	6:30:00 PM	19.8424	0.5150	0.2835	10.5021	18.6339			423.2894
7/21/2016	7:00:00 PM	19.8793	0.4979	0.3142	8.0984	14.3298			325.5167
7/21/2016	7:30:00 PM	19.0863	0.3555	0.3235	1.6600	2.9347			66.6640

7/21/2016	8:00:00 PM	17.9502	0.3669	0.3754	-0.4042	-0.7158			-16.2609
7/21/2016	8:30:00 PM	17.4195	0.3810	0.4110	-1.3311	-2.3596			-53.6005
7/21/2016	9:00:00 PM	17.1150	0.3793	0.3985	-0.8691	-1.5398			-34.9781
7/21/2016	9:30:00 PM	16.6505	0.3615	0.3964	-1.6195	-2.8721			-65.2420
7/21/2016	10:00:00 PM	16.1726	0.3725	0.4035	-1.4065	-2.4936	-1.1642	-0.6134	-56.6450
7/21/2016	10:30:00 PM	15.7793	0.3683	0.4066	-1.7385	-3.0835	-1.4396	-0.8888	-70.0453
7/21/2016	11:00:00 PM	15.4346	0.3793	0.4134	-1.5134	-2.6835	-1.2529	-0.7020	-60.9584
7/21/2016	11:30:00 PM	15.1494	0.3805	0.4172	-1.6194	-2.8718	-1.3408	-0.7899	-65.2361
7/22/2016	12:00:01 AM	14.9444	0.3834	0.4210	-1.6472	-2.9212	-1.3639	-0.8130	-66.3587
7/22/2016	12:30:00 AM	14.7668	0.3791	0.4163	-1.6496	-2.9255	-1.3658	-0.8150	-66.4554
7/22/2016	1:00:00 AM	14.6086	0.3845	0.4188	-1.5016	-2.6625	-1.2430	-0.6922	-60.4811
7/22/2016	1:30:00 AM	14.4578	0.3780	0.4209	-1.8901	-3.3531	-1.5655	-1.0146	-76.1691
7/22/2016	2:00:00 AM	14.2905	0.3813	0.4217	-1.7695	-3.1386	-1.4653	-0.9145	-71.2969
7/22/2016	2:30:00 AM	14.1755	0.3777	0.4242	-2.0432	-3.6255	-1.6927	-1.1418	-82.3582
7/22/2016	3:00:00 AM	13.9992	0.3831	0.4177	-1.5201	-2.6954	-1.2584	-0.7076	-61.2292
7/22/2016	3:30:00 AM	13.8673	0.3758	0.4150	-1.7427	-3.0909	-1.4431	-0.8922	-70.2142
7/22/2016	4:00:00 AM	13.7207	0.3833	0.4299	-2.0190	-3.5824	-1.6726	-1.1217	-81.3790
7/22/2016	4:30:00 AM	13.5283	0.3787	0.4174	-1.7124	-3.0371	-1.4180	-0.8671	-68.9916
7/22/2016	5:00:00 AM	13.2948	0.3757	0.4207	-1.9900	-3.5308	-1.6484	-1.0976	-80.2055
7/22/2016	5:30:00 AM	13.1154	0.3894	0.4294	-1.7185	-3.0479	-1.4230	-0.8721	-69.2363
7/22/2016	6:00:00 AM	13.0475	0.3772	0.4273	-2.1971	-3.8994	-1.8205	-1.2697	-88.5787
7/22/2016	6:30:00 AM	13.0677	0.3995	0.4383	-1.6336	-2.8970	-1.3525	-0.8017	-65.8085
7/22/2016	7:00:00 AM	13.2372	0.3996	0.4318	-1.3655	-2.4207	-1.1302	-0.5793	-54.9893
7/22/2016	7:30:00 AM	13.4773	0.4051	0.4227	-0.7497	-1.3281	-0.6201	-0.0692	-30.1698
7/22/2016	8:00:00 AM	13.6409	0.4184	0.4147	0.1572	0.2783	0.1299	0.6808	6.3213
7/22/2016	8:30:00 AM	14.0765	0.4477	0.4006	1.9530	3.4520	1.6117	2.1625	78.4170
7/22/2016	9:00:00 AM	14.5604	0.4798	0.3841	3.9110	6.9088	3.2256	3.7764	156.9413
7/22/2016	9:30:00 AM	15.4643	0.5474	0.3804	6.4044	11.3193	5.2847	5.8356	257.1300
7/22/2016	10:00:00 AM	17.0689	0.5993	0.3545	9.2368	16.3626	7.6393	8.1902	371.6952

7/22/2016	10:30:00 AM	17.1264	0.6066	0.3438	9.9906	17.7141	8.2703	8.8211	402.3941
7/22/2016	11:00:00 AM	17.9522	0.6407	0.2873	14.1126	25.2043	11.7673	12.3181	572.5423
7/22/2016	11:30:00 AM	18.4014	0.5892	0.1959	19.3764	35.1148	16.3943	16.9452	797.6716
7/22/2016	12:00:01 PM	18.6419	0.6257	0.1903	20.9425	38.1617	17.8168	18.3677	866.8854
7/22/2016	12:30:00 PM	19.7096	0.6160	0.1848	21.1806	38.6295	18.0352	18.5861	877.5113
7/22/2016	1:00:00 PM	20.4425	0.5986	0.1697	22.1786	40.6041	18.9571	19.5080	922.3655
7/22/2016	1:30:00 PM	21.2098	0.6348	0.1776	22.4136	41.0724	19.1757	19.7266	933.0034
7/22/2016	2:00:00 PM	21.4514	0.5994	0.1586	23.3920	43.0358	20.0924	20.6433	977.6059
7/22/2016	2:30:00 PM	21.8404	0.5877	0.1675	22.0856	40.4191	18.8708	19.4216	918.1650
7/22/2016	3:00:00 PM	22.2398	0.6649	0.2110	20.1914	36.6942	17.1317	17.6825	833.5486
7/22/2016	3:30:00 PM	22.9764	0.6566	0.2003	20.8917	38.0622	17.7704	18.3212	864.6244
7/22/2016	4:00:00 PM	23.7960	0.6229	0.1666	23.2045	42.6577	19.9159	20.4668	969.0168
7/22/2016	4:30:00 PM	24.2501	0.6294	0.1723	22.7913	41.8275	19.5283	20.0792	950.1584
7/22/2016	5:00:00 PM	24.4251	0.6176	0.1913	20.6182	37.5265	17.5203	18.0711	852.4559
7/22/2016	5:30:00 PM	24.8044	0.5700	0.1676	21.5398	39.3375	18.3658	18.9166	893.5946
7/22/2016	6:00:00 PM	24.6928	0.5742	0.1865	19.7872	35.9091	16.7652	17.3160	815.7152
7/22/2016	6:30:00 PM	24.6556	0.5666	0.2149	17.0559	30.6885	14.3278	14.8786	697.1230
7/22/2016	7:00:00 PM	24.5578	0.5500	0.2305	15.3047	27.4096	12.7969	13.3477	622.6381
7/22/2016	7:30:00 PM	24.3060	0.5049	0.2491	12.4286	22.1213	10.3279	10.8788	502.5096
7/22/2016	8:00:00 PM	23.9013	0.4611	0.2795	8.8079	15.5957	7.2813	7.8321	354.2736
7/22/2016	8:30:00 PM	23.2028	0.4104	0.3086	5.0137	8.8572	4.1352	4.6861	201.2014
7/22/2016	9:00:00 PM	22.3701	0.3862	0.3377	2.3627	4.1754	1.9494	2.5003	94.8497
7/22/2016	9:30:00 PM	21.6209	0.3788	0.3563	1.0816	1.9128	0.8931	1.4439	43.4523
7/22/2016	10:00:00 PM	20.8750	0.3741	0.3668	0.3467	0.6135	0.2864	0.8373	13.9364
7/22/2016	10:30:00 PM	20.2081	0.3651	0.3737	-0.4117	-0.7291	-0.3404	0.2104	-16.5626
7/22/2016	11:00:00 PM	19.5859	0.3658	0.3768	-0.5190	-0.9192	-0.4292	0.1217	-20.8810
7/22/2016	11:30:00 PM	19.0031	0.3721	0.3879	-0.7296	-1.2924	-0.6034	-0.0525	-29.3575
7/23/2016	12:00:01 AM	18.4637	0.3706	0.3866	-0.7461	-1.3217	-0.6170	-0.0662	-30.0228
7/23/2016	12:30:00 AM	17.9351	0.3644	0.3948	-1.4122	-2.5036	-1.1689	-0.6180	-56.8728

7/23/2016	1:00:00 AM	17.4215	0.3729	0.3989	-1.1840	-2.0985	-0.9797	-0.4289	-47.6697
7/23/2016	1:30:00 AM	17.0823	0.3820	0.4113	-1.3030	-2.3097	-1.0784	-0.5275	-52.4681
7/23/2016	2:00:00 AM	16.9592	0.3800	0.4164	-1.6100	-2.8551	-1.3330	-0.7821	-64.8558
7/23/2016	2:30:00 AM	16.7722	0.3788	0.4134	-1.5388	-2.7287	-1.2740	-0.7231	-61.9848
7/23/2016	3:00:00 AM	16.5575	0.3730	0.4088	-1.6091	-2.8536	-1.3323	-0.7814	-64.8220
7/23/2016	3:30:00 AM	16.3109	0.3854	0.4153	-1.3167	-2.3342	-1.0898	-0.5389	-53.0228
7/23/2016	4:00:00 AM	16.0731	0.3761	0.4032	-1.2248	-2.1710	-1.0136	-0.4627	-49.3164
7/23/2016	4:30:00 AM	15.7931	0.3768	0.4131	-1.6201	-2.8731	-1.3414	-0.7905	-65.2662
7/23/2016	5:00:00 AM	15.6535	0.3835	0.4232	-1.7323	-3.0726	-1.4345	-0.8837	-69.7969
7/23/2016	5:30:00 AM	15.5589	0.3907	0.4197	-1.2615	-2.2361	-1.0440	-0.4932	-50.7965
7/23/2016	6:00:00 AM	15.4643	0.3761	0.4262	-2.2034	-3.9106	-1.8258	-1.2749	-88.8333
7/23/2016	6:30:00 AM	15.4188	0.3863	0.4217	-1.5415	-2.7333	-1.2761	-0.7253	-62.0909
7/23/2016	7:00:00 AM	15.4623	0.3854	0.4274	-1.8158	-3.2210	-1.5038	-0.9530	-73.1694
7/23/2016	7:30:00 AM	15.6850	0.4027	0.4347	-1.3476	-2.3889	-1.1153	-0.5645	-54.2671
7/23/2016	8:00:00 AM	16.0438	0.4094	0.4435	-1.4074	-2.4951	-1.1649	-0.6141	-56.6796
7/23/2016	8:30:00 AM	16.2603	0.3934	0.4265	-1.4211	-2.5195	-1.1763	-0.6255	-57.2336
7/23/2016	9:00:00 AM	16.3362	0.3886	0.4303	-1.7944	-3.1829	-1.4860	-0.9352	-72.3027
7/23/2016	9:30:00 AM	16.4955	0.4053	0.4345	-1.2250	-2.1714	-1.0138	-0.4629	-49.3248
7/23/2016	10:00:00 AM	16.8608	0.4019	0.4282	-1.1155	-1.9769	-0.9230	-0.3721	-44.9080
7/23/2016	10:30:00 AM	17.1264	0.4223	0.4226	-0.0119	-0.0210	-0.0098	0.5410	-0.4779
7/23/2016	11:00:00 AM	17.4308	0.4252	0.4148	0.4392	0.7772	0.3628	0.9137	17.6546
7/23/2016	11:30:00 AM	17.7792	0.4398	0.4090	1.2809	2.2650	1.0575	1.6083	51.4513
7/23/2016	12:00:01 PM	18.1299	0.4449	0.3835	2.6115	4.6145	2.1544	2.7053	104.8243
7/23/2016	12:30:00 PM	18.4425	0.4685	0.3694	4.1808	7.3854	3.4481	3.9989	167.7669
7/23/2016	1:00:00 PM	19.0843	0.5264	0.3322	8.1007	14.3338	6.6921	7.2430	325.6078
7/23/2016	1:30:00 PM	19.5871	0.5429	0.3065	10.0580	17.8353	8.3269	8.8777	405.1474
7/23/2016	2:00:00 PM	19.9540	0.5362	0.2892	10.8594	19.2780	9.0004	9.5513	437.9200
7/23/2016	2:30:00 PM	19.9245	0.4755	0.3122	7.4019	13.0901	6.1115	6.6623	297.3569
7/23/2016	3:00:00 PM	19.7423	0.3992	0.3889	0.4599	0.8138	0.3799	0.9308	18.4858

7/23/2016	3:30:00 PM	19.5818	0.3983	0.4140	-0.6802	-1.2049	-0.5625	-0.0117	-27.3700
7/23/2016	4:00:00 PM	20.1368	0.5056	0.4013	4.0618	7.1751	3.3499	3.9007	162.9897
7/23/2016	4:30:00 PM	20.9610	0.4903	0.2791	9.9099	17.5693	8.2027	8.7535	399.1051
7/23/2016	5:00:00 PM	19.7349	0.3412	0.3407	0.0249	0.0440	0.0206	0.5714	1.0001
7/23/2016	5:30:00 PM	18.9222	0.3925	0.4153	-0.9921	-1.7579	-0.8207	-0.2699	-39.9330
7/23/2016	6:00:00 PM	18.9243	0.3868	0.3949	-0.3618	-0.6406	-0.2991	0.2518	-14.5515
7/23/2016	6:30:00 PM	18.6549	0.3827	0.4010	-0.8250	-1.4617	-0.6824	-0.1316	-33.2038
7/23/2016	7:00:00 PM	18.6549	0.3927	0.4081	-0.6752	-1.1960	-0.5584	-0.0075	-27.1684
7/23/2016	7:30:00 PM	18.6378	0.4038	0.4029	0.0427	0.0756	0.0353	0.5861	1.7172
7/23/2016	8:00:00 PM	18.6228	0.3938	0.3953	-0.0653	-0.1155	-0.0539	0.4969	-2.6243
7/23/2016	8:30:00 PM	18.3864	0.3852	0.3905	-0.2384	-0.4221	-0.1971	0.3538	-9.5876
7/23/2016	9:00:00 PM	17.9179	0.3627	0.3921	-1.3714	-2.4312	-1.1351	-0.5842	-55.2264
7/23/2016	9:30:00 PM	17.4195	0.3707	0.4006	-1.3648	-2.4195	-1.1296	-0.5787	-54.9606
7/23/2016	10:00:00 PM	16.9880	0.3653	0.4050	-1.8160	-3.2213	-1.5040	-0.9531	-73.1754
7/23/2016	10:30:00 PM	16.7258	0.3808	0.4168	-1.5882	-2.8164	-1.3149	-0.7641	-63.9774
7/23/2016	11:00:00 PM	16.4780	0.3750	0.4117	-1.6433	-2.9142	-1.3606	-0.8097	-66.2004
7/23/2016	11:30:00 PM	16.2914	0.3804	0.4139	-1.4859	-2.6345	-1.2300	-0.6791	-59.8460
7/24/2016	12:00:01 AM	16.0926	0.3782	0.4049	-1.1985	-2.1242	-0.9917	-0.4409	-48.2534
7/24/2016	12:30:00 AM	15.7793	0.3680	0.4038	-1.6345	-2.8987	-1.3533	-0.8025	-65.8463
7/24/2016	1:00:00 AM	15.4643	0.3767	0.4108	-1.5245	-2.7031	-1.2620	-0.7112	-61.4037
7/24/2016	1:30:00 AM	15.2110	0.3676	0.4071	-1.7972	-3.1878	-1.4883	-0.9375	-72.4153
7/24/2016	2:00:00 AM	14.9565	0.3679	0.4086	-1.8433	-3.2699	-1.5266	-0.9758	-74.2784
7/24/2016	2:30:00 AM	14.6567	0.3679	0.4172	-2.2130	-3.9277	-1.8337	-1.2829	-89.2218
7/24/2016	3:00:00 AM	14.4195	0.3843	0.4218	-1.6386	-2.9059	-1.3567	-0.8058	-66.0104
7/24/2016	3:30:00 AM	14.2644	0.3754	0.4224	-2.0758	-3.6835	-1.7197	-1.1689	-83.6745
7/24/2016	4:00:00 AM	14.1556	0.3779	0.4246	-2.0500	-3.6375	-1.6983	-1.1474	-82.6305
7/24/2016	4:30:00 AM	14.0117	0.3853	0.4268	-1.7965	-3.1866	-1.4878	-0.9369	-72.3874
7/24/2016	5:00:00 AM	13.8692	0.3825	0.4207	-1.6733	-2.9676	-1.3855	-0.8346	-67.4114
7/24/2016	5:30:00 AM	13.7678	0.3801	0.4294	-2.1474	-3.8109	-1.7792	-1.2284	-86.5696

7/24/2016	6:00:00 AM	13.7841	0.3888	0.4318	-1.8465	-3.2756	-1.5293	-0.9785	-74.4089
7/24/2016	6:30:00 AM	13.9324	0.3968	0.4335	-1.5572	-2.7613	-1.2892	-0.7383	-62.7258
7/24/2016	7:00:00 AM	13.9468	0.3849	0.4183	-1.4633	-2.5944	-1.2113	-0.6604	-58.9349
7/24/2016	7:30:00 AM	14.0298	0.4022	0.4303	-1.1889	-2.1071	-0.9838	-0.4329	-47.8659
7/24/2016	8:00:00 AM	14.4195	0.4609	0.4319	1.1424	2.0203	0.9432	1.4941	45.8934
7/24/2016	8:30:00 AM	14.9444	0.4512	0.3963	2.2833	4.0353	1.8840	2.4348	91.6653
7/24/2016	9:00:00 AM	15.7164	0.5307	0.3790	5.9248	10.4695	4.8879	5.4388	237.8251
7/24/2016	9:30:00 AM	17.1744	0.5740	0.3142	10.6045	18.8184	8.7859	9.3367	427.4815
7/24/2016	10:00:00 AM	18.3583	0.6093	0.2907	13.0189	23.1980	10.8306	11.3815	526.9680
7/24/2016	10:30:00 AM	19.2203	0.6629	0.3007	13.9066	24.8252	11.5903	12.1411	563.9308
7/24/2016	11:00:00 AM	20.1682	0.6341	0.2161	18.9427	34.2799	16.0045	16.5553	778.7051
7/24/2016	11:30:00 AM	20.6762	0.6119	0.1646	23.1041	42.4556	19.8215	20.3724	964.4254
7/24/2016	12:00:01 PM	20.9550	0.6441	0.1772	22.7097	41.6641	19.4520	20.0029	946.4460
7/24/2016	12:30:00 PM	21.5567	0.6476	0.1950	21.1219	38.5140	17.9813	18.5322	874.8875
7/24/2016	1:00:00 PM	21.7030	0.6589	0.1983	21.1304	38.5308	17.9891	18.5400	875.2684
7/24/2016	1:30:00 PM	22.7650	0.6644	0.1953	21.5435	39.3449	18.3692	18.9201	893.7627
7/24/2016	2:00:00 PM	23.3752	0.6382	0.1695	23.3268	42.9044	20.0311	20.5819	974.6202
7/24/2016	2:30:00 PM	24.1029	0.6335	0.1728	22.8588	41.9629	19.5915	20.1424	953.2327
7/24/2016	3:00:00 PM	24.5882	0.5764	0.1415	24.7171	45.7332	21.3518	21.9026	1038.8796
7/24/2016	3:30:00 PM	25.4275	0.6199	0.1591	23.9286	44.1228	20.5999	21.1508	1002.2981
7/24/2016	4:00:00 PM	25.7320	0.6055	0.1594	23.4887	43.2313	20.1837	20.7346	982.0469
7/24/2016	4:30:00 PM	25.7967	0.5608	0.1286	25.9109	48.2028	22.5048	23.0556	1094.9786
7/24/2016	5:00:00 PM	25.6585	0.6041	0.1782	21.4791	39.2178	18.3099	18.8607	890.8749
7/24/2016	5:30:00 PM	25.6746	0.6088	0.1814	21.3040	38.8724	18.1486	18.6995	883.0284
7/24/2016	6:00:00 PM	25.6793	0.5781	0.1828	20.2613	36.8301	17.1951	17.7460	836.6356
7/24/2016	6:30:00 PM	25.4276	0.5458	0.2121	16.6282	29.8830	13.9517	14.5025	678.8247
7/24/2016	7:00:00 PM	25.2889	0.5305	0.2193	15.5417	27.8506	13.0028	13.5536	632.6561
7/24/2016	7:30:00 PM	24.8346	0.5087	0.2659	11.4139	20.2796	9.4681	10.0189	460.6728
7/24/2016	8:00:00 PM	24.3760	0.4543	0.2920	7.7758	13.7551	6.4220	6.9728	312.4631

7/24/2016	8:30:00 PM	23.8661	0.4229	0.3181	5.0108	8.8521	4.1328	4.6837	201.0853
7/24/2016	9:00:00 PM	23.2143	0.3884	0.3320	2.7603	4.8772	2.2770	2.8279	110.7904
7/24/2016	9:30:00 PM	22.3086	0.3720	0.3437	1.3903	2.4583	1.1477	1.6986	55.8428
7/24/2016	10:00:00 PM	21.4817	0.3674	0.3619	0.2674	0.4731	0.2209	0.7717	10.7474
7/24/2016	10:30:00 PM	20.9093	0.3797	0.3826	-0.1322	-0.2340	-0.1093	0.4416	-5.3159
7/24/2016	11:00:00 PM	20.3882	0.3753	0.3761	-0.0365	-0.0646	-0.0302	0.5207	-1.4670
7/24/2016	11:30:00 PM	19.8740	0.3725	0.3836	-0.5177	-0.9169	-0.4281	0.1228	-20.8284
7/25/2016	12:00:01 AM	19.4769	0.3821	0.3899	-0.3526	-0.6244	-0.2915	0.2593	-14.1830
7/25/2016	12:30:00 AM	19.1926	0.3828	0.3936	-0.4905	-0.8687	-0.4056	0.1453	-19.7340
7/25/2016	1:00:00 AM	18.8944	0.3862	0.3971	-0.4892	-0.8664	-0.4045	0.1464	-19.6805
7/25/2016	1:30:00 AM	18.7018	0.3852	0.4004	-0.6824	-1.2088	-0.5643	-0.0135	-27.4582
7/25/2016	2:00:00 AM	18.4917	0.3611	0.3766	-0.7410	-1.3127	-0.6129	-0.0620	-29.8185
7/25/2016	2:30:00 AM	17.8704	0.3674	0.3943	-1.2434	-2.2039	-1.0290	-0.4781	-50.0645
7/25/2016	3:00:00 AM	17.4633	0.3731	0.4026	-1.3414	-2.3780	-1.1102	-0.5594	-54.0183
7/25/2016	3:30:00 AM	17.2378	0.3905	0.4079	-0.7649	-1.3550	-0.6326	-0.0818	-30.7794
7/25/2016	4:00:00 AM	17.0726	0.3837	0.4109	-1.2071	-2.1395	-0.9989	-0.4480	-48.6017
7/25/2016	4:30:00 AM	16.8687	0.3861	0.4045	-0.8206	-1.4538	-0.6787	-0.1279	-33.0240
7/25/2016	5:00:00 AM	16.5885	0.3724	0.3965	-1.1000	-1.9494	-0.9101	-0.3593	-44.2827
7/25/2016	5:30:00 AM	16.2291	0.3731	0.4037	-1.3870	-2.4589	-1.1480	-0.5972	-55.8573
7/25/2016	6:00:00 AM	15.9087	0.3867	0.4086	-0.9681	-1.7155	-0.8009	-0.2501	-38.9687
7/25/2016	6:30:00 AM	15.7479	0.3932	0.4065	-0.5879	-1.0413	-0.4861	0.0647	-23.6532
7/25/2016	7:00:00 AM	15.7360	0.4128	0.4039	0.3836	0.6788	0.3169	0.8678	15.4200
7/25/2016	7:30:00 AM	16.0614	0.4724	0.3941	3.1903	5.6364	2.6315	3.1823	128.0365
7/25/2016	8:00:00 AM	16.4353	0.5077	0.3471	6.6917	11.8289	5.5226	6.0735	268.7056
7/25/2016	8:30:00 AM	16.7741	0.5346	0.2817	11.2731	20.0250	9.3492	9.9000	454.8890
7/25/2016	9:00:00 AM	17.2224	0.5946	0.2741	13.6243	24.3066	11.3482	11.8990	552.1503
7/25/2016	9:30:00 AM	18.5839	0.6440	0.2635	15.7257	28.1934	13.1628	13.7137	640.4434
7/25/2016	10:00:00 AM	20.0381	0.6571	0.2623	16.1581	29.0012	13.5400	14.0909	658.7950
7/25/2016	10:30:00 AM	20.8510	0.6763	0.2714	16.0620	28.8215	13.4561	14.0070	654.7125

7/25/2016	11:00:00 AM	21.4723	0.6206	0.1939	20.4704	37.2379	17.3855	17.9364	845.9006
7/25/2016	11:30:00 AM	21.7772	0.5903	0.1638	22.5598	41.3643	19.3120	19.8629	939.6350
7/25/2016	12:00:01 PM	21.9597	0.6174	0.1816	21.5309	39.3200	18.3576	18.9084	893.1965
7/25/2016	12:30:00 PM	22.3421	0.6486	0.2067	20.1211	36.5574	17.0678	17.6187	830.4416
7/25/2016	1:00:00 PM	23.4227	0.6029	0.1637	22.9408	42.1275	19.6683	20.2192	956.9714
7/25/2016	1:30:00 PM	24.2620	0.6436	0.1857	21.8661	39.9832	18.6673	19.2181	908.2630
7/25/2016	2:00:00 PM	24.8022	0.5952	0.1453	24.8093	45.9226	21.4402	21.9911	1043.1831
7/25/2016	2:30:00 PM	25.0388	0.6136	0.1542	24.3062	44.8920	20.9591	21.5099	1019.7710
7/25/2016	3:00:00 PM	25.2796	0.6231	0.1840	21.4588	39.1776	18.2911	18.8420	889.9618
7/25/2016	3:30:00 PM	25.6512	0.6105	0.1743	22.0539	40.3560	18.8413	19.3921	916.7303
7/25/2016	4:00:00 PM	25.9459	0.6094	0.1656	22.9235	42.0927	19.6521	20.2029	956.1808
7/25/2016	4:30:00 PM	26.0841	0.5828	0.1474	24.1936	44.6623	20.8518	21.4027	1014.5531
7/25/2016	5:00:00 PM	25.9760	0.6101	0.1761	21.8621	39.9753	18.6636	19.2144	908.0830
7/25/2016	5:30:00 PM	26.0405	0.5811	0.1656	22.0840	40.4159	18.8693	19.4201	918.0920
7/25/2016	6:00:00 PM	25.8773	0.5563	0.1871	19.1708	34.7186	16.2093	16.7602	788.6713
7/25/2016	6:30:00 PM	25.4992	0.5418	0.1952	17.9626	32.4062	15.1297	15.6806	736.1428
7/25/2016	7:00:00 PM	24.9692	0.5005	0.2225	14.2671	25.4890	11.9002	12.4511	579.0098
7/25/2016	7:30:00 PM	24.4134	0.4713	0.2587	10.5523	18.7243	8.7419	9.2928	425.3421
7/25/2016	8:00:00 PM	23.8804	0.4417	0.2858	7.6583	13.5461	6.3244	6.8752	307.7153
7/25/2016	8:30:00 PM	23.1346	0.4009	0.3071	4.6911	8.2869	3.8690	4.4198	188.2464
7/25/2016	9:00:00 PM	22.3036	0.3826	0.3246	2.8950	5.1150	2.3881	2.9389	116.1919
7/25/2016	9:30:00 PM	21.3834	0.3643	0.3415	1.1369	2.0105	0.9387	1.4895	45.6712
7/25/2016	10:00:00 PM	20.5302	0.3623	0.3575	0.2312	0.4091	0.1910	0.7419	9.2937
7/25/2016	10:30:00 PM	21.1728	0.3747	0.3524	1.0792	1.9086	0.8911	1.4419	43.3557
7/25/2016	11:00:00 PM	18.9243	0.3570	0.3573	-0.0158	-0.0280	-0.0131	0.5378	-0.6353
7/25/2016	11:30:00 PM	17.8441	0.3355	0.3596	-1.2231	-2.1679	-1.0122	-0.4613	-49.2468
8/6/2016	12:00:01 AM	14.1146	0.3566	0.3707	-0.6809	-1.2061	-0.5631	-0.0123	-27.3977
8/6/2016	12:30:00 AM	13.3624	0.3471	0.3750	-1.3620	-2.4146	-1.1273	-0.5765	-54.8496
8/6/2016	1:00:00 AM	12.6213	0.3624	0.3765	-0.6673	-1.1820	-0.5519	-0.0010	-26.8506

8/6/2016	1:30:00 AM	11.9328	0.3555	0.3813	-1.2371	-2.1928	-1.0238	-0.4729	-49.8112
8/6/2016	2:00:00 AM	11.3047	0.3521	0.3891	-1.7558	-3.1143	-1.4540	-0.9032	-70.7451
8/6/2016	2:30:00 AM	10.7391	0.3586	0.3910	-1.5226	-2.6998	-1.2605	-0.7096	-61.3278
8/6/2016	3:00:00 AM	10.1821	0.3605	0.3916	-1.4564	-2.5822	-1.2056	-0.6547	-58.6577
8/6/2016	3:30:00 AM	9.6660	0.3489	0.3891	-1.9172	-3.4012	-1.5880	-1.0371	-77.2624
8/6/2016	4:00:00 AM	9.1329	0.3642	0.3905	-1.2235	-2.1687	-1.0125	-0.4617	-49.2638
8/6/2016	4:30:00 AM	8.6805	0.3611	0.3928	-1.4779	-2.6205	-1.2234	-0.6726	-59.5268
8/6/2016	5:00:00 AM	8.3002	0.3619	0.4022	-1.8618	-3.3027	-1.5420	-0.9911	-75.0256
8/6/2016	5:30:00 AM	7.9683	0.3663	0.4049	-1.7632	-3.1274	-1.4601	-0.9092	-71.0414
8/6/2016	6:00:00 AM	7.6914	0.3753	0.4046	-1.3225	-2.3443	-1.0945	-0.5437	-53.2542
8/6/2016	6:30:00 AM	7.5591	0.3790	0.4199	-1.8022	-3.1968	-1.4925	-0.9417	-72.6198
8/6/2016	7:00:00 AM	7.6338	0.4051	0.4366	-1.3184	-2.3371	-1.0912	-0.5403	-53.0904
8/6/2016	7:30:00 AM	8.2634	0.4785	0.4686	0.3664	0.6483	0.3027	0.8535	14.7277
8/6/2016	8:00:00 AM	9.5288	0.5100	0.3929	4.5907	8.1095	3.7861	4.3370	184.2159
8/6/2016	8:30:00 AM	10.5322	0.5877	0.3385	9.7064	17.2040	8.0321	8.5830	390.8066
8/6/2016	9:00:00 AM	11.8179	0.6530	0.3155	12.7997	22.7976	10.6437	11.1945	517.8735
8/6/2016	9:30:00 AM	13.8442	0.5919	0.2174	17.6206	31.7566	14.8264	15.3773	721.3868
8/6/2016	10:00:00 AM	14.4517	0.6548	0.2290	18.4863	33.4051	15.5961	16.1469	758.8334
8/6/2016	10:30:00 AM	15.5963	0.6455	0.2216	18.8114	34.0278	15.8868	16.4377	772.9796
8/6/2016	11:00:00 AM	16.8399	0.6088	0.1937	20.1509	36.6153	17.0948	17.6457	831.7564
8/6/2016	11:30:00 AM	17.5284	0.6282	0.2057	19.6440	35.6319	16.6357	17.1866	809.4176
8/6/2016	12:00:01 PM	18.4582	0.6455	0.2091	19.8289	35.9900	16.8029	17.3537	817.5515
8/6/2016	12:30:00 PM	19.8466	0.6677	0.2224	19.3473	35.0587	16.3681	16.9190	796.3974
8/6/2016	1:00:00 PM	21.1604	0.6360	0.1870	21.5348	39.3278	18.3612	18.9121	893.3729
8/6/2016	1:30:00 PM	22.2029	0.6369	0.1984	20.5238	37.3420	17.4341	17.9850	848.2651
8/6/2016	2:00:00 PM	23.2352	0.6120	0.1826	21.2748	38.8150	18.1218	18.6727	881.7252
8/6/2016	2:30:00 PM	23.6946	0.6133	0.1819	21.3893	39.0407	18.2272	18.7780	886.8511
8/6/2016	3:00:00 PM	24.1821	0.6104	0.1762	21.8611	39.9734	18.6627	19.2135	908.0389
8/6/2016	3:30:00 PM	24.7416	0.6177	0.1750	22.1864	40.6196	18.9644	19.5152	922.7191

8/6/2016	4:00:00 PM	24.8741	0.5591	0.1656	21.4142	39.0896	18.2500	18.8009	887.9628
8/6/2016	4:30:00 PM	24.9182	0.5804	0.1943	19.2504	34.8719	16.2809	16.8317	792.1527
8/6/2016	5:00:00 PM	24.5438	0.5019	0.2228	14.2897	25.5306	11.9197	12.4705	579.9560
8/6/2016	5:30:00 PM	24.0604	0.4893	0.2561	11.3913	20.2389	9.4491	9.9999	459.7478
8/6/2016	6:00:00 PM	24.2264	0.5579	0.2189	16.4585	29.5644	13.8030	14.3538	671.5885
8/6/2016	6:30:00 PM	24.1774	0.5407	0.2357	14.6116	26.1250	12.1972	12.7480	593.4574
8/6/2016	7:00:00 PM	23.8332	0.4481	0.2659	9.1798	16.2606	7.5917	8.1425	369.3773
8/6/2016	7:30:00 PM	23.1293	0.4196	0.3106	5.2922	9.3498	4.3652	4.9160	212.3900
8/6/2016	8:00:00 PM	22.6007	0.4090	0.3270	3.9388	6.9578	3.2485	3.7993	158.0551
8/6/2016	8:30:00 PM	22.0502	0.3805	0.3451	1.7177	3.0365	1.4177	1.9685	68.9783
8/6/2016	9:00:00 PM	21.2742	0.3610	0.3413	0.9858	1.7435	0.8140	1.3648	39.6048
8/6/2016	9:30:00 PM	20.3485	0.3552	0.3476	0.3797	0.6719	0.3137	0.8645	15.2633
8/6/2016	10:00:00 PM	19.4028	0.3497	0.3570	-0.3635	-0.6437	-0.3005	0.2503	-14.6227
8/6/2016	10:30:00 PM	18.4281	0.3503	0.3620	-0.5747	-1.0179	-0.4753	0.0756	-23.1237
8/6/2016	11:00:00 PM	17.5589	0.3476	0.3604	-0.6396	-1.1329	-0.5289	0.0219	-25.7348
8/6/2016	11:30:00 PM	16.7028	0.3532	0.3702	-0.8255	-1.4624	-0.6828	-0.1319	-33.2205
8/7/2016	12:00:01 AM	15.8872	0.3528	0.3715	-0.9107	-1.6137	-0.7534	-0.2025	-36.6564
8/7/2016	12:30:00 AM	15.1135	0.3495	0.3762	-1.2989	-2.3025	-1.0750	-0.5241	-52.3043
8/7/2016	1:00:00 AM	14.3792	0.3528	0.3802	-1.3121	-2.3260	-1.0859	-0.5351	-52.8366
8/7/2016	1:30:00 AM	13.6919	0.3563	0.3797	-1.1205	-1.9858	-0.9271	-0.3763	-45.1106
8/7/2016	2:00:00 AM	13.0365	0.3631	0.3870	-1.1241	-1.9921	-0.9301	-0.3792	-45.2536
8/7/2016	2:30:00 AM	12.4896	0.3633	0.3930	-1.3825	-2.4509	-1.1443	-0.5934	-55.6752
8/7/2016	3:00:00 AM	11.9872	0.3710	0.3911	-0.9275	-1.6433	-0.7672	-0.2164	-37.3299
8/7/2016	3:30:00 AM	11.4928	0.3643	0.3958	-1.4574	-2.5840	-1.2064	-0.6556	-58.6988
8/7/2016	4:00:00 AM	11.0935	0.3644	0.3958	-1.4567	-2.5827	-1.2058	-0.6549	-58.6681
8/7/2016	4:30:00 AM	10.7409	0.3695	0.3990	-1.3515	-2.3958	-1.1185	-0.5677	-54.4234
8/7/2016	5:00:00 AM	10.4606	0.3747	0.4003	-1.1624	-2.0602	-0.9619	-0.4110	-46.8000
8/7/2016	5:30:00 AM	10.2663	0.3879	0.4009	-0.5814	-1.0297	-0.4808	0.0701	-23.3912
8/7/2016	6:00:00 AM	10.2716	0.3948	0.4167	-0.9507	-1.6845	-0.7865	-0.2356	-38.2651

8/7/2016	6:30:00 AM	10.3750	0.4020	0.4208	-0.8034	-1.4234	-0.6645	-0.1137	-32.3334
8/7/2016	7:00:00 AM	10.5183	0.4121	0.4295	-0.7271	-1.2880	-0.6014	-0.0505	-29.2591
8/7/2016	7:30:00 AM	11.0763	0.4551	0.4530	0.0825	0.1460	0.0682	0.6190	3.3159
8/7/2016	8:00:00 AM	12.1464	0.5225	0.3907	5.1128	9.0324	4.2170	4.7679	205.1816
8/7/2016	8:30:00 AM	13.2345	0.5543	0.3620	7.4996	13.2638	6.1926	6.7434	301.3018
8/7/2016	9:00:00 AM	14.6001	0.6106	0.3491	9.8380	17.4402	8.1424	8.6933	396.1724
8/7/2016	9:30:00 AM	16.6351	0.5876	0.2822	12.9048	22.9894	10.7332	11.2841	522.2299
8/7/2016	10:00:00 AM	17.8445	0.6434	0.2569	16.1567	28.9986	13.5388	14.0896	658.7355
8/7/2016	10:30:00 AM	19.7939	0.7095	0.2164	20.8931	38.0648	17.7716	18.3224	864.6825
8/7/2016	11:00:00 AM	21.8118	0.6931	0.2041	21.5114	39.2815	18.3396	18.8905	892.3220
8/7/2016	11:30:00 AM	18.1491	0.6451	0.2309	18.0798	32.6293	15.2339	15.7847	741.2104
8/7/2016	12:00:01 PM	19.2286	0.6283	0.2056	19.6525	35.6483	16.6434	17.1942	809.7893
8/7/2016	12:30:00 PM	20.4102	0.6915	0.2391	18.6857	33.7868	15.7743	16.3251	767.5043
8/7/2016	1:00:00 PM	21.1873	0.6542	0.2295	18.4292	33.2961	15.5452	16.0960	756.3565
8/7/2016	1:30:00 PM	22.6791	0.6375	0.2145	19.1639	34.7053	16.2031	16.7539	788.3679
8/7/2016	2:00:00 PM	23.0846	0.5795	0.1683	21.7505	39.7543	18.5604	19.1112	903.0628
8/7/2016	2:30:00 PM	23.9457	0.5647	0.1560	22.6348	41.5141	19.3820	19.9328	943.0390
8/7/2016	3:00:00 PM	24.5624	0.6047	0.1705	22.2769	40.7997	19.0484	19.5993	926.8094
8/7/2016	3:30:00 PM	25.0411	0.5887	0.1603	22.8928	42.0312	19.6234	20.1742	954.7841
8/7/2016	4:00:00 PM	25.0736	0.5689	0.1837	19.8853	36.0994	16.8540	17.4048	820.0380
8/7/2016	4:30:00 PM	25.2242	0.5664	0.1967	18.6078	33.6376	15.7046	16.2555	764.1149
8/7/2016	5:00:00 PM	25.1709	0.5413	0.2195	15.8829	28.4869	13.2999	13.8507	647.1108
8/7/2016	5:30:00 PM	24.8648	0.4762	0.2564	10.8933	19.3391	9.0290	9.5798	439.3084
8/7/2016	6:00:00 PM	24.5624	0.4643	0.2944	8.0148	14.1808	6.6207	7.1715	322.1324
8/7/2016	6:30:00 PM	24.4063	0.4812	0.2983	8.4124	14.8895	6.9516	7.5024	338.2309
8/7/2016	7:00:00 PM	24.2825	0.4861	0.2683	10.4570	18.5526	8.6618	9.2127	421.4437
8/7/2016	7:30:00 PM	23.9364	0.4443	0.2881	7.6227	13.4827	6.2948	6.8456	306.2739
8/7/2016	8:00:00 PM	23.4622	0.4113	0.3239	4.2014	7.4218	3.4651	4.0159	168.5934
8/7/2016	8:30:00 PM	22.9569	0.3864	0.3380	2.3554	4.1624	1.9433	2.4942	94.5536

8/7/2016	9:00:00 PM	22.4322	0.3787	0.3493	1.4221	2.5144	1.1739	1.7248	57.1177
8/7/2016	9:30:00 PM	21.8254	0.3710	0.3512	0.9639	1.7047	0.7959	1.3468	38.7250
8/7/2016	10:00:00 PM	21.2286	0.3643	0.3514	0.6339	1.1215	0.5236	1.0744	25.4751
8/7/2016	10:30:00 PM	20.5595	0.3673	0.3680	-0.0364	-0.0645	-0.0301	0.5207	-1.4650
8/7/2016	11:00:00 PM	19.9919	0.3714	0.3689	0.1165	0.2062	0.0963	0.6471	4.6842
8/7/2016	11:30:00 PM	19.5119	0.3642	0.3749	-0.5089	-0.9012	-0.4207	0.1301	-20.4714
8/8/2016	12:00:01 AM	19.0010	0.3697	0.3805	-0.5033	-0.8914	-0.4162	0.1347	-20.2489
8/8/2016	12:30:00 AM	18.5819	0.3630	0.3839	-0.9853	-1.7460	-0.8152	-0.2643	-39.6623
8/8/2016	1:00:00 AM	18.2336	0.3677	0.3860	-0.8541	-1.5131	-0.7065	-0.1556	-34.3727
8/8/2016	1:30:00 AM	17.9613	0.3716	0.3884	-0.7797	-1.3814	-0.6449	-0.0941	-31.3789
8/8/2016	2:00:00 AM	17.6768	0.3732	0.3943	-0.9670	-1.7135	-0.8000	-0.2491	-38.9233
8/8/2016	2:30:00 AM	17.4327	0.3724	0.3935	-0.9669	-1.7132	-0.7999	-0.2490	-38.9176
8/8/2016	3:00:00 AM	17.1571	0.3748	0.3980	-1.0562	-1.8717	-0.8739	-0.3230	-42.5182
8/8/2016	3:30:00 AM	16.9418	0.3800	0.3994	-0.8757	-1.5516	-0.7244	-0.1735	-35.2455
8/8/2016	4:00:00 AM	16.7432	0.3758	0.3958	-0.9128	-1.6174	-0.7551	-0.2043	-36.7402
8/8/2016	4:30:00 AM	16.5710	0.3828	0.3951	-0.5544	-0.9819	-0.4584	0.0924	-22.3042
8/8/2016	5:00:00 AM	16.3479	0.3770	0.3958	-0.8560	-1.5166	-0.7081	-0.1572	-34.4510
8/8/2016	5:30:00 AM	16.1375	0.3821	0.4021	-0.8992	-1.5932	-0.7438	-0.1930	-36.1904
8/8/2016	6:00:00 AM	15.9695	0.3841	0.4010	-0.7578	-1.3424	-0.6267	-0.0759	-30.4946
8/8/2016	6:30:00 AM	15.8558	0.3816	0.4057	-1.0781	-1.9106	-0.8920	-0.3412	-43.4024
8/8/2016	7:00:00 AM	15.8402	0.3803	0.4153	-1.5478	-2.7445	-1.2813	-0.7305	-62.3444
8/8/2016	7:30:00 AM	15.9048	0.3937	0.4057	-0.5294	-0.9376	-0.4377	0.1131	-21.2981
8/8/2016	8:00:00 AM	16.0926	0.4029	0.4188	-0.6831	-1.2100	-0.5649	-0.0141	-27.4870
8/8/2016	8:30:00 AM	16.2934	0.4010	0.4073	-0.2759	-0.4885	-0.2281	0.3228	-11.0969
8/8/2016	9:00:00 AM	16.5265	0.3979	0.4053	-0.3235	-0.5729	-0.2675	0.2834	-13.0134
8/8/2016	9:30:00 AM	16.6505	0.3920	0.4005	-0.3765	-0.6666	-0.3112	0.2396	-15.1428
8/8/2016	10:00:00 AM	16.7682	0.3980	0.4057	-0.3375	-0.5976	-0.2790	0.2719	-13.5747
8/8/2016	10:30:00 AM	17.0649	0.4114	0.4165	-0.2176	-0.3852	-0.1799	0.3710	-8.7510
8/8/2016	11:00:00 AM	17.8420	0.4881	0.4097	3.0807	5.4429	2.5412	3.0920	123.6414

8/8/2016	11:30:00 AM	18.6269	0.5475	0.2956	10.8454	19.2526	8.9886	9.5395	437.3441
8/8/2016	12:00:01 PM	19.3392	0.5680	0.2323	15.7320	28.2052	13.1683	13.7192	640.7113
8/8/2016	12:30:00 PM	19.8055	0.5817	0.2152	17.4993	31.5268	14.7191	15.2700	716.1649
8/8/2016	1:00:00 PM	20.0633	0.6041	0.2184	17.9035	32.2939	15.0773	15.6281	733.5915
8/8/2016	1:30:00 PM	20.7492	0.6584	0.2282	18.6390	33.6974	15.7325	16.2834	765.4725
8/8/2016	2:00:00 PM	21.7225	0.5558	0.1538	22.6065	41.4576	19.3556	19.9065	941.7551
8/8/2016	2:30:00 PM	21.2264	0.4953	0.1960	16.3093	29.2845	13.6723	14.2231	665.2306
8/8/2016	3:00:00 PM	20.3840	0.4145	0.3361	3.6868	6.5129	3.0407	3.5916	147.9468
8/8/2016	3:30:00 PM	20.6908	0.5057	0.3525	6.3475	11.2184	5.2376	5.7885	254.8389
8/8/2016	4:00:00 PM	21.2409	0.4949	0.2696	10.6885	18.9698	8.8566	9.4074	430.9190
8/8/2016	4:30:00 PM	20.9892	0.5013	0.2728	10.7060	19.0012	8.8712	9.4221	431.6333
8/8/2016	5:00:00 PM	21.1271	0.5626	0.2104	17.3004	31.1502	14.5433	15.0942	707.6110
8/8/2016	5:30:00 PM	21.2264	0.5809	0.1915	19.5281	35.4078	16.5311	17.0819	804.3273
8/8/2016	6:00:00 PM	21.1808	0.5675	0.2204	16.6418	29.9086	13.9637	14.5145	679.4072
8/8/2016	6:30:00 PM	21.5589	0.5712	0.1953	18.8805	34.1605	15.9488	16.4996	775.9930
8/8/2016	7:00:00 PM	21.2554	0.5395	0.1950	17.9062	32.2990	15.0797	15.6305	733.7081
8/8/2016	7:30:00 PM	20.7761	0.5032	0.2398	13.0383	23.2333	10.8471	11.3980	527.7705
8/8/2016	8:00:00 PM	20.3693	0.4600	0.2770	8.9265	15.8076	7.3802	7.9311	359.0880
8/8/2016	8:30:00 PM	19.8129	0.4188	0.3052	5.5664	9.8349	4.5917	5.1425	223.4104
8/8/2016	9:00:00 PM	19.0905	0.3879	0.3268	3.0146	5.3263	2.4867	3.0376	120.9917
8/8/2016	9:30:00 PM	18.2829	0.3707	0.3395	1.5507	2.7415	1.2800	1.8308	62.2766
8/8/2016	10:00:00 PM	17.5742	0.3700	0.3452	1.2212	2.1595	1.0082	1.5591	49.0555
8/8/2016	10:30:00 PM	16.7452	0.3625	0.3531	0.4647	0.8222	0.3839	0.9347	18.6781
8/8/2016	11:00:00 PM	16.0477	0.3655	0.3650	0.0240	0.0424	0.0198	0.5706	0.9632
8/8/2016	11:30:00 PM	15.3258	0.3545	0.3591	-0.2269	-0.4017	-0.1876	0.3633	-9.1257
8/9/2016	12:00:01 AM	14.4782	0.3511	0.3698	-0.9144	-1.6202	-0.7565	-0.2056	-36.8055
8/9/2016	12:30:00 AM	13.6246	0.3492	0.3693	-0.9852	-1.7457	-0.8150	-0.2642	-39.6548
8/9/2016	1:00:00 AM	13.0162	0.3658	0.3880	-1.0370	-1.8377	-0.8580	-0.3071	-41.7455
8/9/2016	1:30:00 AM	12.5379	0.3747	0.3880	-0.6147	-1.0887	-0.5083	0.0426	-24.7311

8/9/2016	2:00:00 AM	12.0812	0.3659	0.3790	-0.6214	-1.1006	-0.5138	0.0370	-25.0008
8/9/2016	2:30:00 AM	11.5489	0.3697	0.3867	-0.7903	-1.4000	-0.6536	-0.1028	-31.8034
8/9/2016	3:00:00 AM	11.0727	0.3719	0.3922	-0.9332	-1.6535	-0.7720	-0.2211	-37.5600
8/9/2016	3:30:00 AM	10.6295	0.3691	0.3820	-0.6037	-1.0692	-0.4992	0.0517	-24.2884
8/9/2016	4:00:00 AM	10.1592	0.3633	0.3886	-1.1848	-2.0999	-0.9804	-0.4295	-47.7007
8/9/2016	4:30:00 AM	9.6162	0.3663	0.3881	-1.0176	-1.8032	-0.8419	-0.2910	-40.9612
8/9/2016	5:00:00 AM	9.0952	0.3593	0.3922	-1.5445	-2.7387	-1.2786	-0.7278	-62.2117
8/9/2016	5:30:00 AM	8.6077	0.3660	0.3883	-1.0418	-1.8462	-0.8619	-0.3111	-41.9374
8/9/2016	6:00:00 AM	8.1329	0.3645	0.3906	-1.2161	-2.1556	-1.0064	-0.4555	-48.9661
8/9/2016	6:30:00 AM	7.7625	0.3709	0.3975	-1.2175	-2.1579	-1.0075	-0.4566	-49.0192
8/9/2016	7:00:00 AM	7.6151	0.4046	0.4115	-0.2974	-0.5267	-0.2459	0.3050	-11.9634
8/9/2016	7:30:00 AM	7.9128	0.4740	0.4196	2.1426	3.7868	1.7680	2.3188	86.0220
8/9/2016	8:00:00 AM	8.6294	0.5015	0.3739	5.1665	9.1273	4.2613	4.8122	207.3376
8/9/2016	8:30:00 AM	9.3018	0.5289	0.3333	8.1248	14.3767	6.7122	7.2630	326.5829
8/9/2016	9:00:00 AM	10.2663	0.6215	0.3765	8.8202	15.6175	7.2915	7.8423	354.7692
8/9/2016	9:30:00 AM	12.2568	0.5413	0.2255	15.4023	27.5911	12.8817	13.4325	626.7624
8/9/2016	10:00:00 AM	12.0885	0.5698	0.2281	16.1066	28.9050	13.4951	14.0459	656.6095
8/9/2016	10:30:00 AM	12.6195	0.6185	0.2291	17.4753	31.4812	14.6978	15.2487	715.1296
8/9/2016	11:00:00 AM	14.3892	0.6257	0.2056	19.5859	35.5194	16.5832	17.1341	806.8628
8/9/2016	11:30:00 AM	14.3290	0.6113	0.2119	18.6390	33.6974	15.7325	16.2834	765.4730
8/9/2016	12:00:01 PM	14.9125	0.6162	0.2140	18.6124	33.6464	15.7088	16.2596	764.3158
8/9/2016	12:30:00 PM	16.2526	0.6852	0.2469	17.9602	32.4017	15.1276	15.6785	736.0399
8/9/2016	1:00:00 PM	17.3796	0.6534	0.2130	19.7267	35.7919	16.7104	17.2613	813.0524
8/9/2016	1:30:00 PM	18.1339	0.6374	0.2153	19.0949	34.5726	16.1411	16.6920	785.3541
8/9/2016	2:00:00 PM	19.2542	0.6128	0.1783	21.7254	39.7046	18.5372	19.0880	901.9340
8/9/2016	2:30:00 PM	19.9498	0.5974	0.1743	21.6753	39.6055	18.4909	19.0418	899.6831
8/9/2016	3:00:00 PM	19.8908	0.6072	0.1935	20.1222	36.5596	17.0688	17.6197	830.4906
8/9/2016	3:30:00 PM	20.3443	0.5758	0.2002	18.5853	33.5946	15.6846	16.2354	763.1382
8/9/2016	4:00:00 PM	20.9041	0.5999	0.2058	18.8237	34.0515	15.8979	16.4487	773.5172

8/9/2016	4:30:00 PM	20.9717	0.5711	0.2184	16.9081	30.4097	14.1976	14.7485	690.7905
8/9/2016	5:00:00 PM	21.1894	0.5893	0.2173	17.5543	31.6310	14.7678	15.3186	718.5321
8/9/2016	5:30:00 PM	21.3899	0.5844	0.2177	17.3768	31.2947	14.6108	15.1616	710.8931
8/9/2016	6:00:00 PM	21.5921	0.5379	0.2145	16.1756	29.0341	13.5554	14.1062	659.5421
8/9/2016	6:30:00 PM	21.4550	0.5264	0.2367	14.0597	25.1069	11.7218	12.2727	570.3303
8/9/2016	7:00:00 PM	21.1873	0.4843	0.2609	10.8832	19.3209	9.0205	9.5713	438.8943
8/9/2016	7:30:00 PM	20.7367	0.4487	0.2936	7.4606	13.1945	6.1602	6.7110	299.7265
8/9/2016	8:00:00 PM	20.3024	0.4217	0.3256	4.5477	8.0336	3.7507	4.3015	182.4918
8/9/2016	8:30:00 PM	19.9035	0.4047	0.3367	3.2354	5.7160	2.6687	3.2195	129.8452
8/9/2016	9:00:00 PM	19.3858	0.3856	0.3474	1.8353	3.2442	1.5147	2.0655	73.6962
8/9/2016	9:30:00 PM	18.8237	0.3766	0.3499	1.2953	2.2905	1.0694	1.6202	52.0304
8/9/2016	10:00:00 PM	18.3000	0.3825	0.3623	0.9558	1.6905	0.7892	1.3401	38.4007
8/9/2016	10:30:00 PM	17.7853	0.3765	0.3656	0.5152	0.9115	0.4255	0.9764	20.7048
8/9/2016	11:00:00 PM	17.2531	0.3758	0.3696	0.2917	0.5162	0.2410	0.7918	11.7259
8/9/2016	11:30:00 PM	16.6989	0.3740	0.3737	0.0117	0.0206	0.0096	0.5605	0.4689
8/10/2016	12:00:01 AM	16.3712	0.3781	0.3860	-0.3626	-0.6421	-0.2998	0.2511	-14.5864
8/10/2016	12:30:00 AM	16.0711	0.3797	0.3844	-0.2132	-0.3775	-0.1762	0.3746	-8.5747
8/10/2016	1:00:00 AM	15.6220	0.3718	0.3763	-0.2091	-0.3703	-0.1729	0.3780	-8.4115
8/10/2016	1:30:00 AM	15.0400	0.3716	0.3781	-0.3030	-0.5365	-0.2505	0.3004	-12.1872
8/10/2016	2:00:00 AM	14.6426	0.3730	0.3920	-0.8772	-1.5542	-0.7256	-0.1748	-35.3055
8/10/2016	2:30:00 AM	14.3551	0.3769	0.3976	-0.9408	-1.6670	-0.7783	-0.2275	-37.8686
8/10/2016	3:00:00 AM	14.1898	0.3831	0.4034	-0.9058	-1.6049	-0.7493	-0.1984	-36.4573
8/10/2016	3:30:00 AM	14.0827	0.3895	0.4024	-0.5737	-1.0161	-0.4744	0.0765	-23.0815
8/10/2016	4:00:00 AM	14.0117	0.3866	0.3934	-0.3080	-0.5454	-0.2546	0.2962	-12.3898
8/10/2016	4:30:00 AM	13.9161	0.3911	0.3969	-0.2569	-0.4549	-0.2124	0.3385	-10.3340
8/10/2016	5:00:00 AM	13.8492	0.3883	0.3931	-0.2180	-0.3860	-0.1802	0.3706	-8.7689
8/10/2016	5:30:00 AM	13.6988	0.3722	0.3918	-0.9041	-1.6019	-0.7479	-0.1971	-36.3893
8/10/2016	6:00:00 AM	13.3789	0.3732	0.3976	-1.1152	-1.9763	-0.9227	-0.3719	-44.8948
8/10/2016	6:30:00 AM	13.2638	0.3941	0.4035	-0.4177	-0.7397	-0.3454	0.2055	-16.8039

8/10/2016	7:00:00 AM	13.3587	0.4036	0.4084	-0.2099	-0.3715	-0.1735	0.3774	-8.4401
8/10/2016	7:30:00 AM	13.5101	0.4282	0.3986	1.2596	2.2273	1.0399	1.5907	50.5959
8/10/2016	8:00:00 AM	13.8692	0.4542	0.3809	3.0971	5.4718	2.5547	3.1055	124.2981
8/10/2016	8:30:00 AM	14.3996	0.5027	0.3576	5.9932	10.5906	4.9445	5.4954	240.5769
8/10/2016	9:00:00 AM	15.0400	0.5105	0.3317	7.5863	13.4179	6.2645	6.8154	304.8033
8/10/2016	9:30:00 AM	15.7812	0.5422	0.2959	10.6539	18.9074	8.8274	9.3783	429.5013
8/10/2016	10:00:00 AM	16.3732	0.5823	0.2666	13.7424	24.5235	11.4495	12.0003	557.0776
8/10/2016	10:30:00 AM	17.0091	0.5925	0.2454	15.5058	27.7836	12.9715	13.5224	631.1355
8/10/2016	11:00:00 AM	17.6636	0.6008	0.2144	18.1264	32.7181	15.2754	15.8262	743.2284
8/10/2016	11:30:00 AM	18.4466	0.6029	0.2142	18.2118	32.8810	15.3514	15.9022	746.9275
8/10/2016	12:00:01 PM	19.0329	0.6224	0.2330	17.2884	31.1275	14.5327	15.0836	707.0949
8/10/2016	12:30:00 PM	19.6546	0.5864	0.2224	17.0608	30.6977	14.3320	14.8829	697.3315
8/10/2016	1:00:00 PM	19.8150	0.5571	0.2258	15.8864	28.4933	13.3029	13.8537	647.2557
8/10/2016	1:30:00 PM	20.1494	0.5763	0.2319	16.0193	28.7417	13.4189	13.9697	652.8996
8/10/2016	2:00:00 PM	20.4425	0.5698	0.2291	16.0309	28.7633	13.4289	13.9798	653.3905
8/10/2016	2:30:00 PM	20.4446	0.5319	0.2303	14.7282	26.3407	12.2979	12.8487	598.3570
8/10/2016	3:00:00 PM	20.1682	0.4755	0.2728	9.7782	17.3329	8.0923	8.6432	393.7349
8/10/2016	3:30:00 PM	19.9329	0.4959	0.2762	10.2992	18.2688	8.5293	9.0801	414.9967
8/10/2016	4:00:00 PM	20.0780	0.5516	0.2607	13.1880	23.5072	10.9750	11.5258	533.9916
8/10/2016	4:30:00 PM	20.3861	0.5553	0.2348	15.1434	27.1101	12.6571	13.2079	615.8360
8/10/2016	5:00:00 PM	20.3150	0.5318	0.2176	15.7228	28.1880	13.1603	13.7112	640.3209
8/10/2016	5:30:00 PM	20.1494	0.5338	0.2453	13.6799	24.4087	11.3959	11.9467	554.4707
8/10/2016	6:00:00 PM	20.0192	0.5418	0.2583	13.0326	23.2231	10.8423	11.3932	527.5374
8/10/2016	6:30:00 PM	19.9140	0.4834	0.2460	11.8821	21.1281	9.8642	10.4151	479.9469
8/10/2016	7:00:00 PM	19.4580	0.4786	0.2833	9.2276	16.3461	7.6316	8.1825	371.3202
8/10/2016	7:30:00 PM	19.2054	0.4556	0.2967	7.5466	13.3474	6.2316	6.7825	303.2018
8/10/2016	8:00:00 PM	18.7148	0.4165	0.3186	4.7175	8.3336	3.8908	4.4416	189.3067
8/10/2016	8:30:00 PM	18.1450	0.3906	0.3349	2.7049	4.7795	2.2314	2.7823	108.5710
8/10/2016	9:00:00 PM	17.5244	0.3771	0.3495	1.3352	2.3609	1.1023	1.6531	53.6309

8/10/2016	9:30:00 PM	16.8070	0.3663	0.3581	0.4007	0.7091	0.3310	0.8819	16.1071
8/10/2016	10:00:00 PM	16.0614	0.3600	0.3679	-0.3819	-0.6762	-0.3157	0.2352	-15.3602
8/10/2016	10:30:00 PM	15.4327	0.3702	0.3768	-0.3127	-0.5537	-0.2585	0.2923	-12.5781
8/10/2016	11:00:00 PM	15.0718	0.3881	0.3879	0.0064	0.0114	0.0053	0.5562	0.2588
8/10/2016	11:30:00 PM	14.8646	0.3877	0.3943	-0.2967	-0.5253	-0.2452	0.3056	-11.9327
8/11/2016	12:00:01 AM	14.5784	0.3824	0.3877	-0.2432	-0.4305	-0.2010	0.3498	-9.7801
8/11/2016	12:30:00 AM	14.2582	0.3844	0.3973	-0.5841	-1.0345	-0.4830	0.0679	-23.4998
8/11/2016	1:00:00 AM	14.0765	0.3882	0.3925	-0.1937	-0.3429	-0.1601	0.3908	-7.7890
8/11/2016	1:30:00 AM	13.8692	0.3816	0.3916	-0.4528	-0.8018	-0.3743	0.1765	-18.2134
8/11/2016	2:00:00 AM	13.6209	0.3841	0.3978	-0.6152	-1.0897	-0.5087	0.0421	-24.7528
8/11/2016	2:30:00 AM	13.4591	0.3822	0.4031	-0.9353	-1.6573	-0.7737	-0.2229	-37.6471
8/11/2016	3:00:00 AM	13.3442	0.3763	0.4051	-1.2976	-2.3001	-1.0739	-0.5230	-52.2502
8/11/2016	3:30:00 AM	13.1960	0.3809	0.4053	-1.0909	-1.9334	-0.9026	-0.3518	-43.9184
8/11/2016	4:00:00 AM	13.0677	0.3825	0.4043	-0.9746	-1.7269	-0.8062	-0.2554	-39.2279
8/11/2016	4:30:00 AM	12.9500	0.3855	0.4084	-1.0151	-1.7988	-0.8398	-0.2890	-40.8622
8/11/2016	5:00:00 AM	12.8653	0.3840	0.4124	-1.2542	-2.2232	-1.0379	-0.4871	-50.5019
8/11/2016	5:30:00 AM	12.7841	0.3885	0.4037	-0.6750	-1.1956	-0.5582	-0.0074	-27.1604
8/11/2016	6:00:00 AM	12.6972	0.3766	0.4062	-1.3324	-2.3620	-1.1028	-0.5519	-53.6558
8/11/2016	6:30:00 AM	12.6510	0.3800	0.4165	-1.6156	-2.8651	-1.3376	-0.7868	-65.0832
8/11/2016	7:00:00 AM	12.6426	0.3835	0.4167	-1.4631	-2.5941	-1.2111	-0.6603	-58.9278
8/11/2016	7:30:00 AM	12.6528	0.3908	0.4146	-1.0404	-1.8437	-0.8608	-0.3100	-41.8827
8/11/2016	8:00:00 AM	12.7342	0.3897	0.4191	-1.2784	-2.2661	-1.0580	-0.5072	-51.4773
8/11/2016	8:30:00 AM	13.0970	0.4049	0.4439	-1.6180	-2.8694	-1.3396	-0.7888	-65.1808
8/11/2016	9:00:00 AM	13.6209	0.4202	0.4292	-0.3755	-0.6649	-0.3104	0.2404	-15.1031
8/11/2016	9:30:00 AM	14.1917	0.4207	0.4167	0.1689	0.2989	0.1396	0.6904	6.7901
8/11/2016	10:00:00 AM	14.7028	0.4270	0.3921	1.4982	2.6489	1.2367	1.7875	60.1720
8/11/2016	10:30:00 AM	15.0540	0.4407	0.3799	2.6096	4.6112	2.1529	2.7037	104.7495
8/11/2016	11:00:00 AM	15.4839	0.4844	0.3626	5.0955	9.0018	4.2027	4.7536	204.4854
8/11/2016	11:30:00 AM	16.1395	0.5048	0.3253	7.7306	13.6747	6.3844	6.9353	310.6359

8/11/2016	12:00:01 PM	16.4509	0.5309	0.3064	9.6727	17.1436	8.0040	8.5548	389.4366
8/11/2016	12:30:00 PM	16.9766	0.5255	0.2756	11.3529	20.1692	9.4165	9.9674	458.1659
8/11/2016	1:00:00 PM	17.1437	0.5354	0.2755	11.6879	20.7758	9.6998	10.2506	471.9461
8/11/2016	1:30:00 PM	17.4195	0.4944	0.2764	10.2281	18.1410	8.4696	9.0205	412.0927
8/11/2016	2:00:00 PM	17.5132	0.5188	0.2823	10.7089	19.0064	8.8737	9.4245	431.7517
8/11/2016	2:30:00 PM	17.9917	0.5699	0.2778	12.6430	22.5117	10.5102	11.0611	511.3787
8/11/2016	3:00:00 PM	18.6310	0.5762	0.2325	15.9683	28.6464	13.3744	13.9252	650.7345
8/11/2016	3:30:00 PM	19.0308	0.5885	0.2235	17.0363	30.6515	14.3105	14.8613	696.2816
8/11/2016	4:00:00 PM	19.2224	0.5600	0.2177	16.6218	29.8711	13.9461	14.4970	678.5538
8/11/2016	4:30:00 PM	19.3285	0.5647	0.2180	16.7456	30.1038	14.0548	14.6056	683.8417
8/11/2016	5:00:00 PM	19.2744	0.5243	0.2398	13.7630	24.5612	11.4671	12.0179	557.9355
8/11/2016	5:30:00 PM	19.2394	0.5373	0.2489	13.5384	24.1490	11.2746	11.8255	548.5705
8/11/2016	6:00:00 PM	19.1629	0.5271	0.2385	13.9526	24.9098	11.6298	12.1806	565.8523
8/11/2016	6:30:00 PM	19.2394	0.5390	0.2543	13.2192	23.5642	11.0016	11.5524	535.2858
8/11/2016	7:00:00 PM	19.2670	0.5113	0.2744	10.9478	19.4374	9.0749	9.6257	441.5426
8/11/2016	7:30:00 PM	19.1075	0.4681	0.2936	8.2078	14.5246	6.7812	7.3321	329.9431
8/11/2016	8:00:00 PM	18.7448	0.4160	0.3195	4.6418	8.1998	3.8283	4.3791	186.2674
8/11/2016	8:30:00 PM	18.1188	0.3924	0.3355	2.7589	4.8748	2.2759	2.8268	110.7361
8/11/2016	9:00:00 PM	17.4195	0.3678	0.3536	0.6946	1.2288	0.5737	1.1246	27.9144
8/11/2016	9:30:00 PM	16.7761	0.3661	0.3653	0.0362	0.0641	0.0299	0.5808	1.4561
8/11/2016	10:00:00 PM	16.1726	0.3602	0.3641	-0.1900	-0.3364	-0.1571	0.3938	-7.6416
8/11/2016	10:30:00 PM	15.5727	0.3623	0.3725	-0.4883	-0.8648	-0.4037	0.1471	-19.6441
8/11/2016	11:00:00 PM	14.9763	0.3639	0.3783	-0.6811	-1.2065	-0.5633	-0.0124	-27.4060
8/11/2016	11:30:00 PM	14.4195	0.3596	0.3741	-0.6953	-1.2317	-0.5751	-0.0242	-27.9800
8/12/2016	12:00:01 AM	13.8692	0.3613	0.3852	-1.1274	-1.9980	-0.9328	-0.3820	-45.3872
8/12/2016	12:30:00 AM	13.4445	0.3655	0.3880	-1.0522	-1.8647	-0.8706	-0.3197	-42.3581
8/12/2016	1:00:00 AM	13.0493	0.3603	0.3890	-1.3457	-2.3856	-1.1138	-0.5629	-54.1913
8/12/2016	1:30:00 AM	12.6177	0.3607	0.3892	-1.3362	-2.3688	-1.1059	-0.5551	-53.8092
8/12/2016	2:00:00 AM	12.1895	0.3711	0.3990	-1.2760	-2.2618	-1.0560	-0.5051	-51.3784

8/12/2016	2:30:00 AM	11.7973	0.3617	0.3887	-1.2687	-2.2489	-1.0500	-0.4991	-51.0865
8/12/2016	3:00:00 AM	11.4434	0.3744	0.4050	-1.3832	-2.4521	-1.1448	-0.5940	-55.7026
8/12/2016	3:30:00 AM	11.2171	0.3761	0.4043	-1.2703	-2.2517	-1.0513	-0.5004	-51.1503
8/12/2016	4:00:00 AM	11.1484	0.3775	0.4203	-1.8884	-3.3500	-1.5640	-1.0132	-76.0992
8/12/2016	4:30:00 AM	11.2360	0.3806	0.4187	-1.6765	-2.9732	-1.3881	-0.8373	-67.5402
8/12/2016	5:00:00 AM	11.3407	0.3854	0.4197	-1.5008	-2.6610	-1.2424	-0.6915	-60.4472
8/12/2016	5:30:00 AM	11.4416	0.3858	0.4202	-1.5057	-2.6698	-1.2465	-0.6956	-60.6481
8/12/2016	6:00:00 AM	11.5099	0.3806	0.4161	-1.5687	-2.7816	-1.2987	-0.7478	-63.1878
8/12/2016	6:30:00 AM	11.5781	0.3908	0.4211	-1.3113	-2.3245	-1.0853	-0.5344	-52.8043
8/12/2016	7:00:00 AM	11.8143	0.3989	0.4277	-1.2289	-2.1782	-1.0170	-0.4661	-49.4802
8/12/2016	7:30:00 AM	12.2699	0.4088	0.4434	-1.4318	-2.5385	-1.1852	-0.6343	-57.6650
8/12/2016	8:00:00 AM	12.8837	0.4133	0.4378	-1.0117	-1.7927	-0.8370	-0.2861	-40.7230
8/12/2016	8:30:00 AM	13.8041	0.4679	0.4254	1.6752	2.9614	1.3826	1.9335	67.2724
8/12/2016	9:00:00 AM	14.4517	0.4845	0.3908	3.7792	6.6761	3.1169	3.6678	151.6552
8/12/2016	9:30:00 AM	14.9942	0.5154	0.3404	7.2974	12.9044	6.0248	6.5756	293.1374
8/12/2016	10:00:00 AM	15.7537	0.5311	0.3243	8.6800	15.3672	7.1746	7.7254	349.0819
8/12/2016	10:30:00 AM	16.3109	0.5100	0.3023	9.2043	16.3045	7.6122	8.1630	370.3745
8/12/2016	11:00:00 AM	16.9344	0.5624	0.2848	11.9717	21.2906	9.9401	10.4909	483.6386
8/12/2016	11:30:00 AM	17.3736	0.5836	0.2625	14.0563	25.1006	11.7189	12.2698	570.1887
8/12/2016	12:00:01 PM	17.9674	0.5624	0.2489	14.3414	25.6260	11.9642	12.5151	582.1236
8/12/2016	12:30:00 PM	18.2376	0.5366	0.2538	13.1726	23.4791	10.9618	11.5127	533.3524
8/12/2016	1:00:00 PM	18.3000	0.5183	0.2706	11.4376	20.3225	9.4881	10.0390	461.6489
8/12/2016	1:30:00 PM	18.5709	0.5622	0.2773	12.4383	22.1389	10.3362	10.8870	502.9101
8/12/2016	2:00:00 PM	19.5679	0.5969	0.2314	16.6748	29.9707	13.9926	14.5435	680.8172
8/12/2016	2:30:00 PM	19.8023	0.5433	0.2135	16.4347	29.5196	13.7820	14.3329	670.5711
8/12/2016	3:00:00 PM	19.6546	0.4405	0.3106	6.1497	10.8677	5.0739	5.6247	246.8727
8/12/2016	3:30:00 PM	19.2075	0.3960	0.3370	2.8418	5.0211	2.3442	2.8951	114.0597
8/12/2016	4:00:00 PM	18.6910	0.3902	0.3594	1.4479	2.5600	1.1952	1.7460	58.1530
8/12/2016	4:30:00 PM	18.4336	0.3849	0.3728	0.5603	0.9914	0.4628	1.0137	22.5199

8/12/2016	5:00:00 PM	18.1752	0.3864	0.3834	0.1390	0.2460	0.1149	0.6657	5.5886
8/12/2016	5:30:00 PM	18.0714	0.4081	0.3882	0.8776	1.5522	0.7247	1.2755	35.2598
8/12/2016	6:00:00 PM	18.1732	0.3934	0.3774	0.7308	1.2927	0.6035	1.1544	29.3646
8/12/2016	6:30:00 PM	18.1319	0.3938	0.3785	0.7002	1.2387	0.5783	1.1292	28.1393
8/12/2016	7:00:00 PM	18.0638	0.3977	0.3905	0.3251	0.5753	0.2686	0.8194	13.0686
8/12/2016	7:30:00 PM	17.9674	0.3892	0.3896	-0.0198	-0.0350	-0.0164	0.5345	-0.7959
8/12/2016	8:00:00 PM	17.7509	0.3767	0.3888	-0.5576	-0.9875	-0.4611	0.0898	-22.4330
8/12/2016	8:30:00 PM	17.5091	0.3683	0.3857	-0.8114	-1.4375	-0.6712	-0.1203	-32.6553
8/12/2016	9:00:00 PM	17.0843	0.3631	0.3861	-1.0817	-1.9170	-0.8950	-0.3442	-43.5471
8/12/2016	9:30:00 PM	16.5595	0.3567	0.3850	-1.3413	-2.3778	-1.1101	-0.5593	-54.0140
8/12/2016	10:00:00 PM	16.1863	0.3701	0.3989	-1.3179	-2.3363	-1.0908	-0.5399	-53.0713
8/12/2016	10:30:00 PM	15.8774	0.3691	0.3904	-0.9854	-1.7462	-0.8153	-0.2644	-39.6664
8/12/2016	11:00:00 PM	15.5293	0.3594	0.3965	-1.7284	-3.0655	-1.4312	-0.8804	-69.6371
8/12/2016	11:30:00 PM	15.1176	0.3634	0.3915	-1.3103	-2.3228	-1.0845	-0.5336	-52.7647
8/13/2016	12:00:01 AM	14.7066	0.3627	0.3918	-1.3573	-2.4063	-1.1234	-0.5726	-54.6611
8/13/2016	12:30:00 AM	14.3475	0.3569	0.3956	-1.8132	-3.2163	-1.5016	-0.9508	-73.0628
8/13/2016	1:00:00 AM	13.9954	0.3563	0.3931	-1.7295	-3.0674	-1.4321	-0.8813	-69.6799
8/13/2016	1:30:00 AM	13.6372	0.3573	0.3966	-1.8382	-3.2608	-1.5224	-0.9715	-74.0722
8/13/2016	2:00:00 AM	13.2143	0.3584	0.3968	-1.7911	-3.1769	-1.4832	-0.9324	-72.1678
8/13/2016	2:30:00 AM	12.7509	0.3543	0.3912	-1.7399	-3.0860	-1.4408	-0.8899	-70.1015
8/13/2016	3:00:00 AM	12.2027	0.3481	0.3906	-2.0309	-3.6036	-1.6825	-1.1316	-81.8603
8/13/2016	3:30:00 AM	11.7785	0.3645	0.4062	-1.9068	-3.3828	-1.5793	-1.0285	-76.8438
8/13/2016	4:00:00 AM	11.5386	0.3631	0.4053	-1.9327	-3.4289	-1.6009	-1.0500	-77.8905
8/13/2016	4:30:00 AM	11.2514	0.3614	0.3988	-1.7336	-3.0748	-1.4355	-0.8847	-69.8472
8/13/2016	5:00:00 AM	10.8897	0.3561	0.3995	-2.0233	-3.5901	-1.6761	-1.1253	-81.5530
8/13/2016	5:30:00 AM	10.5461	0.3594	0.3991	-1.8453	-3.2734	-1.5283	-0.9774	-74.3591
8/13/2016	6:00:00 AM	10.2663	0.3671	0.4036	-1.6666	-2.9557	-1.3799	-0.8291	-67.1415
8/13/2016	6:30:00 AM	10.1592	0.3825	0.4159	-1.4759	-2.6168	-1.2217	-0.6709	-59.4426
8/13/2016	7:00:00 AM	10.3153	0.3785	0.4202	-1.8414	-3.2664	-1.5250	-0.9742	-74.1998

8/13/2016	7:30:00 AM	10.3907	0.3950	0.4351	-1.7020	-3.0187	-1.4093	-0.8585	-68.5724
8/13/2016	8:00:00 AM	11.0486	0.4279	0.4472	-0.7741	-1.3714	-0.6403	-0.0894	-31.1523
8/13/2016	8:30:00 AM	11.8990	0.4497	0.4488	0.0373	0.0660	0.0308	0.5817	1.4991
8/13/2016	9:00:00 AM	13.0696	0.5404	0.4785	2.1413	3.7846	1.7669	2.3178	85.9705
8/13/2016	9:30:00 AM	14.6124	0.4577	0.3426	5.0960	9.0027	4.2031	4.7540	204.5053
8/13/2016	10:00:00 AM	14.8365	0.5088	0.3031	9.1133	16.1416	7.5361	8.0870	366.6744
8/13/2016	10:30:00 AM	15.3891	0.5594	0.2668	13.0286	23.2156	10.8389	11.3897	527.3686
8/13/2016	11:00:00 AM	16.5674	0.5818	0.2194	17.1583	30.8818	14.4180	14.9688	701.5128
8/13/2016	11:30:00 AM	16.4353	0.5978	0.2134	18.1279	32.7210	15.2767	15.8275	743.2937
8/13/2016	12:00:01 PM	17.1227	0.6186	0.2092	19.0760	34.5361	16.1241	16.6750	784.5262
8/13/2016	12:30:00 PM	18.2829	0.6598	0.2540	16.7944	30.1956	14.0976	14.6485	685.9264
8/13/2016	1:00:00 PM	19.1203	0.5986	0.2247	17.2361	31.0287	14.4866	15.0374	704.8509
8/13/2016	1:30:00 PM	19.4431	0.5646	0.2077	17.5911	31.7007	14.8003	15.3512	720.1159
8/13/2016	2:00:00 PM	19.9329	0.6142	0.2422	16.3710	29.4002	13.7263	14.2771	667.8566
8/13/2016	2:30:00 PM	19.9161	0.5766	0.2128	17.5411	31.6058	14.7560	15.3069	717.9604
8/13/2016	3:00:00 PM	20.9195	0.5856	0.2279	16.6063	29.8419	13.9325	14.4833	677.8910
8/13/2016	3:30:00 PM	20.7492	0.5199	0.2510	12.8098	22.8160	10.6523	11.2031	518.2904
8/13/2016	4:00:00 PM	20.6741	0.5099	0.2416	13.1424	23.4238	10.9360	11.4869	532.0972
8/13/2016	4:30:00 PM	20.7928	0.5316	0.2388	14.0807	25.1455	11.7399	12.2907	571.2084
8/13/2016	5:00:00 PM	20.8969	0.5437	0.2326	14.9387	26.7305	12.4798	13.0307	607.2114
8/13/2016	5:30:00 PM	21.1583	0.5548	0.2407	14.6911	26.2719	12.2658	12.8166	596.7955
8/13/2016	6:00:00 PM	21.2047	0.5090	0.2497	12.5326	22.3107	10.4163	10.9672	506.8114
8/13/2016	6:30:00 PM	21.1518	0.5065	0.2720	10.9376	19.4189	9.0663	9.6171	441.1223
8/13/2016	7:00:00 PM	20.9674	0.4537	0.2996	7.2997	12.9084	6.0266	6.5775	293.2279
8/13/2016	7:30:00 PM	20.7877	0.4304	0.3353	4.3904	7.7556	3.6209	4.1718	176.1780
8/13/2016	8:00:00 PM	20.5522	0.4040	0.3438	2.8393	5.0167	2.3422	2.8930	113.9601
8/13/2016	8:30:00 PM	20.0906	0.3789	0.3390	1.9580	3.4608	1.6158	2.1666	78.6150
8/13/2016	9:00:00 PM	19.5954	0.3847	0.3646	0.9447	1.6709	0.7801	1.3310	37.9565
8/13/2016	9:30:00 PM	19.1650	0.3869	0.3684	0.8620	1.5247	0.7118	1.2627	34.6343

8/13/2016	10:00:00 PM	18.7747	0.3795	0.3721	0.3462	0.6126	0.2860	0.8368	13.9151
8/13/2016	10:30:00 PM	18.4034	0.3750	0.3739	0.0491	0.0870	0.0406	0.5915	1.9759
8/13/2016	11:00:00 PM	17.9917	0.3691	0.3750	-0.2786	-0.4932	-0.2303	0.3206	-11.2046
8/13/2016	11:30:00 PM	17.4042	0.3581	0.3687	-0.5160	-0.9139	-0.4267	0.1242	-20.7610
8/14/2016	12:00:01 AM	16.7220	0.3602	0.3733	-0.6292	-1.1144	-0.5203	0.0306	-25.3147
8/14/2016	12:30:00 AM	16.0477	0.3494	0.3638	-0.7121	-1.2615	-0.5890	-0.0381	-28.6566
8/14/2016	1:00:00 AM	15.4207	0.3552	0.3733	-0.8751	-1.5505	-0.7239	-0.1730	-35.2212
8/14/2016	1:30:00 AM	14.8167	0.3619	0.3829	-0.9902	-1.7545	-0.8192	-0.2683	-39.8561
8/14/2016	2:00:00 AM	14.3996	0.3696	0.4011	-1.4351	-2.5444	-1.1879	-0.6371	-57.7992
8/14/2016	2:30:00 AM	14.5443	0.3901	0.4144	-1.0651	-1.8876	-0.8813	-0.3304	-42.8786
8/14/2016	3:00:00 AM	14.6387	0.3932	0.4179	-1.0728	-1.9011	-0.8876	-0.3367	-43.1853
8/14/2016	3:30:00 AM	14.6567	0.3739	0.3950	-0.9677	-1.7147	-0.8005	-0.2497	-38.9505
8/14/2016	4:00:00 AM	14.5122	0.3798	0.4036	-1.0686	-1.8938	-0.8842	-0.3333	-43.0195
8/14/2016	4:30:00 AM	14.3674	0.3762	0.4032	-1.2225	-2.1668	-1.0116	-0.4608	-49.2208
8/14/2016	5:00:00 AM	14.1917	0.3760	0.3953	-0.8800	-1.5592	-0.7279	-0.1771	-35.4182
8/14/2016	5:30:00 AM	13.9854	0.3681	0.3963	-1.2980	-2.3009	-1.0742	-0.5234	-52.2667
8/14/2016	6:00:00 AM	13.7044	0.3725	0.3929	-0.9373	-1.6607	-0.7753	-0.2245	-37.7248
8/14/2016	6:30:00 AM	13.3131	0.3580	0.3894	-1.4831	-2.6297	-1.2277	-0.6769	-59.7361
8/14/2016	7:00:00 AM	13.1154	0.3895	0.4143	-1.0871	-1.9265	-0.8994	-0.3486	-43.7619
8/14/2016	7:30:00 AM	13.3587	0.3885	0.4171	-1.2472	-2.2107	-1.0321	-0.4813	-50.2177
8/14/2016	8:00:00 AM	13.7044	0.4087	0.4275	-0.7901	-1.3998	-0.6535	-0.1027	-31.7974
8/14/2016	8:30:00 AM	14.1936	0.4244	0.4257	-0.0534	-0.0944	-0.0441	0.5068	-2.1453
8/14/2016	9:00:00 AM	15.0559	0.5034	0.4504	1.9590	3.4626	1.6166	2.1675	78.6571
8/14/2016	9:30:00 AM	16.0926	0.4586	0.3562	4.4460	7.8538	3.6668	4.2176	178.4085
8/14/2016	10:00:00 AM	16.4509	0.4884	0.3127	7.8479	13.8836	6.4819	7.0328	315.3816
8/14/2016	10:30:00 AM	16.7936	0.5296	0.2833	11.0101	19.5499	9.1274	9.6782	444.0969
8/14/2016	11:00:00 AM	17.9694	0.5795	0.2625	13.9337	24.8751	11.6136	12.1645	565.0652
8/14/2016	11:30:00 AM	17.6900	0.5419	0.1963	17.8684	32.2270	15.0461	15.5969	732.0719
8/14/2016	12:00:01 PM	18.0260	0.6212	0.2434	16.4848	29.6137	13.8259	14.3768	672.7070

8/14/2016	12:30:00 PM	19.2988	0.6220	0.2128	18.8723	34.1448	15.9414	16.4923	775.6361
8/14/2016	1:00:00 PM	19.9329	0.5780	0.1822	20.3071	36.9195	17.2369	17.7877	838.6663
8/14/2016	1:30:00 PM	20.2081	0.5818	0.2097	17.9517	32.3854	15.1200	15.6709	735.6703
8/14/2016	2:00:00 PM	21.3154	0.6035	0.1990	19.5179	35.3880	16.5218	17.0727	803.8769
8/14/2016	2:30:00 PM	21.7729	0.5908	0.2043	18.6797	33.7753	15.7689	16.3198	767.2439
8/14/2016	3:00:00 PM	22.0651	0.5887	0.1909	19.8099	35.9532	16.7857	17.3366	816.7158
8/14/2016	3:30:00 PM	22.3014	0.6103	0.2011	19.5338	35.4188	16.5362	17.0871	804.5760
8/14/2016	4:00:00 PM	22.9808	0.5847	0.2021	18.6944	33.8036	15.7821	16.3330	767.8854
8/14/2016	4:30:00 PM	23.1036	0.5802	0.1905	19.5928	35.5329	16.5895	17.1403	807.1689
8/14/2016	5:00:00 PM	23.3067	0.5677	0.2043	17.9769	32.4334	15.1424	15.6933	736.7606
8/14/2016	5:30:00 PM	23.4480	0.5583	0.2235	16.1060	28.9038	13.4945	14.0454	656.5817
8/14/2016	6:00:00 PM	23.4904	0.5306	0.2334	14.4494	25.8252	12.0572	12.6081	586.6485
8/14/2016	6:30:00 PM	23.4034	0.5036	0.2537	12.0610	21.4528	10.0158	10.5667	487.3242
8/14/2016	7:00:00 PM	23.2076	0.4666	0.2697	9.6441	17.0924	7.9800	8.5309	388.2724
8/14/2016	7:30:00 PM	22.6845	0.4269	0.2868	7.0026	12.3806	5.7802	6.3311	281.2384
8/14/2016	8:00:00 PM	22.0171	0.4018	0.3109	4.5141	7.9742	3.7230	4.2738	181.1417
8/14/2016	8:30:00 PM	21.3133	0.3839	0.3330	2.5014	4.4203	2.0637	2.6146	100.4115
8/14/2016	9:00:00 PM	20.6179	0.3742	0.3353	1.9303	3.4119	1.5930	2.1438	77.5058
8/14/2016	9:30:00 PM	19.9287	0.3668	0.3417	1.2446	2.2008	1.0275	1.5784	49.9946
8/14/2016	10:00:00 PM	19.1980	0.3642	0.3503	0.6836	1.2094	0.5646	1.1155	27.4725
8/14/2016	10:30:00 PM	18.4917	0.3576	0.3507	0.3430	0.6069	0.2834	0.8342	13.7868
8/14/2016	11:00:00 PM	17.8289	0.3646	0.3661	-0.0729	-0.1291	-0.0603	0.4906	-2.9315
8/14/2016	11:30:00 PM	17.2971	0.3689	0.3710	-0.0978	-0.1732	-0.0808	0.4700	-3.9337
8/15/2016	12:00:01 AM	16.8687	0.3747	0.3799	-0.2418	-0.4280	-0.1998	0.3510	-9.7231
8/15/2016	12:30:00 AM	16.5032	0.3749	0.3843	-0.4361	-0.7723	-0.3605	0.1903	-17.5426
8/15/2016	1:00:00 AM	16.1843	0.3639	0.3804	-0.7764	-1.3754	-0.6422	-0.0913	-31.2445
8/15/2016	1:30:00 AM	15.7812	0.3712	0.3884	-0.7968	-1.4115	-0.6590	-0.1082	-32.0648
8/15/2016	2:00:00 AM	15.4327	0.3728	0.3894	-0.7695	-1.3631	-0.6364	-0.0856	-30.9647
8/15/2016	2:30:00 AM	15.1494	0.3769	0.3963	-0.8860	-1.5697	-0.7329	-0.1820	-35.6581

8/15/2016	3:00:00 AM	14.9125	0.3776	0.3961	-0.8409	-1.4899	-0.6956	-0.1447	-33.8441
8/15/2016	3:30:00 AM	14.7969	0.3910	0.4128	-0.9557	-1.6935	-0.7906	-0.2398	-38.4692
8/15/2016	4:00:00 AM	14.8608	0.3797	0.4061	-1.1824	-2.0957	-0.9785	-0.4276	-47.6071
8/15/2016	4:30:00 AM	14.7329	0.3690	0.3996	-1.3997	-2.4815	-1.1585	-0.6077	-56.3692
8/15/2016	5:00:00 AM	14.5887	0.3748	0.3963	-0.9807	-1.7378	-0.8113	-0.2605	-39.4760
8/15/2016	5:30:00 AM	14.4460	0.3712	0.3980	-1.2276	-2.1758	-1.0159	-0.4650	-49.4267
8/15/2016	6:00:00 AM	14.1413	0.3626	0.3910	-1.3270	-2.3524	-1.0983	-0.5474	-53.4366
8/15/2016	6:30:00 AM	13.9142	0.3771	0.4041	-1.2164	-2.1561	-1.0066	-0.4558	-48.9784
8/15/2016	7:00:00 AM	13.8817	0.3814	0.4159	-1.5205	-2.6960	-1.2587	-0.7079	-61.2429
8/15/2016	7:30:00 AM	14.0584	0.3938	0.4207	-1.1640	-2.0629	-0.9631	-0.4123	-46.8620
8/15/2016	8:00:00 AM	14.6689	0.4187	0.4216	-0.1210	-0.2142	-0.1000	0.4508	-4.8662
8/15/2016	8:30:00 AM	15.3378	0.4473	0.4122	1.4399	2.5459	1.1886	1.7395	57.8331
8/15/2016	9:00:00 AM	16.0809	0.5139	0.3931	4.7135	8.3266	3.8875	4.4383	189.1474
8/15/2016	9:30:00 AM	17.2858	0.4770	0.3087	7.6566	13.5431	6.3230	6.8738	307.6473
8/15/2016	10:00:00 AM	17.4673	0.5140	0.2794	10.7220	19.0301	8.8847	9.4356	432.2900
8/15/2016	10:30:00 AM	17.9522	0.5524	0.2647	12.9429	23.0591	10.7658	11.3166	523.8137
8/15/2016	11:00:00 AM	19.2712	0.5293	0.2198	15.4624	27.7029	12.9338	13.4847	629.3011
8/15/2016	11:30:00 AM	18.9263	0.5715	0.2112	17.5182	31.5624	14.7358	15.2866	716.9747
8/15/2016	12:00:01 PM	19.5954	0.6472	0.2572	16.2337	29.1428	13.6061	14.1570	662.0110
8/15/2016	12:30:00 PM	20.9281	0.5933	0.1909	19.9496	36.2241	16.9122	17.4630	822.8689
8/15/2016	1:00:00 PM	21.1198	0.6060	0.2110	18.5678	33.5610	15.6689	16.2197	762.3751
8/15/2016	1:30:00 PM	22.1605	0.5620	0.2098	17.3404	31.2258	14.5786	15.1295	709.3284
8/15/2016	2:00:00 PM	21.6958	0.5133	0.2187	15.0147	26.8712	12.5456	13.0964	610.4096
8/15/2016	2:30:00 PM	21.6721	0.5163	0.2242	14.6766	26.2452	12.2533	12.8041	596.1889
8/15/2016	3:00:00 PM	22.3201	0.6568	0.2513	16.9058	30.4055	14.1956	14.7465	690.6943
8/15/2016	3:30:00 PM	23.0376	0.6058	0.1998	19.5203	35.3926	16.5240	17.0749	803.9827
8/15/2016	4:00:00 PM	23.6549	0.6097	0.1901	20.5042	37.3039	17.4164	17.9672	847.3998
8/15/2016	4:30:00 PM	23.9223	0.5632	0.1779	20.2722	36.8515	17.2051	17.7560	837.1217
8/15/2016	5:00:00 PM	23.8286	0.5705	0.1908	19.2734	34.9162	16.3016	16.8524	793.1595

8/15/2016	5:30:00 PM	23.9505	0.5602	0.2063	17.5784	31.6766	14.7891	15.3399	719.5689
8/15/2016	6:00:00 PM	23.7420	0.5223	0.2213	15.1077	27.0438	12.6261	13.1770	614.3302
8/15/2016	6:30:00 PM	23.3819	0.5029	0.2622	11.4580	20.3595	9.5054	10.0563	462.4892
8/15/2016	7:00:00 PM	23.2241	0.4801	0.2736	9.8942	17.5411	8.1895	8.7404	398.4644
8/15/2016	7:30:00 PM	22.8388	0.4395	0.2851	7.6160	13.4708	6.2892	6.8400	306.0028
8/15/2016	8:00:00 PM	22.2464	0.4069	0.3087	4.8614	8.5879	4.0095	4.5603	195.0836
8/15/2016	8:30:00 PM	21.6144	0.3824	0.3264	2.7885	4.9271	2.3003	2.8512	111.9238
8/15/2016	9:00:00 PM	20.8387	0.3659	0.3292	1.8635	3.2940	1.5379	2.0887	74.8265
8/15/2016	9:30:00 PM	19.9919	0.3595	0.3427	0.8456	1.4958	0.6983	1.2492	33.9785
8/15/2016	10:00:00 PM	19.1331	0.3604	0.3475	0.6438	1.1390	0.5318	1.0826	25.8741
8/15/2016	10:30:00 PM	18.2960	0.3555	0.3566	-0.0565	-0.1000	-0.0467	0.5042	-2.2717
8/15/2016	11:00:00 PM	17.5132	0.3543	0.3526	0.0840	0.1486	0.0694	0.6202	3.3761
8/15/2016	11:30:00 PM	16.7452	0.3541	0.3595	-0.2685	-0.4754	-0.2219	0.3289	-10.7983
8/16/2016	12:00:01 AM	16.0457	0.3533	0.3719	-0.9044	-1.6024	-0.7481	-0.1973	-36.3991
8/16/2016	12:30:00 AM	15.3575	0.3537	0.3684	-0.7181	-1.2721	-0.5939	-0.0431	-28.8981
8/16/2016	1:00:00 AM	14.7368	0.3638	0.3837	-0.9340	-1.6549	-0.7726	-0.2218	-37.5933
8/16/2016	1:30:00 AM	14.1737	0.3599	0.3824	-1.0673	-1.8914	-0.8831	-0.3322	-42.9654
8/16/2016	2:00:00 AM	13.6409	0.3565	0.3835	-1.2843	-2.2766	-1.0629	-0.5120	-51.7145
8/16/2016	2:30:00 AM	13.1255	0.3641	0.3867	-1.0601	-1.8786	-0.8771	-0.3262	-42.6739
8/16/2016	3:00:00 AM	12.6510	0.3637	0.3870	-1.0962	-1.9426	-0.9070	-0.3561	-44.1291
8/16/2016	3:30:00 AM	12.3035	0.3726	0.3964	-1.0877	-1.9277	-0.9000	-0.3491	-43.7896
8/16/2016	4:00:00 AM	12.0004	0.3770	0.3913	-0.6547	-1.1596	-0.5414	0.0095	-26.3417
8/16/2016	4:30:00 AM	11.7106	0.3700	0.3958	-1.1891	-2.1075	-0.9839	-0.4331	-47.8744
8/16/2016	5:00:00 AM	11.5099	0.3800	0.4004	-0.9196	-1.6293	-0.7607	-0.2098	-37.0114
8/16/2016	5:30:00 AM	11.3371	0.3784	0.3984	-0.9069	-1.6069	-0.7502	-0.1994	-36.5034
8/16/2016	6:00:00 AM	11.1139	0.3803	0.3959	-0.7080	-1.2542	-0.5855	-0.0347	-28.4901
8/16/2016	6:30:00 AM	10.9070	0.3831	0.4002	-0.7714	-1.3665	-0.6380	-0.0872	-31.0421
8/16/2016	7:00:00 AM	10.8395	0.3906	0.4121	-0.9420	-1.6691	-0.7793	-0.2284	-37.9159
8/16/2016	7:30:00 AM	11.0296	0.4091	0.4284	-0.8132	-1.4406	-0.6726	-0.1218	-32.7255

8/16/2016	8:00:00 AM	11.9666	0.4496	0.4447	0.1909	0.3379	0.1578	0.7086	7.6756
8/16/2016	8:30:00 AM	13.4464	0.5264	0.4063	4.5546	8.0457	3.7563	4.3072	182.7661
8/16/2016	9:00:00 AM	14.5803	0.5668	0.3223	9.9341	17.6126	8.2229	8.7738	400.0894
8/16/2016	9:30:01 AM	15.2148	0.5976	0.2733	13.7647	24.5643	11.4685	12.0194	558.0054
8/16/2016	10:00:00 AM	16.0614	0.6244	0.2547	15.7746	28.2847	13.2055	13.7563	642.5178
8/16/2016	10:30:00 AM	17.0956	0.6327	0.2642	15.3639	27.5197	12.8483	13.3992	625.1407
8/16/2016	11:00:00 AM	18.5538	0.5821	0.2213	17.0175	30.6161	14.2940	14.8448	695.4780
8/16/2016	11:30:00 AM	19.1439	0.6235	0.2547	15.7504	28.2395	13.1844	13.7352	641.4901
8/16/2016	12:00:01 PM	20.2563	0.6428	0.2463	16.8776	30.3524	14.1708	14.7217	689.4869
8/16/2016	12:30:00 PM	21.2865	0.6234	0.2293	17.5974	31.7126	14.8059	15.3567	720.3856
8/16/2016	1:00:00 PM	22.4037	0.6140	0.2173	18.2765	33.0043	15.4090	15.9598	749.7287
8/16/2016	1:30:00 PM	23.4313	0.5888	0.2145	17.7665	32.0335	14.9557	15.5065	727.6754
8/16/2016	2:00:00 PM	23.6408	0.5779	0.2053	18.2108	32.8791	15.3505	15.9013	746.8842
8/16/2016	2:30:00 PM	24.1821	0.5997	0.2153	18.0253	32.5255	15.1854	15.7363	738.8533
8/16/2016	3:00:00 PM	24.5298	0.5891	0.2063	18.4652	33.3648	15.5773	16.1281	757.9182
8/16/2016	3:30:00 PM	24.8787	0.5991	0.2152	18.0183	32.5123	15.1793	15.7301	738.5531
8/16/2016	4:00:00 PM	25.2520	0.5696	0.2034	18.1186	32.7032	15.2684	15.8192	742.8882
8/16/2016	4:30:00 PM	25.3214	0.5480	0.2117	16.7357	30.0852	14.0461	14.5969	683.4172
8/16/2016	5:00:00 PM	25.5040	0.5940	0.2366	16.1937	29.0680	13.5712	14.1220	660.3114
8/16/2016	5:30:00 PM	25.7809	0.5361	0.2221	15.5061	27.7843	12.9718	13.5227	631.1502
8/16/2016	6:00:00 PM	25.6378	0.5142	0.2483	12.8112	22.8187	10.6535	11.2044	518.3515
8/16/2016	6:30:00 PM	25.6378	0.4965	0.2695	10.7491	19.0789	8.9075	9.4583	433.3974
8/16/2016	7:00:00 PM	25.4531	0.4855	0.2835	9.4677	16.7762	7.8324	8.3833	381.0897
8/16/2016	7:30:00 PM	25.1153	0.4407	0.2937	7.1418	12.6278	5.8956	6.4465	286.8542
8/16/2016	8:00:00 PM	24.4157	0.4021	0.3154	4.2724	7.5471	3.5236	4.0744	171.4415
8/16/2016	8:30:00 PM	23.5844	0.3830	0.3292	2.6653	4.7096	2.1988	2.7497	106.9844
8/16/2016	9:00:00 PM	22.7152	0.3729	0.3400	1.6276	2.8773	1.3434	1.8942	65.3618
8/16/2016	9:30:00 PM	21.8901	0.3715	0.3501	1.0442	1.8466	0.8622	1.4130	41.9485
8/16/2016	10:00:00 PM	21.1975	0.3734	0.3577	0.7557	1.3367	0.6241	1.1749	30.3653

8/16/2016	10:30:00 PM	20.6544	0.3854	0.3762	0.4245	0.7511	0.3507	0.9015	17.0625
8/16/2016	11:00:00 PM	20.4843	0.3972	0.3910	0.2744	0.4856	0.2267	0.7776	11.0320
8/16/2016	11:30:00 PM	20.3547	0.3916	0.3834	0.3749	0.6634	0.3097	0.8606	15.0694
8/17/2016	12:00:01 AM	20.1598	0.3927	0.3860	0.3008	0.5323	0.2485	0.7994	12.0919
8/17/2016	12:30:00 AM	19.8403	0.3782	0.3684	0.4619	0.8173	0.3816	0.9324	18.5650
8/17/2016	1:00:00 AM	19.3520	0.3773	0.3787	-0.0665	-0.1177	-0.0550	0.4959	-2.6740
8/17/2016	1:30:00 AM	18.8774	0.3774	0.3847	-0.3392	-0.6006	-0.2804	0.2704	-13.6439
8/17/2016	2:00:00 AM	18.4876	0.3818	0.3865	-0.2172	-0.3846	-0.1795	0.3713	-8.7356
8/17/2016	2:30:00 AM	18.1732	0.3778	0.3877	-0.4544	-0.8047	-0.3757	0.1752	-18.2789
8/17/2016	3:00:00 AM	17.8628	0.3758	0.3873	-0.5344	-0.9464	-0.4419	0.1090	-21.4986
8/17/2016	3:30:00 AM	17.5204	0.3754	0.3931	-0.8131	-1.4406	-0.6726	-0.1217	-32.7243
8/17/2016	4:00:00 AM	17.2604	0.3842	0.3956	-0.5136	-0.9095	-0.4246	0.1262	-20.6606
8/17/2016	4:30:00 AM	17.0399	0.3862	0.3969	-0.4780	-0.8465	-0.3952	0.1556	-19.2289
8/17/2016	5:00:00 AM	16.8608	0.3889	0.4002	-0.5077	-0.8991	-0.4198	0.1311	-20.4249
8/17/2016	5:30:00 AM	16.6175	0.3839	0.3980	-0.6324	-1.1201	-0.5230	0.0279	-25.4448
8/17/2016	6:00:00 AM	16.2934	0.3777	0.3807	-0.1382	-0.2446	-0.1142	0.4366	-5.5566
8/17/2016	6:30:00 AM	15.9479	0.3853	0.4029	-0.7855	-1.3915	-0.6497	-0.0988	-31.6104
8/17/2016	7:00:00 AM	15.8088	0.3910	0.4016	-0.4722	-0.8363	-0.3905	0.1604	-18.9981
8/17/2016	7:30:00 AM	15.9185	0.4203	0.4114	0.3785	0.6698	0.3127	0.8636	15.2153
8/17/2016	8:00:00 AM	16.1921	0.4447	0.3876	2.4180	4.2731	1.9950	2.5458	97.0676
8/17/2016	8:30:00 AM	16.7104	0.4807	0.3635	4.9170	8.6863	4.0555	4.6063	197.3198
8/17/2016	9:00:00 AM	17.1090	0.4896	0.3501	5.8995	10.4246	4.8670	5.4179	236.8065
8/17/2016	9:30:00 AM	17.5529	0.5229	0.3225	8.5056	15.0558	7.0292	7.5800	342.0085
8/17/2016	10:00:00 AM	18.0694	0.5470	0.2866	11.3721	20.2040	9.4328	9.9836	458.9555
8/17/2016	10:30:00 AM	18.6119	0.5819	0.2779	13.0017	23.1666	10.8159	11.3668	526.2538
8/17/2016	11:00:00 AM	19.8255	0.5532	0.2171	16.4542	29.5562	13.7991	14.3500	671.4012
8/17/2016	11:30:00 AM	20.2007	0.6119	0.2393	16.5202	29.6802	13.8570	14.4079	674.2186
8/17/2016	12:00:01 PM	20.8271	0.6238	0.2332	17.3098	31.1680	14.5516	15.1025	708.0150
8/17/2016	12:30:00 PM	21.3762	0.6095	0.2294	17.1933	30.9479	14.4489	14.9997	703.0149

8/17/2016	1:00:00 PM	22.3586	0.5863	0.2017	18.7715	33.9514	15.8511	16.4020	771.2427
8/17/2016	1:30:00 PM	23.0420	0.6561	0.2547	16.6528	29.9292	13.9733	14.5241	679.8749
8/17/2016	2:00:00 PM	23.8216	0.5662	0.1907	19.1471	34.6730	16.1880	16.7389	787.6348
8/17/2016	2:30:00 PM	23.8827	0.5574	0.1837	19.5313	35.4141	16.5340	17.0849	804.4695
8/17/2016	3:00:00 PM	23.9951	0.5609	0.1855	19.4666	35.2890	16.4756	17.0265	801.6288
8/17/2016	3:30:00 PM	24.1916	0.5814	0.2068	18.1849	32.8296	15.3274	15.8782	745.7607
8/17/2016	4:00:00 PM	24.4693	0.5635	0.2036	17.9095	32.3051	15.0825	15.6334	733.8467
8/17/2016	4:30:00 PM	24.2289	0.5685	0.2038	18.0524	32.5771	15.2095	15.7604	740.0252
8/17/2016	5:00:00 PM	24.1051	0.5579	0.2061	17.5202	31.5662	14.7376	15.2884	717.0615
8/17/2016	5:30:00 PM	23.9881	0.5406	0.2147	16.2450	29.1641	13.6160	14.1669	662.4936
8/17/2016	6:00:00 PM	23.8028	0.5237	0.2439	13.4473	23.9820	11.1967	11.7475	544.7785
8/17/2016	6:30:00 PM	23.5773	0.5067	0.2712	10.9996	19.5309	9.1185	9.6694	443.6658
8/17/2016	7:00:00 PM	23.2501	0.4671	0.2876	8.5305	15.1003	7.0500	7.6008	343.0188
8/17/2016	7:30:00 PM	22.7032	0.4345	0.3083	6.0376	10.6692	4.9812	5.5320	242.3617
8/17/2016	8:00:00 PM	22.1869	0.4143	0.3228	4.3932	7.7605	3.6232	4.1741	176.2890
8/17/2016	8:30:00 PM	21.6699	0.3976	0.3387	2.8207	4.9839	2.3269	2.8777	113.2147
8/17/2016	9:00:00 PM	21.0067	0.3710	0.3380	1.6427	2.9040	1.3558	1.9066	65.9665
8/17/2016	9:30:00 PM	20.0906	0.3741	0.3579	0.7748	1.3705	0.6399	1.1907	31.1327
8/17/2016	10:00:00 PM	19.4876	0.3817	0.3661	0.7325	1.2957	0.6049	1.1558	29.4336
8/17/2016	10:30:00 PM	18.9412	0.3875	0.3669	0.9595	1.6970	0.7923	1.3431	38.5484
8/17/2016	11:00:00 PM	18.3748	0.3804	0.3736	0.3195	0.5653	0.2639	0.8148	12.8422
8/17/2016	11:30:00 PM	17.8875	0.3787	0.3781	0.0288	0.0510	0.0238	0.5746	1.1578
8/18/2016	12:00:01 AM	17.4155	0.3844	0.3754	0.4160	0.7362	0.3437	0.8945	16.7225
8/18/2016	12:30:00 AM	16.9418	0.3737	0.3794	-0.2628	-0.4653	-0.2172	0.3336	-10.5703
8/18/2016	1:00:00 AM	16.4159	0.3747	0.3784	-0.1732	-0.3067	-0.1432	0.4076	-6.9675
8/18/2016	1:30:00 AM	15.9048	0.3852	0.3787	0.2995	0.5299	0.2474	0.7983	12.0384
8/18/2016	2:00:00 AM	15.4386	0.3782	0.3815	-0.1547	-0.2739	-0.1279	0.4230	-6.2216
8/18/2016	2:30:00 AM	15.0381	0.3879	0.3980	-0.4525	-0.8013	-0.3741	0.1767	-18.2021
8/18/2016	3:00:00 AM	14.7828	0.3843	0.3970	-0.5692	-1.0081	-0.4707	0.0802	-22.9001

8/18/2016	3:30:00 AM	14.5122	0.3956	0.3982	-0.1179	-0.2086	-0.0974	0.4534	-4.7393
8/18/2016	4:00:00 AM	14.3797	0.3866	0.3975	-0.4907	-0.8690	-0.4057	0.1452	-19.7392
8/18/2016	4:30:00 AM	14.1737	0.3892	0.3994	-0.4555	-0.8067	-0.3766	0.1742	-18.3253
8/18/2016	5:00:00 AM	13.9917	0.3862	0.3990	-0.5735	-1.0158	-0.4742	0.0766	-23.0743
8/18/2016	5:30:00 AM	13.7640	0.3832	0.4000	-0.7551	-1.3376	-0.6245	-0.0737	-30.3858
8/18/2016	6:00:00 AM	13.4900	0.3876	0.3963	-0.3888	-0.6885	-0.3214	0.2294	-15.6392
8/18/2016	6:30:00 AM	13.3258	0.3993	0.4031	-0.1689	-0.2990	-0.1396	0.4112	-6.7931
8/18/2016	7:00:00 AM	13.4098	0.4107	0.4119	-0.0542	-0.0960	-0.0448	0.5060	-2.1797
8/18/2016	7:30:00 AM	13.6372	0.4268	0.4067	0.8495	1.5026	0.7015	1.2524	34.1321
8/18/2016	8:00:00 AM	13.9936	0.4523	0.3796	3.0815	5.4443	2.5418	3.0927	123.6740
8/18/2016	8:30:00 AM	14.3152	0.4681	0.3611	4.5667	8.0672	3.7664	4.3172	183.2549
8/18/2016	9:00:00 AM	14.4460	0.4751	0.3522	5.2647	9.3011	4.3424	4.8933	211.2835
8/18/2016	9:30:00 AM	14.7390	0.4921	0.3309	6.9850	12.3494	5.7656	6.3165	280.5299
8/18/2016	10:00:00 AM	15.1157	0.5286	0.3393	7.7989	13.7963	6.4412	6.9920	313.3990
8/18/2016	10:30:00 AM	15.5255	0.5323	0.3002	10.0795	17.8738	8.3449	8.8957	406.0230
8/18/2016	11:00:00 AM	15.7793	0.5191	0.2775	11.0227	19.5725	9.1380	9.6888	444.6112
8/18/2016	11:30:00 AM	15.9988	0.5403	0.2933	10.7499	19.0804	8.9082	9.4591	433.4322
8/18/2016	12:00:01 PM	16.1375	0.5459	0.2874	11.2883	20.0525	9.3621	9.9129	455.5148
8/18/2016	12:30:00 PM	16.5595	0.5597	0.2786	12.2750	21.8418	10.1974	10.7483	496.1605
8/18/2016	1:00:00 PM	16.8667	0.5628	0.2780	12.4115	22.0902	10.3134	10.8642	501.8021
8/18/2016	1:30:00 PM	17.4195	0.5788	0.2644	13.7818	24.5957	11.4832	12.0340	558.7188
8/18/2016	2:00:00 PM	17.9027	0.5754	0.2484	14.7799	26.4363	12.3425	12.8933	600.5291
8/18/2016	2:30:00 PM	18.2185	0.5909	0.2474	15.3210	27.4399	12.8111	13.3619	623.3268
8/18/2016	3:00:00 PM	18.3261	0.5557	0.2370	14.9944	26.8336	12.5280	13.0788	609.5549
8/18/2016	3:30:00 PM	18.8454	0.5629	0.2346	15.3947	27.5769	12.8750	13.4259	626.4404
8/18/2016	4:00:00 PM	18.9819	0.6003	0.2525	15.2338	27.2780	12.7355	13.2863	619.6488
8/18/2016	4:30:00 PM	18.8176	0.4540	0.2380	11.3624	20.1866	9.4247	9.9755	458.5602
8/18/2016	5:00:00 PM	17.9897	0.4325	0.3000	6.4388	11.3802	5.3132	5.8640	258.5146
8/18/2016	5:30:00 PM	17.6159	0.4820	0.2914	8.8566	15.6826	7.3219	7.8727	356.2483

8/18/2016	6:00:00 PM	17.1264	0.4490	0.3068	6.7005	11.8445	5.5299	6.0808	269.0604
8/18/2016	6:30:00 PM	16.8687	0.4834	0.3054	8.0788	14.2948	6.6739	7.2248	324.7222
8/18/2016	7:00:00 PM	16.5381	0.4131	0.3169	4.6625	8.2364	3.8454	4.3962	187.0993
8/18/2016	7:30:00 PM	15.7479	0.3948	0.3340	2.9409	5.1961	2.4259	2.9768	118.0344
8/18/2016	8:00:00 PM	15.2307	0.4051	0.3618	1.9881	3.5141	1.6406	2.1915	79.8257
8/18/2016	8:30:00 PM	14.7368	0.3973	0.3658	1.4527	2.5685	1.1992	1.7500	58.3455
8/18/2016	9:00:00 PM	14.2867	0.3914	0.3825	0.4042	0.7152	0.3339	0.8847	16.2459
8/18/2016	9:30:00 PM	13.9667	0.3970	0.3809	0.7290	1.2896	0.6021	1.1529	29.2955
8/18/2016	10:00:00 PM	13.6372	0.3820	0.3925	-0.4739	-0.8392	-0.3918	0.1590	-19.0632
8/18/2016	10:30:00 PM	13.3587	0.3840	0.3971	-0.5897	-1.0445	-0.4876	0.0632	-23.7265
8/18/2016	11:00:00 PM	13.1154	0.3869	0.4038	-0.7548	-1.3371	-0.6243	-0.0734	-30.3740
8/18/2016	11:30:00 PM	12.9150	0.3845	0.4092	-1.0939	-1.9387	-0.9051	-0.3543	-44.0391
8/19/2016	12:00:01 AM	12.7638	0.3905	0.4044	-0.6159	-1.0910	-0.5093	0.0415	-24.7826
8/19/2016	12:30:00 AM	12.6510	0.3909	0.4125	-0.9437	-1.6722	-0.7807	-0.2299	-37.9857
8/19/2016	1:00:00 AM	12.5360	0.3839	0.4144	-1.3441	-2.3827	-1.1124	-0.5616	-54.1262
8/19/2016	1:30:00 AM	12.3669	0.3883	0.4111	-1.0073	-1.7850	-0.8334	-0.2825	-40.5477
8/19/2016	2:00:00 AM	12.2494	0.3836	0.4057	-0.9827	-1.7414	-0.8130	-0.2622	-39.5572
8/19/2016	2:30:00 AM	12.1354	0.3955	0.4153	-0.8587	-1.5213	-0.7103	-0.1594	-34.5587
8/19/2016	3:00:00 AM	12.0812	0.3855	0.4127	-1.2003	-2.1274	-0.9932	-0.4424	-48.3260
8/19/2016	3:30:00 AM	12.0137	0.3929	0.4118	-0.8240	-1.4598	-0.6816	-0.1307	-33.1612
8/19/2016	4:00:00 AM	11.9056	0.3894	0.4068	-0.7692	-1.3627	-0.6362	-0.0854	-30.9561
8/19/2016	4:30:00 AM	11.8312	0.3902	0.4149	-1.0792	-1.9125	-0.8929	-0.3421	-43.4456
8/19/2016	5:00:00 AM	11.7531	0.3951	0.4144	-0.8357	-1.4805	-0.6912	-0.1404	-33.6321
8/19/2016	5:30:00 AM	11.6748	0.3877	0.4105	-1.0077	-1.7857	-0.8337	-0.2829	-40.5642
8/19/2016	6:00:00 AM	11.5319	0.3855	0.4090	-1.0391	-1.8414	-0.8597	-0.3089	-41.8299
8/19/2016	6:30:00 AM	11.4056	0.3957	0.4136	-0.7795	-1.3809	-0.6447	-0.0939	-31.3686
8/19/2016	7:00:00 AM	11.3011	0.3851	0.4000	-0.6638	-1.1757	-0.5489	0.0019	-26.7083
8/19/2016	7:30:00 AM	11.2857	0.4107	0.4115	-0.0376	-0.0665	-0.0311	0.5198	-1.5112
8/19/2016	8:00:00 AM	11.4434	0.4232	0.4086	0.6196	1.0961	0.5118	1.0626	24.9001

8/19/2016	8:30:00 AM	11.6274	0.4221	0.4061	0.6797	1.2024	0.5614	1.1122	27.3131
8/19/2016	9:00:00 AM	11.8718	0.4279	0.3881	1.7183	3.0375	1.4182	1.9690	69.0008
8/19/2016	9:30:00 AM	12.0510	0.4494	0.3921	2.3977	4.2371	1.9782	2.5290	96.2500
8/19/2016	10:00:00 AM	12.4710	0.4578	0.3739	3.5629	6.2941	2.9386	3.4894	142.9780
8/19/2016	10:30:00 AM	12.7777	0.4566	0.3697	3.7148	6.5624	3.0638	3.6147	149.0712
8/19/2016	11:00:00 AM	13.3150	0.4899	0.3507	5.8826	10.3946	4.8530	5.4038	236.1248
8/19/2016	11:30:00 AM	13.8367	0.5210	0.3153	8.8367	15.6471	7.3053	7.8561	355.4413
8/19/2016	12:00:01 PM	14.1108	0.5430	0.3082	9.9668	17.6713	8.2503	8.8012	401.4231
8/19/2016	12:30:00 PM	14.5141	0.5653	0.2971	11.3177	20.1056	9.3868	9.9377	456.7204
8/19/2016	1:00:00 PM	14.9623	0.5794	0.2772	12.9708	23.1101	10.7896	11.3404	524.9710
8/19/2016	1:30:00 PM	15.8283	0.6366	0.2846	14.1631	25.2972	11.8107	12.3615	574.6538
8/19/2016	2:00:00 PM	16.2487	0.5906	0.2464	15.3778	27.5455	12.8604	13.4112	625.7265
8/19/2016	2:30:00 PM	16.4353	0.5834	0.2661	13.8111	24.6496	11.5083	12.0592	559.9420
8/19/2016	3:00:00 PM	16.6814	0.6007	0.2496	15.4538	27.6868	12.9263	13.4772	628.9366
8/19/2016	3:30:00 PM	17.3277	0.5782	0.2450	15.1094	27.0470	12.6276	13.1785	614.4014
8/19/2016	4:00:00 PM	17.5244	0.5443	0.2441	14.1104	25.2003	11.7654	12.3163	572.4518
8/19/2016	4:30:00 PM	17.7245	0.5497	0.2266	15.5949	27.9496	13.0490	13.5999	634.9050
8/19/2016	5:00:00 PM	17.5854	0.5252	0.2502	13.0450	23.2457	10.8529	11.4037	528.0511
8/19/2016	5:30:00 PM	17.4938	0.5212	0.2570	12.4443	22.1498	10.3412	10.8921	503.1565
8/19/2016	6:00:00 PM	17.4195	0.5121	0.2715	11.1647	19.8290	9.2577	9.8086	450.4375
8/19/2016	6:30:00 PM	17.0977	0.4739	0.2996	8.0693	14.2778	6.6660	7.2168	324.3362
8/19/2016	7:00:00 PM	16.9746	0.4827	0.3009	8.3117	14.7100	6.8678	7.4186	334.1540
8/19/2016	7:30:00 PM	16.6215	0.4403	0.3128	6.0147	10.6286	4.9623	5.5131	241.4405
8/19/2016	8:00:00 PM	15.9381	0.4081	0.3268	3.9095	6.9061	3.2243	3.7751	156.8796
8/19/2016	8:30:00 PM	15.1672	0.3821	0.3433	1.8818	3.3263	1.5530	2.1038	75.5617
8/19/2016	9:00:00 PM	14.3551	0.3797	0.3601	0.9357	1.6549	0.7726	1.3235	37.5926
8/19/2016	9:30:00 PM	13.5429	0.3631	0.3622	0.0438	0.0776	0.0362	0.5871	1.7625
8/19/2016	10:00:00 PM	12.7712	0.3656	0.3657	-0.0032	-0.0057	-0.0027	0.5482	-0.1303
8/19/2016	10:30:00 PM	12.0210	0.3639	0.3767	-0.6058	-1.0730	-0.5010	0.0499	-24.3744

8/19/2016	11:00:00 PM	11.2207	0.3643	0.3791	-0.7014	-1.2424	-0.5800	-0.0292	-28.2221
8/19/2016	11:30:00 PM	10.5129	0.3634	0.3842	-0.9783	-1.7336	-0.8094	-0.2585	-39.3804

APPENDIX H. RAW DENDROMETER DATA

Date & Time	Raw Data µm	Vi Sensor Movement mm	Ri (mm)	Ci mm
8/7/16 12:00 AM	6,673.62	6.674	54.942	345.210
8/7/16 12:10 AM	6,676.14	6.676	54.943	345.215
8/7/16 12:20 AM	6,677.94	6.678	54.943	345.219
8/7/16 12:30 AM	6,681.60	6.682	54.944	345.226
8/7/16 12:40 AM	6,684.60	6.685	54.945	345.232
8/7/16 12:50 AM	6,688.92	6.689	54.947	345.240
8/7/16 1:00 AM	6,694.20	6.694	54.948	345.251
8/7/16 1:10 AM	6,699.48	6.699	54.950	345.262
8/7/16 1:20 AM	6,704.52	6.705	54.952	345.272
8/7/16 1:30 AM	6,708.84	6.709	54.953	345.281
8/7/16 1:40 AM	6,712.98	6.713	54.955	345.289
8/7/16 1:50 AM	6,716.40	6.716	54.956	345.296
8/7/16 2:00 AM	6,720.54	6.721	54.957	345.305
8/7/16 2:10 AM	6,723.96	6.724	54.958	345.312
8/7/16 2:20 AM	6,726.96	6.727	54.959	345.318
8/7/16 2:30 AM	6,729.48	6.729	54.960	345.323
8/7/16 2:40 AM	6,732.18	6.732	54.961	345.329
8/7/16 2:50 AM	6,734.52	6.735	54.962	345.334
8/7/16 3:00 AM	6,736.80	6.737	54.962	345.338
8/7/16 3:10 AM	6,738.60	6.739	54.963	345.342
8/7/16 3:20 AM	6,741.36	6.741	54.964	345.347
8/7/16 3:30 AM	6,744.54	6.745	54.965	345.354
8/7/16 3:40 AM	6,746.88	6.747	54.966	345.359
8/7/16 3:50 AM	6,749.16	6.749	54.966	345.363
8/7/16 4:00 AM	6,751.86	6.752	54.967	345.369
8/7/16 4:10 AM	6,754.38	6.754	54.968	345.374
8/7/16 4:20 AM	6,757.14	6.757	54.969	345.379
8/7/16 4:30 AM	6,759.66	6.760	54.970	345.385
8/7/16 4:40 AM	6,762.42	6.762	54.971	345.390
8/7/16 4:50 AM	6,764.46	6.764	54.971	345.394
8/7/16 5:00 AM	6,767.22	6.767	54.972	345.400
8/7/16 5:10 AM	6,769.74	6.770	54.973	345.405
8/7/16 5:20 AM	6,771.36	6.771	54.974	345.409
8/7/16 5:30 AM	6,773.88	6.774	54.974	345.414
8/7/16 5:40 AM	6,777.06	6.777	54.975	345.420
8/7/16 5:50 AM	6,778.92	6.779	54.976	345.424
8/7/16 6:00 AM	6,781.62	6.782	54.977	345.429
8/7/16 6:10 AM	6,784.62	6.785	54.978	345.435
8/7/16 6:20 AM	6,788.04	6.788	54.979	345.442
8/7/16 6:30 AM	6,790.56	6.791	54.980	345.447
8/7/16 6:40 AM	6,793.80	6.794	54.981	345.454
8/7/16 6:50 AM	6,797.64	6.798	54.982	345.462
8/7/16 7:00 AM	6,800.64	6.801	54.983	345.468

8/7/16 7:10 AM	6,805.44	6.805	54.984	345.477
8/7/16 7:20 AM	6,809.10	6.809	54.986	345.485
8/7/16 7:30 AM	6,811.86	6.812	54.987	345.491
8/7/16 7:40 AM	6,815.76	6.816	54.988	345.498
8/7/16 7:50 AM	6,819.18	6.819	54.989	345.505
8/7/16 8:00 AM	6,823.98	6.824	54.990	345.515
8/7/16 8:10 AM	6,826.26	6.826	54.991	345.520
8/7/16 8:20 AM	6,828.54	6.829	54.992	345.525
8/7/16 8:30 AM	6,832.02	6.832	54.993	345.532
8/7/16 8:40 AM	6,833.16	6.833	54.994	345.534
8/7/16 8:50 AM	6,836.82	6.837	54.995	345.541
8/7/16 9:00 AM	6,840.90	6.841	54.996	345.549
8/7/16 9:10 AM	6,841.14	6.841	54.996	345.551
8/7/16 9:20 AM	6,841.14	6.841	54.996	345.551
8/7/16 9:30 AM	6,841.14	6.841	54.996	345.551
8/7/16 9:40 AM	6,841.62	6.842	54.996	345.552
8/7/16 9:50 AM	6,841.62	6.842	54.996	345.552
8/7/16 10:00 AM	6,841.86	6.842	54.996	345.552
8/7/16 10:10 AM	6,842.04	6.842	54.996	345.553
8/7/16 10:20 AM	6,840.72	6.841	54.996	345.550
8/7/16 10:30 AM	6,837.06	6.837	54.995	345.543
8/7/16 10:40 AM	6,829.68	6.830	54.993	345.529
8/7/16 10:50 AM	6,825.84	6.826	54.991	345.520
8/7/16 11:00 AM	6,820.32	6.820	54.990	345.509
8/7/16 11:10 AM	6,813.48	6.813	54.987	345.496
8/7/16 11:20 AM	6,806.58	6.807	54.985	345.482
8/7/16 11:30 AM	6,796.98	6.797	54.982	345.463
8/7/16 11:40 AM	6,786.24	6.786	54.979	345.441
8/7/16 11:50 AM	6,766.74	6.767	54.973	345.403
8/7/16 12:00 PM	6,755.76	6.756	54.969	345.379
8/7/16 12:10 PM	6,738.60	6.739	54.963	345.345
8/7/16 12:20 PM	6,718.92	6.719	54.957	345.306
8/7/16 12:30 PM	6,705.90	6.706	54.953	345.278
8/7/16 12:40 PM	6,685.74	6.686	54.946	345.238
8/7/16 12:50 PM	6,671.10	6.671	54.942	345.208
8/7/16 1:00 PM	6,644.52	6.645	54.933	345.156
8/7/16 1:10 PM	6,628.74	6.629	54.928	345.122
8/7/16 1:20 PM	6,605.88	6.606	54.921	345.077
8/7/16 1:30 PM	6,583.44	6.583	54.913	345.031
8/7/16 1:40 PM	6,571.74	6.572	54.909	345.005
8/7/16 1:50 PM	6,539.94	6.540	54.900	344.944
8/7/16 2:00 PM	6,528.24	6.528	54.895	344.917
8/7/16 2:10 PM	6,527.34	6.527	54.895	344.913
8/7/16 2:20 PM	6,527.34	6.527	54.895	344.913
8/7/16 2:30 PM	6,522.78	6.523	54.893	344.904
8/7/16 2:40 PM	6,497.58	6.498	54.886	344.857
8/7/16 2:50 PM	6,468.78	6.469	54.876	344.799
8/7/16 3:00 PM	6,457.08	6.457	54.872	344.772

8/7/16 3:10 PM	6,451.80	6.452	54.870	344.760
8/7/16 3:20 PM	6,446.76	6.447	54.869	344.750
8/7/16 3:30 PM	6,428.46	6.428	54.863	344.715
8/7/16 3:40 PM	6,419.34	6.419	54.860	344.695
8/7/16 3:50 PM	6,412.02	6.412	54.857	344.679
8/7/16 4:00 PM	6,405.84	6.406	54.855	344.667
8/7/16 4:10 PM	6,399.42	6.399	54.853	344.654
8/7/16 4:20 PM	6,393.90	6.394	54.852	344.642
8/7/16 4:30 PM	6,391.14	6.391	54.851	344.636
8/7/16 4:40 PM	6,380.40	6.380	54.847	344.616
8/7/16 4:50 PM	6,373.32	6.373	54.845	344.601
8/7/16 5:00 PM	6,371.46	6.371	54.844	344.596
8/7/16 5:10 PM	6,371.46	6.371	54.844	344.596
8/7/16 5:20 PM	6,380.64	6.381	54.847	344.613
8/7/16 5:30 PM	6,396.42	6.396	54.852	344.643
8/7/16 5:40 PM	6,407.64	6.408	54.855	344.667
8/7/16 5:50 PM	6,409.68	6.410	54.856	344.673
8/7/16 6:00 PM	6,410.40	6.410	54.857	344.675
8/7/16 6:10 PM	6,409.50	6.410	54.856	344.673
8/7/16 6:20 PM	6,407.88	6.408	54.856	344.670
8/7/16 6:30 PM	6,406.50	6.407	54.856	344.667
8/7/16 6:40 PM	6,403.74	6.404	54.855	344.662
8/7/16 6:50 PM	6,399.42	6.399	54.853	344.653
8/7/16 7:00 PM	6,399.66	6.400	54.853	344.653
8/7/16 7:10 PM	6,403.74	6.404	54.854	344.660
8/7/16 7:20 PM	6,409.92	6.410	54.856	344.673
8/7/16 7:30 PM	6,417.00	6.417	54.859	344.687
8/7/16 7:40 PM	6,424.80	6.425	54.861	344.703
8/7/16 7:50 PM	6,430.98	6.431	54.863	344.715
8/7/16 8:00 PM	6,435.12	6.435	54.865	344.724
8/7/16 8:10 PM	6,439.68	6.440	54.866	344.733
8/7/16 8:20 PM	6,444.96	6.445	54.868	344.744
8/7/16 8:30 PM	6,448.62	6.449	54.869	344.752
8/7/16 8:40 PM	6,452.76	6.453	54.870	344.760
8/7/16 8:50 PM	6,457.80	6.458	54.872	344.770
8/7/16 9:00 PM	6,460.74	6.461	54.873	344.777
8/7/16 9:10 PM	6,465.78	6.466	54.875	344.786
8/7/16 9:20 PM	6,469.20	6.469	54.876	344.794
8/7/16 9:30 PM	6,475.14	6.475	54.878	344.805
8/7/16 9:40 PM	6,480.90	6.481	54.879	344.817
8/7/16 9:50 PM	6,483.66	6.484	54.880	344.823
8/7/16 10:00 PM	6,490.74	6.491	54.883	344.837
8/7/16 10:10 PM	6,503.34	6.503	54.886	344.862
8/7/16 10:20 PM	6,517.08	6.517	54.891	344.889
8/7/16 10:30 PM	6,525.30	6.525	54.894	344.907
8/7/16 10:40 PM	6,530.34	6.530	54.895	344.918
8/7/16 10:50 PM	6,543.36	6.543	54.899	344.943
8/7/16 11:00 PM	6,555.48	6.555	54.903	344.968

8/7/16 11:10 PM	6,565.80	6.566	54.907	344.989
8/7/16 11:20 PM	6,575.64	6.576	54.910	345.009
8/7/16 11:30 PM	6,584.82	6.585	54.913	345.028
8/7/16 11:40 PM	6,593.70	6.594	54.916	345.046
8/7/16 11:50 PM	6,600.36	6.600	54.918	345.060
9/7/16 12:00 AM	6,607.44	6.607	54.920	345.074
9/7/16 12:10 AM	6,613.44	6.613	54.922	345.087
9/7/16 12:20 AM	6,620.04	6.620	54.924	345.100
9/7/16 12:30 AM	6,626.70	6.627	54.927	345.113
9/7/16 12:40 AM	6,633.12	6.633	54.929	345.127
9/7/16 12:50 AM	6,639.30	6.639	54.931	345.139
9/7/16 1:00 AM	6,645.48	6.645	54.933	345.152
9/7/16 1:10 AM	6,650.70	6.651	54.934	345.163
9/7/16 1:20 AM	6,655.98	6.656	54.936	345.173
9/7/16 1:30 AM	6,661.02	6.661	54.938	345.184
9/7/16 1:40 AM	6,666.96	6.667	54.940	345.196
9/7/16 1:50 AM	6,672.90	6.673	54.942	345.208
9/7/16 2:00 AM	6,677.70	6.678	54.943	345.218
9/7/16 2:10 AM	6,684.60	6.685	54.945	345.231
9/7/16 2:20 AM	6,688.74	6.689	54.947	345.240
9/7/16 2:30 AM	6,693.06	6.693	54.948	345.249
9/7/16 2:40 AM	6,696.24	6.696	54.949	345.256
9/7/16 2:50 AM	6,700.86	6.701	54.951	345.265
9/7/16 3:00 AM	6,705.42	6.705	54.952	345.274
9/7/16 3:10 AM	6,708.42	6.708	54.953	345.280
9/7/16 3:20 AM	6,711.36	6.711	54.954	345.286
9/7/16 3:30 AM	6,714.12	6.714	54.955	345.292
9/7/16 3:40 AM	6,717.30	6.717	54.956	345.298
9/7/16 3:50 AM	6,720.06	6.720	54.957	345.304
9/7/16 4:00 AM	6,723.06	6.723	54.958	345.310
9/7/16 4:10 AM	6,727.38	6.727	54.959	345.319
9/7/16 4:20 AM	6,730.62	6.731	54.960	345.325
9/7/16 4:30 AM	6,733.56	6.734	54.961	345.331
9/7/16 4:40 AM	6,737.04	6.737	54.962	345.338
9/7/16 4:50 AM	6,740.46	6.740	54.963	345.345
9/7/16 5:00 AM	6,743.88	6.744	54.965	345.352
9/7/16 5:10 AM	6,747.54	6.748	54.966	345.360
9/7/16 5:20 AM	6,750.72	6.751	54.967	345.366
9/7/16 5:30 AM	6,753.48	6.753	54.968	345.372
9/7/16 5:40 AM	6,756.72	6.757	54.969	345.379
9/7/16 5:50 AM	6,759.90	6.760	54.970	345.385
9/7/16 6:00 AM	6,763.08	6.763	54.971	345.391
9/7/16 6:10 AM	6,767.22	6.767	54.972	345.400
9/7/16 6:20 AM	6,770.40	6.770	54.973	345.406
9/7/16 6:30 AM	6,773.40	6.773	54.974	345.412
9/7/16 6:40 AM	6,777.30	6.777	54.975	345.420
9/7/16 6:50 AM	6,780.72	6.781	54.977	345.427
9/7/16 7:00 AM	6,783.72	6.784	54.977	345.433

9/7/16 7:10 AM	6,787.62	6.788	54.979	345.441
9/7/16 7:20 AM	6,790.32	6.790	54.980	345.447
9/7/16 7:30 AM	6,794.22	6.794	54.981	345.455
9/7/16 7:40 AM	6,796.98	6.797	54.982	345.460
9/7/16 7:50 AM	6,799.98	6.800	54.983	345.467
9/7/16 8:00 AM	6,802.50	6.803	54.984	345.472
9/7/16 8:10 AM	6,805.68	6.806	54.985	345.478
9/7/16 8:20 AM	6,808.20	6.808	54.985	345.483
9/7/16 8:30 AM	6,810.96	6.811	54.986	345.489
9/7/16 8:40 AM	6,814.62	6.815	54.987	345.496
9/7/16 8:50 AM	6,817.56	6.818	54.988	345.502
9/7/16 9:00 AM	6,820.32	6.820	54.989	345.508
9/7/16 9:10 AM	6,823.50	6.824	54.990	345.514
9/7/16 9:20 AM	6,827.88	6.828	54.992	345.523
9/7/16 9:30 AM	6,832.92	6.833	54.993	345.533
9/7/16 9:40 AM	6,834.54	6.835	54.994	345.537
9/7/16 9:50 AM	6,836.10	6.836	54.994	345.540
9/7/16 10:00 AM	6,836.10	6.836	54.995	345.540
9/7/16 10:10 AM	6,835.86	6.836	54.994	345.540
9/7/16 10:20 AM	6,835.86	6.836	54.994	345.540
9/7/16 10:30 AM	6,835.68	6.836	54.994	345.540
9/7/16 10:40 AM	6,835.44	6.835	54.994	345.539
9/7/16 10:50 AM	6,833.40	6.833	54.994	345.535
9/7/16 11:00 AM	6,829.26	6.829	54.992	345.527
9/7/16 11:10 AM	6,827.64	6.828	54.992	345.524
9/7/16 11:20 AM	6,824.46	6.824	54.991	345.517
9/7/16 11:30 AM	6,822.18	6.822	54.990	345.513
9/7/16 11:40 AM	6,819.84	6.820	54.989	345.508
9/7/16 11:50 AM	6,816.66	6.817	54.988	345.502
9/7/16 12:00 PM	6,811.62	6.812	54.987	345.492
9/7/16 12:10 PM	6,806.58	6.807	54.985	345.481
9/7/16 12:20 PM	6,804.54	6.805	54.984	345.477
9/7/16 12:30 PM	6,800.64	6.801	54.983	345.469
9/7/16 12:40 PM	6,795.60	6.796	54.982	345.459
9/7/16 12:50 PM	6,783.72	6.784	54.978	345.436
9/7/16 1:00 PM	6,775.26	6.775	54.975	345.418
9/7/16 1:10 PM	6,762.66	6.763	54.971	345.394
9/7/16 1:20 PM	6,751.68	6.752	54.968	345.371
9/7/16 1:30 PM	6,733.32	6.733	54.962	345.335
9/7/16 1:40 PM	6,718.92	6.719	54.957	345.305
9/7/16 1:50 PM	6,704.28	6.704	54.952	345.275
9/7/16 2:00 PM	6,687.36	6.687	54.947	345.241
9/7/16 2:10 PM	6,658.26	6.658	54.938	345.184
9/7/16 2:20 PM	6,629.46	6.629	54.929	345.126
9/7/16 2:30 PM	6,600.36	6.600	54.919	345.067
9/7/16 2:40 PM	6,568.80	6.569	54.909	345.003
9/7/16 2:50 PM	6,541.80	6.542	54.900	344.947
9/7/16 3:00 PM	6,517.08	6.517	54.892	344.896

9/7/16 3:10 PM	6,490.98	6.491	54.884	344.844
9/7/16 3:20 PM	6,478.38	6.478	54.879	344.816
9/7/16 3:30 PM	6,458.94	6.459	54.873	344.777
9/7/16 3:40 PM	6,448.38	6.448	54.869	344.754
9/7/16 3:50 PM	6,426.18	6.426	54.862	344.711
9/7/16 4:00 PM	6,415.68	6.416	54.859	344.688
9/7/16 4:10 PM	6,399.66	6.400	54.854	344.656
9/7/16 4:20 PM	6,400.98	6.401	54.854	344.656
9/7/16 4:30 PM	6,389.58	6.390	54.850	344.634
9/7/16 4:40 PM	6,382.68	6.383	54.848	344.620
9/7/16 4:50 PM	6,377.64	6.378	54.846	344.609
9/7/16 5:00 PM	6,381.54	6.382	54.847	344.615
9/7/16 5:10 PM	6,380.16	6.380	54.847	344.613
9/7/16 5:20 PM	6,370.32	6.370	54.844	344.595
9/7/16 5:30 PM	6,369.90	6.370	54.844	344.593
9/7/16 5:40 PM	6,366.90	6.367	54.843	344.587
9/7/16 5:50 PM	6,363.72	6.364	54.842	344.580
9/7/16 6:00 PM	6,366.00	6.366	54.842	344.584
9/7/16 6:10 PM	6,374.46	6.374	54.845	344.600
9/7/16 6:20 PM	6,376.08	6.376	54.846	344.604
9/7/16 6:30 PM	6,376.26	6.376	54.846	344.605
9/7/16 6:40 PM	6,380.16	6.380	54.847	344.612
9/7/16 6:50 PM	6,383.40	6.383	54.848	344.619
9/7/16 7:00 PM	6,383.40	6.383	54.848	344.620
9/7/16 7:10 PM	6,386.58	6.387	54.849	344.626
9/7/16 7:20 PM	6,386.58	6.387	54.849	344.626
9/7/16 7:30 PM	6,387.48	6.387	54.849	344.628
9/7/16 7:40 PM	6,391.62	6.392	54.851	344.636
9/7/16 7:50 PM	6,391.62	6.392	54.851	344.636
9/7/16 8:00 PM	6,396.90	6.397	54.852	344.646
9/7/16 8:10 PM	6,400.80	6.401	54.854	344.654
9/7/16 8:20 PM	6,406.50	6.407	54.855	344.666
9/7/16 8:30 PM	6,412.02	6.412	54.857	344.677
9/7/16 8:40 PM	6,418.62	6.419	54.859	344.690
9/7/16 8:50 PM	6,423.90	6.424	54.861	344.701
9/7/16 9:00 PM	6,430.08	6.430	54.863	344.714
9/7/16 9:10 PM	6,435.36	6.435	54.865	344.724
9/7/16 9:20 PM	6,440.82	6.441	54.866	344.736
9/7/16 9:30 PM	6,447.48	6.447	54.869	344.749
9/7/16 9:40 PM	6,452.28	6.452	54.870	344.759
9/7/16 9:50 PM	6,458.22	6.458	54.872	344.771
9/7/16 10:00 PM	6,463.02	6.463	54.874	344.781
9/7/16 10:10 PM	6,468.30	6.468	54.875	344.792
9/7/16 10:20 PM	6,474.48	6.474	54.877	344.804
9/7/16 10:30 PM	6,479.52	6.480	54.879	344.814
9/7/16 10:40 PM	6,483.42	6.483	54.880	344.823
9/7/16 10:50 PM	6,487.98	6.488	54.882	344.832
9/7/16 11:00 PM	6,493.50	6.494	54.883	344.843

9/7/16 11:10 PM	6,498.72	6.499	54.885	344.853
9/7/16 11:20 PM	6,503.52	6.504	54.887	344.863
9/7/16 11:30 PM	6,507.42	6.507	54.888	344.871
9/7/16 11:40 PM	6,512.46	6.512	54.890	344.881
9/7/16 11:50 PM	6,517.50	6.518	54.891	344.892
10/7/16 12:00 AM	6,520.50	6.521	54.892	344.898
10/7/16 12:10 AM	6,523.26	6.523	54.893	344.904
10/7/16 12:20 AM	6,526.68	6.527	54.894	344.911
10/7/16 12:30 AM	6,530.58	6.531	54.896	344.919
10/7/16 12:40 AM	6,533.28	6.533	54.896	344.924
10/7/16 12:50 AM	6,537.18	6.537	54.898	344.932
10/7/16 1:00 AM	6,539.94	6.540	54.899	344.938
10/7/16 1:10 AM	6,543.12	6.543	54.900	344.944
10/7/16 1:20 AM	6,545.46	6.545	54.900	344.949
10/7/16 1:30 AM	6,548.40	6.548	54.901	344.955
10/7/16 1:40 AM	6,552.06	6.552	54.902	344.962
10/7/16 1:50 AM	6,557.58	6.558	54.904	344.973
10/7/16 2:00 AM	6,561.24	6.561	54.905	344.981
10/7/16 2:10 AM	6,564.90	6.565	54.907	344.988
10/7/16 2:20 AM	6,568.56	6.569	54.908	344.996
10/7/16 2:30 AM	6,572.22	6.572	54.909	345.003
10/7/16 2:40 AM	6,577.50	6.578	54.911	345.014
10/7/16 2:50 AM	6,580.92	6.581	54.912	345.021
10/7/16 3:00 AM	6,585.96	6.586	54.913	345.031
10/7/16 3:10 AM	6,591.00	6.591	54.915	345.041
10/7/16 3:20 AM	6,594.90	6.595	54.916	345.049
10/7/16 3:30 AM	6,599.46	6.599	54.918	345.058
10/7/16 3:40 AM	6,602.88	6.603	54.919	345.066
10/7/16 3:50 AM	6,606.54	6.607	54.920	345.073
10/7/16 4:00 AM	6,609.30	6.609	54.921	345.079
10/7/16 4:10 AM	6,612.24	6.612	54.922	345.085
10/7/16 4:20 AM	6,615.24	6.615	54.923	345.091
10/7/16 4:30 AM	6,618.24	6.618	54.924	345.097
10/7/16 4:40 AM	6,620.52	6.621	54.925	345.102
10/7/16 4:50 AM	6,623.04	6.623	54.926	345.107
10/7/16 5:00 AM	6,625.80	6.626	54.926	345.112
10/7/16 5:10 AM	6,629.22	6.629	54.927	345.119
10/7/16 5:20 AM	6,631.74	6.632	54.928	345.125
10/7/16 5:30 AM	6,634.26	6.634	54.929	345.130
10/7/16 5:40 AM	6,636.30	6.636	54.930	345.134
10/7/16 5:50 AM	6,639.06	6.639	54.931	345.139
10/7/16 6:00 AM	6,641.10	6.641	54.931	345.144
10/7/16 6:10 AM	6,644.76	6.645	54.933	345.151
10/7/16 6:20 AM	6,647.04	6.647	54.933	345.156
10/7/16 6:30 AM	6,648.66	6.649	54.934	345.159
10/7/16 6:40 AM	6,652.08	6.652	54.935	345.166
10/7/16 6:50 AM	6,654.60	6.655	54.936	345.171
10/7/16 7:00 AM	6,656.46	6.656	54.936	345.175

10/7/16 7:10 AM	6,656.70	6.657	54.936	345.176
10/7/16 7:20 AM	6,656.88	6.657	54.937	345.176
10/7/16 7:30 AM	6,656.70	6.657	54.936	345.176
10/7/16 7:40 AM	6,656.70	6.657	54.936	345.176
10/7/16 7:50 AM	6,656.70	6.657	54.936	345.176
10/7/16 8:00 AM	6,656.70	6.657	54.936	345.176
10/7/16 8:10 AM	6,656.70	6.657	54.936	345.176
10/7/16 8:20 AM	6,656.70	6.657	54.936	345.176
10/7/16 8:30 AM	6,656.70	6.657	54.936	345.176
10/7/16 8:40 AM	6,655.74	6.656	54.936	345.174
10/7/16 8:50 AM	6,650.94	6.651	54.935	345.165
10/7/16 9:00 AM	6,648.90	6.649	54.934	345.160
10/7/16 9:10 AM	6,648.18	6.648	54.934	345.159
10/7/16 9:20 AM	6,648.18	6.648	54.934	345.158
10/7/16 9:30 AM	6,645.00	6.645	54.933	345.153
10/7/16 9:40 AM	6,642.24	6.642	54.932	345.147
10/7/16 9:50 AM	6,639.48	6.639	54.931	345.141
10/7/16 10:00 AM	6,635.40	6.635	54.930	345.133
10/7/16 10:10 AM	6,633.12	6.633	54.929	345.128
10/7/16 10:20 AM	6,631.26	6.631	54.928	345.124
10/7/16 10:30 AM	6,628.50	6.629	54.927	345.119
10/7/16 10:40 AM	6,625.08	6.625	54.926	345.112
10/7/16 10:50 AM	6,623.04	6.623	54.926	345.108
10/7/16 11:00 AM	6,620.04	6.620	54.925	345.102
10/7/16 11:10 AM	6,616.38	6.616	54.924	345.094
10/7/16 11:20 AM	6,610.68	6.611	54.922	345.083
10/7/16 11:30 AM	6,608.16	6.608	54.921	345.078
10/7/16 11:40 AM	6,602.64	6.603	54.919	345.067
10/7/16 11:50 AM	6,587.76	6.588	54.915	345.038
10/7/16 12:00 PM	6,577.68	6.578	54.911	345.017
10/7/16 12:10 PM	6,574.50	6.575	54.910	345.009
10/7/16 12:20 PM	6,559.86	6.560	54.906	344.981
10/7/16 12:30 PM	6,552.78	6.553	54.903	344.966
10/7/16 12:40 PM	6,541.56	6.542	54.900	344.944
10/7/16 12:50 PM	6,539.70	6.540	54.899	344.938
10/7/16 1:00 PM	6,526.20	6.526	54.895	344.913
10/7/16 1:10 PM	6,514.56	6.515	54.891	344.889
10/7/16 1:20 PM	6,511.56	6.512	54.890	344.881
10/7/16 1:30 PM	6,493.92	6.494	54.884	344.848
10/7/16 1:40 PM	6,486.84	6.487	54.882	344.832
10/7/16 1:50 PM	6,480.00	6.480	54.879	344.818
10/7/16 2:00 PM	6,462.60	6.463	54.874	344.784
10/7/16 2:10 PM	6,449.76	6.450	54.870	344.757
10/7/16 2:20 PM	6,438.78	6.439	54.866	344.735
10/7/16 2:30 PM	6,431.70	6.432	54.864	344.719
10/7/16 2:40 PM	6,428.70	6.429	54.863	344.713
10/7/16 2:50 PM	6,427.80	6.428	54.862	344.710
10/7/16 3:00 PM	6,427.80	6.428	54.862	344.710

10/7/16 3:10 PM	6,428.22	6.428	54.862	344.711
10/7/16 3:20 PM	6,430.56	6.431	54.863	344.715
10/7/16 3:30 PM	6,431.46	6.431	54.864	344.717
10/7/16 3:40 PM	6,431.46	6.431	54.864	344.718
10/7/16 3:50 PM	6,431.46	6.431	54.864	344.718
10/7/16 4:00 PM	6,432.12	6.432	54.864	344.719
10/7/16 4:10 PM	6,432.12	6.432	54.864	344.719
10/7/16 4:20 PM	6,411.06	6.411	54.858	344.680
10/7/16 4:30 PM	6,407.16	6.407	54.856	344.669
10/7/16 4:40 PM	6,406.98	6.407	54.856	344.668
10/7/16 4:50 PM	6,406.26	6.406	54.855	344.666
10/7/16 5:00 PM	6,406.26	6.406	54.855	344.666
10/7/16 5:10 PM	6,406.26	6.406	54.855	344.666
10/7/16 5:20 PM	6,407.16	6.407	54.856	344.668
10/7/16 5:30 PM	6,410.82	6.411	54.857	344.675
10/7/16 5:40 PM	6,413.82	6.414	54.858	344.681
10/7/16 5:50 PM	6,419.76	6.420	54.860	344.693
10/7/16 6:00 PM	6,420.90	6.421	54.860	344.696
10/7/16 6:10 PM	6,420.90	6.421	54.860	344.696
10/7/16 6:20 PM	6,420.72	6.421	54.860	344.696
10/7/16 6:30 PM	6,419.76	6.420	54.860	344.694
10/7/16 6:40 PM	6,417.72	6.418	54.859	344.690
10/7/16 6:50 PM	6,417.00	6.417	54.859	344.688
10/7/16 7:00 PM	6,417.00	6.417	54.859	344.688
10/7/16 7:10 PM	6,417.00	6.417	54.859	344.688
10/7/16 7:20 PM	6,417.24	6.417	54.859	344.689
10/7/16 7:30 PM	6,418.38	6.418	54.859	344.691
10/7/16 7:40 PM	6,419.52	6.420	54.860	344.693
10/7/16 7:50 PM	6,421.14	6.421	54.860	344.696
10/7/16 8:00 PM	6,424.80	6.425	54.861	344.703
10/7/16 8:10 PM	6,427.32	6.427	54.862	344.709
10/7/16 8:20 PM	6,430.98	6.431	54.863	344.716
10/7/16 8:30 PM	6,434.40	6.434	54.864	344.723
10/7/16 8:40 PM	6,439.26	6.439	54.866	344.733
10/7/16 8:50 PM	6,444.06	6.444	54.867	344.742
10/7/16 9:00 PM	6,449.10	6.449	54.869	344.753
10/7/16 9:10 PM	6,452.94	6.453	54.870	344.761
10/7/16 9:20 PM	6,457.56	6.458	54.872	344.770
10/7/16 9:30 PM	6,461.64	6.462	54.873	344.778
10/7/16 9:40 PM	6,466.68	6.467	54.875	344.788
10/7/16 9:50 PM	6,469.92	6.470	54.876	344.795
10/7/16 10:00 PM	6,474.96	6.475	54.877	344.805
10/7/16 10:10 PM	6,479.04	6.479	54.879	344.814
10/7/16 10:20 PM	6,482.70	6.483	54.880	344.821
10/7/16 10:30 PM	6,485.94	6.486	54.881	344.828
10/7/16 10:40 PM	6,489.84	6.490	54.882	344.836
10/7/16 10:50 PM	6,493.92	6.494	54.884	344.844
10/7/16 11:00 PM	6,498.06	6.498	54.885	344.852

10/7/16 11:10 PM	6,501.96	6.502	54.886	344.860
10/7/16 11:20 PM	6,505.86	6.506	54.888	344.868
10/7/16 11:30 PM	6,509.52	6.510	54.889	344.876
10/7/16 11:40 PM	6,513.36	6.513	54.890	344.883
10/7/16 11:50 PM	6,517.26	6.517	54.891	344.891
11/7/16 12:00 AM	6,520.50	6.521	54.892	344.898
11/7/16 12:10 AM	6,524.82	6.525	54.894	344.907
11/7/16 12:20 AM	6,528.06	6.528	54.895	344.913
11/7/16 12:30 AM	6,531.90	6.532	54.896	344.921
11/7/16 12:40 AM	6,535.14	6.535	54.897	344.928
11/7/16 12:50 AM	6,538.32	6.538	54.898	344.934
11/7/16 1:00 AM	6,541.80	6.542	54.899	344.941
11/7/16 1:10 AM	6,545.46	6.545	54.900	344.949
11/7/16 1:20 AM	6,549.30	6.549	54.902	344.957
11/7/16 1:30 AM	6,553.20	6.553	54.903	344.965
11/7/16 1:40 AM	6,557.10	6.557	54.904	344.972
11/7/16 1:50 AM	6,560.52	6.561	54.905	344.979
11/7/16 2:00 AM	6,565.14	6.565	54.907	344.989
11/7/16 2:10 AM	6,573.12	6.573	54.909	345.004
11/7/16 2:20 AM	6,581.34	6.581	54.912	345.021
11/7/16 2:30 AM	6,591.90	6.592	54.915	345.042
11/7/16 2:40 AM	6,604.26	6.604	54.919	345.067
11/7/16 2:50 AM	6,614.34	6.614	54.922	345.088
11/7/16 3:00 AM	6,623.28	6.623	54.925	345.106
11/7/16 3:10 AM	6,633.12	6.633	54.929	345.126
11/7/16 3:20 AM	6,643.38	6.643	54.932	345.147
11/7/16 3:30 AM	6,650.70	6.651	54.934	345.162
11/7/16 3:40 AM	6,658.26	6.658	54.937	345.177
11/7/16 3:50 AM	6,665.82	6.666	54.939	345.193
11/7/16 4:00 AM	6,675.42	6.675	54.942	345.212
11/7/16 4:10 AM	6,682.74	6.683	54.945	345.227
11/7/16 4:20 AM	6,688.74	6.689	54.947	345.240
11/7/16 4:30 AM	6,695.82	6.696	54.949	345.254
11/7/16 4:40 AM	6,700.38	6.700	54.950	345.264
11/7/16 4:50 AM	6,705.90	6.706	54.952	345.275
11/7/16 5:00 AM	6,711.12	6.711	54.954	345.285
11/7/16 5:10 AM	6,715.98	6.716	54.956	345.295
11/7/16 5:20 AM	6,720.06	6.720	54.957	345.304
11/7/16 5:30 AM	6,724.68	6.725	54.958	345.313
11/7/16 5:40 AM	6,730.14	6.730	54.960	345.324
11/7/16 5:50 AM	6,734.94	6.735	54.962	345.334
11/7/16 6:00 AM	6,740.46	6.740	54.963	345.345
11/7/16 6:10 AM	6,745.68	6.746	54.965	345.356
11/7/16 6:20 AM	6,752.10	6.752	54.967	345.369
11/7/16 6:30 AM	6,756.90	6.757	54.969	345.379
11/7/16 6:40 AM	6,762.42	6.762	54.971	345.390
11/7/16 6:50 AM	6,764.94	6.765	54.971	345.395
11/7/16 7:00 AM	6,770.22	6.770	54.973	345.406

11/7/16 7:10 AM	6,776.40	6.776	54.975	345.418
11/7/16 7:20 AM	6,783.00	6.783	54.977	345.431
11/7/16 7:30 AM	6,786.00	6.786	54.978	345.438
11/7/16 7:40 AM	6,790.80	6.791	54.980	345.448
11/7/16 7:50 AM	6,793.98	6.794	54.981	345.454
11/7/16 8:00 AM	6,797.22	6.797	54.982	345.461
11/7/16 8:10 AM	6,801.54	6.802	54.983	345.469
11/7/16 8:20 AM	6,804.30	6.804	54.984	345.475
11/7/16 8:30 AM	6,810.00	6.810	54.986	345.486
11/7/16 8:40 AM	6,812.76	6.813	54.987	345.492
11/7/16 8:50 AM	6,818.04	6.818	54.989	345.503
11/7/16 9:00 AM	6,821.04	6.821	54.990	345.509
11/7/16 9:10 AM	6,826.26	6.826	54.991	345.520
11/7/16 9:20 AM	6,830.16	6.830	54.992	345.528
11/7/16 9:30 AM	6,834.30	6.834	54.994	345.536
11/7/16 9:40 AM	6,839.34	6.839	54.995	345.546
11/7/16 9:50 AM	6,843.66	6.844	54.997	345.555
11/7/16 10:00 AM	6,845.28	6.845	54.997	345.559
11/7/16 10:10 AM	6,848.22	6.848	54.998	345.565
11/7/16 10:20 AM	6,851.22	6.851	54.999	345.571
11/7/16 10:30 AM	6,853.08	6.853	55.000	345.575
11/7/16 10:40 AM	6,855.36	6.855	55.001	345.579
11/7/16 10:50 AM	6,857.64	6.858	55.001	345.584
11/7/16 11:00 AM	6,860.82	6.861	55.002	345.590
11/7/16 11:10 AM	6,862.68	6.863	55.003	345.594
11/7/16 11:20 AM	6,864.06	6.864	55.004	345.597
11/7/16 11:30 AM	6,867.48	6.867	55.005	345.604
11/7/16 11:40 AM	6,870.24	6.870	55.005	345.609
11/7/16 11:50 AM	6,876.18	6.876	55.007	345.621
11/7/16 12:00 PM	6,881.64	6.882	55.009	345.632
11/7/16 12:10 PM	6,881.64	6.882	55.009	345.633
11/7/16 12:20 PM	6,886.50	6.887	55.011	345.642
11/7/16 12:30 PM	6,888.06	6.888	55.011	345.646
11/7/16 12:40 PM	6,888.30	6.888	55.011	345.647
11/7/16 12:50 PM	6,889.44	6.889	55.012	345.649
11/7/16 1:00 PM	6,889.44	6.889	55.012	345.649
11/7/16 1:10 PM	6,893.82	6.894	55.013	345.657
11/7/16 1:20 PM	6,893.82	6.894	55.013	345.658
11/7/16 1:30 PM	6,894.72	6.895	55.013	345.659
11/7/16 1:40 PM	6,897.00	6.897	55.014	345.664
11/7/16 1:50 PM	6,899.52	6.900	55.015	345.669
11/7/16 2:00 PM	6,900.90	6.901	55.015	345.672
11/7/16 2:10 PM	6,903.42	6.903	55.016	345.677
11/7/16 2:20 PM	6,905.46	6.905	55.017	345.681
11/7/16 2:30 PM	6,907.98	6.908	55.018	345.686
11/7/16 2:40 PM	6,908.70	6.909	55.018	345.688
11/7/16 2:50 PM	6,910.50	6.911	55.019	345.691
11/7/16 3:00 PM	6,912.54	6.913	55.019	345.695

11/7/16 3:10 PM	6,916.02	6.916	55.020	345.702
11/7/16 3:20 PM	6,918.06	6.918	55.021	345.707
11/7/16 3:30 PM	6,919.20	6.919	55.021	345.709
11/7/16 3:40 PM	6,920.34	6.920	55.022	345.711
11/7/16 3:50 PM	6,916.20	6.916	55.021	345.704
11/7/16 4:00 PM	6,917.58	6.918	55.021	345.706
11/7/16 4:10 PM	6,918.06	6.918	55.021	345.707
11/7/16 4:20 PM	6,927.66	6.928	55.024	345.725
11/7/16 4:30 PM	6,945.54	6.946	55.029	345.760
11/7/16 4:40 PM	6,950.58	6.951	55.031	345.772
11/7/16 4:50 PM	6,954.24	6.954	55.033	345.780
11/7/16 5:00 PM	6,958.56	6.959	55.034	345.789
11/7/16 5:10 PM	6,964.50	6.965	55.036	345.800
11/7/16 5:20 PM	6,965.22	6.965	55.036	345.803
11/7/16 5:30 PM	6,966.60	6.967	55.037	345.805
11/7/16 5:40 PM	6,967.02	6.967	55.037	345.806
11/7/16 5:50 PM	6,968.40	6.968	55.037	345.809
11/7/16 6:00 PM	6,969.78	6.970	55.038	345.812
11/7/16 6:10 PM	6,970.26	6.970	55.038	345.813
11/7/16 6:20 PM	6,970.68	6.971	55.038	345.814
11/7/16 6:30 PM	6,971.82	6.972	55.038	345.816
11/7/16 6:40 PM	6,974.16	6.974	55.039	345.821
11/7/16 6:50 PM	6,974.16	6.974	55.039	345.821
11/7/16 7:00 PM	6,974.82	6.975	55.039	345.822
11/7/16 7:10 PM	6,978.00	6.978	55.040	345.828
11/7/16 7:20 PM	6,979.20	6.979	55.041	345.831
11/7/16 7:30 PM	6,980.76	6.981	55.041	345.834
11/7/16 7:40 PM	6,981.48	6.981	55.042	345.836
11/7/16 7:50 PM	6,982.62	6.983	55.042	345.838
11/7/16 8:00 PM	6,985.56	6.986	55.043	345.844
11/7/16 8:10 PM	6,985.80	6.986	55.043	345.845
11/7/16 8:20 PM	6,986.52	6.987	55.043	345.846
11/7/16 8:30 PM	6,986.70	6.987	55.043	345.847
11/7/16 8:40 PM	6,986.70	6.987	55.043	345.847
11/7/16 8:50 PM	6,989.04	6.989	55.044	345.851
11/7/16 9:00 PM	6,988.80	6.989	55.044	345.851
11/7/16 9:10 PM	6,990.36	6.990	55.044	345.854
11/7/16 9:20 PM	6,990.36	6.990	55.044	345.854
11/7/16 9:30 PM	6,990.84	6.991	55.045	345.855
11/7/16 9:40 PM	6,990.84	6.991	55.045	345.855
11/7/16 9:50 PM	6,990.84	6.991	55.045	345.855
11/7/16 10:00 PM	6,991.98	6.992	55.045	345.857
11/7/16 10:10 PM	6,997.26	6.997	55.047	345.867
11/7/16 10:20 PM	6,998.64	6.999	55.047	345.871
11/7/16 10:30 PM	6,998.64	6.999	55.047	345.871
11/7/16 10:40 PM	6,999.30	6.999	55.047	345.872
11/7/16 10:50 PM	7,000.20	7.000	55.048	345.874
11/7/16 11:00 PM	7,001.40	7.001	55.048	345.876

11/7/16 11:10 PM	7,002.06	7.002	55.048	345.878
11/7/16 11:20 PM	7,002.96	7.003	55.048	345.879
11/7/16 11:30 PM	7,004.10	7.004	55.049	345.882
11/7/16 11:40 PM	7,005.96	7.006	55.049	345.885
11/7/16 11:50 PM	7,006.62	7.007	55.050	345.887
12/7/16 12:00 AM	7,011.24	7.011	55.051	345.896
12/7/16 12:10 AM	7,011.42	7.011	55.051	345.897
12/7/16 12:20 AM	7,013.76	7.014	55.052	345.901
12/7/16 12:30 AM	7,013.76	7.014	55.052	345.902
12/7/16 12:40 AM	7,014.66	7.015	55.052	345.903
12/7/16 12:50 AM	7,014.66	7.015	55.052	345.903
12/7/16 1:00 AM	7,014.42	7.014	55.052	345.903
12/7/16 1:10 AM	7,015.80	7.016	55.053	345.905
12/7/16 1:20 AM	7,015.80	7.016	55.053	345.906
12/7/16 1:30 AM	7,015.80	7.016	55.053	345.906
12/7/16 1:40 AM	7,015.56	7.016	55.053	345.905
12/7/16 1:50 AM	7,016.28	7.016	55.053	345.907
12/7/16 2:00 AM	7,017.18	7.017	55.053	345.908
12/7/16 2:10 AM	7,018.74	7.019	55.054	345.911
12/7/16 2:20 AM	7,020.36	7.020	55.054	345.915
12/7/16 2:30 AM	7,020.60	7.021	55.054	345.915
12/7/16 2:40 AM	7,021.08	7.021	55.054	345.916
12/7/16 2:50 AM	7,022.22	7.022	55.055	345.919
12/7/16 3:00 AM	7,022.46	7.022	55.055	345.919
12/7/16 3:10 AM	7,023.12	7.023	55.055	345.920
12/7/16 3:20 AM	7,024.02	7.024	55.055	345.922
12/7/16 3:30 AM	7,025.40	7.025	55.056	345.925
12/7/16 3:40 AM	7,026.12	7.026	55.056	345.927
12/7/16 3:50 AM	7,026.54	7.027	55.056	345.927
12/7/16 4:00 AM	7,027.92	7.028	55.057	345.930
12/7/16 4:10 AM	7,029.06	7.029	55.057	345.932
12/7/16 4:20 AM	7,030.20	7.030	55.057	345.935
12/7/16 4:30 AM	7,032.48	7.032	55.058	345.939
12/7/16 4:40 AM	7,033.62	7.034	55.058	345.942
12/7/16 4:50 AM	7,035.72	7.036	55.059	345.946
12/7/16 5:00 AM	7,037.52	7.038	55.060	345.949
12/7/16 5:10 AM	7,037.76	7.038	55.060	345.950
12/7/16 5:20 AM	7,038.66	7.039	55.060	345.952
12/7/16 5:30 AM	7,039.14	7.039	55.060	345.953
12/7/16 5:40 AM	7,041.18	7.041	55.061	345.957
12/7/16 5:50 AM	7,043.94	7.044	55.062	345.962
12/7/16 6:00 AM	7,044.42	7.044	55.062	345.964
12/7/16 6:10 AM	7,046.46	7.046	55.063	345.968
12/7/16 6:20 AM	7,047.18	7.047	55.063	345.969
12/7/16 6:30 AM	7,047.84	7.048	55.063	345.971
12/7/16 6:40 AM	7,048.50	7.049	55.063	345.972
12/7/16 6:50 AM	7,050.84	7.051	55.064	345.976
12/7/16 7:00 AM	7,051.50	7.052	55.064	345.978

12/7/16 7:10 AM	7,051.98	7.052	55.064	345.979
12/7/16 7:20 AM	7,055.82	7.056	55.065	345.986
12/7/16 7:30 AM	7,058.34	7.058	55.066	345.992
12/7/16 7:40 AM	7,058.16	7.058	55.066	345.992
12/7/16 7:50 AM	7,060.86	7.061	55.067	345.997
12/7/16 8:00 AM	7,063.62	7.064	55.068	346.002
12/7/16 8:10 AM	7,063.86	7.064	55.068	346.003
12/7/16 8:20 AM	7,064.10	7.064	55.068	346.004
12/7/16 8:30 AM	7,064.10	7.064	55.068	346.004
12/7/16 8:40 AM	7,064.34	7.064	55.068	346.004
12/7/16 8:50 AM	7,065.24	7.065	55.069	346.006
12/7/16 9:00 AM	7,066.14	7.066	55.069	346.008
12/7/16 9:10 AM	7,067.28	7.067	55.069	346.010
12/7/16 9:20 AM	7,068.42	7.068	55.070	346.012
12/7/16 9:30 AM	7,071.84	7.072	55.071	346.019
12/7/16 9:40 AM	7,073.04	7.073	55.071	346.022
12/7/16 9:50 AM	7,073.04	7.073	55.071	346.022
12/7/16 10:00 AM	7,074.84	7.075	55.072	346.025
12/7/16 10:10 AM	7,076.22	7.076	55.072	346.028
12/7/16 10:20 AM	7,077.60	7.078	55.073	346.031
12/7/16 10:30 AM	7,077.84	7.078	55.073	346.032
12/7/16 10:40 AM	7,078.02	7.078	55.073	346.032
12/7/16 10:50 AM	7,078.74	7.079	55.073	346.033
12/7/16 11:00 AM	7,078.98	7.079	55.073	346.034
12/7/16 11:10 AM	7,078.74	7.079	55.073	346.034
12/7/16 11:20 AM	7,080.78	7.081	55.074	346.037
12/7/16 11:30 AM	7,080.54	7.081	55.074	346.037
12/7/16 11:40 AM	7,080.12	7.080	55.073	346.036
12/7/16 11:50 AM	7,080.36	7.080	55.074	346.037
12/7/16 12:00 PM	7,080.12	7.080	55.073	346.036
12/7/16 12:10 PM	7,079.40	7.079	55.073	346.035
12/7/16 12:20 PM	7,078.02	7.078	55.073	346.032
12/7/16 12:30 PM	7,078.26	7.078	55.073	346.033
12/7/16 12:40 PM	7,078.74	7.079	55.073	346.033
12/7/16 12:50 PM	7,079.22	7.079	55.073	346.034
12/7/16 1:00 PM	7,080.78	7.081	55.074	346.037
12/7/16 1:10 PM	7,082.64	7.083	55.074	346.041
12/7/16 1:20 PM	7,082.64	7.083	55.074	346.041
12/7/16 1:30 PM	7,082.88	7.083	55.074	346.042
12/7/16 1:40 PM	7,083.78	7.084	55.075	346.044
12/7/16 1:50 PM	7,084.20	7.084	55.075	346.045
12/7/16 2:00 PM	7,084.92	7.085	55.075	346.046
12/7/16 2:10 PM	7,087.20	7.087	55.076	346.050
12/7/16 2:20 PM	7,088.10	7.088	55.076	346.052
12/7/16 2:30 PM	7,090.38	7.090	55.077	346.057
12/7/16 2:40 PM	7,089.72	7.090	55.077	346.056
12/7/16 2:50 PM	7,090.20	7.090	55.077	346.057
12/7/16 3:00 PM	7,091.34	7.091	55.077	346.059

12/7/16 3:10 PM	7,090.20	7.090	55.077	346.057
12/7/16 3:20 PM	7,089.48	7.089	55.076	346.056
12/7/16 3:30 PM	7,088.10	7.088	55.076	346.053
12/7/16 3:40 PM	7,086.30	7.086	55.075	346.049
12/7/16 3:50 PM	7,083.30	7.083	55.075	346.043
12/7/16 4:00 PM	7,078.02	7.078	55.073	346.033
12/7/16 4:10 PM	7,077.84	7.078	55.073	346.032
12/7/16 4:20 PM	7,070.28	7.070	55.070	346.018
12/7/16 4:30 PM	7,062.48	7.062	55.068	346.002
12/7/16 4:40 PM	7,058.16	7.058	55.066	345.993
12/7/16 4:50 PM	7,055.64	7.056	55.066	345.987
12/7/16 5:00 PM	7,045.98	7.046	55.063	345.969
12/7/16 5:10 PM	7,033.86	7.034	55.059	345.945
12/7/16 5:20 PM	7,020.36	7.020	55.055	345.917
12/7/16 5:30 PM	7,017.60	7.018	55.053	345.910
12/7/16 5:40 PM	7,016.28	7.016	55.053	345.907
12/7/16 5:50 PM	7,009.62	7.010	55.051	345.894
12/7/16 6:00 PM	7,007.10	7.007	55.050	345.889
12/7/16 6:10 PM	7,003.68	7.004	55.049	345.882
12/7/16 6:20 PM	6,996.12	6.996	55.046	345.867
12/7/16 6:30 PM	6,989.04	6.989	55.044	345.853
12/7/16 6:40 PM	6,978.48	6.978	55.041	345.832
12/7/16 6:50 PM	6,970.92	6.971	55.038	345.816
12/7/16 7:00 PM	6,964.98	6.965	55.036	345.804
12/7/16 7:10 PM	6,959.46	6.959	55.035	345.792
12/7/16 7:20 PM	6,954.48	6.954	55.033	345.782
12/7/16 7:30 PM	6,945.54	6.946	55.030	345.765
12/7/16 7:40 PM	6,940.02	6.940	55.028	345.753
12/7/16 7:50 PM	6,937.08	6.937	55.027	345.746
12/7/16 8:00 PM	6,934.98	6.935	55.027	345.742
12/7/16 8:10 PM	6,931.32	6.931	55.025	345.735
12/7/16 8:20 PM	6,927.66	6.928	55.024	345.727
12/7/16 8:30 PM	6,922.86	6.923	55.023	345.718
12/7/16 8:40 PM	6,919.44	6.919	55.022	345.711
12/7/16 8:50 PM	6,918.54	6.919	55.021	345.708
12/7/16 9:00 PM	6,918.06	6.918	55.021	345.707
12/7/16 9:10 PM	6,917.40	6.917	55.021	345.706
12/7/16 9:20 PM	6,917.58	6.918	55.021	345.706
12/7/16 9:30 PM	6,917.82	6.918	55.021	345.707
12/7/16 9:40 PM	6,918.30	6.918	55.021	345.707
12/7/16 9:50 PM	6,917.82	6.918	55.021	345.707
12/7/16 10:00 PM	6,918.06	6.918	55.021	345.707
12/7/16 10:10 PM	6,918.96	6.919	55.021	345.709
12/7/16 10:20 PM	6,919.44	6.919	55.021	345.710
12/7/16 10:30 PM	6,919.92	6.920	55.022	345.711
12/7/16 10:40 PM	6,920.10	6.920	55.022	345.711
12/7/16 10:50 PM	6,920.34	6.920	55.022	345.712
12/7/16 11:00 PM	6,921.06	6.921	55.022	345.713

12/7/16 11:10 PM	6,921.06	6.921	55.022	345.713
12/7/16 11:20 PM	6,921.06	6.921	55.022	345.713
12/7/16 11:30 PM	6,921.06	6.921	55.022	345.713
12/7/16 11:40 PM	6,921.06	6.921	55.022	345.713
12/7/16 11:50 PM	6,921.06	6.921	55.022	345.713
07/13/16 12:00:00 AM	6,920.82	6.921	55.022	345.713
07/13/16 12:10:00 AM	6,919.92	6.920	55.022	345.711
07/13/16 12:20:00 AM	6,920.10	6.920	55.022	345.711
07/13/16 12:30:00 AM	6,920.34	6.920	55.022	345.712
07/13/16 12:40:00 AM	6,920.58	6.921	55.022	345.712
07/13/16 12:50:00 AM	6,920.58	6.921	55.022	345.712
07/13/16 01:00:00 AM	6,919.20	6.919	55.021	345.710
07/13/16 01:10:00 AM	6,919.20	6.919	55.021	345.709
07/13/16 01:20:00 AM	6,919.20	6.919	55.021	345.709
07/13/16 01:30:00 AM	6,919.20	6.919	55.021	345.709
07/13/16 01:40:00 AM	6,919.20	6.919	55.021	345.709
07/13/16 01:50:00 AM	6,918.72	6.919	55.021	345.709
07/13/16 02:00:00 AM	6,917.58	6.918	55.021	345.706
07/13/16 02:10:00 AM	6,917.40	6.917	55.021	345.706
07/13/16 02:20:00 AM	6,914.40	6.914	55.020	345.700
07/13/16 02:30:00 AM	6,914.64	6.915	55.020	345.700
07/13/16 02:40:00 AM	6,913.74	6.914	55.020	345.698
07/13/16 02:50:00 AM	6,914.64	6.915	55.020	345.700
07/13/16 03:00:00 AM	6,913.26	6.913	55.020	345.698
07/13/16 03:10:00 AM	6,913.02	6.913	55.019	345.697
07/13/16 03:20:00 AM	6,913.02	6.913	55.019	345.697

07/13/16 03:30:00 AM	6,910.98	6.911	55.019	345.693
07/13/16 03:40:00 AM	6,910.50	6.911	55.019	345.692
07/13/16 03:50:00 AM	6,909.84	6.910	55.018	345.690
07/13/16 04:00:00 AM	6,908.22	6.908	55.018	345.687
07/13/16 04:10:00 AM	6,905.94	6.906	55.017	345.683
07/13/16 04:20:00 AM	6,904.08	6.904	55.017	345.679
07/13/16 04:30:00 AM	6,901.56	6.902	55.016	345.674
07/13/16 04:40:00 AM	6,902.28	6.902	55.016	345.675
07/13/16 04:50:00 AM	6,900.00	6.900	55.015	345.671
07/13/16 05:00:00 AM	6,897.66	6.898	55.015	345.666
07/13/16 05:10:00 AM	6,896.10	6.896	55.014	345.663
07/13/16 05:20:00 AM	6,894.48	6.894	55.013	345.659
07/13/16 05:30:00 AM	6,891.96	6.892	55.013	345.654
07/13/16 05:40:00 AM	6,891.48	6.891	55.012	345.653
07/13/16 05:50:00 AM	6,889.20	6.889	55.012	345.649
07/13/16 06:00:00 AM	6,887.64	6.888	55.011	345.646
07/13/16 06:10:00 AM	6,884.64	6.885	55.010	345.640
07/13/16 06:20:00 AM	6,884.88	6.885	55.010	345.640
07/13/16 06:30:00 AM	6,882.12	6.882	55.009	345.635
07/13/16 06:40:00 AM	6,877.98	6.878	55.008	345.626
07/13/16 06:50:00 AM	6,877.08	6.877	55.008	345.624
07/13/16 07:00:00 AM	6,870.66	6.871	55.006	345.612
07/13/16 07:10:00 AM	6,869.52	6.870	55.005	345.609
07/13/16 07:20:00 AM	6,867.72	6.868	55.005	345.605

07/13/16 07:30:00 AM	6,862.92	6.863	55.003	345.596
07/13/16 07:40:00 AM	6,862.68	6.863	55.003	345.595
07/13/16 07:50:00 AM	6,861.30	6.861	55.003	345.592
07/13/16 08:00:00 AM	6,856.74	6.857	55.001	345.583
07/13/16 08:10:00 AM	6,858.30	6.858	55.002	345.585
07/13/16 08:20:00 AM	6,856.50	6.857	55.001	345.582
07/13/16 08:30:00 AM	6,854.88	6.855	55.001	345.579
07/13/16 08:40:00 AM	6,854.22	6.854	55.000	345.577
07/13/16 08:50:00 AM	6,851.70	6.852	55.000	345.573
07/13/16 09:00:00 AM	6,851.22	6.851	54.999	345.571
07/13/16 09:10:00 AM	6,849.60	6.850	54.999	345.568
07/13/16 09:20:00 AM	6,848.46	6.848	54.999	345.566
07/13/16 09:30:00 AM	6,845.94	6.846	54.998	345.561
07/13/16 09:40:00 AM	6,844.14	6.844	54.997	345.557
07/13/16 09:50:00 AM	6,843.00	6.843	54.997	345.555
07/13/16 10:00:00 AM	6,840.72	6.841	54.996	345.550
07/13/16 10:10:00 AM	6,839.10	6.839	54.996	345.547
07/13/16 10:20:00 AM	6,832.92	6.833	54.994	345.535
07/13/16 10:30:00 AM	6,829.50	6.830	54.992	345.528
07/13/16 10:40:00 AM	6,829.50	6.830	54.992	345.527
07/13/16 10:50:00 AM	6,824.22	6.824	54.991	345.517
07/13/16 11:00:00 AM	6,819.42	6.819	54.989	345.507
07/13/16 11:10:00 AM	6,814.38	6.814	54.988	345.497
07/13/16 11:20:00 AM	6,809.58	6.810	54.986	345.487

07/13/16 11:30:00 AM	6,807.06	6.807	54.985	345.482
07/13/16 11:40:00 AM	6,806.16	6.806	54.985	345.480
07/13/16 11:50:00 AM	6,803.16	6.803	54.984	345.474
07/13/16 12:00:00 PM	6,800.64	6.801	54.983	345.469
07/13/16 12:10:00 PM	6,796.08	6.796	54.982	345.460
07/13/16 12:20:00 PM	6,791.28	6.791	54.980	345.450
07/13/16 12:30:00 PM	6,790.14	6.790	54.980	345.447
07/13/16 12:40:00 PM	6,790.14	6.790	54.980	345.447
07/13/16 12:50:00 PM	6,790.56	6.791	54.980	345.448
07/13/16 01:00:00 PM	6,789.66	6.790	54.980	345.446
07/13/16 01:10:00 PM	6,779.82	6.780	54.977	345.428
07/13/16 01:20:00 PM	6,775.68	6.776	54.975	345.419
07/13/16 01:30:00 PM	6,768.12	6.768	54.973	345.404
07/13/16 01:40:00 PM	6,769.98	6.770	54.973	345.406
07/13/16 01:50:00 PM	6,772.50	6.773	54.974	345.411
07/13/16 02:00:00 PM	6,762.18	6.762	54.971	345.392
07/13/16 02:10:00 PM	6,743.40	6.743	54.965	345.355
07/13/16 02:20:00 PM	6,725.10	6.725	54.959	345.318
07/13/16 02:30:00 PM	6,712.08	6.712	54.955	345.291
07/13/16 02:40:00 PM	6,702.90	6.703	54.952	345.271
07/13/16 02:50:00 PM	6,691.92	6.692	54.948	345.249
07/13/16 03:00:00 PM	6,672.48	6.672	54.942	345.211
07/13/16 03:10:00 PM	6,659.64	6.660	54.938	345.184
07/13/16 03:20:00 PM	6,653.94	6.654	54.936	345.171

07/13/16 03:30:00 PM	6,640.44	6.640	54.932	345.145
07/13/16 03:40:00 PM	6,629.22	6.629	54.928	345.122
07/13/16 03:50:00 PM	6,614.10	6.614	54.923	345.092
07/13/16 04:00:00 PM	6,609.06	6.609	54.921	345.080
07/13/16 04:10:00 PM	6,602.88	6.603	54.919	345.067
07/13/16 04:20:00 PM	6,598.32	6.598	54.918	345.058
07/13/16 04:30:00 PM	6,598.32	6.598	54.918	345.057
07/13/16 04:40:00 PM	6,591.90	6.592	54.916	345.045
07/13/16 04:50:00 PM	6,586.86	6.587	54.914	345.035
07/13/16 05:00:00 PM	6,583.20	6.583	54.913	345.027
07/13/16 05:10:00 PM	6,583.20	6.583	54.913	345.026
07/13/16 05:20:00 PM	6,581.82	6.582	54.912	345.024
07/13/16 05:30:00 PM	6,580.92	6.581	54.912	345.022
07/13/16 05:40:00 PM	6,581.16	6.581	54.912	345.022
07/13/16 05:50:00 PM	6,581.16	6.581	54.912	345.022
07/13/16 06:00:00 PM	6,581.16	6.581	54.912	345.022
07/13/16 06:10:00 PM	6,581.16	6.581	54.912	345.022
07/13/16 06:20:00 PM	6,581.16	6.581	54.912	345.022
07/13/16 06:30:00 PM	6,581.16	6.581	54.912	345.022
07/13/16 06:40:00 PM	6,581.16	6.581	54.912	345.022
07/13/16 06:50:00 PM	6,581.16	6.581	54.912	345.022
07/13/16 07:00:00 PM	6,581.16	6.581	54.912	345.022
07/13/16 07:10:00 PM	6,580.02	6.580	54.912	345.020
07/13/16 07:20:00 PM	6,578.64	6.579	54.911	345.017

07/13/16 07:30:00 PM	6,578.16	6.578	54.911	345.016
07/13/16 07:40:00 PM	6,577.92	6.578	54.911	345.016
07/13/16 07:50:00 PM	6,578.16	6.578	54.911	345.016
07/13/16 08:00:00 PM	6,577.26	6.577	54.911	345.014
07/13/16 08:10:00 PM	6,577.02	6.577	54.911	345.014
07/13/16 08:20:00 PM	6,575.16	6.575	54.910	345.010
07/13/16 08:30:00 PM	6,574.98	6.575	54.910	345.010
07/13/16 08:40:00 PM	6,574.98	6.575	54.910	345.010
07/13/16 08:50:00 PM	6,574.98	6.575	54.910	345.010
07/13/16 09:00:00 PM	6,574.98	6.575	54.910	345.010
07/13/16 09:10:00 PM	6,574.98	6.575	54.910	345.010
07/13/16 09:20:00 PM	6,574.98	6.575	54.910	345.010
07/13/16 09:30:00 PM	6,575.16	6.575	54.910	345.010
07/13/16 09:40:00 PM	6,576.78	6.577	54.911	345.013
07/13/16 09:50:00 PM	6,579.06	6.579	54.911	345.017
07/13/16 10:00:00 PM	6,581.34	6.581	54.912	345.022
07/13/16 10:10:00 PM	6,584.82	6.585	54.913	345.029
07/13/16 10:20:00 PM	6,589.62	6.590	54.915	345.038
07/13/16 10:30:00 PM	6,593.94	6.594	54.916	345.047
07/13/16 10:40:00 PM	6,597.42	6.597	54.917	345.055
07/13/16 10:50:00 PM	6,601.26	6.601	54.918	345.062
07/13/16 11:00:00 PM	6,603.12	6.603	54.919	345.066
07/13/16 11:10:00 PM	6,605.40	6.605	54.920	345.071
07/13/16 11:20:00 PM	6,607.44	6.607	54.920	345.075

07/13/16 11:30:00 PM	6,609.54	6.610	54.921	345.079
07/13/16 11:40:00 PM	6,612.24	6.612	54.922	345.085
07/13/16 11:50:00 PM	6,614.10	6.614	54.923	345.089
07/14/16 12:00:00 AM	6,616.14	6.616	54.923	345.093
07/14/16 12:10:00 AM	6,618.24	6.618	54.924	345.097
07/14/16 12:20:00 AM	6,620.28	6.620	54.925	345.101
07/14/16 12:30:00 AM	6,622.14	6.622	54.925	345.105
07/14/16 12:40:00 AM	6,624.18	6.624	54.926	345.109
07/14/16 12:50:00 AM	6,626.22	6.626	54.927	345.113
07/14/16 01:00:00 AM	6,628.74	6.629	54.927	345.118
07/14/16 01:10:00 AM	6,631.26	6.631	54.928	345.124
07/14/16 01:20:00 AM	6,633.30	6.633	54.929	345.128
07/14/16 01:30:00 AM	6,635.16	6.635	54.929	345.132
07/14/16 01:40:00 AM	6,636.78	6.637	54.930	345.135
07/14/16 01:50:00 AM	6,639.30	6.639	54.931	345.140
07/14/16 02:00:00 AM	6,641.10	6.641	54.931	345.144
07/14/16 02:10:00 AM	6,642.96	6.643	54.932	345.147
07/14/16 02:20:00 AM	6,645.90	6.646	54.933	345.153
07/14/16 02:30:00 AM	6,648.42	6.648	54.934	345.158
07/14/16 02:40:00 AM	6,650.70	6.651	54.934	345.163
07/14/16 02:50:00 AM	6,653.94	6.654	54.935	345.170
07/14/16 03:00:00 AM	6,656.22	6.656	54.936	345.174
07/14/16 03:10:00 AM	6,658.98	6.659	54.937	345.180
07/14/16 03:20:00 AM	6,661.02	6.661	54.938	345.184

07/14/16 03:30:00 AM	6,663.06	6.663	54.938	345.188
07/14/16 03:40:00 AM	6,665.34	6.665	54.939	345.193
07/14/16 03:50:00 AM	6,667.44	6.667	54.940	345.197
07/14/16 04:00:00 AM	6,670.86	6.671	54.941	345.204
07/14/16 04:10:00 AM	6,674.28	6.674	54.942	345.211
07/14/16 04:20:00 AM	6,677.52	6.678	54.943	345.217
07/14/16 04:30:00 AM	6,679.32	6.679	54.944	345.221
07/14/16 04:40:00 AM	6,682.32	6.682	54.945	345.227
07/14/16 04:50:00 AM	6,684.84	6.685	54.946	345.232
07/14/16 05:00:00 AM	6,687.78	6.688	54.946	345.238
07/14/16 05:10:00 AM	6,690.78	6.691	54.947	345.244
07/14/16 05:20:00 AM	6,693.96	6.694	54.948	345.251
07/14/16 05:30:00 AM	6,697.20	6.697	54.949	345.257
07/14/16 05:40:00 AM	6,698.76	6.699	54.950	345.261
07/14/16 05:50:00 AM	6,699.96	6.700	54.950	345.263
07/14/16 06:00:00 AM	6,702.24	6.702	54.951	345.268
07/14/16 06:10:00 AM	6,704.52	6.705	54.952	345.273
07/14/16 06:20:00 AM	6,706.56	6.707	54.953	345.277
07/14/16 06:30:00 AM	6,707.94	6.708	54.953	345.280
07/14/16 06:40:00 AM	6,709.32	6.709	54.953	345.282
07/14/16 06:50:00 AM	6,710.22	6.710	54.954	345.284
07/14/16 07:00:00 AM	6,710.94	6.711	54.954	345.286
07/14/16 07:10:00 AM	6,711.36	6.711	54.954	345.287
07/14/16 07:20:00 AM	6,711.36	6.711	54.954	345.287

07/14/16 07:30:00 AM	6,712.08	6.712	54.954	345.288
07/14/16 07:40:00 AM	6,712.32	6.712	54.954	345.289
07/14/16 07:50:00 AM	6,712.08	6.712	54.954	345.288
07/14/16 08:00:00 AM	6,712.32	6.712	54.954	345.289
07/14/16 08:10:00 AM	6,712.08	6.712	54.954	345.288
07/14/16 08:20:00 AM	6,712.08	6.712	54.954	345.288
07/14/16 08:30:00 AM	6,711.60	6.712	54.954	345.287
07/14/16 08:40:00 AM	6,709.80	6.710	54.954	345.284
07/14/16 08:50:00 AM	6,707.94	6.708	54.953	345.280
07/14/16 09:00:00 AM	6,707.28	6.707	54.953	345.279
07/14/16 09:10:00 AM	6,706.80	6.707	54.953	345.278
07/14/16 09:20:00 AM	6,704.76	6.705	54.952	345.274
07/14/16 09:30:00 AM	6,699.72	6.700	54.951	345.264
07/14/16 09:40:00 AM	6,692.40	6.692	54.948	345.250
07/14/16 09:50:00 AM	6,689.64	6.690	54.947	345.243
07/14/16 10:00:00 AM	6,678.66	6.679	54.944	345.222
07/14/16 10:10:00 AM	6,665.34	6.665	54.940	345.196
07/14/16 10:20:00 AM	6,657.36	6.657	54.937	345.179
07/14/16 10:30:00 AM	6,648.42	6.648	54.934	345.161
07/14/16 10:40:00 AM	6,635.64	6.636	54.930	345.135
07/14/16 10:50:00 AM	6,619.80	6.620	54.925	345.104
07/14/16 11:00:00 AM	6,603.12	6.603	54.920	345.070
07/14/16 11:10:00 AM	6,584.82	6.585	54.914	345.033
07/14/16 11:20:00 AM	6,568.56	6.569	54.908	345.000

07/14/16 11:30:00 AM	6,560.52	6.561	54.906	344.982
07/14/16 11:40:00 AM	6,537.42	6.537	54.899	344.937
07/14/16 11:50:00 AM	6,525.72	6.526	54.894	344.912
07/14/16 12:00:00 PM	6,512.04	6.512	54.890	344.884
07/14/16 12:10:00 PM	6,497.58	6.498	54.885	344.855
07/14/16 12:20:00 PM	6,497.82	6.498	54.885	344.853
07/14/16 12:30:00 PM	6,498.06	6.498	54.885	344.853
07/14/16 12:40:00 PM	6,498.96	6.499	54.885	344.855
07/14/16 12:50:00 PM	6,498.54	6.499	54.885	344.854
07/14/16 01:00:00 PM	6,494.88	6.495	54.884	344.847
07/14/16 01:10:00 PM	6,501.48	6.501	54.886	344.859
07/14/16 01:20:00 PM	6,515.70	6.516	54.890	344.886
07/14/16 01:30:00 PM	6,519.36	6.519	54.892	344.896
07/14/16 01:40:00 PM	6,520.50	6.521	54.892	344.898
07/14/16 01:50:00 PM	6,517.74	6.518	54.892	344.894
07/14/16 02:00:00 PM	6,510.18	6.510	54.889	344.879
07/14/16 02:10:00 PM	6,497.16	6.497	54.885	344.854
07/14/16 02:20:00 PM	6,482.94	6.483	54.881	344.825
07/14/16 02:30:00 PM	6,479.04	6.479	54.879	344.815
07/14/16 02:40:00 PM	6,465.54	6.466	54.875	344.789
07/14/16 02:50:00 PM	6,443.10	6.443	54.868	344.745
07/14/16 03:00:00 PM	6,430.98	6.431	54.864	344.719
07/14/16 03:10:00 PM	6,430.08	6.430	54.863	344.715
07/14/16 03:20:00 PM	6,431.46	6.431	54.864	344.717

07/14/16 03:30:00 PM	6,447.48	6.447	54.868	344.747
07/14/16 03:40:00 PM	6,473.34	6.473	54.876	344.798
07/14/16 03:50:00 PM	6,498.72	6.499	54.885	344.850
07/14/16 04:00:00 PM	6,516.84	6.517	54.891	344.888
07/14/16 04:10:00 PM	6,528.72	6.529	54.895	344.913
07/14/16 04:20:00 PM	6,528.48	6.528	54.895	344.915
07/14/16 04:30:00 PM	6,529.62	6.530	54.895	344.917
07/14/16 04:40:00 PM	6,543.60	6.544	54.899	344.943
07/14/16 04:50:00 PM	6,553.92	6.554	54.903	344.965
07/14/16 05:00:00 PM	6,552.54	6.553	54.903	344.964
07/14/16 05:10:00 PM	6,544.98	6.545	54.901	344.950
07/14/16 05:20:00 PM	6,540.84	6.541	54.899	344.941
07/14/16 05:30:00 PM	6,534.00	6.534	54.897	344.927
07/14/16 05:40:00 PM	6,527.58	6.528	54.895	344.914
07/14/16 05:50:00 PM	6,524.82	6.525	54.894	344.908
07/14/16 06:00:00 PM	6,517.74	6.518	54.892	344.894
07/14/16 06:10:00 PM	6,516.60	6.517	54.891	344.891
07/14/16 06:20:00 PM	6,516.12	6.516	54.891	344.890
07/14/16 06:30:00 PM	6,515.88	6.516	54.891	344.889
07/14/16 06:40:00 PM	6,508.80	6.509	54.889	344.876
07/14/16 06:50:00 PM	6,500.82	6.501	54.886	344.860
07/14/16 07:00:00 PM	6,496.20	6.496	54.885	344.850
07/14/16 07:10:00 PM	6,494.64	6.495	54.884	344.846
07/14/16 07:20:00 PM	6,494.64	6.495	54.884	344.846

07/14/16 07:30:00 PM	6,494.40	6.494	54.884	344.846
07/14/16 07:40:00 PM	6,494.40	6.494	54.884	344.846
07/14/16 07:50:00 PM	6,494.40	6.494	54.884	344.846
07/14/16 08:00:00 PM	6,495.30	6.495	54.884	344.847
07/14/16 08:10:00 PM	6,497.34	6.497	54.885	344.851
07/14/16 08:20:00 PM	6,500.10	6.500	54.886	344.857
07/14/16 08:30:00 PM	6,503.52	6.504	54.887	344.864
07/14/16 08:40:00 PM	6,508.38	6.508	54.888	344.873
07/14/16 08:50:00 PM	6,515.46	6.515	54.891	344.887
07/14/16 09:00:00 PM	6,520.74	6.521	54.892	344.898
07/14/16 09:10:00 PM	6,525.30	6.525	54.894	344.908
07/14/16 09:20:00 PM	6,529.86	6.530	54.895	344.917
07/14/16 09:30:00 PM	6,533.76	6.534	54.897	344.925
07/14/16 09:40:00 PM	6,537.42	6.537	54.898	344.932
07/14/16 09:50:00 PM	6,540.84	6.541	54.899	344.939
07/14/16 10:00:00 PM	6,545.22	6.545	54.900	344.948
07/14/16 10:10:00 PM	6,548.64	6.549	54.901	344.955
07/14/16 10:20:00 PM	6,551.40	6.551	54.902	344.961
07/14/16 10:30:00 PM	6,554.58	6.555	54.903	344.967
07/14/16 10:40:00 PM	6,558.24	6.558	54.904	344.975
07/14/16 10:50:00 PM	6,561.24	6.561	54.905	344.981
07/14/16 11:00:00 PM	6,563.52	6.564	54.906	344.986
07/14/16 11:10:00 PM	6,565.80	6.566	54.907	344.990
07/14/16 11:20:00 PM	6,568.98	6.569	54.908	344.997

07/14/16 11:30:00 PM	6,571.08	6.571	54.909	345.001
07/14/16 11:40:00 PM	6,574.02	6.574	54.910	345.007
07/14/16 11:50:00 PM	6,576.78	6.577	54.911	345.013
07/15/16 12:00:00 AM	6,578.40	6.578	54.911	345.016
07/15/16 12:10:00 AM	6,580.92	6.581	54.912	345.021
07/15/16 12:20:00 AM	6,582.72	6.583	54.912	345.025
07/15/16 12:30:00 AM	6,585.06	6.585	54.913	345.030
07/15/16 12:40:00 AM	6,587.76	6.588	54.914	345.035
07/15/16 12:50:00 AM	6,588.90	6.589	54.914	345.038
07/15/16 01:00:00 AM	6,591.42	6.591	54.915	345.043
07/15/16 01:10:00 AM	6,593.28	6.593	54.916	345.046
07/15/16 01:20:00 AM	6,595.32	6.595	54.917	345.051
07/15/16 01:30:00 AM	6,597.18	6.597	54.917	345.054
07/15/16 01:40:00 AM	6,599.88	6.600	54.918	345.060
07/15/16 01:50:00 AM	6,601.50	6.602	54.919	345.063
07/15/16 02:00:00 AM	6,604.02	6.604	54.919	345.068
07/15/16 02:10:00 AM	6,605.16	6.605	54.920	345.071
07/15/16 02:20:00 AM	6,606.78	6.607	54.920	345.074
07/15/16 02:30:00 AM	6,607.68	6.608	54.921	345.076
07/15/16 02:40:00 AM	6,610.20	6.610	54.921	345.081
07/15/16 02:50:00 AM	6,612.72	6.613	54.922	345.086
07/15/16 03:00:00 AM	6,613.20	6.613	54.922	345.087
07/15/16 03:10:00 AM	6,614.34	6.614	54.923	345.089
07/15/16 03:20:00 AM	6,616.86	6.617	54.924	345.094

07/15/16 03:30:00 AM	6,618.90	6.619	54.924	345.098
07/15/16 03:40:00 AM	6,619.38	6.619	54.924	345.100
07/15/16 03:50:00 AM	6,620.28	6.620	54.925	345.102
07/15/16 04:00:00 AM	6,621.90	6.622	54.925	345.105
07/15/16 04:10:00 AM	6,623.70	6.624	54.926	345.108
07/15/16 04:20:00 AM	6,625.80	6.626	54.926	345.113
07/15/16 04:30:00 AM	6,627.60	6.628	54.927	345.116
07/15/16 04:40:00 AM	6,630.12	6.630	54.928	345.121
07/15/16 04:50:00 AM	6,632.88	6.633	54.929	345.127
07/15/16 05:00:00 AM	6,636.06	6.636	54.930	345.133
07/15/16 05:10:00 AM	6,639.06	6.639	54.931	345.139
07/15/16 05:20:00 AM	6,641.10	6.641	54.931	345.144
07/15/16 05:30:00 AM	6,644.10	6.644	54.932	345.150
07/15/16 05:40:00 AM	6,647.76	6.648	54.933	345.157
07/15/16 05:50:00 AM	6,650.52	6.651	54.934	345.163
07/15/16 06:00:00 AM	6,653.46	6.653	54.935	345.169
07/15/16 06:10:00 AM	6,657.60	6.658	54.937	345.177
07/15/16 06:20:00 AM	6,661.26	6.661	54.938	345.184
07/15/16 06:30:00 AM	6,666.54	6.667	54.940	345.195
07/15/16 06:40:00 AM	6,673.38	6.673	54.942	345.208
07/15/16 06:50:00 AM	6,678.18	6.678	54.943	345.218
07/15/16 07:00:00 AM	6,678.90	6.679	54.944	345.221
07/15/16 07:10:00 AM	6,678.90	6.679	54.944	345.221
07/15/16 07:20:00 AM	6,678.90	6.679	54.944	345.221

07/15/16 07:30:00 AM	6,678.90	6.679	54.944	345.221
07/15/16 07:40:00 AM	6,678.66	6.679	54.944	345.220
07/15/16 07:50:00 AM	6,678.66	6.679	54.944	345.220
07/15/16 08:00:00 AM	6,677.04	6.677	54.943	345.217
07/15/16 08:10:00 AM	6,673.38	6.673	54.942	345.210
07/15/16 08:20:00 AM	6,669.48	6.669	54.941	345.202
07/15/16 08:30:00 AM	6,663.30	6.663	54.939	345.190
07/15/16 08:40:00 AM	6,656.46	6.656	54.937	345.177
07/15/16 08:50:00 AM	6,646.14	6.646	54.933	345.156
07/15/16 09:00:00 AM	6,634.50	6.635	54.930	345.133
07/15/16 09:10:00 AM	6,625.56	6.626	54.927	345.114
07/15/16 09:20:00 AM	6,618.24	6.618	54.924	345.099
07/15/16 09:30:00 AM	6,605.88	6.606	54.920	345.075
07/15/16 09:40:00 AM	6,593.04	6.593	54.916	345.049
07/15/16 09:50:00 AM	6,580.02	6.580	54.912	345.022
07/15/16 10:00:00 AM	6,564.42	6.564	54.907	344.991
07/15/16 10:10:00 AM	6,552.96	6.553	54.903	344.967
07/15/16 10:20:00 AM	6,542.46	6.542	54.900	344.945
07/15/16 10:30:00 AM	6,525.72	6.526	54.895	344.912
07/15/16 10:40:00 AM	6,516.12	6.516	54.891	344.892
07/15/16 10:50:00 AM	6,512.46	6.512	54.890	344.883
07/15/16 11:00:00 AM	6,504.24	6.504	54.887	344.867
07/15/16 11:10:00 AM	6,496.20	6.496	54.885	344.851
07/15/16 11:20:00 AM	6,479.52	6.480	54.880	344.818

07/15/16 11:30:00 AM	6,466.68	6.467	54.875	344.792
07/15/16 11:40:00 AM	6,454.56	6.455	54.871	344.767
07/15/16 11:50:00 AM	6,441.96	6.442	54.867	344.741
07/15/16 12:00:00 PM	6,441.54	6.442	54.867	344.738
07/15/16 12:10:00 PM	6,444.48	6.444	54.868	344.744
07/15/16 12:20:00 PM	6,439.26	6.439	54.866	344.734
07/15/16 12:30:00 PM	6,429.18	6.429	54.863	344.715
07/15/16 12:40:00 PM	6,415.86	6.416	54.859	344.688
07/15/16 12:50:00 PM	6,402.84	6.403	54.855	344.662
07/15/16 01:00:00 PM	6,393.90	6.394	54.852	344.643
07/15/16 01:10:00 PM	6,382.68	6.383	54.848	344.620
07/15/16 01:20:00 PM	6,376.08	6.376	54.846	344.606
07/15/16 01:30:00 PM	6,364.38	6.364	54.842	344.583
07/15/16 01:40:00 PM	6,358.44	6.358	54.840	344.570
07/15/16 01:50:00 PM	6,346.56	6.347	54.836	344.547
07/15/16 02:00:00 PM	6,333.24	6.333	54.832	344.520
07/15/16 02:10:00 PM	6,319.50	6.320	54.828	344.492
07/15/16 02:20:00 PM	6,312.90	6.313	54.825	344.478
07/15/16 02:30:00 PM	6,313.80	6.314	54.825	344.478
07/15/16 02:40:00 PM	6,309.48	6.309	54.824	344.470
07/15/16 02:50:00 PM	6,313.80	6.314	54.825	344.477
07/15/16 03:00:00 PM	6,316.80	6.317	54.826	344.484
07/15/16 03:10:00 PM	6,314.94	6.315	54.826	344.481
07/15/16 03:20:00 PM	6,315.66	6.316	54.826	344.482

07/15/16 03:30:00 PM	6,320.88	6.321	54.828	344.492
07/15/16 03:40:00 PM	6,328.92	6.329	54.830	344.507
07/15/16 03:50:00 PM	6,326.40	6.326	54.830	344.504
07/15/16 04:00:00 PM	6,320.46	6.320	54.828	344.493
07/15/16 04:10:00 PM	6,314.46	6.314	54.826	344.481
07/15/16 04:20:00 PM	6,312.00	6.312	54.825	344.475
07/15/16 04:30:00 PM	6,301.20	6.301	54.822	344.454
07/15/16 04:40:00 PM	6,293.22	6.293	54.819	344.438
07/15/16 04:50:00 PM	6,292.08	6.292	54.818	344.434
07/15/16 05:00:00 PM	6,291.12	6.291	54.818	344.432
07/15/16 05:10:00 PM	6,288.42	6.288	54.817	344.427
07/15/16 05:20:00 PM	6,288.42	6.288	54.817	344.427
07/15/16 05:30:00 PM	6,286.80	6.287	54.817	344.423
07/15/16 05:40:00 PM	6,287.04	6.287	54.817	344.424
07/15/16 05:50:00 PM	6,287.04	6.287	54.817	344.424
07/15/16 06:00:00 PM	6,288.42	6.288	54.817	344.426
07/15/16 06:10:00 PM	6,291.12	6.291	54.818	344.431
07/15/16 06:20:00 PM	6,291.60	6.292	54.818	344.433
07/15/16 06:30:00 PM	6,292.74	6.293	54.819	344.435
07/15/16 06:40:00 PM	6,295.50	6.296	54.819	344.440
07/15/16 06:50:00 PM	6,298.44	6.298	54.820	344.446
07/15/16 07:00:00 PM	6,302.82	6.303	54.822	344.455
07/15/16 07:10:00 PM	6,310.80	6.311	54.824	344.471
07/15/16 07:20:00 PM	6,311.04	6.311	54.825	344.472

07/15/16 07:30:00 PM	6,316.80	6.317	54.826	344.483
07/15/16 07:40:00 PM	6,321.36	6.321	54.828	344.493
07/15/16 07:50:00 PM	6,325.68	6.326	54.829	344.501
07/15/16 08:00:00 PM	6,330.30	6.330	54.831	344.511
07/15/16 08:10:00 PM	6,335.34	6.335	54.832	344.521
07/15/16 08:20:00 PM	6,341.94	6.342	54.834	344.534
07/15/16 08:30:00 PM	6,347.46	6.347	54.836	344.546
07/15/16 08:40:00 PM	6,353.88	6.354	54.838	344.558
07/15/16 08:50:00 PM	6,360.06	6.360	54.840	344.571
07/15/16 09:00:00 PM	6,365.10	6.365	54.842	344.582
07/15/16 09:10:00 PM	6,371.04	6.371	54.844	344.594
07/15/16 09:20:00 PM	6,378.12	6.378	54.846	344.608
07/15/16 09:30:00 PM	6,383.40	6.383	54.848	344.619
07/15/16 09:40:00 PM	6,389.10	6.389	54.850	344.630
07/15/16 09:50:00 PM	6,394.38	6.394	54.851	344.641
07/15/16 10:00:00 PM	6,400.32	6.400	54.853	344.653
07/15/16 10:10:00 PM	6,405.36	6.405	54.855	344.663
07/15/16 10:20:00 PM	6,410.82	6.411	54.857	344.675
07/15/16 10:30:00 PM	6,417.00	6.417	54.859	344.687
07/15/16 10:40:00 PM	6,423.00	6.423	54.861	344.699
07/15/16 10:50:00 PM	6,430.08	6.430	54.863	344.713
07/15/16 11:00:00 PM	6,434.64	6.435	54.864	344.723
07/15/16 11:10:00 PM	6,439.26	6.439	54.866	344.733
07/15/16 11:20:00 PM	6,443.10	6.443	54.867	344.741

07/15/16 11:30:00 PM	6,447.90	6.448	54.869	344.750
07/15/16 11:40:00 PM	6,450.66	6.451	54.870	344.756
07/15/16 11:50:00 PM	6,455.46	6.455	54.871	344.766
07/16/16 12:00:00 AM	6,458.46	6.458	54.872	344.772
07/16/16 12:10:00 AM	6,461.46	6.461	54.873	344.778
07/16/16 12:20:00 AM	6,463.26	6.463	54.874	344.782
07/16/16 12:30:00 AM	6,465.78	6.466	54.875	344.787
07/16/16 12:40:00 AM	6,468.06	6.468	54.875	344.792
07/16/16 12:50:00 AM	6,470.16	6.470	54.876	344.796
07/16/16 01:00:00 AM	6,472.44	6.472	54.877	344.801
07/16/16 01:10:00 AM	6,474.48	6.474	54.877	344.805
07/16/16 01:20:00 AM	6,477.00	6.477	54.878	344.810
07/16/16 01:30:00 AM	6,478.80	6.479	54.879	344.814
07/16/16 01:40:00 AM	6,481.32	6.481	54.880	344.819
07/16/16 01:50:00 AM	6,482.94	6.483	54.880	344.822
07/16/16 02:00:00 AM	6,484.08	6.484	54.881	344.824
07/16/16 02:10:00 AM	6,486.36	6.486	54.881	344.829
07/16/16 02:20:00 AM	6,490.26	6.490	54.882	344.836
07/16/16 02:30:00 AM	6,493.68	6.494	54.884	344.844
07/16/16 02:40:00 AM	6,496.68	6.497	54.885	344.850
07/16/16 02:50:00 AM	6,501.72	6.502	54.886	344.860
07/16/16 03:00:00 AM	6,505.86	6.506	54.888	344.868
07/16/16 03:10:00 AM	6,509.28	6.509	54.889	344.875
07/16/16 03:20:00 AM	6,512.46	6.512	54.890	344.882

07/16/16 03:30:00 AM	6,515.70	6.516	54.891	344.888
07/16/16 03:40:00 AM	6,517.98	6.518	54.891	344.893
07/16/16 03:50:00 AM	6,520.26	6.520	54.892	344.898
07/16/16 04:00:00 AM	6,522.30	6.522	54.893	344.902
07/16/16 04:10:00 AM	6,525.54	6.526	54.894	344.908
07/16/16 04:20:00 AM	6,527.58	6.528	54.895	344.913
07/16/16 04:30:00 AM	6,529.62	6.530	54.895	344.917
07/16/16 04:40:00 AM	6,532.38	6.532	54.896	344.922
07/16/16 04:50:00 AM	6,535.62	6.536	54.897	344.929
07/16/16 05:00:00 AM	6,538.80	6.539	54.898	344.935
07/16/16 05:10:00 AM	6,541.08	6.541	54.899	344.940
07/16/16 05:20:00 AM	6,544.98	6.545	54.900	344.948
07/16/16 05:30:00 AM	6,548.88	6.549	54.901	344.956
07/16/16 05:40:00 AM	6,552.96	6.553	54.903	344.964
07/16/16 05:50:00 AM	6,555.72	6.556	54.904	344.970
07/16/16 06:00:00 AM	6,559.62	6.560	54.905	344.978
07/16/16 06:10:00 AM	6,562.80	6.563	54.906	344.984
07/16/16 06:20:00 AM	6,564.90	6.565	54.907	344.989
07/16/16 06:30:00 AM	6,567.42	6.567	54.907	344.994
07/16/16 06:40:00 AM	6,570.18	6.570	54.908	344.999
07/16/16 06:50:00 AM	6,572.70	6.573	54.909	345.004
07/16/16 07:00:00 AM	6,573.36	6.573	54.909	345.006
07/16/16 07:10:00 AM	6,573.36	6.573	54.909	345.006
07/16/16 07:20:00 AM	6,574.02	6.574	54.910	345.007

07/16/16 07:30:00 AM	6,574.02	6.574	54.910	345.008
07/16/16 07:40:00 AM	6,573.84	6.574	54.910	345.007
07/16/16 07:50:00 AM	6,573.84	6.574	54.910	345.007
07/16/16 08:00:00 AM	6,573.36	6.573	54.910	345.006
07/16/16 08:10:00 AM	6,571.98	6.572	54.909	345.004
07/16/16 08:20:00 AM	6,569.46	6.569	54.908	344.999
07/16/16 08:30:00 AM	6,561.48	6.561	54.906	344.983
07/16/16 08:40:00 AM	6,553.68	6.554	54.903	344.968
07/16/16 08:50:00 AM	6,543.36	6.543	54.900	344.947
07/16/16 09:00:00 AM	6,533.76	6.534	54.897	344.928
07/16/16 09:10:00 AM	6,523.02	6.523	54.894	344.906
07/16/16 09:20:00 AM	6,512.94	6.513	54.890	344.885
07/16/16 09:30:00 AM	6,499.44	6.499	54.886	344.858
07/16/16 09:40:00 AM	6,488.70	6.489	54.882	344.836
07/16/16 09:50:00 AM	6,479.28	6.479	54.879	344.817
07/16/16 10:00:00 AM	6,469.44	6.469	54.876	344.797
07/16/16 10:10:00 AM	6,458.70	6.459	54.873	344.775
07/16/16 10:20:00 AM	6,449.10	6.449	54.870	344.755
07/16/16 10:30:00 AM	6,439.44	6.439	54.866	344.736
07/16/16 10:40:00 AM	6,431.70	6.432	54.864	344.720
07/16/16 10:50:00 AM	6,425.04	6.425	54.862	344.706
07/16/16 11:00:00 AM	6,418.38	6.418	54.860	344.692
07/16/16 11:10:00 AM	6,411.30	6.411	54.857	344.678
07/16/16 11:20:00 AM	6,401.70	6.402	54.854	344.659

07/16/16 11:30:00 AM	6,395.04	6.395	54.852	344.645
07/16/16 11:40:00 AM	6,385.20	6.385	54.849	344.625
07/16/16 11:50:00 AM	6,376.50	6.377	54.846	344.607
07/16/16 12:00:00 PM	6,363.72	6.364	54.842	344.582
07/16/16 12:10:00 PM	6,359.82	6.360	54.840	344.573
07/16/16 12:20:00 PM	6,360.48	6.360	54.841	344.573
07/16/16 12:30:00 PM	6,354.54	6.355	54.839	344.562
07/16/16 12:40:00 PM	6,333.00	6.333	54.832	344.521
07/16/16 12:50:00 PM	6,336.72	6.337	54.833	344.524
07/16/16 01:00:00 PM	6,331.44	6.331	54.831	344.515
07/16/16 01:10:00 PM	6,334.20	6.334	54.832	344.519
07/16/16 01:20:00 PM	6,333.24	6.333	54.832	344.518
07/16/16 01:30:00 PM	6,328.92	6.329	54.830	344.510
07/16/16 01:40:00 PM	6,314.94	6.315	54.826	344.483
07/16/16 01:50:00 PM	6,295.92	6.296	54.820	344.445
07/16/16 02:00:00 PM	6,298.02	6.298	54.820	344.446
07/16/16 02:10:00 PM	6,294.60	6.295	54.819	344.440
07/16/16 02:20:00 PM	6,285.90	6.286	54.817	344.423
07/16/16 02:30:00 PM	6,276.06	6.276	54.814	344.403
07/16/16 02:40:00 PM	6,280.38	6.280	54.815	344.410
07/16/16 02:50:00 PM	6,278.34	6.278	54.814	344.406
07/16/16 03:00:00 PM	6,270.06	6.270	54.812	344.391
07/16/16 03:10:00 PM	6,273.06	6.273	54.812	344.395
07/16/16 03:20:00 PM	6,268.50	6.269	54.811	344.387

07/16/16 03:30:00 PM	6,269.64	6.270	54.811	344.388
07/16/16 03:40:00 PM	6,252.24	6.252	54.806	344.356
07/16/16 03:50:00 PM	6,253.62	6.254	54.806	344.356
07/16/16 04:00:00 PM	6,250.86	6.251	54.805	344.350
07/16/16 04:10:00 PM	6,241.92	6.242	54.802	344.333
07/16/16 04:20:00 PM	6,244.02	6.244	54.803	344.336
07/16/16 04:30:00 PM	6,245.82	6.246	54.803	344.339
07/16/16 04:40:00 PM	6,252.00	6.252	54.805	344.351
07/16/16 04:50:00 PM	6,254.04	6.254	54.806	344.356
07/16/16 05:00:00 PM	6,252.90	6.253	54.806	344.354
07/16/16 05:10:00 PM	6,253.14	6.253	54.806	344.355
07/16/16 05:20:00 PM	6,252.90	6.253	54.806	344.354
07/16/16 05:30:00 PM	6,252.90	6.253	54.806	344.354
07/16/16 05:40:00 PM	6,252.90	6.253	54.806	344.354
07/16/16 05:50:00 PM	6,255.42	6.255	54.806	344.359
07/16/16 06:00:00 PM	6,259.56	6.260	54.808	344.367
07/16/16 06:10:00 PM	6,261.18	6.261	54.808	344.371
07/16/16 06:20:00 PM	6,263.22	6.263	54.809	344.375
07/16/16 06:30:00 PM	6,266.22	6.266	54.810	344.381
07/16/16 06:40:00 PM	6,273.96	6.274	54.812	344.396
07/16/16 06:50:00 PM	6,283.56	6.284	54.815	344.415
07/16/16 07:00:00 PM	6,289.08	6.289	54.817	344.427
07/16/16 07:10:00 PM	6,294.12	6.294	54.819	344.437
07/16/16 07:20:00 PM	6,301.92	6.302	54.821	344.453

07/16/16 07:30:00 PM	6,307.38	6.307	54.823	344.464
07/16/16 07:40:00 PM	6,312.66	6.313	54.825	344.475
07/16/16 07:50:00 PM	6,318.36	6.318	54.827	344.486
07/16/16 08:00:00 PM	6,322.26	6.322	54.828	344.495
07/16/16 08:10:00 PM	6,328.44	6.328	54.830	344.507
07/16/16 08:20:00 PM	6,334.20	6.334	54.832	344.519
07/16/16 08:30:00 PM	6,342.18	6.342	54.834	344.534
07/16/16 08:40:00 PM	6,349.74	6.350	54.837	344.550
07/16/16 08:50:00 PM	6,357.30	6.357	54.839	344.565
07/16/16 09:00:00 PM	6,363.90	6.364	54.841	344.579
07/16/16 09:10:00 PM	6,368.28	6.368	54.843	344.588
07/16/16 09:20:00 PM	6,375.60	6.376	54.845	344.603
07/16/16 09:30:00 PM	6,381.30	6.381	54.847	344.614
07/16/16 09:40:00 PM	6,386.82	6.387	54.849	344.626
07/16/16 09:50:00 PM	6,391.62	6.392	54.851	344.636
07/16/16 10:00:00 PM	6,396.90	6.397	54.852	344.646
07/16/16 10:10:00 PM	6,402.36	6.402	54.854	344.657
07/16/16 10:20:00 PM	6,407.16	6.407	54.856	344.667
07/16/16 10:30:00 PM	6,411.06	6.411	54.857	344.675
07/16/16 10:40:00 PM	6,415.20	6.415	54.858	344.684
07/16/16 10:50:00 PM	6,418.20	6.418	54.859	344.690
07/16/16 11:00:00 PM	6,423.42	6.423	54.861	344.700
07/16/16 11:10:00 PM	6,427.80	6.428	54.862	344.709
07/16/16 11:20:00 PM	6,432.60	6.433	54.864	344.719

07/16/16 11:30:00 PM	6,435.78	6.436	54.865	344.726
07/16/16 11:40:00 PM	6,439.92	6.440	54.866	344.734
07/16/16 11:50:00 PM	6,442.92	6.443	54.867	344.740
07/17/16 12:00:00 AM	6,446.76	6.447	54.868	344.748
07/17/16 12:10:00 AM	6,451.80	6.452	54.870	344.758
07/17/16 12:20:00 AM	6,456.18	6.456	54.871	344.767
07/17/16 12:30:00 AM	6,458.46	6.458	54.872	344.772
07/17/16 12:40:00 AM	6,460.98	6.461	54.873	344.777
07/17/16 12:50:00 AM	6,464.16	6.464	54.874	344.784
07/17/16 01:00:00 AM	6,467.64	6.468	54.875	344.791
07/17/16 01:10:00 AM	6,470.58	6.471	54.876	344.797
07/17/16 01:20:00 AM	6,473.10	6.473	54.877	344.802
07/17/16 01:30:00 AM	6,479.28	6.479	54.879	344.814
07/17/16 01:40:00 AM	6,481.56	6.482	54.880	344.819
07/17/16 01:50:00 AM	6,483.84	6.484	54.880	344.824
07/17/16 02:00:00 AM	6,486.84	6.487	54.881	344.830
07/17/16 02:10:00 AM	6,489.36	6.489	54.882	344.835
07/17/16 02:20:00 AM	6,491.64	6.492	54.883	344.840
07/17/16 02:30:00 AM	6,494.16	6.494	54.884	344.845
07/17/16 02:40:00 AM	6,497.34	6.497	54.885	344.851
07/17/16 02:50:00 AM	6,501.00	6.501	54.886	344.858
07/17/16 03:00:00 AM	6,506.28	6.506	54.888	344.869
07/17/16 03:10:00 AM	6,512.22	6.512	54.890	344.881
07/17/16 03:20:00 AM	6,516.36	6.516	54.891	344.889

07/17/16 03:30:00 AM	6,518.64	6.519	54.892	344.894
07/17/16 03:40:00 AM	6,521.88	6.522	54.893	344.901
07/17/16 03:50:00 AM	6,526.44	6.526	54.894	344.910
07/17/16 04:00:00 AM	6,529.86	6.530	54.895	344.917
07/17/16 04:10:00 AM	6,534.24	6.534	54.897	344.926
07/17/16 04:20:00 AM	6,537.66	6.538	54.898	344.933
07/17/16 04:30:00 AM	6,541.56	6.542	54.899	344.941
07/17/16 04:40:00 AM	6,546.36	6.546	54.901	344.950
07/17/16 04:50:00 AM	6,550.68	6.551	54.902	344.959
07/17/16 05:00:00 AM	6,555.30	6.555	54.904	344.969
07/17/16 05:10:00 AM	6,560.34	6.560	54.905	344.979
07/17/16 05:20:00 AM	6,564.42	6.564	54.906	344.987
07/17/16 05:30:00 AM	6,568.08	6.568	54.908	344.995
07/17/16 05:40:00 AM	6,572.70	6.573	54.909	345.004
07/17/16 05:50:00 AM	6,577.26	6.577	54.911	345.013
07/17/16 06:00:00 AM	6,581.82	6.582	54.912	345.023
07/17/16 06:10:00 AM	6,586.20	6.586	54.914	345.032
07/17/16 06:20:00 AM	6,587.52	6.588	54.914	345.035
07/17/16 06:30:00 AM	6,589.14	6.589	54.915	345.038
07/17/16 06:40:00 AM	6,591.24	6.591	54.915	345.042
07/17/16 06:50:00 AM	6,592.56	6.593	54.916	345.045
07/17/16 07:00:00 AM	6,592.56	6.593	54.916	345.045
07/17/16 07:10:00 AM	6,592.56	6.593	54.916	345.045
07/17/16 07:20:00 AM	6,592.56	6.593	54.916	345.045

07/17/16 07:30:00 AM	6,592.56	6.593	54.916	345.045
07/17/16 07:40:00 AM	6,592.56	6.593	54.916	345.045
07/17/16 07:50:00 AM	6,592.38	6.592	54.916	345.045
07/17/16 08:00:00 AM	6,592.14	6.592	54.916	345.044
07/17/16 08:10:00 AM	6,591.90	6.592	54.916	345.044
07/17/16 08:20:00 AM	6,590.76	6.591	54.915	345.042
07/17/16 08:30:00 AM	6,588.48	6.588	54.914	345.037
07/17/16 08:40:00 AM	6,588.00	6.588	54.914	345.036
07/17/16 08:50:00 AM	6,586.62	6.587	54.914	345.033
07/17/16 09:00:00 AM	6,581.58	6.582	54.912	345.024
07/17/16 09:10:00 AM	6,578.88	6.579	54.911	345.018
07/17/16 09:20:00 AM	6,577.02	6.577	54.911	345.014
07/17/16 09:30:00 AM	6,574.98	6.575	54.910	345.010
07/17/16 09:40:00 AM	6,572.46	6.572	54.909	345.005
07/17/16 09:50:00 AM	6,565.56	6.566	54.907	344.992
07/17/16 10:00:00 AM	6,564.66	6.565	54.907	344.989
07/17/16 10:10:00 AM	6,558.72	6.559	54.905	344.978
07/17/16 10:20:00 AM	6,550.68	6.551	54.902	344.962
07/17/16 10:30:00 AM	6,549.54	6.550	54.902	344.958
07/17/16 10:40:00 AM	6,539.28	6.539	54.899	344.939
07/17/16 10:50:00 AM	6,536.04	6.536	54.898	344.931
07/17/16 11:00:00 AM	6,535.14	6.535	54.897	344.929
07/17/16 11:10:00 AM	6,524.16	6.524	54.894	344.908
07/17/16 11:20:00 AM	6,514.98	6.515	54.891	344.889

07/17/16 11:30:00 AM	6,506.76	6.507	54.888	344.872
07/17/16 11:40:00 AM	6,495.54	6.496	54.885	344.850
07/17/16 11:50:00 AM	6,486.60	6.487	54.882	344.831
07/17/16 12:00:00 PM	6,485.22	6.485	54.881	344.827
07/17/16 12:10:00 PM	6,467.16	6.467	54.876	344.793
07/17/16 12:20:00 PM	6,460.74	6.461	54.873	344.779
07/17/16 12:30:00 PM	6,447.48	6.447	54.869	344.753
07/17/16 12:40:00 PM	6,444.06	6.444	54.868	344.744
07/17/16 12:50:00 PM	6,435.78	6.436	54.865	344.728
07/17/16 01:00:00 PM	6,410.64	6.411	54.858	344.680
07/17/16 01:10:00 PM	6,409.26	6.409	54.856	344.673
07/17/16 01:20:00 PM	6,403.08	6.403	54.855	344.661
07/17/16 01:30:00 PM	6,387.30	6.387	54.850	344.631
07/17/16 01:40:00 PM	6,382.68	6.383	54.848	344.619
07/17/16 01:50:00 PM	6,377.22	6.377	54.846	344.608
07/17/16 02:00:00 PM	6,372.42	6.372	54.845	344.598
07/17/16 02:10:00 PM	6,369.42	6.369	54.844	344.592
07/17/16 02:20:00 PM	6,366.66	6.367	54.843	344.586
07/17/16 02:30:00 PM	6,369.90	6.370	54.844	344.592
07/17/16 02:40:00 PM	6,359.10	6.359	54.840	344.572
07/17/16 02:50:00 PM	6,350.22	6.350	54.838	344.554
07/17/16 03:00:00 PM	6,337.62	6.338	54.834	344.529
07/17/16 03:10:00 PM	6,342.18	6.342	54.835	344.535
07/17/16 03:20:00 PM	6,332.58	6.333	54.832	344.518

07/17/16 03:30:00 PM	6,334.38	6.334	54.832	344.520
07/17/16 03:40:00 PM	6,333.24	6.333	54.832	344.518
07/17/16 03:50:00 PM	6,328.92	6.329	54.830	344.510
07/17/16 04:00:00 PM	6,324.36	6.324	54.829	344.500
07/17/16 04:10:00 PM	6,319.32	6.319	54.827	344.490
07/17/16 04:20:00 PM	6,318.18	6.318	54.827	344.487
07/17/16 04:30:00 PM	6,307.86	6.308	54.824	344.468
07/17/16 04:40:00 PM	6,307.86	6.308	54.824	344.466
07/17/16 04:50:00 PM	6,310.14	6.310	54.824	344.470
07/17/16 05:00:00 PM	6,300.30	6.300	54.821	344.452
07/17/16 05:10:00 PM	6,301.44	6.301	54.821	344.453
07/17/16 05:20:00 PM	6,302.82	6.303	54.822	344.456
07/17/16 05:30:00 PM	6,301.92	6.302	54.822	344.454
07/17/16 05:40:00 PM	6,301.20	6.301	54.821	344.453
07/17/16 05:50:00 PM	6,302.82	6.303	54.822	344.456
07/17/16 06:00:00 PM	6,304.86	6.305	54.822	344.460
07/17/16 06:10:00 PM	6,306.00	6.306	54.823	344.462
07/17/16 06:20:00 PM	6,306.24	6.306	54.823	344.463
07/17/16 06:30:00 PM	6,308.52	6.309	54.824	344.467
07/17/16 06:40:00 PM	6,309.00	6.309	54.824	344.468
07/17/16 06:50:00 PM	6,311.76	6.312	54.825	344.473
07/17/16 07:00:00 PM	6,317.94	6.318	54.827	344.485
07/17/16 07:10:00 PM	6,323.40	6.323	54.828	344.497
07/17/16 07:20:00 PM	6,325.50	6.326	54.829	344.501

07/17/16 07:30:00 PM	6,325.68	6.326	54.829	344.502
07/17/16 07:40:00 PM	6,329.34	6.329	54.830	344.509
07/17/16 07:50:00 PM	6,332.34	6.332	54.831	344.515
07/17/16 08:00:00 PM	6,335.76	6.336	54.832	344.522
07/17/16 08:10:00 PM	6,339.42	6.339	54.834	344.530
07/17/16 08:20:00 PM	6,344.22	6.344	54.835	344.539
07/17/16 08:30:00 PM	6,349.74	6.350	54.837	344.550
07/17/16 08:40:00 PM	6,355.44	6.355	54.839	344.562
07/17/16 08:50:00 PM	6,360.24	6.360	54.840	344.572
07/17/16 09:00:00 PM	6,364.86	6.365	54.842	344.581
07/17/16 09:10:00 PM	6,368.04	6.368	54.843	344.588
07/17/16 09:20:00 PM	6,373.32	6.373	54.845	344.598
07/17/16 09:30:00 PM	6,377.64	6.378	54.846	344.607
07/17/16 09:40:00 PM	6,381.78	6.382	54.847	344.616
07/17/16 09:50:00 PM	6,384.78	6.385	54.848	344.622
07/17/16 10:00:00 PM	6,389.34	6.389	54.850	344.631
07/17/16 10:10:00 PM	6,392.76	6.393	54.851	344.638
07/17/16 10:20:00 PM	6,395.04	6.395	54.852	344.643
07/17/16 10:30:00 PM	6,398.94	6.399	54.853	344.651
07/17/16 10:40:00 PM	6,403.32	6.403	54.854	344.659
07/17/16 10:50:00 PM	6,407.16	6.407	54.856	344.667
07/17/16 11:00:00 PM	6,409.92	6.410	54.856	344.673
07/17/16 11:10:00 PM	6,413.16	6.413	54.858	344.680
07/17/16 11:20:00 PM	6,416.58	6.417	54.859	344.687

07/17/16 11:30:00 PM	6,419.76	6.420	54.860	344.693
07/17/16 11:40:00 PM	6,423.00	6.423	54.861	344.700
07/17/16 11:50:00 PM	6,426.18	6.426	54.862	344.706
07/18/16 12:00:00 AM	6,429.60	6.430	54.863	344.713
07/18/16 12:10:00 AM	6,433.50	6.434	54.864	344.721
07/18/16 12:20:00 AM	6,436.74	6.437	54.865	344.728
07/18/16 12:30:00 AM	6,439.68	6.440	54.866	344.734
07/18/16 12:40:00 AM	6,442.44	6.442	54.867	344.739
07/18/16 12:50:00 AM	6,444.06	6.444	54.868	344.743
07/18/16 01:00:00 AM	6,446.76	6.447	54.868	344.748
07/18/16 01:10:00 AM	6,449.76	6.450	54.869	344.754
07/18/16 01:20:00 AM	6,452.04	6.452	54.870	344.759
07/18/16 01:30:00 AM	6,454.08	6.454	54.871	344.763
07/18/16 01:40:00 AM	6,457.08	6.457	54.872	344.769
07/18/16 01:50:00 AM	6,459.36	6.459	54.873	344.774
07/18/16 02:00:00 AM	6,460.74	6.461	54.873	344.777
07/18/16 02:10:00 AM	6,463.26	6.463	54.874	344.782
07/18/16 02:20:00 AM	6,465.54	6.466	54.875	344.786
07/18/16 02:30:00 AM	6,467.82	6.468	54.875	344.791
07/18/16 02:40:00 AM	6,469.44	6.469	54.876	344.795
07/18/16 02:50:00 AM	6,471.06	6.471	54.876	344.798
07/18/16 03:00:00 AM	6,473.10	6.473	54.877	344.802
07/18/16 03:10:00 AM	6,475.14	6.475	54.878	344.806
07/18/16 03:20:00 AM	6,477.48	6.477	54.878	344.811

07/18/16 03:30:00 AM	6,480.42	6.480	54.879	344.817
07/18/16 03:40:00 AM	6,482.94	6.483	54.880	344.822
07/18/16 03:50:00 AM	6,484.80	6.485	54.881	344.826
07/18/16 04:00:00 AM	6,487.32	6.487	54.882	344.831
07/18/16 04:10:00 AM	6,489.60	6.490	54.882	344.835
07/18/16 04:20:00 AM	6,493.26	6.493	54.883	344.843
07/18/16 04:30:00 AM	6,497.34	6.497	54.885	344.851
07/18/16 04:40:00 AM	6,501.24	6.501	54.886	344.859
07/18/16 04:50:00 AM	6,505.86	6.506	54.888	344.868
07/18/16 05:00:00 AM	6,509.04	6.509	54.889	344.875
07/18/16 05:10:00 AM	6,512.70	6.513	54.890	344.882
07/18/16 05:20:00 AM	6,516.84	6.517	54.891	344.891
07/18/16 05:30:00 AM	6,520.50	6.521	54.892	344.898
07/18/16 05:40:00 AM	6,523.26	6.523	54.893	344.904
07/18/16 05:50:00 AM	6,526.92	6.527	54.894	344.911
07/18/16 06:00:00 AM	6,531.24	6.531	54.896	344.920
07/18/16 06:10:00 AM	6,534.66	6.535	54.897	344.927
07/18/16 06:20:00 AM	6,538.08	6.538	54.898	344.934
07/18/16 06:30:00 AM	6,542.46	6.542	54.899	344.943
07/18/16 06:40:00 AM	6,546.36	6.546	54.901	344.951
07/18/16 06:50:00 AM	6,551.82	6.552	54.902	344.961
07/18/16 07:00:00 AM	6,556.44	6.556	54.904	344.971
07/18/16 07:10:00 AM	6,557.10	6.557	54.904	344.973
07/18/16 07:20:00 AM	6,560.52	6.561	54.905	344.980

07/18/16 07:30:00 AM	6,564.18	6.564	54.906	344.987
07/18/16 07:40:00 AM	6,564.42	6.564	54.907	344.988
07/18/16 07:50:00 AM	6,564.18	6.564	54.907	344.988
07/18/16 08:00:00 AM	6,564.18	6.564	54.907	344.988
07/18/16 08:10:00 AM	6,563.52	6.564	54.906	344.986
07/18/16 08:20:00 AM	6,562.80	6.563	54.906	344.985
07/18/16 08:30:00 AM	6,561.66	6.562	54.906	344.983
07/18/16 08:40:00 AM	6,559.62	6.560	54.905	344.979
07/18/16 08:50:00 AM	6,557.10	6.557	54.904	344.974
07/18/16 09:00:00 AM	6,552.96	6.553	54.903	344.966
07/18/16 09:10:00 AM	6,548.16	6.548	54.901	344.956
07/18/16 09:20:00 AM	6,542.22	6.542	54.900	344.944
07/18/16 09:30:00 AM	6,535.80	6.536	54.898	344.931
07/18/16 09:40:00 AM	6,530.10	6.530	54.896	344.919
07/18/16 09:50:00 AM	6,523.02	6.523	54.893	344.905
07/18/16 10:00:00 AM	6,516.12	6.516	54.891	344.891
07/18/16 10:10:00 AM	6,509.28	6.509	54.889	344.877
07/18/16 10:20:00 AM	6,501.00	6.501	54.886	344.861
07/18/16 10:30:00 AM	6,496.68	6.497	54.885	344.851
07/18/16 10:40:00 AM	6,487.32	6.487	54.882	344.833
07/18/16 10:50:00 AM	6,478.38	6.478	54.879	344.815
07/18/16 11:00:00 AM	6,470.16	6.470	54.876	344.798
07/18/16 11:10:00 AM	6,466.02	6.466	54.875	344.789
07/18/16 11:20:00 AM	6,447.72	6.448	54.869	344.754

07/18/16 11:30:00 AM	6,435.36	6.435	54.865	344.728
07/18/16 11:40:00 AM	6,430.56	6.431	54.863	344.717
07/18/16 11:50:00 AM	6,419.52	6.420	54.860	344.695
07/18/16 12:00:00 PM	6,405.84	6.406	54.856	344.668
07/18/16 12:10:00 PM	6,394.38	6.394	54.852	344.644
07/18/16 12:20:00 PM	6,382.92	6.383	54.848	344.621
07/18/16 12:30:00 PM	6,373.56	6.374	54.845	344.602
07/18/16 12:40:00 PM	6,364.14	6.364	54.842	344.582
07/18/16 12:50:00 PM	6,364.62	6.365	54.842	344.582
07/18/16 01:00:00 PM	6,359.34	6.359	54.840	344.572
07/18/16 01:10:00 PM	6,343.80	6.344	54.836	344.542
07/18/16 01:20:00 PM	6,328.44	6.328	54.831	344.511
07/18/16 01:30:00 PM	6,322.98	6.323	54.829	344.498
07/18/16 01:40:00 PM	6,314.70	6.315	54.826	344.481
07/18/16 01:50:00 PM	6,304.62	6.305	54.823	344.461
07/18/16 02:00:00 PM	6,291.84	6.292	54.819	344.436
07/18/16 02:10:00 PM	6,287.94	6.288	54.817	344.426
07/18/16 02:20:00 PM	6,288.18	6.288	54.817	344.426
07/18/16 02:30:00 PM	6,292.26	6.292	54.818	344.434
07/18/16 02:40:00 PM	6,289.56	6.290	54.818	344.429
07/18/16 02:50:00 PM	6,290.94	6.291	54.818	344.431
07/18/16 03:00:00 PM	6,292.74	6.293	54.819	344.435
07/18/16 03:10:00 PM	6,292.08	6.292	54.818	344.434
07/18/16 03:20:00 PM	6,295.50	6.296	54.819	344.440

07/18/16 03:30:00 PM	6,291.36	6.291	54.818	344.433
07/18/16 03:40:00 PM	6,284.94	6.285	54.816	344.421
07/18/16 03:50:00 PM	6,283.56	6.284	54.816	344.417
07/18/16 04:00:00 PM	6,287.46	6.287	54.817	344.424
07/18/16 04:10:00 PM	6,287.04	6.287	54.817	344.424
07/18/16 04:20:00 PM	6,285.66	6.286	54.816	344.421
07/18/16 04:30:00 PM	6,280.38	6.280	54.815	344.411
07/18/16 04:40:00 PM	6,273.54	6.274	54.813	344.397
07/18/16 04:50:00 PM	6,275.34	6.275	54.813	344.400
07/18/16 05:00:00 PM	6,271.20	6.271	54.812	344.392
07/18/16 05:10:00 PM	6,271.02	6.271	54.812	344.391
07/18/16 05:20:00 PM	6,271.20	6.271	54.812	344.391
07/18/16 05:30:00 PM	6,271.02	6.271	54.812	344.391
07/18/16 05:40:00 PM	6,273.30	6.273	54.812	344.395
07/18/16 05:50:00 PM	6,274.68	6.275	54.813	344.398
07/18/16 06:00:00 PM	6,274.44	6.274	54.813	344.398
07/18/16 06:10:00 PM	6,275.82	6.276	54.813	344.401
07/18/16 06:20:00 PM	6,276.24	6.276	54.813	344.402
07/18/16 06:30:00 PM	6,277.86	6.278	54.814	344.405
07/18/16 06:40:00 PM	6,278.58	6.279	54.814	344.406
07/18/16 06:50:00 PM	6,282.66	6.283	54.815	344.414
07/18/16 07:00:00 PM	6,285.18	6.285	54.816	344.419
07/18/16 07:10:00 PM	6,290.46	6.290	54.818	344.430
07/18/16 07:20:00 PM	6,292.98	6.293	54.819	344.435

07/18/16 07:30:00 PM	6,299.64	6.300	54.821	344.448
07/18/16 07:40:00 PM	6,306.24	6.306	54.823	344.461
07/18/16 07:50:00 PM	6,313.32	6.313	54.825	344.476
07/18/16 08:00:00 PM	6,319.50	6.320	54.827	344.489
07/18/16 08:10:00 PM	6,323.64	6.324	54.829	344.497
07/18/16 08:20:00 PM	6,328.68	6.329	54.830	344.507
07/18/16 08:30:00 PM	6,333.72	6.334	54.832	344.518
07/18/16 08:40:00 PM	6,340.38	6.340	54.834	344.531
07/18/16 08:50:00 PM	6,346.74	6.347	54.836	344.544
07/18/16 09:00:00 PM	6,354.30	6.354	54.838	344.559
07/18/16 09:10:00 PM	6,360.96	6.361	54.841	344.573
07/18/16 09:20:00 PM	6,366.42	6.366	54.842	344.584
07/18/16 09:30:00 PM	6,373.98	6.374	54.845	344.599
07/18/16 09:40:00 PM	6,379.92	6.380	54.847	344.612
07/18/16 09:50:00 PM	6,385.44	6.385	54.848	344.623
07/18/16 10:00:00 PM	6,390.72	6.391	54.850	344.634
07/18/16 10:10:00 PM	6,396.00	6.396	54.852	344.644
07/18/16 10:20:00 PM	6,400.80	6.401	54.853	344.654
07/18/16 10:30:00 PM	6,405.36	6.405	54.855	344.664
07/18/16 10:40:00 PM	6,410.82	6.411	54.857	344.675
07/18/16 10:50:00 PM	6,415.20	6.415	54.858	344.684
07/18/16 11:00:00 PM	6,420.24	6.420	54.860	344.694
07/18/16 11:10:00 PM	6,425.70	6.426	54.862	344.705
07/18/16 11:20:00 PM	6,430.74	6.431	54.863	344.715

07/18/16 11:30:00 PM	6,435.12	6.435	54.865	344.724
07/18/16 11:40:00 PM	6,439.02	6.439	54.866	344.732
07/18/16 11:50:00 PM	6,442.92	6.443	54.867	344.740
07/19/16 12:00:00 AM	6,447.48	6.447	54.869	344.749
07/19/16 12:10:00 AM	6,451.62	6.452	54.870	344.758
07/19/16 12:20:00 AM	6,455.28	6.455	54.871	344.765
07/19/16 12:30:00 AM	6,458.46	6.458	54.872	344.772
07/19/16 12:40:00 AM	6,462.78	6.463	54.874	344.780
07/19/16 12:50:00 AM	6,466.68	6.467	54.875	344.788
07/19/16 01:00:00 AM	6,470.16	6.470	54.876	344.796
07/19/16 01:10:00 AM	6,473.58	6.474	54.877	344.803
07/19/16 01:20:00 AM	6,477.24	6.477	54.878	344.810
07/19/16 01:30:00 AM	6,481.32	6.481	54.880	344.818
07/19/16 01:40:00 AM	6,484.32	6.484	54.881	344.825
07/19/16 01:50:00 AM	6,488.88	6.489	54.882	344.834
07/19/16 02:00:00 AM	6,495.06	6.495	54.884	344.846
07/19/16 02:10:00 AM	6,498.72	6.499	54.885	344.854
07/19/16 02:20:00 AM	6,502.38	6.502	54.886	344.861
07/19/16 02:30:00 AM	6,506.76	6.507	54.888	344.870
07/19/16 02:40:00 AM	6,510.42	6.510	54.889	344.878
07/19/16 02:50:00 AM	6,515.88	6.516	54.891	344.888
07/19/16 03:00:00 AM	6,519.78	6.520	54.892	344.897
07/19/16 03:10:00 AM	6,523.26	6.523	54.893	344.904
07/19/16 03:20:00 AM	6,527.82	6.528	54.895	344.913

07/19/16 03:30:00 AM	6,532.62	6.533	54.896	344.922
07/19/16 03:40:00 AM	6,538.08	6.538	54.898	344.933
07/19/16 03:50:00 AM	6,542.22	6.542	54.899	344.942
07/19/16 04:00:00 AM	6,547.74	6.548	54.901	344.953
07/19/16 04:10:00 AM	6,551.40	6.551	54.902	344.961
07/19/16 04:20:00 AM	6,556.20	6.556	54.904	344.970
07/19/16 04:30:00 AM	6,560.52	6.561	54.905	344.979
07/19/16 04:40:00 AM	6,564.90	6.565	54.907	344.988
07/19/16 04:50:00 AM	6,568.98	6.569	54.908	344.997
07/19/16 05:00:00 AM	6,574.98	6.575	54.910	345.008
07/19/16 05:10:00 AM	6,579.54	6.580	54.911	345.018
07/19/16 05:20:00 AM	6,583.44	6.583	54.913	345.026
07/19/16 05:30:00 AM	6,588.00	6.588	54.914	345.035
07/19/16 05:40:00 AM	6,591.90	6.592	54.915	345.043
07/19/16 05:50:00 AM	6,596.70	6.597	54.917	345.053
07/19/16 06:00:00 AM	6,600.84	6.601	54.918	345.061
07/19/16 06:10:00 AM	6,604.74	6.605	54.920	345.069
07/19/16 06:20:00 AM	6,608.40	6.608	54.921	345.077
07/19/16 06:30:00 AM	6,612.72	6.613	54.922	345.086
07/19/16 06:40:00 AM	6,617.52	6.618	54.924	345.095
07/19/16 06:50:00 AM	6,621.42	6.621	54.925	345.103
07/19/16 07:00:00 AM	6,624.60	6.625	54.926	345.110
07/19/16 07:10:00 AM	6,628.50	6.629	54.927	345.118
07/19/16 07:20:00 AM	6,631.02	6.631	54.928	345.123

07/19/16 07:30:00 AM	6,634.50	6.635	54.929	345.130
07/19/16 07:40:00 AM	6,637.20	6.637	54.930	345.136
07/19/16 07:50:00 AM	6,641.82	6.642	54.932	345.145
07/19/16 08:00:00 AM	6,646.80	6.647	54.933	345.155
07/19/16 08:10:00 AM	6,649.32	6.649	54.934	345.160
07/19/16 08:20:00 AM	6,650.52	6.651	54.934	345.163
07/19/16 08:30:00 AM	6,650.70	6.651	54.935	345.163
07/19/16 08:40:00 AM	6,650.04	6.650	54.934	345.162
07/19/16 08:50:00 AM	6,648.66	6.649	54.934	345.160
07/19/16 09:00:00 AM	6,648.00	6.648	54.934	345.158
07/19/16 09:10:00 AM	6,648.00	6.648	54.934	345.158
07/19/16 09:20:00 AM	6,645.66	6.646	54.933	345.154
07/19/16 09:30:00 AM	6,642.48	6.642	54.932	345.147
07/19/16 09:40:00 AM	6,635.16	6.635	54.930	345.133
07/19/16 09:50:00 AM	6,625.08	6.625	54.927	345.113
07/19/16 10:00:00 AM	6,609.78	6.610	54.922	345.083
07/19/16 10:10:00 AM	6,586.86	6.587	54.915	345.038
07/19/16 10:20:00 AM	6,570.60	6.571	54.909	345.004
07/19/16 10:30:00 AM	6,555.96	6.556	54.904	344.974
07/19/16 10:40:00 AM	6,542.46	6.542	54.900	344.946
07/19/16 10:50:00 AM	6,530.10	6.530	54.896	344.921
07/19/16 11:00:00 AM	6,516.36	6.516	54.891	344.893
07/19/16 11:10:00 AM	6,501.96	6.502	54.887	344.864
07/19/16 11:20:00 AM	6,482.28	6.482	54.881	344.825

07/19/16 11:30:00 AM	6,468.06	6.468	54.876	344.795
07/19/16 11:40:00 AM	6,457.98	6.458	54.872	344.774
07/19/16 11:50:00 AM	6,448.14	6.448	54.869	344.753
07/19/16 12:00:00 PM	6,434.88	6.435	54.865	344.727
07/19/16 12:10:00 PM	6,418.62	6.419	54.860	344.694
07/19/16 12:20:00 PM	6,394.38	6.394	54.852	344.647
07/19/16 12:30:00 PM	6,386.58	6.387	54.849	344.628
07/19/16 12:40:00 PM	6,376.08	6.376	54.846	344.607
07/19/16 12:50:00 PM	6,369.42	6.369	54.844	344.593
07/19/16 01:00:00 PM	6,354.06	6.354	54.839	344.563
07/19/16 01:10:00 PM	6,340.56	6.341	54.835	344.535
07/19/16 01:20:00 PM	6,338.04	6.338	54.833	344.528
07/19/16 01:30:00 PM	6,325.02	6.325	54.829	344.503
07/19/16 01:40:00 PM	6,318.60	6.319	54.827	344.489
07/19/16 01:50:00 PM	6,303.72	6.304	54.823	344.460
07/19/16 02:00:00 PM	6,300.78	6.301	54.821	344.452
07/19/16 02:10:00 PM	6,303.72	6.304	54.822	344.457
07/19/16 02:20:00 PM	6,298.44	6.298	54.821	344.448
07/19/16 02:30:00 PM	6,292.50	6.293	54.819	344.436
07/19/16 02:40:00 PM	6,276.72	6.277	54.814	344.405
07/19/16 02:50:00 PM	6,268.26	6.268	54.811	344.387
07/19/16 03:00:00 PM	6,262.98	6.263	54.809	344.376
07/19/16 03:10:00 PM	6,258.18	6.258	54.808	344.366
07/19/16 03:20:00 PM	6,253.14	6.253	54.806	344.356

07/19/16 03:30:00 PM	6,246.06	6.246	54.804	344.342
07/19/16 03:40:00 PM	6,241.68	6.242	54.802	344.332
07/19/16 03:50:00 PM	6,237.12	6.237	54.801	344.323
07/19/16 04:00:00 PM	6,228.18	6.228	54.798	344.305
07/19/16 04:10:00 PM	6,221.10	6.221	54.796	344.291
07/19/16 04:20:00 PM	6,222.00	6.222	54.796	344.291
07/19/16 04:30:00 PM	6,218.10	6.218	54.795	344.284
07/19/16 04:40:00 PM	6,217.20	6.217	54.794	344.282
07/19/16 04:50:00 PM	6,216.78	6.217	54.794	344.281
07/19/16 05:00:00 PM	6,217.92	6.218	54.794	344.283
07/19/16 05:10:00 PM	6,217.92	6.218	54.794	344.283
07/19/16 05:20:00 PM	6,221.10	6.221	54.795	344.289
07/19/16 05:30:00 PM	6,222.00	6.222	54.796	344.291
07/19/16 05:40:00 PM	6,229.56	6.230	54.798	344.305
07/19/16 05:50:00 PM	6,231.42	6.231	54.799	344.310
07/19/16 06:00:00 PM	6,237.36	6.237	54.801	344.321
07/19/16 06:10:00 PM	6,237.12	6.237	54.801	344.322
07/19/16 06:20:00 PM	6,238.50	6.239	54.801	344.325
07/19/16 06:30:00 PM	6,245.82	6.246	54.803	344.338
07/19/16 06:40:00 PM	6,255.00	6.255	54.806	344.357
07/19/16 06:50:00 PM	6,256.14	6.256	54.807	344.360
07/19/16 07:00:00 PM	6,262.32	6.262	54.809	344.372
07/19/16 07:10:00 PM	6,269.16	6.269	54.811	344.386
07/19/16 07:20:00 PM	6,274.92	6.275	54.813	344.398

07/19/16 07:30:00 PM	6,280.38	6.280	54.814	344.409
07/19/16 07:40:00 PM	6,288.42	6.288	54.817	344.425
07/19/16 07:50:00 PM	6,296.16	6.296	54.819	344.441
07/19/16 08:00:00 PM	6,301.20	6.301	54.821	344.451
07/19/16 08:10:00 PM	6,306.96	6.307	54.823	344.463
07/19/16 08:20:00 PM	6,313.80	6.314	54.825	344.477
07/19/16 08:30:00 PM	6,319.32	6.319	54.827	344.488
07/19/16 08:40:00 PM	6,325.02	6.325	54.829	344.500
07/19/16 08:50:00 PM	6,331.68	6.332	54.831	344.513
07/19/16 09:00:00 PM	6,340.80	6.341	54.834	344.531
07/19/16 09:10:00 PM	6,348.12	6.348	54.836	344.547
07/19/16 09:20:00 PM	6,355.44	6.355	54.839	344.561
07/19/16 09:30:00 PM	6,361.20	6.361	54.841	344.573
07/19/16 09:40:00 PM	6,366.66	6.367	54.842	344.585
07/19/16 09:50:00 PM	6,372.18	6.372	54.844	344.596
07/19/16 10:00:00 PM	6,377.88	6.378	54.846	344.607
07/19/16 10:10:00 PM	6,381.30	6.381	54.847	344.615
07/19/16 10:20:00 PM	6,384.78	6.385	54.848	344.622
07/19/16 10:30:00 PM	6,389.58	6.390	54.850	344.631
07/19/16 10:40:00 PM	6,395.52	6.396	54.852	344.643
07/19/16 10:50:00 PM	6,400.80	6.401	54.853	344.654
07/19/16 11:00:00 PM	6,404.22	6.404	54.855	344.661
07/19/16 11:10:00 PM	6,407.88	6.408	54.856	344.669
07/19/16 11:20:00 PM	6,415.20	6.415	54.858	344.683

07/19/16 11:30:00 PM	6,421.14	6.421	54.860	344.695
07/19/16 11:40:00 PM	6,423.00	6.423	54.861	344.700
07/19/16 11:50:00 PM	6,427.08	6.427	54.862	344.708
07/20/16 12:00:00 AM	6,430.74	6.431	54.863	344.715
07/20/16 12:10:00 AM	6,433.26	6.433	54.864	344.721
07/20/16 12:20:00 AM	6,436.92	6.437	54.865	344.728
07/20/16 12:30:00 AM	6,439.92	6.440	54.866	344.734
07/20/16 12:40:00 AM	6,442.44	6.442	54.867	344.739
07/20/16 12:50:00 AM	6,445.86	6.446	54.868	344.746
07/20/16 01:00:00 AM	6,448.86	6.449	54.869	344.752
07/20/16 01:10:00 AM	6,453.66	6.454	54.871	344.762
07/20/16 01:20:00 AM	6,455.46	6.455	54.871	344.766
07/20/16 01:30:00 AM	6,460.08	6.460	54.873	344.775
07/20/16 01:40:00 AM	6,463.50	6.464	54.874	344.782
07/20/16 01:50:00 AM	6,465.54	6.466	54.875	344.787
07/20/16 02:00:00 AM	6,467.82	6.468	54.875	344.791
07/20/16 02:10:00 AM	6,471.48	6.471	54.876	344.798
07/20/16 02:20:00 AM	6,476.34	6.476	54.878	344.808
07/20/16 02:30:00 AM	6,483.84	6.484	54.880	344.823
07/20/16 02:40:00 AM	6,494.16	6.494	54.884	344.843
07/20/16 02:50:00 AM	6,502.86	6.503	54.886	344.861
07/20/16 03:00:00 AM	6,507.90	6.508	54.888	344.872
07/20/16 03:10:00 AM	6,512.46	6.512	54.890	344.881
07/20/16 03:20:00 AM	6,520.74	6.521	54.892	344.898

07/20/16 03:30:00 AM	6,523.26	6.523	54.893	344.904
07/20/16 03:40:00 AM	6,527.58	6.528	54.895	344.912
07/20/16 03:50:00 AM	6,531.00	6.531	54.896	344.919
07/20/16 04:00:00 AM	6,534.66	6.535	54.897	344.927
07/20/16 04:10:00 AM	6,538.80	6.539	54.898	344.935
07/20/16 04:20:00 AM	6,543.36	6.543	54.900	344.944
07/20/16 04:30:00 AM	6,547.26	6.547	54.901	344.952
07/20/16 04:40:00 AM	6,550.68	6.551	54.902	344.959
07/20/16 04:50:00 AM	6,553.44	6.553	54.903	344.965
07/20/16 05:00:00 AM	6,556.86	6.557	54.904	344.972
07/20/16 05:10:00 AM	6,560.10	6.560	54.905	344.979
07/20/16 05:20:00 AM	6,562.62	6.563	54.906	344.984
07/20/16 05:30:00 AM	6,566.52	6.567	54.907	344.992
07/20/16 05:40:00 AM	6,569.70	6.570	54.908	344.998
07/20/16 05:50:00 AM	6,572.46	6.572	54.909	345.004
07/20/16 06:00:00 AM	6,576.78	6.577	54.910	345.012
07/20/16 06:10:00 AM	6,580.44	6.580	54.912	345.020
07/20/16 06:20:00 AM	6,583.86	6.584	54.913	345.027
07/20/16 06:30:00 AM	6,588.72	6.589	54.914	345.037
07/20/16 06:40:00 AM	6,591.24	6.591	54.915	345.042
07/20/16 06:50:00 AM	6,592.56	6.593	54.916	345.045
07/20/16 07:00:00 AM	6,593.28	6.593	54.916	345.047
07/20/16 07:10:00 AM	6,594.66	6.595	54.916	345.049
07/20/16 07:20:00 AM	6,594.66	6.595	54.916	345.050

07/20/16 07:30:00 AM	6,593.52	6.594	54.916	345.047
07/20/16 07:40:00 AM	6,591.42	6.591	54.915	345.043
07/20/16 07:50:00 AM	6,586.86	6.587	54.914	345.035
07/20/16 08:00:00 AM	6,580.44	6.580	54.912	345.022
07/20/16 08:10:00 AM	6,573.84	6.574	54.910	345.008
07/20/16 08:20:00 AM	6,568.80	6.569	54.908	344.998
07/20/16 08:30:00 AM	6,561.24	6.561	54.906	344.983
07/20/16 08:40:00 AM	6,549.54	6.550	54.902	344.960
07/20/16 08:50:00 AM	6,539.46	6.539	54.899	344.939
07/20/16 09:00:00 AM	6,528.48	6.528	54.895	344.917
07/20/16 09:10:00 AM	6,519.78	6.520	54.892	344.899
07/20/16 09:20:00 AM	6,505.62	6.506	54.888	344.871
07/20/16 09:30:00 AM	6,493.50	6.494	54.884	344.846
07/20/16 09:40:00 AM	6,482.04	6.482	54.880	344.823
07/20/16 09:50:00 AM	6,468.54	6.469	54.876	344.796
07/20/16 10:00:00 AM	6,457.80	6.458	54.872	344.773
07/20/16 10:10:00 AM	6,444.96	6.445	54.868	344.747
07/20/16 10:20:00 AM	6,439.02	6.439	54.866	344.734
07/20/16 10:30:00 AM	6,427.56	6.428	54.863	344.712
07/20/16 10:40:00 AM	6,420.24	6.420	54.860	344.696
07/20/16 10:50:00 AM	6,404.46	6.404	54.855	344.665
07/20/16 11:00:00 AM	6,398.04	6.398	54.853	344.651
07/20/16 11:10:00 AM	6,389.34	6.389	54.850	344.633
07/20/16 11:20:00 AM	6,375.84	6.376	54.846	344.607

07/20/16 11:30:00 AM	6,369.90	6.370	54.844	344.594
07/20/16 11:40:00 AM	6,357.54	6.358	54.840	344.569
07/20/16 11:50:00 AM	6,354.06	6.354	54.839	344.561
07/20/16 12:00:00 PM	6,341.28	6.341	54.835	344.536
07/20/16 12:10:00 PM	6,332.34	6.332	54.832	344.518
07/20/16 12:20:00 PM	6,320.88	6.321	54.828	344.495
07/20/16 12:30:00 PM	6,311.52	6.312	54.825	344.475
07/20/16 12:40:00 PM	6,293.46	6.293	54.819	344.440
07/20/16 12:50:00 PM	6,290.22	6.290	54.818	344.431
07/20/16 01:00:00 PM	6,272.16	6.272	54.812	344.397
07/20/16 01:10:00 PM	6,266.22	6.266	54.810	344.383
07/20/16 01:20:00 PM	6,257.94	6.258	54.808	344.366
07/20/16 01:30:00 PM	6,243.06	6.243	54.803	344.337
07/20/16 01:40:00 PM	6,232.32	6.232	54.799	344.314
07/20/16 01:50:00 PM	6,231.66	6.232	54.799	344.311
07/20/16 02:00:00 PM	6,247.86	6.248	54.804	344.341
07/20/16 02:10:00 PM	6,263.22	6.263	54.809	344.372
07/20/16 02:20:00 PM	6,279.48	6.279	54.814	344.405
07/20/16 02:30:00 PM	6,295.50	6.296	54.819	344.438
07/20/16 02:40:00 PM	6,317.94	6.318	54.826	344.482
07/20/16 02:50:00 PM	6,342.90	6.343	54.834	344.533
07/20/16 03:00:00 PM	6,368.94	6.369	54.843	344.585
07/20/16 03:10:00 PM	6,393.48	6.393	54.851	344.636
07/20/16 03:20:00 PM	6,414.06	6.414	54.857	344.678

07/20/16 03:30:00 PM	6,432.36	6.432	54.863	344.716
07/20/16 03:40:00 PM	6,446.58	6.447	54.868	344.746
07/20/16 03:50:00 PM	6,457.56	6.458	54.872	344.769
07/20/16 04:00:00 PM	6,465.78	6.466	54.874	344.786
07/20/16 04:10:00 PM	6,474.48	6.474	54.877	344.803
07/20/16 04:20:00 PM	6,482.94	6.483	54.880	344.821
07/20/16 04:30:00 PM	6,492.12	6.492	54.883	344.839
07/20/16 04:40:00 PM	6,504.00	6.504	54.887	344.863
07/20/16 04:50:00 PM	6,510.90	6.511	54.889	344.878
07/20/16 05:00:00 PM	6,517.74	6.518	54.891	344.892
07/20/16 05:10:00 PM	6,522.54	6.523	54.893	344.902
07/20/16 05:20:00 PM	6,523.02	6.523	54.893	344.904
07/20/16 05:30:00 PM	6,524.16	6.524	54.894	344.906
07/20/16 05:40:00 PM	6,526.92	6.527	54.894	344.911
07/20/16 05:50:00 PM	6,531.48	6.531	54.896	344.920
07/20/16 06:00:00 PM	6,536.76	6.537	54.897	344.931
07/20/16 06:10:00 PM	6,543.12	6.543	54.900	344.944
07/20/16 06:20:00 PM	6,549.78	6.550	54.902	344.957
07/20/16 06:30:00 PM	6,558.72	6.559	54.904	344.975
07/20/16 06:40:00 PM	6,565.32	6.565	54.907	344.989
07/20/16 06:50:00 PM	6,571.08	6.571	54.909	345.001
07/20/16 07:00:00 PM	6,573.60	6.574	54.909	345.006
07/20/16 07:10:00 PM	6,574.98	6.575	54.910	345.009
07/20/16 07:20:00 PM	6,575.64	6.576	54.910	345.011

07/20/16 07:30:00 PM	6,575.64	6.576	54.910	345.011
07/20/16 07:40:00 PM	6,575.40	6.575	54.910	345.010
07/20/16 07:50:00 PM	6,574.98	6.575	54.910	345.010
07/20/16 08:00:00 PM	6,573.36	6.573	54.910	345.007
07/20/16 08:10:00 PM	6,572.88	6.573	54.909	345.005
07/20/16 08:20:00 PM	6,572.22	6.572	54.909	345.004
07/20/16 08:30:00 PM	6,572.22	6.572	54.909	345.004
07/20/16 08:40:00 PM	6,572.22	6.572	54.909	345.004
07/20/16 08:50:00 PM	6,572.22	6.572	54.909	345.004
07/20/16 09:00:00 PM	6,572.22	6.572	54.909	345.004
07/20/16 09:10:00 PM	6,572.22	6.572	54.909	345.004
07/20/16 09:20:00 PM	6,572.88	6.573	54.909	345.005
07/20/16 09:30:00 PM	6,573.84	6.574	54.910	345.007
07/20/16 09:40:00 PM	6,575.16	6.575	54.910	345.010
07/20/16 09:50:00 PM	6,577.02	6.577	54.911	345.013
07/20/16 10:00:00 PM	6,578.64	6.579	54.911	345.017
07/20/16 10:10:00 PM	6,581.34	6.581	54.912	345.022
07/20/16 10:20:00 PM	6,584.82	6.585	54.913	345.029
07/20/16 10:30:00 PM	6,587.34	6.587	54.914	345.034
07/20/16 10:40:00 PM	6,589.86	6.590	54.915	345.039
07/20/16 10:50:00 PM	6,591.00	6.591	54.915	345.042
07/20/16 11:00:00 PM	6,592.56	6.593	54.916	345.045
07/20/16 11:10:00 PM	6,596.04	6.596	54.917	345.052
07/20/16 11:20:00 PM	6,598.08	6.598	54.917	345.056

07/20/16 11:30:00 PM	6,600.60	6.601	54.918	345.061
07/20/16 11:40:00 PM	6,602.64	6.603	54.919	345.065
07/20/16 11:50:00 PM	6,605.64	6.606	54.920	345.071
07/21/16 12:00:00 AM	6,607.44	6.607	54.920	345.075
07/21/16 12:10:00 AM	6,609.96	6.610	54.921	345.080
07/21/16 12:20:00 AM	6,612.06	6.612	54.922	345.085
07/21/16 12:30:00 AM	6,614.58	6.615	54.923	345.090
07/21/16 12:40:00 AM	6,617.10	6.617	54.924	345.095
07/21/16 12:50:00 AM	6,619.80	6.620	54.924	345.100
07/21/16 01:00:00 AM	6,622.56	6.623	54.925	345.106
07/21/16 01:10:00 AM	6,623.94	6.624	54.926	345.109
07/21/16 01:20:00 AM	6,626.46	6.626	54.927	345.114
07/21/16 01:30:00 AM	6,629.22	6.629	54.927	345.119
07/21/16 01:40:00 AM	6,631.74	6.632	54.928	345.125
07/21/16 01:50:00 AM	6,633.78	6.634	54.929	345.129
07/21/16 02:00:00 AM	6,636.30	6.636	54.930	345.134
07/21/16 02:10:00 AM	6,638.82	6.639	54.931	345.139
07/21/16 02:20:00 AM	6,641.34	6.641	54.931	345.144
07/21/16 02:30:00 AM	6,645.00	6.645	54.933	345.151
07/21/16 02:40:00 AM	6,648.66	6.649	54.934	345.159
07/21/16 02:50:00 AM	6,650.94	6.651	54.935	345.164
07/21/16 03:00:00 AM	6,653.70	6.654	54.935	345.169
07/21/16 03:10:00 AM	6,655.98	6.656	54.936	345.174
07/21/16 03:20:00 AM	6,658.98	6.659	54.937	345.180

07/21/16 03:30:00 AM	6,661.68	6.662	54.938	345.185
07/21/16 03:40:00 AM	6,663.78	6.664	54.939	345.190
07/21/16 03:50:00 AM	6,666.72	6.667	54.940	345.196
07/21/16 04:00:00 AM	6,669.24	6.669	54.940	345.201
07/21/16 04:10:00 AM	6,672.72	6.673	54.942	345.208
07/21/16 04:20:00 AM	6,676.38	6.676	54.943	345.215
07/21/16 04:30:00 AM	6,680.04	6.680	54.944	345.223
07/21/16 04:40:00 AM	6,682.56	6.683	54.945	345.228
07/21/16 04:50:00 AM	6,685.50	6.686	54.946	345.234
07/21/16 05:00:00 AM	6,688.26	6.688	54.947	345.239
07/21/16 05:10:00 AM	6,692.58	6.693	54.948	345.248
07/21/16 05:20:00 AM	6,696.48	6.696	54.949	345.256
07/21/16 05:30:00 AM	6,699.96	6.700	54.950	345.263
07/21/16 05:40:00 AM	6,703.38	6.703	54.951	345.270
07/21/16 05:50:00 AM	6,706.56	6.707	54.953	345.277
07/21/16 06:00:00 AM	6,709.80	6.710	54.954	345.283
07/21/16 06:10:00 AM	6,712.74	6.713	54.955	345.289
07/21/16 06:20:00 AM	6,715.02	6.715	54.955	345.294
07/21/16 06:30:00 AM	6,717.12	6.717	54.956	345.298
07/21/16 06:40:00 AM	6,718.92	6.719	54.957	345.302
07/21/16 06:50:00 AM	6,718.92	6.719	54.957	345.302
07/21/16 07:00:00 AM	6,719.16	6.719	54.957	345.303
07/21/16 07:10:00 AM	6,719.82	6.720	54.957	345.304
07/21/16 07:20:00 AM	6,720.06	6.720	54.957	345.305

07/21/16 07:30:00 AM	6,720.30	6.720	54.957	345.305
07/21/16 07:40:00 AM	6,720.78	6.721	54.957	345.306
07/21/16 07:50:00 AM	6,720.96	6.721	54.957	345.306
07/21/16 08:00:00 AM	6,720.96	6.721	54.957	345.306
07/21/16 08:10:00 AM	6,720.96	6.721	54.957	345.306
07/21/16 08:20:00 AM	6,720.96	6.721	54.957	345.306
07/21/16 08:30:00 AM	6,720.78	6.721	54.957	345.306
07/21/16 08:40:00 AM	6,720.78	6.721	54.957	345.306
07/21/16 08:50:00 AM	6,720.78	6.721	54.957	345.306
07/21/16 09:00:00 AM	6,720.54	6.721	54.957	345.306
07/21/16 09:10:00 AM	6,719.16	6.719	54.957	345.303
07/21/16 09:20:00 AM	6,718.92	6.719	54.957	345.302
07/21/16 09:30:00 AM	6,716.40	6.716	54.956	345.298
07/21/16 09:40:00 AM	6,712.74	6.713	54.955	345.290
07/21/16 09:50:00 AM	6,707.28	6.707	54.953	345.280
07/21/16 10:00:00 AM	6,702.42	6.702	54.951	345.270
07/21/16 10:10:00 AM	6,698.10	6.698	54.950	345.261
07/21/16 10:20:00 AM	6,696.48	6.696	54.949	345.257
07/21/16 10:30:00 AM	6,687.36	6.687	54.947	345.240
07/21/16 10:40:00 AM	6,685.26	6.685	54.946	345.234
07/21/16 10:50:00 AM	6,682.08	6.682	54.945	345.228
07/21/16 11:00:00 AM	6,678.90	6.679	54.944	345.221
07/21/16 11:10:00 AM	6,676.80	6.677	54.943	345.217
07/21/16 11:20:00 AM	6,680.22	6.680	54.944	345.223

07/21/16 11:30:00 AM	6,688.50	6.689	54.947	345.239
07/21/16 11:40:00 AM	6,696.24	6.696	54.949	345.255
07/21/16 11:50:00 AM	6,702.24	6.702	54.951	345.267
07/21/16 12:00:00 PM	6,707.28	6.707	54.953	345.278
07/21/16 12:10:00 PM	6,712.08	6.712	54.954	345.287
07/21/16 12:20:00 PM	6,716.64	6.717	54.956	345.297
07/21/16 12:30:00 PM	6,719.16	6.719	54.957	345.302
07/21/16 12:40:00 PM	6,720.96	6.721	54.957	345.306
07/21/16 12:50:00 PM	6,721.92	6.722	54.958	345.308
07/21/16 01:00:00 PM	6,723.96	6.724	54.958	345.312
07/21/16 01:10:00 PM	6,723.72	6.724	54.958	345.312
07/21/16 01:20:00 PM	6,723.30	6.723	54.958	345.311
07/21/16 01:30:00 PM	6,720.06	6.720	54.957	345.305
07/21/16 01:40:00 PM	6,719.40	6.719	54.957	345.303
07/21/16 01:50:00 PM	6,719.16	6.719	54.957	345.303
07/21/16 02:00:00 PM	6,719.16	6.719	54.957	345.303
07/21/16 02:10:00 PM	6,720.30	6.720	54.957	345.305
07/21/16 02:20:00 PM	6,723.48	6.723	54.958	345.311
07/21/16 02:30:00 PM	6,729.48	6.729	54.960	345.323
07/21/16 02:40:00 PM	6,734.52	6.735	54.962	345.333
07/21/16 02:50:00 PM	6,739.98	6.740	54.963	345.344
07/21/16 03:00:00 PM	6,746.40	6.746	54.965	345.357
07/21/16 03:10:00 PM	6,750.06	6.750	54.967	345.365
07/21/16 03:20:00 PM	6,753.24	6.753	54.968	345.371

07/21/16 03:30:00 PM	6,753.72	6.754	54.968	345.373
07/21/16 03:40:00 PM	6,755.76	6.756	54.968	345.377
07/21/16 03:50:00 PM	6,758.04	6.758	54.969	345.381
07/21/16 04:00:00 PM	6,759.24	6.759	54.970	345.384
07/21/16 04:10:00 PM	6,759.24	6.759	54.970	345.384
07/21/16 04:20:00 PM	6,759.66	6.760	54.970	345.385
07/21/16 04:30:00 PM	6,759.90	6.760	54.970	345.386
07/21/16 04:40:00 PM	6,759.90	6.760	54.970	345.386
07/21/16 04:50:00 PM	6,759.24	6.759	54.970	345.384
07/21/16 05:00:00 PM	6,753.24	6.753	54.968	345.373
07/21/16 05:10:00 PM	6,740.22	6.740	54.964	345.348
07/21/16 05:20:00 PM	6,724.20	6.724	54.959	345.316
07/21/16 05:30:00 PM	6,712.32	6.712	54.955	345.291
07/21/16 05:40:00 PM	6,704.04	6.704	54.952	345.274
07/21/16 05:50:00 PM	6,696.72	6.697	54.950	345.259
07/21/16 06:00:00 PM	6,689.16	6.689	54.947	345.243
07/21/16 06:10:00 PM	6,676.14	6.676	54.943	345.218
07/21/16 06:20:00 PM	6,667.20	6.667	54.940	345.199
07/21/16 06:30:00 PM	6,664.02	6.664	54.939	345.191
07/21/16 06:40:00 PM	6,662.40	6.662	54.938	345.188
07/21/16 06:50:00 PM	6,662.64	6.663	54.938	345.188
07/21/16 07:00:00 PM	6,662.64	6.663	54.938	345.188
07/21/16 07:10:00 PM	6,652.80	6.653	54.935	345.170
07/21/16 07:20:00 PM	6,661.50	6.662	54.938	345.184

07/21/16 07:30:00 PM	6,674.52	6.675	54.942	345.210
07/21/16 07:40:00 PM	6,681.42	6.681	54.944	345.225
07/21/16 07:50:00 PM	6,689.64	6.690	54.947	345.241
07/21/16 08:00:00 PM	6,699.24	6.699	54.950	345.260
07/21/16 08:10:00 PM	6,706.80	6.707	54.952	345.276
07/21/16 08:20:00 PM	6,716.16	6.716	54.955	345.295
07/21/16 08:30:00 PM	6,723.48	6.723	54.958	345.310
07/21/16 08:40:00 PM	6,730.86	6.731	54.960	345.325
07/21/16 08:50:00 PM	6,737.04	6.737	54.962	345.338
07/21/16 09:00:00 PM	6,742.02	6.742	54.964	345.348
07/21/16 09:10:00 PM	6,747.78	6.748	54.966	345.360
07/21/16 09:20:00 PM	6,753.96	6.754	54.968	345.372
07/21/16 09:30:00 PM	6,759.66	6.760	54.970	345.384
07/21/16 09:40:00 PM	6,763.32	6.763	54.971	345.392
07/21/16 09:50:00 PM	6,768.36	6.768	54.972	345.402
07/21/16 10:00:00 PM	6,773.40	6.773	54.974	345.412
07/21/16 10:10:00 PM	6,778.92	6.779	54.976	345.423
07/21/16 10:20:00 PM	6,783.48	6.783	54.977	345.433
07/21/16 10:30:00 PM	6,787.80	6.788	54.979	345.441
07/21/16 10:40:00 PM	6,791.94	6.792	54.980	345.450
07/21/16 10:50:00 PM	6,795.12	6.795	54.981	345.457
07/21/16 11:00:00 PM	6,798.36	6.798	54.982	345.463
07/21/16 11:10:00 PM	6,802.50	6.803	54.984	345.471
07/21/16 11:20:00 PM	6,806.16	6.806	54.985	345.479

07/21/16 11:30:00 PM	6,809.10	6.809	54.986	345.485
07/21/16 11:40:00 PM	6,813.24	6.813	54.987	345.493
07/21/16 11:50:00 PM	6,816.90	6.817	54.988	345.501
07/22/16 12:00:00 AM	6,820.80	6.821	54.989	345.509
07/22/16 12:10:00 AM	6,824.22	6.824	54.991	345.516
07/22/16 12:20:00 AM	6,827.64	6.828	54.992	345.523
07/22/16 12:30:00 AM	6,831.54	6.832	54.993	345.531
07/22/16 12:40:00 AM	6,834.06	6.834	54.994	345.536
07/22/16 12:50:00 AM	6,837.72	6.838	54.995	345.543
07/22/16 01:00:00 AM	6,840.72	6.841	54.996	345.549
07/22/16 01:10:00 AM	6,843.42	6.843	54.997	345.555
07/22/16 01:20:00 AM	6,846.18	6.846	54.998	345.560
07/22/16 01:30:00 AM	6,848.70	6.849	54.999	345.566
07/22/16 01:40:00 AM	6,851.46	6.851	54.999	345.571
07/22/16 01:50:00 AM	6,854.88	6.855	55.000	345.578
07/22/16 02:00:00 AM	6,856.74	6.857	55.001	345.582
07/22/16 02:10:00 AM	6,859.44	6.859	55.002	345.587
07/22/16 02:20:00 AM	6,861.54	6.862	55.003	345.592
07/22/16 02:30:00 AM	6,863.34	6.863	55.003	345.596
07/22/16 02:40:00 AM	6,865.44	6.865	55.004	345.600
07/22/16 02:50:00 AM	6,867.96	6.868	55.005	345.605
07/22/16 03:00:00 AM	6,870.48	6.870	55.006	345.610
07/22/16 03:10:00 AM	6,873.42	6.873	55.007	345.616
07/22/16 03:20:00 AM	6,876.42	6.876	55.007	345.622

07/22/16 03:30:00 AM	6,878.70	6.879	55.008	345.627
07/22/16 03:40:00 AM	6,881.22	6.881	55.009	345.632
07/22/16 03:50:00 AM	6,883.74	6.884	55.010	345.637
07/22/16 04:00:00 AM	6,885.54	6.886	55.010	345.641
07/22/16 04:10:00 AM	6,888.30	6.888	55.011	345.646
07/22/16 04:20:00 AM	6,889.20	6.889	55.012	345.648
07/22/16 04:30:00 AM	6,891.48	6.891	55.012	345.653
07/22/16 04:40:00 AM	6,892.86	6.893	55.013	345.656
07/22/16 04:50:00 AM	6,895.38	6.895	55.014	345.661
07/22/16 05:00:00 AM	6,897.48	6.897	55.014	345.665
07/22/16 05:10:00 AM	6,898.62	6.899	55.015	345.667
07/22/16 05:20:00 AM	6,902.70	6.903	55.016	345.675
07/22/16 05:30:00 AM	6,905.22	6.905	55.017	345.680
07/22/16 05:40:00 AM	6,907.08	6.907	55.017	345.684
07/22/16 05:50:00 AM	6,908.46	6.908	55.018	345.687
07/22/16 06:00:00 AM	6,911.22	6.911	55.019	345.693
07/22/16 06:10:00 AM	6,913.26	6.913	55.019	345.697
07/22/16 06:20:00 AM	6,915.78	6.916	55.020	345.702
07/22/16 06:30:00 AM	6,917.82	6.918	55.021	345.706
07/22/16 06:40:00 AM	6,919.20	6.919	55.021	345.709
07/22/16 06:50:00 AM	6,920.82	6.921	55.022	345.712
07/22/16 07:00:00 AM	6,923.34	6.923	55.023	345.717
07/22/16 07:10:00 AM	6,924.90	6.925	55.023	345.721
07/22/16 07:20:00 AM	6,927.66	6.928	55.024	345.726

07/22/16 07:30:00 AM	6,927.66	6.928	55.024	345.727
07/22/16 07:40:00 AM	6,927.66	6.928	55.024	345.727
07/22/16 07:50:00 AM	6,927.90	6.928	55.024	345.727
07/22/16 08:00:00 AM	6,928.38	6.928	55.024	345.728
07/22/16 08:10:00 AM	6,928.56	6.929	55.024	345.728
07/22/16 08:20:00 AM	6,928.56	6.929	55.024	345.728
07/22/16 08:30:00 AM	6,928.38	6.928	55.024	345.728
07/22/16 08:40:00 AM	6,928.38	6.928	55.024	345.728
07/22/16 08:50:00 AM	6,927.66	6.928	55.024	345.727
07/22/16 09:00:00 AM	6,926.76	6.927	55.024	345.725
07/22/16 09:10:00 AM	6,925.38	6.925	55.023	345.722
07/22/16 09:20:00 AM	6,924.24	6.924	55.023	345.720
07/22/16 09:30:00 AM	6,918.30	6.918	55.021	345.709
07/22/16 09:40:00 AM	6,913.26	6.913	55.020	345.698
07/22/16 09:50:00 AM	6,905.94	6.906	55.017	345.684
07/22/16 10:00:00 AM	6,899.28	6.899	55.015	345.670
07/22/16 10:10:00 AM	6,884.16	6.884	55.011	345.641
07/22/16 10:20:00 AM	6,878.94	6.879	55.009	345.629
07/22/16 10:30:00 AM	6,871.62	6.872	55.006	345.614
07/22/16 10:40:00 AM	6,858.54	6.859	55.002	345.588
07/22/16 10:50:00 AM	6,843.00	6.843	54.997	345.557
07/22/16 11:00:00 AM	6,829.50	6.830	54.993	345.530
07/22/16 11:10:00 AM	6,813.90	6.814	54.988	345.498
07/22/16 11:20:00 AM	6,798.60	6.799	54.983	345.467

07/22/16 11:30:00 AM	6,784.38	6.784	54.978	345.438
07/22/16 11:40:00 AM	6,765.60	6.766	54.972	345.401
07/22/16 11:50:00 AM	6,745.92	6.746	54.966	345.361
07/22/16 12:00:00 PM	6,732.66	6.733	54.961	345.333
07/22/16 12:10:00 PM	6,713.88	6.714	54.956	345.295
07/22/16 12:20:00 PM	6,691.26	6.691	54.948	345.250
07/22/16 12:30:00 PM	6,678.66	6.679	54.944	345.223
07/22/16 12:40:00 PM	6,656.46	6.656	54.937	345.179
07/22/16 12:50:00 PM	6,649.32	6.649	54.934	345.162
07/22/16 01:00:00 PM	6,634.26	6.634	54.930	345.133
07/22/16 01:10:00 PM	6,624.18	6.624	54.926	345.112
07/22/16 01:20:00 PM	6,608.82	6.609	54.921	345.081
07/22/16 01:30:00 PM	6,586.62	6.587	54.914	345.037
07/22/16 01:40:00 PM	6,572.70	6.573	54.910	345.008
07/22/16 01:50:00 PM	6,562.62	6.563	54.906	344.986
07/22/16 02:00:00 PM	6,561.24	6.561	54.906	344.982
07/22/16 02:10:00 PM	6,552.06	6.552	54.903	344.965
07/22/16 02:20:00 PM	6,536.94	6.537	54.898	344.935
07/22/16 02:30:00 PM	6,528.48	6.528	54.895	344.917
07/22/16 02:40:00 PM	6,526.92	6.527	54.895	344.912
07/22/16 02:50:00 PM	6,525.72	6.526	54.894	344.910
07/22/16 03:00:00 PM	6,516.84	6.517	54.891	344.893
07/22/16 03:10:00 PM	6,497.16	6.497	54.885	344.855
07/22/16 03:20:00 PM	6,484.56	6.485	54.881	344.828

07/22/16 03:30:00 PM	6,484.80	6.485	54.881	344.826
07/22/16 03:40:00 PM	6,468.54	6.469	54.876	344.796
07/22/16 03:50:00 PM	6,465.12	6.465	54.875	344.787
07/22/16 04:00:00 PM	6,454.56	6.455	54.871	344.766
07/22/16 04:10:00 PM	6,451.38	6.451	54.870	344.759
07/22/16 04:20:00 PM	6,449.10	6.449	54.869	344.754
07/22/16 04:30:00 PM	6,436.26	6.436	54.865	344.730
07/22/16 04:40:00 PM	6,431.70	6.432	54.864	344.719
07/22/16 04:50:00 PM	6,431.88	6.432	54.864	344.718
07/22/16 05:00:00 PM	6,433.74	6.434	54.864	344.722
07/22/16 05:10:00 PM	6,431.88	6.432	54.864	344.719
07/22/16 05:20:00 PM	6,427.32	6.427	54.862	344.710
07/22/16 05:30:00 PM	6,425.70	6.426	54.862	344.706
07/22/16 05:40:00 PM	6,430.08	6.430	54.863	344.714
07/22/16 05:50:00 PM	6,431.70	6.432	54.864	344.718
07/22/16 06:00:00 PM	6,431.70	6.432	54.864	344.718
07/22/16 06:10:00 PM	6,431.70	6.432	54.864	344.718
07/22/16 06:20:00 PM	6,431.88	6.432	54.864	344.718
07/22/16 06:30:00 PM	6,433.50	6.434	54.864	344.721
07/22/16 06:40:00 PM	6,434.88	6.435	54.865	344.724
07/22/16 06:50:00 PM	6,438.54	6.439	54.866	344.731
07/22/16 07:00:00 PM	6,441.30	6.441	54.867	344.737
07/22/16 07:10:00 PM	6,444.48	6.444	54.868	344.743
07/22/16 07:20:00 PM	6,449.28	6.449	54.869	344.753

07/22/16 07:30:00 PM	6,454.08	6.454	54.871	344.763
07/22/16 07:40:00 PM	6,459.36	6.459	54.872	344.773
07/22/16 07:50:00 PM	6,463.26	6.463	54.874	344.782
07/22/16 08:00:00 PM	6,468.54	6.469	54.875	344.792
07/22/16 08:10:00 PM	6,475.62	6.476	54.878	344.806
07/22/16 08:20:00 PM	6,482.94	6.483	54.880	344.821
07/22/16 08:30:00 PM	6,490.74	6.491	54.883	344.837
07/22/16 08:40:00 PM	6,497.16	6.497	54.885	344.850
07/22/16 08:50:00 PM	6,503.76	6.504	54.887	344.863
07/22/16 09:00:00 PM	6,509.70	6.510	54.889	344.876
07/22/16 09:10:00 PM	6,516.12	6.516	54.891	344.889
07/22/16 09:20:00 PM	6,523.02	6.523	54.893	344.903
07/22/16 09:30:00 PM	6,528.06	6.528	54.895	344.913
07/22/16 09:40:00 PM	6,535.14	6.535	54.897	344.927
07/22/16 09:50:00 PM	6,541.80	6.542	54.899	344.941
07/22/16 10:00:00 PM	6,547.02	6.547	54.901	344.952
07/22/16 10:10:00 PM	6,553.44	6.553	54.903	344.965
07/22/16 10:20:00 PM	6,559.86	6.560	54.905	344.978
07/22/16 10:30:00 PM	6,564.18	6.564	54.906	344.987
07/22/16 10:40:00 PM	6,567.84	6.568	54.908	344.994
07/22/16 10:50:00 PM	6,572.46	6.572	54.909	345.004
07/22/16 11:00:00 PM	6,576.78	6.577	54.910	345.012
07/22/16 11:10:00 PM	6,580.44	6.580	54.912	345.020
07/22/16 11:20:00 PM	6,585.48	6.585	54.913	345.030

07/22/16 11:30:00 PM	6,590.76	6.591	54.915	345.041
07/22/16 11:40:00 PM	6,594.66	6.595	54.916	345.049
07/22/16 11:50:00 PM	6,598.74	6.599	54.918	345.057
07/23/16 12:00:00 AM	6,603.12	6.603	54.919	345.066
07/23/16 12:10:00 AM	6,607.44	6.607	54.920	345.075
07/23/16 12:20:00 AM	6,611.82	6.612	54.922	345.084
07/23/16 12:30:00 AM	6,615.48	6.615	54.923	345.091
07/23/16 12:40:00 AM	6,619.80	6.620	54.924	345.100
07/23/16 12:50:00 AM	6,623.28	6.623	54.926	345.107
07/23/16 01:00:00 AM	6,627.36	6.627	54.927	345.115
07/23/16 01:10:00 AM	6,631.02	6.631	54.928	345.123
07/23/16 01:20:00 AM	6,635.82	6.636	54.930	345.132
07/23/16 01:30:00 AM	6,640.68	6.641	54.931	345.142
07/23/16 01:40:00 AM	6,645.90	6.646	54.933	345.153
07/23/16 01:50:00 AM	6,652.80	6.653	54.935	345.167
07/23/16 02:00:00 AM	6,666.30	6.666	54.939	345.193
07/23/16 02:10:00 AM	6,674.52	6.675	54.942	345.210
07/23/16 02:20:00 AM	6,684.12	6.684	54.945	345.230
07/23/16 02:30:00 AM	6,692.40	6.692	54.948	345.247
07/23/16 02:40:00 AM	6,702.42	6.702	54.951	345.267
07/23/16 02:50:00 AM	6,715.26	6.715	54.955	345.292
07/23/16 03:00:00 AM	6,726.72	6.727	54.959	345.316
07/23/16 03:10:00 AM	6,738.36	6.738	54.963	345.340
07/23/16 03:20:00 AM	6,747.30	6.747	54.966	345.358

07/23/16 03:30:00 AM	6,759.42	6.759	54.969	345.382
07/23/16 03:40:00 AM	6,766.98	6.767	54.972	345.398
07/23/16 03:50:00 AM	6,773.16	6.773	54.974	345.411
07/23/16 04:00:00 AM	6,780.72	6.781	54.976	345.427
07/23/16 04:10:00 AM	6,787.62	6.788	54.979	345.441
07/23/16 04:20:00 AM	6,794.46	6.794	54.981	345.455
07/23/16 04:30:00 AM	6,802.92	6.803	54.984	345.471
07/23/16 04:40:00 AM	6,806.82	6.807	54.985	345.480
07/23/16 04:50:00 AM	6,813.24	6.813	54.987	345.493
07/23/16 05:00:00 AM	6,818.28	6.818	54.989	345.503
07/23/16 05:10:00 AM	6,824.46	6.824	54.991	345.516
07/23/16 05:20:00 AM	6,829.02	6.829	54.992	345.525
07/23/16 05:30:00 AM	6,833.58	6.834	54.994	345.535
07/23/16 05:40:00 AM	6,838.62	6.839	54.995	345.545
07/23/16 05:50:00 AM	6,843.24	6.843	54.997	345.554
07/23/16 06:00:00 AM	6,847.80	6.848	54.998	345.563
07/23/16 06:10:00 AM	6,853.50	6.854	55.000	345.575
07/23/16 06:20:00 AM	6,857.16	6.857	55.001	345.583
07/23/16 06:30:00 AM	6,861.30	6.861	55.003	345.591
07/23/16 06:40:00 AM	6,865.62	6.866	55.004	345.600
07/23/16 06:50:00 AM	6,870.90	6.871	55.006	345.610
07/23/16 07:00:00 AM	6,875.94	6.876	55.007	345.621
07/23/16 07:10:00 AM	6,882.12	6.882	55.009	345.633
07/23/16 07:20:00 AM	6,887.82	6.888	55.011	345.645

07/23/16 07:30:00 AM	6,892.68	6.893	55.013	345.655
07/23/16 07:40:00 AM	6,897.48	6.897	55.014	345.664
07/23/16 07:50:00 AM	6,902.70	6.903	55.016	345.675
07/23/16 08:00:00 AM	6,906.36	6.906	55.017	345.683
07/23/16 08:10:00 AM	6,909.84	6.910	55.018	345.690
07/23/16 08:20:00 AM	6,911.88	6.912	55.019	345.694
07/23/16 08:30:00 AM	6,914.40	6.914	55.020	345.699
07/23/16 08:40:00 AM	6,918.54	6.919	55.021	345.707
07/23/16 08:50:00 AM	6,921.96	6.922	55.022	345.714
07/23/16 09:00:00 AM	6,925.86	6.926	55.023	345.722
07/23/16 09:10:00 AM	6,930.42	6.930	55.025	345.731
07/23/16 09:20:00 AM	6,934.56	6.935	55.026	345.740
07/23/16 09:30:00 AM	6,940.02	6.940	55.028	345.751
07/23/16 09:40:00 AM	6,943.92	6.944	55.029	345.759
07/23/16 09:50:00 AM	6,946.44	6.946	55.030	345.764
07/23/16 10:00:00 AM	6,947.10	6.947	55.030	345.766
07/23/16 10:10:00 AM	6,949.44	6.949	55.031	345.770
07/23/16 10:20:00 AM	6,950.10	6.950	55.031	345.772
07/23/16 10:30:00 AM	6,951.48	6.951	55.032	345.775
07/23/16 10:40:00 AM	6,951.72	6.952	55.032	345.775
07/23/16 10:50:00 AM	6,952.62	6.953	55.032	345.777
07/23/16 11:00:00 AM	6,952.62	6.953	55.032	345.777
07/23/16 11:10:00 AM	6,952.62	6.953	55.032	345.777
07/23/16 11:20:00 AM	6,953.10	6.953	55.032	345.778

07/23/16 11:30:00 AM	6,953.28	6.953	55.032	345.779
07/23/16 11:40:00 AM	6,953.28	6.953	55.032	345.779
07/23/16 11:50:00 AM	6,953.28	6.953	55.032	345.779
07/23/16 12:00:00 PM	6,953.10	6.953	55.032	345.778
07/23/16 12:10:00 PM	6,953.10	6.953	55.032	345.778
07/23/16 12:20:00 PM	6,953.10	6.953	55.032	345.778
07/23/16 12:30:00 PM	6,953.10	6.953	55.032	345.778
07/23/16 12:40:00 PM	6,952.14	6.952	55.032	345.777
07/23/16 12:50:00 PM	6,948.72	6.949	55.031	345.770
07/23/16 01:00:00 PM	6,946.44	6.946	55.030	345.765
07/23/16 01:10:00 PM	6,943.92	6.944	55.029	345.760
07/23/16 01:20:00 PM	6,938.22	6.938	55.028	345.749
07/23/16 01:30:00 PM	6,934.08	6.934	55.026	345.740
07/23/16 01:40:00 PM	6,927.66	6.928	55.024	345.728
07/23/16 01:50:00 PM	6,923.10	6.923	55.023	345.718
07/23/16 02:00:00 PM	6,917.16	6.917	55.021	345.706
07/23/16 02:10:00 PM	6,911.64	6.912	55.019	345.695
07/23/16 02:20:00 PM	6,910.74	6.911	55.019	345.692
07/23/16 02:30:00 PM	6,909.36	6.909	55.018	345.690
07/23/16 02:40:00 PM	6,908.88	6.909	55.018	345.689
07/23/16 02:50:00 PM	6,912.36	6.912	55.019	345.695
07/23/16 03:00:00 PM	6,914.40	6.914	55.020	345.699
07/23/16 03:10:00 PM	6,918.06	6.918	55.021	345.706
07/23/16 03:20:00 PM	6,921.06	6.921	55.022	345.713

07/23/16 03:30:00 PM	6,927.42	6.927	55.024	345.725
07/23/16 03:40:00 PM	6,933.42	6.933	55.026	345.737
07/23/16 03:50:00 PM	6,938.64	6.939	55.028	345.748
07/23/16 04:00:00 PM	6,933.42	6.933	55.026	345.739
07/23/16 04:10:00 PM	6,908.88	6.909	55.019	345.693
07/23/16 04:20:00 PM	6,889.02	6.889	55.012	345.652
07/23/16 04:30:00 PM	6,879.60	6.880	55.009	345.631
07/23/16 04:40:00 PM	6,870.90	6.871	55.006	345.613
07/23/16 04:50:00 PM	6,877.56	6.878	55.008	345.624
07/23/16 05:00:00 PM	6,886.02	6.886	55.010	345.640
07/23/16 05:10:00 PM	6,892.44	6.892	55.013	345.654
07/23/16 05:20:00 PM	6,898.62	6.899	55.015	345.666
07/23/16 05:30:00 PM	6,904.56	6.905	55.016	345.679
07/23/16 05:40:00 PM	6,907.56	6.908	55.018	345.685
07/23/16 05:50:00 PM	6,908.70	6.909	55.018	345.688
07/23/16 06:00:00 PM	6,909.60	6.910	55.018	345.690
07/23/16 06:10:00 PM	6,911.22	6.911	55.019	345.693
07/23/16 06:20:00 PM	6,912.78	6.913	55.019	345.696
07/23/16 06:30:00 PM	6,916.20	6.916	55.020	345.703
07/23/16 06:40:00 PM	6,921.48	6.921	55.022	345.713
07/23/16 06:50:00 PM	6,921.96	6.922	55.022	345.715
07/23/16 07:00:00 PM	6,922.38	6.922	55.022	345.716
07/23/16 07:10:00 PM	6,925.38	6.925	55.023	345.721
07/23/16 07:20:00 PM	6,925.38	6.925	55.023	345.722

07/23/16 07:30:00 PM	6,925.38	6.925	55.023	345.722
07/23/16 07:40:00 PM	6,925.38	6.925	55.023	345.722
07/23/16 07:50:00 PM	6,925.38	6.925	55.023	345.722
07/23/16 08:00:00 PM	6,925.38	6.925	55.023	345.722
07/23/16 08:10:00 PM	6,925.38	6.925	55.023	345.722
07/23/16 08:20:00 PM	6,925.38	6.925	55.023	345.722
07/23/16 08:30:00 PM	6,925.62	6.926	55.023	345.722
07/23/16 08:40:00 PM	6,925.62	6.926	55.023	345.722
07/23/16 08:50:00 PM	6,925.62	6.926	55.023	345.722
07/23/16 09:00:00 PM	6,925.86	6.926	55.024	345.723
07/23/16 09:10:00 PM	6,926.28	6.926	55.024	345.724
07/23/16 09:20:00 PM	6,927.24	6.927	55.024	345.726
07/23/16 09:30:00 PM	6,929.04	6.929	55.025	345.729
07/23/16 09:40:00 PM	6,930.42	6.930	55.025	345.732
07/23/16 09:50:00 PM	6,931.80	6.932	55.025	345.735
07/23/16 10:00:00 PM	6,934.08	6.934	55.026	345.739
07/23/16 10:10:00 PM	6,936.36	6.936	55.027	345.744
07/23/16 10:20:00 PM	6,937.74	6.938	55.027	345.747
07/23/16 10:30:00 PM	6,939.36	6.939	55.028	345.750
07/23/16 10:40:00 PM	6,940.74	6.941	55.028	345.753
07/23/16 10:50:00 PM	6,942.12	6.942	55.029	345.756
07/23/16 11:00:00 PM	6,944.58	6.945	55.030	345.761
07/23/16 11:10:00 PM	6,947.10	6.947	55.030	345.766
07/23/16 11:20:00 PM	6,948.30	6.948	55.031	345.768

07/23/16 11:30:00 PM	6,949.44	6.949	55.031	345.771
07/23/16 11:40:00 PM	6,949.62	6.950	55.031	345.771
07/23/16 11:50:00 PM	6,949.62	6.950	55.031	345.771
07/24/16 12:00:00 AM	6,951.00	6.951	55.032	345.774
07/24/16 12:10:00 AM	6,951.48	6.951	55.032	345.775
07/24/16 12:20:00 AM	6,951.96	6.952	55.032	345.776
07/24/16 12:30:00 AM	6,952.62	6.953	55.032	345.777
07/24/16 12:40:00 AM	6,954.24	6.954	55.033	345.780
07/24/16 12:50:00 AM	6,955.14	6.955	55.033	345.782
07/24/16 01:00:00 AM	6,956.28	6.956	55.033	345.785
07/24/16 01:10:00 AM	6,957.42	6.957	55.034	345.787
07/24/16 01:20:00 AM	6,958.56	6.959	55.034	345.789
07/24/16 01:30:00 AM	6,959.70	6.960	55.034	345.791
07/24/16 01:40:00 AM	6,959.94	6.960	55.035	345.792
07/24/16 01:50:00 AM	6,960.42	6.960	55.035	345.793
07/24/16 02:00:00 AM	6,960.84	6.961	55.035	345.794
07/24/16 02:10:00 AM	6,961.32	6.961	55.035	345.795
07/24/16 02:20:00 AM	6,962.22	6.962	55.035	345.797
07/24/16 02:30:00 AM	6,963.36	6.963	55.036	345.799
07/24/16 02:40:00 AM	6,964.74	6.965	55.036	345.802
07/24/16 02:50:00 AM	6,966.36	6.966	55.037	345.805
07/24/16 03:00:00 AM	6,967.26	6.967	55.037	345.807
07/24/16 03:10:00 AM	6,968.64	6.969	55.037	345.810
07/24/16 03:20:00 AM	6,969.54	6.970	55.038	345.812

07/24/16 03:30:00 AM	6,970.92	6.971	55.038	345.814
07/24/16 03:40:00 AM	6,972.30	6.972	55.039	345.817
07/24/16 03:50:00 AM	6,973.20	6.973	55.039	345.819
07/24/16 04:00:00 AM	6,974.16	6.974	55.039	345.821
07/24/16 04:10:00 AM	6,975.06	6.975	55.039	345.823
07/24/16 04:20:00 AM	6,976.44	6.976	55.040	345.825
07/24/16 04:30:00 AM	6,977.10	6.977	55.040	345.827
07/24/16 04:40:00 AM	6,977.82	6.978	55.040	345.828
07/24/16 04:50:00 AM	6,978.72	6.979	55.041	345.830
07/24/16 05:00:00 AM	6,979.62	6.980	55.041	345.832
07/24/16 05:10:00 AM	6,981.24	6.981	55.041	345.835
07/24/16 05:20:00 AM	6,982.38	6.982	55.042	345.838
07/24/16 05:30:00 AM	6,983.76	6.984	55.042	345.840
07/24/16 05:40:00 AM	6,984.90	6.985	55.043	345.843
07/24/16 05:50:00 AM	6,986.94	6.987	55.043	345.847
07/24/16 06:00:00 AM	6,988.56	6.989	55.044	345.850
07/24/16 06:10:00 AM	6,990.18	6.990	55.044	345.853
07/24/16 06:20:00 AM	6,990.36	6.990	55.044	345.854
07/24/16 06:30:00 AM	6,990.36	6.990	55.044	345.854
07/24/16 06:40:00 AM	6,990.60	6.991	55.044	345.854
07/24/16 06:50:00 AM	6,990.60	6.991	55.044	345.854
07/24/16 07:00:00 AM	6,990.60	6.991	55.044	345.854
07/24/16 07:10:00 AM	6,991.08	6.991	55.045	345.855
07/24/16 07:20:00 AM	6,991.08	6.991	55.045	345.855

07/24/16 07:30:00 AM	6,991.08	6.991	55.045	345.855
07/24/16 07:40:00 AM	6,992.22	6.992	55.045	345.858
07/24/16 07:50:00 AM	6,991.98	6.992	55.045	345.857
07/24/16 08:00:00 AM	6,991.74	6.992	55.045	345.857
07/24/16 08:10:00 AM	6,989.46	6.989	55.044	345.853
07/24/16 08:20:00 AM	6,987.42	6.987	55.044	345.848
07/24/16 08:30:00 AM	6,986.04	6.986	55.043	345.845
07/24/16 08:40:00 AM	6,984.42	6.984	55.043	345.842
07/24/16 08:50:00 AM	6,976.68	6.977	55.040	345.828
07/24/16 09:00:00 AM	6,968.64	6.969	55.038	345.811
07/24/16 09:10:00 AM	6,961.32	6.961	55.035	345.796
07/24/16 09:20:00 AM	6,951.96	6.952	55.032	345.778
07/24/16 09:30:00 AM	6,941.88	6.942	55.029	345.757
07/24/16 09:40:00 AM	6,930.18	6.930	55.025	345.734
07/24/16 09:50:00 AM	6,918.30	6.918	55.021	345.710
07/24/16 10:00:00 AM	6,907.08	6.907	55.018	345.687
07/24/16 10:10:00 AM	6,892.86	6.893	55.013	345.658
07/24/16 10:20:00 AM	6,876.66	6.877	55.008	345.626
07/24/16 10:30:00 AM	6,863.82	6.864	55.004	345.599
07/24/16 10:40:00 AM	6,848.22	6.848	54.999	345.568
07/24/16 10:50:00 AM	6,833.82	6.834	54.994	345.539
07/24/16 11:00:00 AM	6,817.80	6.818	54.989	345.506
07/24/16 11:10:00 AM	6,803.64	6.804	54.984	345.477
07/24/16 11:20:00 AM	6,786.24	6.786	54.979	345.442

07/24/16 11:30:00 AM	6,764.04	6.764	54.972	345.398
07/24/16 11:40:00 AM	6,750.72	6.751	54.967	345.370
07/24/16 11:50:00 AM	6,730.62	6.731	54.961	345.330
07/24/16 12:00:00 PM	6,711.84	6.712	54.955	345.291
07/24/16 12:10:00 PM	6,696.72	6.697	54.950	345.260
07/24/16 12:20:00 PM	6,679.08	6.679	54.944	345.225
07/24/16 12:30:00 PM	6,674.28	6.674	54.942	345.213
07/24/16 12:40:00 PM	6,650.52	6.651	54.935	345.167
07/24/16 12:50:00 PM	6,648.42	6.648	54.934	345.160
07/24/16 01:00:00 PM	6,649.14	6.649	54.934	345.160
07/24/16 01:10:00 PM	6,627.12	6.627	54.928	345.119
07/24/16 01:20:00 PM	6,617.52	6.618	54.924	345.098
07/24/16 01:30:00 PM	6,603.60	6.604	54.920	345.070
07/24/16 01:40:00 PM	6,582.30	6.582	54.913	345.028
07/24/16 01:50:00 PM	6,577.02	6.577	54.911	345.015
07/24/16 02:00:00 PM	6,563.04	6.563	54.907	344.988
07/24/16 02:10:00 PM	6,559.38	6.559	54.905	344.979
07/24/16 02:20:00 PM	6,546.36	6.546	54.901	344.954
07/24/16 02:30:00 PM	6,529.86	6.530	54.896	344.921
07/24/16 02:40:00 PM	6,518.40	6.518	54.892	344.897
07/24/16 02:50:00 PM	6,505.14	6.505	54.888	344.870
07/24/16 03:00:00 PM	6,501.48	6.501	54.886	344.861
07/24/16 03:10:00 PM	6,496.92	6.497	54.885	344.852
07/24/16 03:20:00 PM	6,489.36	6.489	54.883	344.837

07/24/16 03:30:00 PM	6,481.14	6.481	54.880	344.820
07/24/16 03:40:00 PM	6,476.76	6.477	54.878	344.811
07/24/16 03:50:00 PM	6,469.68	6.470	54.876	344.797
07/24/16 04:00:00 PM	6,469.92	6.470	54.876	344.796
07/24/16 04:10:00 PM	6,469.44	6.469	54.876	344.795
07/24/16 04:20:00 PM	6,468.30	6.468	54.876	344.793
07/24/16 04:30:00 PM	6,462.78	6.463	54.874	344.782
07/24/16 04:40:00 PM	6,467.64	6.468	54.875	344.790
07/24/16 04:50:00 PM	6,463.74	6.464	54.874	344.784
07/24/16 05:00:00 PM	6,468.96	6.469	54.876	344.793
07/24/16 05:10:00 PM	6,463.50	6.464	54.874	344.784
07/24/16 05:20:00 PM	6,468.06	6.468	54.875	344.791
07/24/16 05:30:00 PM	6,468.78	6.469	54.876	344.793
07/24/16 05:40:00 PM	6,470.58	6.471	54.876	344.797
07/24/16 05:50:00 PM	6,468.78	6.469	54.876	344.794
07/24/16 06:00:00 PM	6,469.20	6.469	54.876	344.794
07/24/16 06:10:00 PM	6,471.72	6.472	54.877	344.799
07/24/16 06:20:00 PM	6,474.48	6.474	54.877	344.805
07/24/16 06:30:00 PM	6,480.18	6.480	54.879	344.816
07/24/16 06:40:00 PM	6,486.36	6.486	54.881	344.828
07/24/16 06:50:00 PM	6,488.70	6.489	54.882	344.834
07/24/16 07:00:00 PM	6,489.60	6.490	54.882	344.836
07/24/16 07:10:00 PM	6,495.06	6.495	54.884	344.846
07/24/16 07:20:00 PM	6,503.34	6.503	54.887	344.862

07/24/16 07:30:00 PM	6,506.28	6.506	54.888	344.869
07/24/16 07:40:00 PM	6,511.32	6.511	54.889	344.879
07/24/16 07:50:00 PM	6,517.74	6.518	54.891	344.892
07/24/16 08:00:00 PM	6,523.92	6.524	54.893	344.905
07/24/16 08:10:00 PM	6,530.34	6.530	54.895	344.918
07/24/16 08:20:00 PM	6,536.04	6.536	54.897	344.929
07/24/16 08:30:00 PM	6,542.94	6.543	54.899	344.943
07/24/16 08:40:00 PM	6,549.12	6.549	54.901	344.956
07/24/16 08:50:00 PM	6,554.82	6.555	54.903	344.967
07/24/16 09:00:00 PM	6,561.00	6.561	54.905	344.980
07/24/16 09:10:00 PM	6,565.80	6.566	54.907	344.990
07/24/16 09:20:00 PM	6,571.32	6.571	54.909	345.001
07/24/16 09:30:00 PM	6,576.78	6.577	54.910	345.012
07/24/16 09:40:00 PM	6,582.30	6.582	54.912	345.023
07/24/16 09:50:00 PM	6,589.14	6.589	54.914	345.037
07/24/16 10:00:00 PM	6,595.08	6.595	54.916	345.049
07/24/16 10:10:00 PM	6,601.08	6.601	54.918	345.062
07/24/16 10:20:00 PM	6,606.06	6.606	54.920	345.072
07/24/16 10:30:00 PM	6,610.92	6.611	54.922	345.082
07/24/16 10:40:00 PM	6,614.10	6.614	54.923	345.088
07/24/16 10:50:00 PM	6,617.52	6.618	54.924	345.095
07/24/16 11:00:00 PM	6,620.76	6.621	54.925	345.102
07/24/16 11:10:00 PM	6,624.60	6.625	54.926	345.110
07/24/16 11:20:00 PM	6,628.74	6.629	54.927	345.118

07/24/16 11:30:00 PM	6,632.16	6.632	54.928	345.125
07/24/16 11:40:00 PM	6,636.96	6.637	54.930	345.135
07/24/16 11:50:00 PM	6,639.72	6.640	54.931	345.141
07/25/16 12:00:00 AM	6,644.76	6.645	54.932	345.151
07/25/16 12:10:00 AM	6,650.04	6.650	54.934	345.161
07/25/16 12:20:00 AM	6,654.18	6.654	54.936	345.170
07/25/16 12:30:00 AM	6,655.32	6.655	54.936	345.173
07/25/16 12:40:00 AM	6,657.12	6.657	54.937	345.176
07/25/16 12:50:00 AM	6,661.02	6.661	54.938	345.184
07/25/16 01:00:00 AM	6,663.54	6.664	54.939	345.189
07/25/16 01:10:00 AM	6,665.16	6.665	54.939	345.193
07/25/16 01:20:00 AM	6,666.30	6.666	54.940	345.195
07/25/16 01:30:00 AM	6,668.58	6.669	54.940	345.199
07/25/16 01:40:00 AM	6,677.52	6.678	54.943	345.217
07/25/16 01:50:00 AM	6,677.28	6.677	54.943	345.218
07/25/16 02:00:00 AM	6,687.36	6.687	54.946	345.236
07/25/16 02:10:00 AM	6,696.48	6.696	54.949	345.255
07/25/16 02:20:00 AM	6,702.90	6.703	54.951	345.268
07/25/16 02:30:00 AM	6,707.04	6.707	54.953	345.277
07/25/16 02:40:00 AM	6,709.56	6.710	54.954	345.283
07/25/16 02:50:00 AM	6,714.60	6.715	54.955	345.293
07/25/16 03:00:00 AM	6,716.64	6.717	54.956	345.297
07/25/16 03:10:00 AM	6,717.54	6.718	54.956	345.299
07/25/16 03:20:00 AM	6,718.68	6.719	54.956	345.302

07/25/16 03:30:00 AM	6,720.30	6.720	54.957	345.305
07/25/16 03:40:00 AM	6,720.78	6.721	54.957	345.306
07/25/16 03:50:00 AM	6,721.68	6.722	54.957	345.308
07/25/16 04:00:00 AM	6,724.20	6.724	54.958	345.313
07/25/16 04:10:00 AM	6,725.82	6.726	54.959	345.316
07/25/16 04:20:00 AM	6,727.86	6.728	54.959	345.320
07/25/16 04:30:00 AM	6,730.62	6.731	54.960	345.326
07/25/16 04:40:00 AM	6,732.00	6.732	54.961	345.329
07/25/16 04:50:00 AM	6,733.80	6.734	54.961	345.332
07/25/16 05:00:00 AM	6,735.66	6.736	54.962	345.336
07/25/16 05:10:00 AM	6,738.18	6.738	54.963	345.341
07/25/16 05:20:00 AM	6,739.98	6.740	54.963	345.345
07/25/16 05:30:00 AM	6,742.26	6.742	54.964	345.349
07/25/16 05:40:00 AM	6,745.50	6.746	54.965	345.356
07/25/16 05:50:00 AM	6,749.40	6.749	54.966	345.364
07/25/16 06:00:00 AM	6,751.86	6.752	54.967	345.369
07/25/16 06:10:00 AM	6,755.58	6.756	54.968	345.376
07/25/16 06:20:00 AM	6,758.28	6.758	54.969	345.382
07/25/16 06:30:00 AM	6,759.90	6.760	54.970	345.385
07/25/16 06:40:00 AM	6,761.04	6.761	54.970	345.388
07/25/16 06:50:00 AM	6,761.94	6.762	54.971	345.390
07/25/16 07:00:00 AM	6,763.56	6.764	54.971	345.393
07/25/16 07:10:00 AM	6,763.56	6.764	54.971	345.393
07/25/16 07:20:00 AM	6,763.56	6.764	54.971	345.393

07/25/16 07:30:00 AM	6,760.56	6.761	54.970	345.387
07/25/16 07:40:00 AM	6,760.56	6.761	54.970	345.387
07/25/16 07:50:00 AM	6,756.90	6.757	54.969	345.380
07/25/16 08:00:00 AM	6,751.68	6.752	54.967	345.370
07/25/16 08:10:00 AM	6,747.30	6.747	54.966	345.361
07/25/16 08:20:00 AM	6,740.70	6.741	54.964	345.348
07/25/16 08:30:00 AM	6,736.32	6.736	54.962	345.339
07/25/16 08:40:00 AM	6,726.24	6.726	54.959	345.319
07/25/16 08:50:00 AM	6,718.92	6.719	54.957	345.304
07/25/16 09:00:00 AM	6,715.02	6.715	54.955	345.295
07/25/16 09:10:00 AM	6,705.18	6.705	54.952	345.276
07/25/16 09:20:00 AM	6,697.86	6.698	54.950	345.261
07/25/16 09:30:00 AM	6,687.78	6.688	54.947	345.241
07/25/16 09:40:00 AM	6,674.04	6.674	54.942	345.214
07/25/16 09:50:00 AM	6,663.30	6.663	54.939	345.191
07/25/16 10:00:00 AM	6,657.60	6.658	54.937	345.179
07/25/16 10:10:00 AM	6,647.04	6.647	54.934	345.158
07/25/16 10:20:00 AM	6,635.40	6.635	54.930	345.135
07/25/16 10:30:00 AM	6,627.60	6.628	54.927	345.118
07/25/16 10:40:00 AM	6,617.28	6.617	54.924	345.097
07/25/16 10:50:00 AM	6,608.82	6.609	54.921	345.080
07/25/16 11:00:00 AM	6,597.84	6.598	54.918	345.058
07/25/16 11:10:00 AM	6,594.42	6.594	54.916	345.050
07/25/16 11:20:00 AM	6,591.00	6.591	54.915	345.043

07/25/16 11:30:00 AM	6,580.44	6.580	54.912	345.023
07/25/16 11:40:00 AM	6,572.88	6.573	54.910	345.007
07/25/16 11:50:00 AM	6,565.14	6.565	54.907	344.991
07/25/16 12:00:00 PM	6,561.48	6.561	54.906	344.983
07/25/16 12:10:00 PM	6,553.68	6.554	54.903	344.968
07/25/16 12:20:00 PM	6,549.54	6.550	54.902	344.959
07/25/16 12:30:00 PM	6,540.42	6.540	54.899	344.941
07/25/16 12:40:00 PM	6,530.10	6.530	54.896	344.920
07/25/16 12:50:00 PM	6,524.82	6.525	54.894	344.909
07/25/16 01:00:00 PM	6,510.18	6.510	54.889	344.880
07/25/16 01:10:00 PM	6,511.56	6.512	54.889	344.881
07/25/16 01:20:00 PM	6,506.04	6.506	54.888	344.870
07/25/16 01:30:00 PM	6,491.40	6.491	54.883	344.842
07/25/16 01:40:00 PM	6,484.80	6.485	54.881	344.827
07/25/16 01:50:00 PM	6,476.76	6.477	54.878	344.811
07/25/16 02:00:00 PM	6,465.54	6.466	54.875	344.789
07/25/16 02:10:00 PM	6,465.54	6.466	54.875	344.787
07/25/16 02:20:00 PM	6,455.28	6.455	54.872	344.768
07/25/16 02:30:00 PM	6,446.76	6.447	54.869	344.750
07/25/16 02:40:00 PM	6,444.24	6.444	54.868	344.744
07/25/16 02:50:00 PM	6,436.02	6.436	54.865	344.728
07/25/16 03:00:00 PM	6,437.64	6.438	54.866	344.730
07/25/16 03:10:00 PM	6,433.74	6.434	54.864	344.723
07/25/16 03:20:00 PM	6,420.48	6.420	54.860	344.698

07/25/16 03:30:00 PM	6,422.76	6.423	54.861	344.700
07/25/16 03:40:00 PM	6,416.82	6.417	54.859	344.689
07/25/16 03:50:00 PM	6,414.30	6.414	54.858	344.683
07/25/16 04:00:00 PM	6,412.20	6.412	54.857	344.679
07/25/16 04:10:00 PM	6,402.36	6.402	54.854	344.660
07/25/16 04:20:00 PM	6,400.08	6.400	54.853	344.654
07/25/16 04:30:00 PM	6,404.22	6.404	54.855	344.661
07/25/16 04:40:00 PM	6,397.80	6.398	54.853	344.650
07/25/16 04:50:00 PM	6,402.18	6.402	54.854	344.657
07/25/16 05:00:00 PM	6,399.84	6.400	54.853	344.654
07/25/16 05:10:00 PM	6,398.28	6.398	54.853	344.650
07/25/16 05:20:00 PM	6,396.90	6.397	54.852	344.648
07/25/16 05:30:00 PM	6,396.18	6.396	54.852	344.646
07/25/16 05:40:00 PM	6,400.80	6.401	54.853	344.654
07/25/16 05:50:00 PM	6,398.94	6.399	54.853	344.652
07/25/16 06:00:00 PM	6,402.18	6.402	54.854	344.657
07/25/16 06:10:00 PM	6,403.08	6.403	54.854	344.660
07/25/16 06:20:00 PM	6,403.50	6.404	54.854	344.661
07/25/16 06:30:00 PM	6,404.64	6.405	54.855	344.663
07/25/16 06:40:00 PM	6,411.06	6.411	54.857	344.675
07/25/16 06:50:00 PM	6,417.24	6.417	54.859	344.687
07/25/16 07:00:00 PM	6,421.62	6.422	54.860	344.697
07/25/16 07:10:00 PM	6,429.18	6.429	54.863	344.712
07/25/16 07:20:00 PM	6,433.98	6.434	54.864	344.722

07/25/16 07:30:00 PM	6,438.06	6.438	54.866	344.730
07/25/16 07:40:00 PM	6,443.10	6.443	54.867	344.740
07/25/16 07:50:00 PM	6,446.10	6.446	54.868	344.747
07/25/16 08:00:00 PM	6,451.62	6.452	54.870	344.758
07/25/16 08:10:00 PM	6,457.08	6.457	54.872	344.769
07/25/16 08:20:00 PM	6,462.78	6.463	54.874	344.780
07/25/16 08:30:00 PM	6,468.30	6.468	54.875	344.791
07/25/16 08:40:00 PM	6,474.24	6.474	54.877	344.803
07/25/16 08:50:00 PM	6,480.42	6.480	54.879	344.816
07/25/16 09:00:00 PM	6,486.36	6.486	54.881	344.828
07/25/16 09:10:00 PM	6,490.98	6.491	54.883	344.838
07/25/16 09:20:00 PM	6,496.68	6.497	54.885	344.849
07/25/16 09:30:00 PM	6,503.76	6.504	54.887	344.863
07/25/16 09:40:00 PM	6,508.56	6.509	54.888	344.873
07/25/16 09:50:00 PM	6,512.04	6.512	54.890	344.881
07/25/16 10:00:00 PM	6,516.60	6.517	54.891	344.890
07/25/16 10:10:00 PM	6,520.50	6.521	54.892	344.898
07/25/16 10:20:00 PM	6,523.44	6.523	54.893	344.904
07/25/16 10:30:00 PM	6,526.92	6.527	54.894	344.911
07/25/16 10:40:00 PM	6,529.86	6.530	54.895	344.917
07/25/16 10:50:00 PM	6,533.52	6.534	54.896	344.925
07/25/16 11:00:00 PM	6,536.28	6.536	54.897	344.930
07/25/16 11:10:00 PM	6,537.90	6.538	54.898	344.934
07/25/16 11:20:00 PM	6,542.70	6.543	54.899	344.943

07/25/16 11:30:00 PM	6,546.36	6.546	54.901	344.951
07/25/16 11:40:00 PM	6,549.78	6.550	54.902	344.958
07/25/16 11:50:00 PM	6,553.68	6.554	54.903	344.965
6/8/16 12:00 AM	6,545.46	6.545	54.900	344.949
6/8/16 12:10 AM	6,548.16	6.548	54.901	344.954
6/8/16 12:20 AM	6,551.16	6.551	54.902	344.961
6/8/16 12:30 AM	6,553.68	6.554	54.903	344.966
6/8/16 12:40 AM	6,555.96	6.556	54.904	344.970
6/8/16 12:50 AM	6,558.96	6.559	54.905	344.976
6/8/16 1:00 AM	6,560.34	6.560	54.905	344.979
6/8/16 1:10 AM	6,563.04	6.563	54.906	344.985
6/8/16 1:20 AM	6,565.14	6.565	54.907	344.989
6/8/16 1:30 AM	6,567.42	6.567	54.908	344.994
6/8/16 1:40 AM	6,570.18	6.570	54.908	344.999
6/8/16 1:50 AM	6,572.70	6.573	54.909	345.004
6/8/16 2:00 AM	6,575.88	6.576	54.910	345.011
6/8/16 2:10 AM	6,577.26	6.577	54.911	345.014
6/8/16 2:20 AM	6,579.78	6.580	54.912	345.019
6/8/16 2:30 AM	6,582.96	6.583	54.913	345.025
6/8/16 2:40 AM	6,584.82	6.585	54.913	345.029
6/8/16 2:50 AM	6,586.86	6.587	54.914	345.033
6/8/16 3:00 AM	6,588.72	6.589	54.914	345.037
6/8/16 3:10 AM	6,591.24	6.591	54.915	345.042
6/8/16 3:20 AM	6,592.80	6.593	54.916	345.045
6/8/16 3:30 AM	6,594.66	6.595	54.916	345.049
6/8/16 3:40 AM	6,597.18	6.597	54.917	345.054
6/8/16 3:50 AM	6,598.98	6.599	54.918	345.058
6/8/16 4:00 AM	6,601.08	6.601	54.918	345.062
6/8/16 4:10 AM	6,603.36	6.603	54.919	345.067
6/8/16 4:20 AM	6,606.54	6.607	54.920	345.073
6/8/16 4:30 AM	6,608.82	6.609	54.921	345.078
6/8/16 4:40 AM	6,610.68	6.611	54.922	345.082
6/8/16 4:50 AM	6,612.96	6.613	54.922	345.086
6/8/16 5:00 AM	6,615.24	6.615	54.923	345.091
6/8/16 5:10 AM	6,617.28	6.617	54.924	345.095
6/8/16 5:20 AM	6,619.62	6.620	54.924	345.100
6/8/16 5:30 AM	6,621.66	6.622	54.925	345.104
6/8/16 5:40 AM	6,623.94	6.624	54.926	345.109
6/8/16 5:50 AM	6,625.98	6.626	54.926	345.113
6/8/16 6:00 AM	6,628.74	6.629	54.927	345.118
6/8/16 6:10 AM	6,631.74	6.632	54.928	345.124
6/8/16 6:20 AM	6,635.16	6.635	54.929	345.131
6/8/16 6:30 AM	6,638.34	6.638	54.930	345.138
6/8/16 6:40 AM	6,642.00	6.642	54.932	345.145
6/8/16 6:50 AM	6,645.66	6.646	54.933	345.153

6/8/16 7:00 AM	6,650.94	6.651	54.934	345.163
6/8/16 7:10 AM	6,655.08	6.655	54.936	345.172
6/8/16 7:20 AM	6,658.98	6.659	54.937	345.180
6/8/16 7:30 AM	6,662.16	6.662	54.938	345.186
6/8/16 7:40 AM	6,663.30	6.663	54.939	345.189
6/8/16 7:50 AM	6,663.30	6.663	54.939	345.189
6/8/16 8:00 AM	6,663.30	6.663	54.939	345.189
6/8/16 8:10 AM	6,663.30	6.663	54.939	345.189
6/8/16 8:20 AM	6,661.92	6.662	54.938	345.187
6/8/16 8:30 AM	6,660.36	6.660	54.938	345.183
6/8/16 8:40 AM	6,656.46	6.656	54.937	345.176
6/8/16 8:50 AM	6,652.80	6.653	54.935	345.169
6/8/16 9:00 AM	6,645.00	6.645	54.933	345.153
6/8/16 9:10 AM	6,637.92	6.638	54.931	345.139
6/8/16 9:20 AM	6,628.98	6.629	54.928	345.121
6/8/16 9:30 AM	6,619.38	6.619	54.925	345.102
6/8/16 9:40 AM	6,609.30	6.609	54.921	345.081
6/8/16 9:50 AM	6,597.18	6.597	54.918	345.057
6/8/16 10:00 AM	6,585.72	6.586	54.914	345.034
6/8/16 10:10 AM	6,574.74	6.575	54.910	345.011
6/8/16 10:20 AM	6,566.52	6.567	54.908	344.994
6/8/16 10:30 AM	6,558.24	6.558	54.905	344.977
6/8/16 10:40 AM	6,548.40	6.548	54.902	344.957
6/8/16 10:50 AM	6,539.94	6.540	54.899	344.940
6/8/16 11:00 AM	6,529.86	6.530	54.896	344.920
6/8/16 11:10 AM	6,520.26	6.520	54.893	344.900
6/8/16 11:20 AM	6,510.66	6.511	54.889	344.881
6/8/16 11:30 AM	6,502.86	6.503	54.887	344.864
6/8/16 11:40 AM	6,490.98	6.491	54.883	344.841
6/8/16 11:50 AM	6,479.28	6.479	54.879	344.817
6/8/16 12:00 PM	6,469.68	6.470	54.876	344.797
6/8/16 12:10 PM	6,461.88	6.462	54.874	344.781
6/8/16 12:20 PM	6,454.08	6.454	54.871	344.765
6/8/16 12:30 PM	6,442.92	6.443	54.868	344.743
6/8/16 12:40 PM	6,428.04	6.428	54.863	344.713
6/8/16 12:50 PM	6,412.44	6.412	54.858	344.682
6/8/16 1:00 PM	6,400.98	6.401	54.854	344.658
6/8/16 1:10 PM	6,390.00	6.390	54.850	344.635
6/8/16 1:20 PM	6,382.02	6.382	54.848	344.619
6/8/16 1:30 PM	6,374.94	6.375	54.845	344.604
6/8/16 1:40 PM	6,367.80	6.368	54.843	344.589
6/8/16 1:50 PM	6,359.82	6.360	54.841	344.573
6/8/16 2:00 PM	6,353.88	6.354	54.839	344.561
6/8/16 2:10 PM	6,346.08	6.346	54.836	344.545
6/8/16 2:20 PM	6,335.34	6.335	54.833	344.524
6/8/16 2:30 PM	6,327.78	6.328	54.830	344.508
6/8/16 2:40 PM	6,319.98	6.320	54.828	344.492
6/8/16 2:50 PM	6,316.80	6.317	54.827	344.485

6/8/16 3:00 PM	6,311.76	6.312	54.825	344.475
6/8/16 3:10 PM	6,305.58	6.306	54.823	344.463
6/8/16 3:20 PM	6,302.82	6.303	54.822	344.456
6/8/16 3:30 PM	6,297.30	6.297	54.820	344.446
6/8/16 3:40 PM	6,291.84	6.292	54.818	344.434
6/8/16 3:50 PM	6,285.90	6.286	54.817	344.422
6/8/16 4:00 PM	6,287.04	6.287	54.817	344.424
6/8/16 4:10 PM	6,290.46	6.290	54.818	344.430
6/8/16 4:20 PM	6,290.22	6.290	54.818	344.430
6/8/16 4:30 PM	6,292.08	6.292	54.818	344.434
6/8/16 4:40 PM	6,296.40	6.296	54.820	344.442
6/8/16 4:50 PM	6,306.00	6.306	54.823	344.461
6/8/16 5:00 PM	6,317.70	6.318	54.826	344.484
6/8/16 5:10 PM	6,328.44	6.328	54.830	344.506
6/8/16 5:20 PM	6,339.66	6.340	54.833	344.529
6/8/16 5:30 PM	6,350.22	6.350	54.837	344.550
6/8/16 5:40 PM	6,351.54	6.352	54.838	344.555
6/8/16 5:50 PM	6,349.08	6.349	54.837	344.550
6/8/16 6:00 PM	6,346.98	6.347	54.836	344.546
6/8/16 6:10 PM	6,346.56	6.347	54.836	344.545
6/8/16 6:20 PM	6,346.56	6.347	54.836	344.545
6/8/16 6:30 PM	6,346.56	6.347	54.836	344.545
6/8/16 6:40 PM	6,347.46	6.347	54.836	344.546
6/8/16 6:50 PM	6,353.40	6.353	54.838	344.558
6/8/16 7:00 PM	6,363.72	6.364	54.841	344.578
6/8/16 7:10 PM	6,375.60	6.376	54.845	344.602
6/8/16 7:20 PM	6,386.34	6.386	54.849	344.624
6/8/16 7:30 PM	6,395.52	6.396	54.852	344.643
6/8/16 7:40 PM	6,403.50	6.404	54.854	344.659
6/8/16 7:50 PM	6,411.54	6.412	54.857	344.676
6/8/16 8:00 PM	6,417.48	6.417	54.859	344.688
6/8/16 8:10 PM	6,425.04	6.425	54.861	344.703
6/8/16 8:20 PM	6,433.08	6.433	54.864	344.719
6/8/16 8:30 PM	6,441.96	6.442	54.867	344.737
6/8/16 8:40 PM	6,449.10	6.449	54.869	344.752
6/8/16 8:50 PM	6,456.18	6.456	54.871	344.767
6/8/16 9:00 PM	6,462.60	6.463	54.873	344.780
6/8/16 9:10 PM	6,468.30	6.468	54.875	344.791
6/8/16 9:20 PM	6,474.48	6.474	54.877	344.804
6/8/16 9:30 PM	6,480.00	6.480	54.879	344.815
6/8/16 9:40 PM	6,486.18	6.486	54.881	344.828
6/8/16 9:50 PM	6,492.12	6.492	54.883	344.840
6/8/16 10:00 PM	6,497.16	6.497	54.885	344.850
6/8/16 10:10 PM	6,501.48	6.501	54.886	344.859
6/8/16 10:20 PM	6,505.14	6.505	54.887	344.867
6/8/16 10:30 PM	6,508.14	6.508	54.888	344.873
6/8/16 10:40 PM	6,510.90	6.511	54.889	344.879
6/8/16 10:50 PM	6,513.60	6.514	54.890	344.884

6/8/16 11:00 PM	6,516.60	6.517	54.891	344.890
6/8/16 11:10 PM	6,520.02	6.520	54.892	344.897
6/8/16 11:20 PM	6,523.92	6.524	54.893	344.905
6/8/16 11:30 PM	6,526.92	6.527	54.894	344.911
6/8/16 11:40 PM	6,529.86	6.530	54.895	344.917
6/8/16 11:50 PM	6,533.76	6.534	54.897	344.925
7/8/16 12:00 AM	6,536.76	6.537	54.898	344.931
7/8/16 12:10 AM	6,539.46	6.539	54.898	344.937
7/8/16 12:20 AM	6,542.22	6.542	54.899	344.942
7/8/16 12:30 AM	6,544.74	6.545	54.900	344.948
7/8/16 12:40 AM	6,547.50	6.548	54.901	344.953
7/8/16 12:50 AM	6,549.54	6.550	54.902	344.957
7/8/16 1:00 AM	6,551.64	6.552	54.902	344.962
7/8/16 1:10 AM	6,553.44	6.553	54.903	344.965
7/8/16 1:20 AM	6,554.58	6.555	54.903	344.968
7/8/16 1:30 AM	6,557.82	6.558	54.904	344.974
7/8/16 1:40 AM	6,559.62	6.560	54.905	344.978
7/8/16 1:50 AM	6,561.66	6.562	54.906	344.982
7/8/16 2:00 AM	6,564.00	6.564	54.906	344.987
7/8/16 2:10 AM	6,565.80	6.566	54.907	344.991
7/8/16 2:20 AM	6,567.42	6.567	54.908	344.994
7/8/16 2:30 AM	6,569.94	6.570	54.908	344.999
7/8/16 2:40 AM	6,571.32	6.571	54.909	345.002
7/8/16 2:50 AM	6,572.88	6.573	54.909	345.005
7/8/16 3:00 AM	6,574.98	6.575	54.910	345.009
7/8/16 3:10 AM	6,576.54	6.577	54.910	345.012
7/8/16 3:20 AM	6,579.06	6.579	54.911	345.017
7/8/16 3:30 AM	6,581.34	6.581	54.912	345.022
7/8/16 3:40 AM	6,584.82	6.585	54.913	345.029
7/8/16 3:50 AM	6,586.62	6.587	54.914	345.033
7/8/16 4:00 AM	6,588.48	6.588	54.914	345.037
7/8/16 4:10 AM	6,590.04	6.590	54.915	345.040
7/8/16 4:20 AM	6,591.42	6.591	54.915	345.043
7/8/16 4:30 AM	6,593.70	6.594	54.916	345.047
7/8/16 4:40 AM	6,595.08	6.595	54.916	345.050
7/8/16 4:50 AM	6,596.94	6.597	54.917	345.054
7/8/16 5:00 AM	6,599.88	6.600	54.918	345.060
7/8/16 5:10 AM	6,601.08	6.601	54.918	345.062
7/8/16 5:20 AM	6,605.88	6.606	54.920	345.072
7/8/16 5:30 AM	6,609.06	6.609	54.921	345.078
7/8/16 5:40 AM	6,611.34	6.611	54.922	345.083
7/8/16 5:50 AM	6,614.58	6.615	54.923	345.089
7/8/16 6:00 AM	6,616.86	6.617	54.924	345.094
7/8/16 6:10 AM	6,619.62	6.620	54.924	345.100
7/8/16 6:20 AM	6,621.90	6.622	54.925	345.105
7/8/16 6:30 AM	6,624.84	6.625	54.926	345.110
7/8/16 6:40 AM	6,628.50	6.629	54.927	345.118
7/8/16 6:50 AM	6,632.16	6.632	54.928	345.125

7/8/16 7:00 AM	6,636.30	6.636	54.930	345.133
7/8/16 7:10 AM	6,639.06	6.639	54.931	345.139
7/8/16 7:20 AM	6,642.24	6.642	54.932	345.146
7/8/16 7:30 AM	6,643.86	6.644	54.932	345.149
7/8/16 7:40 AM	6,644.52	6.645	54.933	345.151
7/8/16 7:50 AM	6,644.76	6.645	54.933	345.151
7/8/16 8:00 AM	6,644.76	6.645	54.933	345.151
7/8/16 8:10 AM	6,644.52	6.645	54.933	345.151
7/8/16 8:20 AM	6,644.52	6.645	54.933	345.151
7/8/16 8:30 AM	6,644.34	6.644	54.932	345.151
7/8/16 8:40 AM	6,644.34	6.644	54.932	345.151
7/8/16 8:50 AM	6,643.62	6.644	54.932	345.149
7/8/16 9:00 AM	6,641.10	6.641	54.931	345.144
7/8/16 9:10 AM	6,638.16	6.638	54.931	345.139
7/8/16 9:20 AM	6,631.74	6.632	54.929	345.126
7/8/16 9:30 AM	6,623.04	6.623	54.926	345.109
7/8/16 9:40 AM	6,614.34	6.614	54.923	345.091
7/8/16 9:50 AM	6,605.64	6.606	54.920	345.074
7/8/16 10:00 AM	6,594.90	6.595	54.917	345.052
7/8/16 10:10 AM	6,584.58	6.585	54.913	345.031
7/8/16 10:20 AM	6,571.50	6.572	54.909	345.005
7/8/16 10:30 AM	6,561.00	6.561	54.906	344.983
7/8/16 10:40 AM	6,550.26	6.550	54.902	344.961
7/8/16 10:50 AM	6,541.56	6.542	54.899	344.943
7/8/16 11:00 AM	6,523.26	6.523	54.894	344.908
7/8/16 11:10 AM	6,512.22	6.512	54.890	344.884
7/8/16 11:20 AM	6,502.20	6.502	54.887	344.863
7/8/16 11:30 AM	6,489.60	6.490	54.883	344.838
7/8/16 11:40 AM	6,473.34	6.473	54.878	344.806
7/8/16 11:50 AM	6,458.22	6.458	54.873	344.775
7/8/16 12:00 PM	6,447.00	6.447	54.869	344.751
7/8/16 12:10 PM	6,437.88	6.438	54.866	344.732
7/8/16 12:20 PM	6,434.64	6.435	54.865	344.725
7/8/16 12:30 PM	6,414.96	6.415	54.859	344.687
7/8/16 12:40 PM	6,395.76	6.396	54.853	344.649
7/8/16 12:50 PM	6,382.92	6.383	54.848	344.621
7/8/16 1:00 PM	6,382.92	6.383	54.848	344.619
7/8/16 1:10 PM	6,371.04	6.371	54.844	344.597
7/8/16 1:20 PM	6,357.30	6.357	54.840	344.569
7/8/16 1:30 PM	6,348.36	6.348	54.837	344.550
7/8/16 1:40 PM	6,333.24	6.333	54.832	344.520
7/8/16 1:50 PM	6,333.24	6.333	54.832	344.518
7/8/16 2:00 PM	6,330.54	6.331	54.831	344.513
7/8/16 2:10 PM	6,327.06	6.327	54.830	344.506
7/8/16 2:20 PM	6,317.70	6.318	54.827	344.488
7/8/16 2:30 PM	6,307.86	6.308	54.824	344.468
7/8/16 2:40 PM	6,301.20	6.301	54.822	344.454
7/8/16 2:50 PM	6,286.08	6.286	54.817	344.424

7/8/16 3:00 PM	6,276.48	6.276	54.814	344.404
7/8/16 3:10 PM	6,268.74	6.269	54.811	344.388
7/8/16 3:20 PM	6,259.80	6.260	54.808	344.370
7/8/16 3:30 PM	6,252.66	6.253	54.806	344.355
7/8/16 3:40 PM	6,243.30	6.243	54.803	344.336
7/8/16 3:50 PM	6,242.40	6.242	54.802	344.333
7/8/16 4:00 PM	6,246.72	6.247	54.804	344.341
7/8/16 4:10 PM	6,247.44	6.247	54.804	344.343
7/8/16 4:20 PM	6,248.82	6.249	54.804	344.346
7/8/16 4:30 PM	6,253.14	6.253	54.806	344.354
7/8/16 4:40 PM	6,257.70	6.258	54.807	344.363
7/8/16 4:50 PM	6,263.88	6.264	54.809	344.375
7/8/16 5:00 PM	6,272.16	6.272	54.812	344.392
7/8/16 5:10 PM	6,283.14	6.283	54.815	344.414
7/8/16 5:20 PM	6,293.46	6.293	54.819	344.435
7/8/16 5:30 PM	6,304.62	6.305	54.822	344.457
7/8/16 5:40 PM	6,315.66	6.316	54.826	344.480
7/8/16 5:50 PM	6,325.68	6.326	54.829	344.500
7/8/16 6:00 PM	6,331.44	6.331	54.831	344.513
7/8/16 6:10 PM	6,339.42	6.339	54.834	344.529
7/8/16 6:20 PM	6,349.08	6.349	54.837	344.548
7/8/16 6:30 PM	6,353.88	6.354	54.838	344.559
7/8/16 6:40 PM	6,353.64	6.354	54.838	344.559
7/8/16 6:50 PM	6,353.64	6.354	54.838	344.559
7/8/16 7:00 PM	6,353.64	6.354	54.838	344.559
7/8/16 7:10 PM	6,355.02	6.355	54.839	344.562
7/8/16 7:20 PM	6,359.34	6.359	54.840	344.570
7/8/16 7:30 PM	6,365.76	6.366	54.842	344.583
7/8/16 7:40 PM	6,375.36	6.375	54.845	344.602
7/8/16 7:50 PM	6,383.16	6.383	54.848	344.618
7/8/16 8:00 PM	6,390.96	6.391	54.850	344.634
7/8/16 8:10 PM	6,400.80	6.401	54.853	344.653
7/8/16 8:20 PM	6,409.50	6.410	54.856	344.671
7/8/16 8:30 PM	6,416.34	6.416	54.858	344.685
7/8/16 8:40 PM	6,423.18	6.423	54.861	344.699
7/8/16 8:50 PM	6,430.98	6.431	54.863	344.715
7/8/16 9:00 PM	6,437.16	6.437	54.865	344.728
7/8/16 9:10 PM	6,443.82	6.444	54.867	344.741
7/8/16 9:20 PM	6,449.76	6.450	54.869	344.754
7/8/16 9:30 PM	6,454.80	6.455	54.871	344.764
7/8/16 9:40 PM	6,460.98	6.461	54.873	344.776
7/8/16 9:50 PM	6,463.98	6.464	54.874	344.783
7/8/16 10:00 PM	6,467.40	6.467	54.875	344.790
7/8/16 10:10 PM	6,472.86	6.473	54.877	344.801
7/8/16 10:20 PM	6,479.28	6.479	54.879	344.814
7/8/16 10:30 PM	6,486.36	6.486	54.881	344.828
7/8/16 10:40 PM	6,492.12	6.492	54.883	344.840
7/8/16 10:50 PM	6,497.34	6.497	54.885	344.851

7/8/16 11:00 PM	6,501.48	6.501	54.886	344.859
7/8/16 11:10 PM	6,506.28	6.506	54.888	344.869
7/8/16 11:20 PM	6,510.42	6.510	54.889	344.877
7/8/16 11:30 PM	6,513.60	6.514	54.890	344.884
7/8/16 11:40 PM	6,517.08	6.517	54.891	344.891
7/8/16 11:50 PM	6,521.88	6.522	54.893	344.901
8/8/16 12:00 AM	6,525.72	6.526	54.894	344.909
8/8/16 12:10 AM	6,529.86	6.530	54.895	344.917
8/8/16 12:20 AM	6,534.42	6.534	54.897	344.926
8/8/16 12:30 AM	6,539.70	6.540	54.898	344.937
8/8/16 12:40 AM	6,543.60	6.544	54.900	344.945
8/8/16 12:50 AM	6,547.26	6.547	54.901	344.952
8/8/16 1:00 AM	6,550.92	6.551	54.902	344.960
8/8/16 1:10 AM	6,553.44	6.553	54.903	344.965
8/8/16 1:20 AM	6,556.86	6.557	54.904	344.972
8/8/16 1:30 AM	6,559.62	6.560	54.905	344.978
8/8/16 1:40 AM	6,562.80	6.563	54.906	344.984
8/8/16 1:50 AM	6,565.80	6.566	54.907	344.990
8/8/16 2:00 AM	6,568.32	6.568	54.908	344.996
8/8/16 2:10 AM	6,571.32	6.571	54.909	345.002
8/8/16 2:20 AM	6,574.02	6.574	54.910	345.007
8/8/16 2:30 AM	6,577.26	6.577	54.911	345.014
8/8/16 2:40 AM	6,580.20	6.580	54.912	345.020
8/8/16 2:50 AM	6,584.34	6.584	54.913	345.028
8/8/16 3:00 AM	6,587.34	6.587	54.914	345.034
8/8/16 3:10 AM	6,590.76	6.591	54.915	345.041
8/8/16 3:20 AM	6,593.04	6.593	54.916	345.046
8/8/16 3:30 AM	6,595.80	6.596	54.917	345.051
8/8/16 3:40 AM	6,598.74	6.599	54.918	345.057
8/8/16 3:50 AM	6,602.64	6.603	54.919	345.065
8/8/16 4:00 AM	6,606.54	6.607	54.920	345.073
8/8/16 4:10 AM	6,609.06	6.609	54.921	345.078
8/8/16 4:20 AM	6,611.58	6.612	54.922	345.084
8/8/16 4:30 AM	6,613.86	6.614	54.923	345.088
8/8/16 4:40 AM	6,616.38	6.616	54.923	345.093
8/8/16 4:50 AM	6,619.14	6.619	54.924	345.099
8/8/16 5:00 AM	6,621.18	6.621	54.925	345.103
8/8/16 5:10 AM	6,623.70	6.624	54.926	345.108
8/8/16 5:20 AM	6,625.80	6.626	54.926	345.113
8/8/16 5:30 AM	6,628.74	6.629	54.927	345.118
8/8/16 5:40 AM	6,632.40	6.632	54.929	345.126
8/8/16 5:50 AM	6,635.40	6.635	54.929	345.132
8/8/16 6:00 AM	6,637.92	6.638	54.930	345.137
8/8/16 6:10 AM	6,640.86	6.641	54.931	345.143
8/8/16 6:20 AM	6,643.38	6.643	54.932	345.148
8/8/16 6:30 AM	6,647.28	6.647	54.933	345.156
8/8/16 6:40 AM	6,651.42	6.651	54.935	345.164
8/8/16 6:50 AM	6,653.94	6.654	54.936	345.170

8/8/16 7:00 AM	6,657.84	6.658	54.937	345.177
8/8/16 7:10 AM	6,661.02	6.661	54.938	345.184
8/8/16 7:20 AM	6,663.78	6.664	54.939	345.190
8/8/16 7:30 AM	6,666.30	6.666	54.940	345.195
8/8/16 7:40 AM	6,669.48	6.669	54.941	345.201
8/8/16 7:50 AM	6,673.14	6.673	54.942	345.209
8/8/16 8:00 AM	6,676.56	6.677	54.943	345.215
8/8/16 8:10 AM	6,678.90	6.679	54.944	345.220
8/8/16 8:20 AM	6,680.94	6.681	54.944	345.225
8/8/16 8:30 AM	6,684.84	6.685	54.945	345.232
8/8/16 8:40 AM	6,686.88	6.687	54.946	345.237
8/8/16 8:50 AM	6,689.40	6.689	54.947	345.242
8/8/16 9:00 AM	6,691.02	6.691	54.948	345.245
8/8/16 9:10 AM	6,692.82	6.693	54.948	345.249
8/8/16 9:20 AM	6,695.58	6.696	54.949	345.254
8/8/16 9:30 AM	6,697.86	6.698	54.950	345.259
8/8/16 9:40 AM	6,700.14	6.700	54.950	345.264
8/8/16 9:50 AM	6,703.14	6.703	54.951	345.270
8/8/16 10:00 AM	6,705.66	6.706	54.952	345.275
8/8/16 10:10 AM	6,708.84	6.709	54.953	345.281
8/8/16 10:20 AM	6,713.46	6.713	54.955	345.290
8/8/16 10:30 AM	6,717.12	6.717	54.956	345.298
8/8/16 10:40 AM	6,717.78	6.718	54.956	345.300
8/8/16 10:50 AM	6,718.02	6.718	54.956	345.300
8/8/16 11:00 AM	6,716.64	6.717	54.956	345.298
8/8/16 11:10 AM	6,711.84	6.712	54.954	345.289
8/8/16 11:20 AM	6,702.66	6.703	54.952	345.271
8/8/16 11:30 AM	6,692.16	6.692	54.948	345.250
8/8/16 11:40 AM	6,680.22	6.680	54.944	345.226
8/8/16 11:50 AM	6,664.44	6.664	54.939	345.194
8/8/16 12:00 PM	6,648.18	6.648	54.934	345.161
8/8/16 12:10 PM	6,633.12	6.633	54.929	345.131
8/8/16 12:20 PM	6,615.72	6.616	54.924	345.096
8/8/16 12:30 PM	6,601.26	6.601	54.919	345.066
8/8/16 12:40 PM	6,589.14	6.589	54.915	345.041
8/8/16 12:50 PM	6,579.30	6.579	54.912	345.020
8/8/16 1:00 PM	6,567.18	6.567	54.908	344.996
8/8/16 1:10 PM	6,554.34	6.554	54.904	344.970
8/8/16 1:20 PM	6,540.42	6.540	54.899	344.942
8/8/16 1:30 PM	6,518.40	6.518	54.892	344.898
8/8/16 1:40 PM	6,494.64	6.495	54.885	344.851
8/8/16 1:50 PM	6,459.84	6.460	54.874	344.782
8/8/16 2:00 PM	6,448.14	6.448	54.869	344.754
8/8/16 2:10 PM	6,443.58	6.444	54.868	344.743
8/8/16 2:20 PM	6,439.26	6.439	54.866	344.734
8/8/16 2:30 PM	6,443.34	6.443	54.867	344.741
8/8/16 2:40 PM	6,457.08	6.457	54.871	344.767
8/8/16 2:50 PM	6,475.14	6.475	54.877	344.803

8/8/16 3:00 PM	6,493.02	6.493	54.883	344.839
8/8/16 3:10 PM	6,507.00	6.507	54.888	344.869
8/8/16 3:20 PM	6,516.36	6.516	54.891	344.888
8/8/16 3:30 PM	6,516.36	6.516	54.891	344.890
8/8/16 3:40 PM	6,512.04	6.512	54.890	344.882
8/8/16 3:50 PM	6,507.18	6.507	54.888	344.873
8/8/16 4:00 PM	6,506.76	6.507	54.888	344.871
8/8/16 4:10 PM	6,508.80	6.509	54.889	344.875
8/8/16 4:20 PM	6,512.94	6.513	54.890	344.883
8/8/16 4:30 PM	6,512.70	6.513	54.890	344.883
8/8/16 4:40 PM	6,508.80	6.509	54.889	344.876
8/8/16 4:50 PM	6,498.30	6.498	54.885	344.855
8/8/16 5:00 PM	6,484.98	6.485	54.881	344.829
8/8/16 5:10 PM	6,473.82	6.474	54.878	344.806
8/8/16 5:20 PM	6,460.98	6.461	54.873	344.780
8/8/16 5:30 PM	6,448.38	6.448	54.869	344.754
8/8/16 5:40 PM	6,442.20	6.442	54.867	344.741
8/8/16 5:50 PM	6,440.16	6.440	54.866	344.736
8/8/16 6:00 PM	6,439.92	6.440	54.866	344.735
8/8/16 6:10 PM	6,434.64	6.435	54.865	344.725
8/8/16 6:20 PM	6,418.20	6.418	54.860	344.694
8/8/16 6:30 PM	6,412.68	6.413	54.858	344.681
8/8/16 6:40 PM	6,408.36	6.408	54.856	344.671
8/8/16 6:50 PM	6,399.18	6.399	54.853	344.654
8/8/16 7:00 PM	6,396.42	6.396	54.852	344.647
8/8/16 7:10 PM	6,396.66	6.397	54.852	344.647
8/8/16 7:20 PM	6,399.66	6.400	54.853	344.652
8/8/16 7:30 PM	6,404.64	6.405	54.855	344.662
8/8/16 7:40 PM	6,408.12	6.408	54.856	344.669
8/8/16 7:50 PM	6,412.68	6.413	54.857	344.679
8/8/16 8:00 PM	6,416.58	6.417	54.859	344.687
8/8/16 8:10 PM	6,420.48	6.420	54.860	344.694
8/8/16 8:20 PM	6,425.70	6.426	54.862	344.705
8/8/16 8:30 PM	6,431.70	6.432	54.863	344.717
8/8/16 8:40 PM	6,438.06	6.438	54.865	344.730
8/8/16 8:50 PM	6,443.82	6.444	54.867	344.742
8/8/16 9:00 PM	6,450.00	6.450	54.869	344.754
8/8/16 9:10 PM	6,455.28	6.455	54.871	344.765
8/8/16 9:20 PM	6,460.98	6.461	54.873	344.777
8/8/16 9:30 PM	6,464.88	6.465	54.874	344.785
8/8/16 9:40 PM	6,469.20	6.469	54.876	344.794
8/8/16 9:50 PM	6,472.86	6.473	54.877	344.801
8/8/16 10:00 PM	6,476.10	6.476	54.878	344.808
8/8/16 10:10 PM	6,480.42	6.480	54.879	344.816
8/8/16 10:20 PM	6,485.22	6.485	54.881	344.826
8/8/16 10:30 PM	6,489.60	6.490	54.882	344.835
8/8/16 10:40 PM	6,493.26	6.493	54.883	344.843
8/8/16 10:50 PM	6,496.20	6.496	54.884	344.849

8/8/16 11:00 PM	6,498.96	6.499	54.885	344.854
8/8/16 11:10 PM	6,500.82	6.501	54.886	344.858
8/8/16 11:20 PM	6,503.10	6.503	54.887	344.863
8/8/16 11:30 PM	6,504.48	6.504	54.887	344.866
8/8/16 11:40 PM	6,506.28	6.506	54.888	344.869
8/8/16 11:50 PM	6,508.14	6.508	54.888	344.873
9/8/16 12:00 AM	6,509.70	6.510	54.889	344.876
9/8/16 12:10 AM	6,511.80	6.512	54.890	344.881
9/8/16 12:20 AM	6,513.84	6.514	54.890	344.885
9/8/16 12:30 AM	6,516.60	6.517	54.891	344.890
9/8/16 12:40 AM	6,519.36	6.519	54.892	344.896
9/8/16 12:50 AM	6,522.06	6.522	54.893	344.901
9/8/16 1:00 AM	6,523.92	6.524	54.893	344.905
9/8/16 1:10 AM	6,526.44	6.526	54.894	344.910
9/8/16 1:20 AM	6,527.10	6.527	54.894	344.912
9/8/16 1:30 AM	6,529.20	6.529	54.895	344.916
9/8/16 1:40 AM	6,530.58	6.531	54.896	344.919
9/8/16 1:50 AM	6,532.14	6.532	54.896	344.922
9/8/16 2:00 AM	6,533.52	6.534	54.897	344.925
9/8/16 2:10 AM	6,538.32	6.538	54.898	344.934
9/8/16 2:20 AM	6,538.80	6.539	54.898	344.936
9/8/16 2:30 AM	6,540.18	6.540	54.899	344.939
9/8/16 2:40 AM	6,541.08	6.541	54.899	344.940
9/8/16 2:50 AM	6,543.36	6.543	54.900	344.945
9/8/16 3:00 AM	6,544.08	6.544	54.900	344.947
9/8/16 3:10 AM	6,545.88	6.546	54.901	344.950
9/8/16 3:20 AM	6,547.26	6.547	54.901	344.953
9/8/16 3:30 AM	6,547.98	6.548	54.901	344.954
9/8/16 3:40 AM	6,549.12	6.549	54.902	344.957
9/8/16 3:50 AM	6,550.92	6.551	54.902	344.960
9/8/16 4:00 AM	6,551.82	6.552	54.902	344.962
9/8/16 4:10 AM	6,552.78	6.553	54.903	344.964
9/8/16 4:20 AM	6,554.16	6.554	54.903	344.967
9/8/16 4:30 AM	6,555.96	6.556	54.904	344.971
9/8/16 4:40 AM	6,557.34	6.557	54.904	344.973
9/8/16 4:50 AM	6,558.96	6.559	54.905	344.977
9/8/16 5:00 AM	6,560.10	6.560	54.905	344.979
9/8/16 5:10 AM	6,561.48	6.561	54.906	344.982
9/8/16 5:20 AM	6,562.62	6.563	54.906	344.984
9/8/16 5:30 AM	6,563.52	6.564	54.906	344.986
9/8/16 5:40 AM	6,565.56	6.566	54.907	344.990
9/8/16 5:50 AM	6,566.94	6.567	54.907	344.993
9/8/16 6:00 AM	6,568.56	6.569	54.908	344.996
9/8/16 6:10 AM	6,570.60	6.571	54.909	345.000
9/8/16 6:20 AM	6,572.22	6.572	54.909	345.004
9/8/16 6:30 AM	6,574.50	6.575	54.910	345.008
9/8/16 6:40 AM	6,576.54	6.577	54.910	345.012
9/8/16 6:50 AM	6,577.92	6.578	54.911	345.015

9/8/16 7:00 AM	6,579.30	6.579	54.911	345.018
9/8/16 7:10 AM	6,579.54	6.580	54.911	345.019
9/8/16 7:20 AM	6,579.54	6.580	54.911	345.019
9/8/16 7:30 AM	6,579.54	6.580	54.911	345.019
9/8/16 7:40 AM	6,579.54	6.580	54.911	345.019
9/8/16 7:50 AM	6,579.30	6.579	54.911	345.018
9/8/16 8:00 AM	6,578.16	6.578	54.911	345.016
9/8/16 8:10 AM	6,576.12	6.576	54.910	345.012
9/8/16 8:20 AM	6,573.36	6.573	54.910	345.007
9/8/16 8:30 AM	6,569.22	6.569	54.908	344.999
9/8/16 8:40 AM	6,566.28	6.566	54.907	344.992
9/8/16 8:50 AM	6,562.38	6.562	54.906	344.985
9/8/16 9:00 AM	6,558.24	6.558	54.905	344.976
9/8/16 9:10 AM	6,553.20	6.553	54.903	344.966
9/8/16 9:20 AM	6,547.50	6.548	54.901	344.955
9/8/16 9:30 AM	6,541.08	6.541	54.899	344.942
9/8/16 9:40 AM	6,532.38	6.532	54.896	344.924
9/8/16 9:50 AM	6,521.88	6.522	54.893	344.903
9/8/16 10:00 AM	6,512.70	6.513	54.890	344.885
9/8/16 10:10 AM	6,504.72	6.505	54.888	344.868
9/8/16 10:20 AM	6,496.02	6.496	54.885	344.851
9/8/16 10:30 AM	6,484.56	6.485	54.881	344.828
9/8/16 10:40 AM	6,472.20	6.472	54.877	344.803
9/8/16 10:50 AM	6,460.74	6.461	54.873	344.779
9/8/16 11:00 AM	6,449.28	6.449	54.870	344.756
9/8/16 11:10 AM	6,436.74	6.437	54.866	344.731
9/8/16 11:20 AM	6,426.90	6.427	54.862	344.710
9/8/16 11:30 AM	6,416.58	6.417	54.859	344.689
9/8/16 11:40 AM	6,409.50	6.410	54.857	344.674
9/8/16 11:50 AM	6,395.28	6.395	54.852	344.647
9/8/16 12:00 PM	6,387.48	6.387	54.850	344.630
9/8/16 12:10 PM	6,374.70	6.375	54.846	344.604
9/8/16 12:20 PM	6,360.96	6.361	54.841	344.577
9/8/16 12:30 PM	6,345.84	6.346	54.836	344.546
9/8/16 12:40 PM	6,330.96	6.331	54.831	344.516
9/8/16 12:50 PM	6,321.36	6.321	54.828	344.495
9/8/16 1:00 PM	6,308.52	6.309	54.824	344.470
9/8/16 1:10 PM	6,298.44	6.298	54.821	344.449
9/8/16 1:20 PM	6,285.42	6.285	54.817	344.423
9/8/16 1:30 PM	6,277.20	6.277	54.814	344.405
9/8/16 1:40 PM	6,265.26	6.265	54.810	344.382
9/8/16 1:50 PM	6,257.52	6.258	54.807	344.365
9/8/16 2:00 PM	6,247.20	6.247	54.804	344.344
9/8/16 2:10 PM	6,235.32	6.235	54.800	344.321
9/8/16 2:20 PM	6,224.52	6.225	54.797	344.298
9/8/16 2:30 PM	6,207.84	6.208	54.792	344.265
9/8/16 2:40 PM	6,203.46	6.203	54.790	344.255
9/8/16 2:50 PM	6,203.28	6.203	54.790	344.253

9/8/16 3:00 PM	6,202.56	6.203	54.789	344.252
9/8/16 3:10 PM	6,197.52	6.198	54.788	344.242
9/8/16 3:20 PM	6,191.10	6.191	54.786	344.230
9/8/16 3:30 PM	6,191.10	6.191	54.786	344.228
9/8/16 3:40 PM	6,192.72	6.193	54.786	344.231
9/8/16 3:50 PM	6,192.24	6.192	54.786	344.231
9/8/16 4:00 PM	6,187.44	6.187	54.785	344.222
9/8/16 4:10 PM	6,186.78	6.187	54.784	344.220
9/8/16 4:20 PM	6,187.02	6.187	54.784	344.220
9/8/16 4:30 PM	6,189.30	6.189	54.785	344.224
9/8/16 4:40 PM	6,190.44	6.190	54.785	344.227
9/8/16 4:50 PM	6,192.24	6.192	54.786	344.230
9/8/16 5:00 PM	6,192.24	6.192	54.786	344.231
9/8/16 5:10 PM	6,191.82	6.192	54.786	344.230
9/8/16 5:20 PM	6,190.44	6.190	54.786	344.227
9/8/16 5:30 PM	6,190.68	6.191	54.786	344.227
9/8/16 5:40 PM	6,189.96	6.190	54.785	344.226
9/8/16 5:50 PM	6,189.96	6.190	54.785	344.226
9/8/16 6:00 PM	6,190.68	6.191	54.786	344.227
9/8/16 6:10 PM	6,192.96	6.193	54.786	344.232
9/8/16 6:20 PM	6,196.62	6.197	54.787	344.239
9/8/16 6:30 PM	6,200.76	6.201	54.789	344.247
9/8/16 6:40 PM	6,205.32	6.205	54.790	344.256
9/8/16 6:50 PM	6,210.78	6.211	54.792	344.267
9/8/16 7:00 PM	6,220.44	6.220	54.795	344.286
9/8/16 7:10 PM	6,230.46	6.230	54.798	344.307
9/8/16 7:20 PM	6,240.30	6.240	54.801	344.327
9/8/16 7:30 PM	6,249.48	6.249	54.804	344.345
9/8/16 7:40 PM	6,258.66	6.259	54.807	344.364
9/8/16 7:50 PM	6,269.16	6.269	54.811	344.385
9/8/16 8:00 PM	6,280.38	6.280	54.814	344.408
9/8/16 8:10 PM	6,289.32	6.289	54.817	344.427
9/8/16 8:20 PM	6,297.54	6.298	54.820	344.443
9/8/16 8:30 PM	6,304.86	6.305	54.822	344.459
9/8/16 8:40 PM	6,313.32	6.313	54.825	344.476
9/8/16 8:50 PM	6,321.12	6.321	54.828	344.492
9/8/16 9:00 PM	6,327.78	6.328	54.830	344.505
9/8/16 9:10 PM	6,336.00	6.336	54.832	344.522
9/8/16 9:20 PM	6,343.08	6.343	54.835	344.536
9/8/16 9:30 PM	6,351.12	6.351	54.837	344.553
9/8/16 9:40 PM	6,358.44	6.358	54.840	344.568
9/8/16 9:50 PM	6,365.10	6.365	54.842	344.581
9/8/16 10:00 PM	6,372.60	6.373	54.844	344.596
9/8/16 10:10 PM	6,378.78	6.379	54.846	344.609
9/8/16 10:20 PM	6,384.06	6.384	54.848	344.620
9/8/16 10:30 PM	6,389.58	6.390	54.850	344.631
9/8/16 10:40 PM	6,395.28	6.395	54.852	344.643
9/8/16 10:50 PM	6,400.32	6.400	54.853	344.653

9/8/16 11:00 PM	6,404.88	6.405	54.855	344.663
9/8/16 11:10 PM	6,410.40	6.410	54.857	344.674
9/8/16 11:20 PM	6,414.30	6.414	54.858	344.682
9/8/16 11:30 PM	6,418.20	6.418	54.859	344.690
9/8/16 11:40 PM	6,422.28	6.422	54.860	344.698
9/8/16 11:50 PM	6,427.56	6.428	54.862	344.709
10/8/16 12:00 AM	6,432.12	6.432	54.864	344.718
10/8/16 12:10 AM	6,436.50	6.437	54.865	344.727
10/8/16 12:20 AM	6,441.06	6.441	54.867	344.736
10/8/16 12:30 AM	6,444.48	6.444	54.868	344.743
10/8/16 12:40 AM	6,447.90	6.448	54.869	344.750
10/8/16 12:50 AM	6,450.42	6.450	54.870	344.756
10/8/16 1:00 AM	6,453.90	6.454	54.871	344.763
10/8/16 1:10 AM	6,456.60	6.457	54.872	344.768
10/8/16 1:20 AM	6,459.36	6.459	54.873	344.774
10/8/16 1:30 AM	6,462.36	6.462	54.873	344.780
10/8/16 1:40 AM	6,465.78	6.466	54.875	344.787
10/8/16 1:50 AM	6,469.20	6.469	54.876	344.794
10/8/16 2:00 AM	6,472.44	6.472	54.877	344.800
10/8/16 2:10 AM	6,476.10	6.476	54.878	344.808
10/8/16 2:20 AM	6,479.52	6.480	54.879	344.815
10/8/16 2:30 AM	6,483.66	6.484	54.880	344.823
10/8/16 2:40 AM	6,487.50	6.488	54.882	344.831
10/8/16 2:50 AM	6,491.88	6.492	54.883	344.840
10/8/16 3:00 AM	6,494.88	6.495	54.884	344.846
10/8/16 3:10 AM	6,498.72	6.499	54.885	344.854
10/8/16 3:20 AM	6,501.72	6.502	54.886	344.860
10/8/16 3:30 AM	6,504.72	6.505	54.887	344.866
10/8/16 3:40 AM	6,507.66	6.508	54.888	344.872
10/8/16 3:50 AM	6,509.94	6.510	54.889	344.877
10/8/16 4:00 AM	6,512.70	6.513	54.890	344.882
10/8/16 4:10 AM	6,514.74	6.515	54.890	344.887
10/8/16 4:20 AM	6,517.98	6.518	54.891	344.893
10/8/16 4:30 AM	6,521.16	6.521	54.893	344.899
10/8/16 4:40 AM	6,523.92	6.524	54.893	344.905
10/8/16 4:50 AM	6,527.58	6.528	54.895	344.912
10/8/16 5:00 AM	6,530.34	6.530	54.895	344.918
10/8/16 5:10 AM	6,533.28	6.533	54.896	344.924
10/8/16 5:20 AM	6,535.80	6.536	54.897	344.929
10/8/16 5:30 AM	6,537.90	6.538	54.898	344.934
10/8/16 5:40 AM	6,540.84	6.541	54.899	344.940
10/8/16 5:50 AM	6,543.36	6.543	54.900	344.945
10/8/16 6:00 AM	6,546.12	6.546	54.901	344.950
10/8/16 6:10 AM	6,549.30	6.549	54.902	344.957
10/8/16 6:20 AM	6,552.06	6.552	54.903	344.962
10/8/16 6:30 AM	6,554.16	6.554	54.903	344.967
10/8/16 6:40 AM	6,557.10	6.557	54.904	344.973
10/8/16 6:50 AM	6,558.96	6.559	54.905	344.977

10/8/16 7:00 AM	6,560.76	6.561	54.905	344.980
10/8/16 7:10 AM	6,561.90	6.562	54.906	344.983
10/8/16 7:20 AM	6,562.38	6.562	54.906	344.984
10/8/16 7:30 AM	6,563.28	6.563	54.906	344.986
10/8/16 7:40 AM	6,564.18	6.564	54.906	344.987
10/8/16 7:50 AM	6,564.42	6.564	54.907	344.988
10/8/16 8:00 AM	6,564.42	6.564	54.907	344.988
10/8/16 8:10 AM	6,564.18	6.564	54.907	344.988
10/8/16 8:20 AM	6,562.62	6.563	54.906	344.985
10/8/16 8:30 AM	6,560.52	6.561	54.905	344.981
10/8/16 8:40 AM	6,558.00	6.558	54.905	344.975
10/8/16 8:50 AM	6,555.06	6.555	54.904	344.970
10/8/16 9:00 AM	6,551.16	6.551	54.902	344.962
10/8/16 9:10 AM	6,548.16	6.548	54.901	344.956
10/8/16 9:20 AM	6,543.36	6.543	54.900	344.946
10/8/16 9:30 AM	6,535.62	6.536	54.898	344.931
10/8/16 9:40 AM	6,525.96	6.526	54.894	344.912
10/8/16 9:50 AM	6,513.60	6.514	54.891	344.887
10/8/16 10:00 AM	6,503.34	6.503	54.887	344.866
10/8/16 10:10 AM	6,492.12	6.492	54.884	344.843
10/8/16 10:20 AM	6,481.14	6.481	54.880	344.821
10/8/16 10:30 AM	6,466.92	6.467	54.875	344.792
10/8/16 10:40 AM	6,451.62	6.452	54.871	344.761
10/8/16 10:50 AM	6,432.36	6.432	54.864	344.723
10/8/16 11:00 AM	6,416.10	6.416	54.859	344.689
10/8/16 11:10 AM	6,398.28	6.398	54.853	344.653
10/8/16 11:20 AM	6,376.08	6.376	54.846	344.609
10/8/16 11:30 AM	6,357.72	6.358	54.840	344.571
10/8/16 11:40 AM	6,345.84	6.346	54.836	344.546
10/8/16 11:50 AM	6,339.66	6.340	54.834	344.532
10/8/16 12:00 PM	6,332.10	6.332	54.832	344.517
10/8/16 12:10 PM	6,323.64	6.324	54.829	344.500
10/8/16 12:20 PM	6,308.76	6.309	54.824	344.471
10/8/16 12:30 PM	6,303.06	6.303	54.822	344.457
10/8/16 12:40 PM	6,299.40	6.299	54.821	344.450
10/8/16 12:50 PM	6,298.02	6.298	54.820	344.446
10/8/16 1:00 PM	6,298.02	6.298	54.820	344.446
10/8/16 1:10 PM	6,298.02	6.298	54.820	344.446
10/8/16 1:20 PM	6,298.02	6.298	54.820	344.446
10/8/16 1:30 PM	6,296.88	6.297	54.820	344.444
10/8/16 1:40 PM	6,295.02	6.295	54.819	344.440
10/8/16 1:50 PM	6,294.36	6.294	54.819	344.439
10/8/16 2:00 PM	6,290.94	6.291	54.818	344.432
10/8/16 2:10 PM	6,289.98	6.290	54.818	344.430
10/8/16 2:20 PM	6,288.60	6.289	54.817	344.427
10/8/16 2:30 PM	6,288.60	6.289	54.817	344.427
10/8/16 2:40 PM	6,288.84	6.289	54.817	344.427
10/8/16 2:50 PM	6,293.46	6.293	54.819	344.436

10/8/16 3:00 PM	6,303.06	6.303	54.822	344.455
10/8/16 3:10 PM	6,314.28	6.314	54.825	344.477
10/8/16 3:20 PM	6,318.36	6.318	54.827	344.487
10/8/16 3:30 PM	6,319.74	6.320	54.827	344.490
10/8/16 3:40 PM	6,320.88	6.321	54.828	344.492
10/8/16 3:50 PM	6,320.64	6.321	54.828	344.492
10/8/16 4:00 PM	6,320.46	6.320	54.828	344.492
10/8/16 4:10 PM	6,314.04	6.314	54.826	344.480
10/8/16 4:20 PM	6,307.86	6.308	54.824	344.467
10/8/16 4:30 PM	6,301.68	6.302	54.822	344.455
10/8/16 4:40 PM	6,294.12	6.294	54.819	344.439
10/8/16 4:50 PM	6,287.70	6.288	54.817	344.426
10/8/16 5:00 PM	6,284.04	6.284	54.816	344.418
10/8/16 5:10 PM	6,283.56	6.284	54.816	344.417
10/8/16 5:20 PM	6,283.80	6.284	54.816	344.417
10/8/16 5:30 PM	6,283.56	6.284	54.816	344.417
10/8/16 5:40 PM	6,283.80	6.284	54.816	344.417
10/8/16 5:50 PM	6,283.80	6.284	54.816	344.417
10/8/16 6:00 PM	6,283.80	6.284	54.816	344.417
10/8/16 6:10 PM	6,282.00	6.282	54.815	344.414
10/8/16 6:20 PM	6,280.62	6.281	54.815	344.411
10/8/16 6:30 PM	6,280.86	6.281	54.815	344.411
10/8/16 6:40 PM	6,283.80	6.284	54.816	344.417
10/8/16 6:50 PM	6,291.12	6.291	54.818	344.431
10/8/16 7:00 PM	6,294.12	6.294	54.819	344.437
10/8/16 7:10 PM	6,296.88	6.297	54.820	344.443
10/8/16 7:20 PM	6,301.20	6.301	54.821	344.452
10/8/16 7:30 PM	6,303.72	6.304	54.822	344.457
10/8/16 7:40 PM	6,309.48	6.309	54.824	344.468
10/8/16 7:50 PM	6,314.04	6.314	54.825	344.478
10/8/16 8:00 PM	6,320.22	6.320	54.827	344.490
10/8/16 8:10 PM	6,326.16	6.326	54.829	344.502
10/8/16 8:20 PM	6,331.86	6.332	54.831	344.514
10/8/16 8:30 PM	6,338.76	6.339	54.833	344.528
10/8/16 8:40 PM	6,344.94	6.345	54.835	344.540
10/8/16 8:50 PM	6,350.88	6.351	54.837	344.552
10/8/16 9:00 PM	6,356.58	6.357	54.839	344.564
10/8/16 9:10 PM	6,362.34	6.362	54.841	344.576
10/8/16 9:20 PM	6,366.66	6.367	54.842	344.585
10/8/16 9:30 PM	6,372.42	6.372	54.844	344.596
10/8/16 9:40 PM	6,377.46	6.377	54.846	344.607
10/8/16 9:50 PM	6,382.02	6.382	54.847	344.616
10/8/16 10:00 PM	6,385.44	6.385	54.849	344.623
10/8/16 10:10 PM	6,389.82	6.390	54.850	344.632
10/8/16 10:20 PM	6,394.14	6.394	54.851	344.641
10/8/16 10:30 PM	6,400.56	6.401	54.853	344.654
10/8/16 10:40 PM	6,404.64	6.405	54.855	344.662
10/8/16 10:50 PM	6,410.16	6.410	54.856	344.673

10/8/16 11:00 PM	6,414.06	6.414	54.858	344.681
10/8/16 11:10 PM	6,416.82	6.417	54.859	344.687
10/8/16 11:20 PM	6,420.24	6.420	54.860	344.694
10/8/16 11:30 PM	6,423.42	6.423	54.861	344.701
10/8/16 11:40 PM	6,426.66	6.427	54.862	344.707
10/8/16 11:50 PM	6,429.36	6.429	54.863	344.713
11/8/16 12:00 AM	6,432.36	6.432	54.864	344.719
11/8/16 12:10 AM	6,435.78	6.436	54.865	344.726
11/8/16 12:20 AM	6,439.92	6.440	54.866	344.734
11/8/16 12:30 AM	6,443.82	6.444	54.867	344.742
11/8/16 12:40 AM	6,447.72	6.448	54.869	344.750
11/8/16 12:50 AM	6,450.66	6.451	54.870	344.756
11/8/16 1:00 AM	6,453.66	6.454	54.871	344.762
11/8/16 1:10 AM	6,456.84	6.457	54.872	344.769
11/8/16 1:20 AM	6,459.84	6.460	54.873	344.775
11/8/16 1:30 AM	6,463.02	6.463	54.874	344.781
11/8/16 1:40 AM	6,465.54	6.466	54.875	344.786
11/8/16 1:50 AM	6,468.78	6.469	54.876	344.793
11/8/16 2:00 AM	6,472.44	6.472	54.877	344.800
11/8/16 2:10 AM	6,476.76	6.477	54.878	344.809
11/8/16 2:20 AM	6,480.42	6.480	54.879	344.816
11/8/16 2:30 AM	6,483.66	6.484	54.880	344.823
11/8/16 2:40 AM	6,487.08	6.487	54.881	344.830
11/8/16 2:50 AM	6,491.16	6.491	54.883	344.838
11/8/16 3:00 AM	6,494.16	6.494	54.884	344.845
11/8/16 3:10 AM	6,498.06	6.498	54.885	344.852
11/8/16 3:20 AM	6,500.82	6.501	54.886	344.858
11/8/16 3:30 AM	6,504.24	6.504	54.887	344.865
11/8/16 3:40 AM	6,507.18	6.507	54.888	344.871
11/8/16 3:50 AM	6,509.70	6.510	54.889	344.876
11/8/16 4:00 AM	6,512.22	6.512	54.890	344.881
11/8/16 4:10 AM	6,515.22	6.515	54.891	344.887
11/8/16 4:20 AM	6,517.98	6.518	54.891	344.893
11/8/16 4:30 AM	6,522.06	6.522	54.893	344.901
11/8/16 4:40 AM	6,525.30	6.525	54.894	344.908
11/8/16 4:50 AM	6,528.72	6.529	54.895	344.915
11/8/16 5:00 AM	6,533.10	6.533	54.896	344.924
11/8/16 5:10 AM	6,536.94	6.537	54.898	344.931
11/8/16 5:20 AM	6,540.42	6.540	54.899	344.939
11/8/16 5:30 AM	6,543.84	6.544	54.900	344.946
11/8/16 5:40 AM	6,547.02	6.547	54.901	344.952
11/8/16 5:50 AM	6,550.26	6.550	54.902	344.959
11/8/16 6:00 AM	6,552.96	6.553	54.903	344.964
11/8/16 6:10 AM	6,555.96	6.556	54.904	344.970
11/8/16 6:20 AM	6,558.96	6.559	54.905	344.976
11/8/16 6:30 AM	6,562.38	6.562	54.906	344.983
11/8/16 6:40 AM	6,565.56	6.566	54.907	344.990
11/8/16 6:50 AM	6,568.08	6.568	54.908	344.995

11/8/16 7:00 AM	6,571.08	6.571	54.909	345.001
11/8/16 7:10 AM	6,573.84	6.574	54.910	345.007
11/8/16 7:20 AM	6,576.78	6.577	54.911	345.013
11/8/16 7:30 AM	6,579.06	6.579	54.911	345.017
11/8/16 7:40 AM	6,582.30	6.582	54.912	345.024
11/8/16 7:50 AM	6,586.62	6.587	54.914	345.032
11/8/16 8:00 AM	6,590.76	6.591	54.915	345.041
11/8/16 8:10 AM	6,594.66	6.595	54.916	345.049
11/8/16 8:20 AM	6,599.22	6.599	54.918	345.058
11/8/16 8:30 AM	6,604.02	6.604	54.919	345.068
11/8/16 8:40 AM	6,607.26	6.607	54.920	345.075
11/8/16 8:50 AM	6,608.82	6.609	54.921	345.078
11/8/16 9:00 AM	6,612.06	6.612	54.922	345.084
11/8/16 9:10 AM	6,613.62	6.614	54.922	345.088
11/8/16 9:20 AM	6,614.76	6.615	54.923	345.090
11/8/16 9:30 AM	6,615.48	6.615	54.923	345.092
11/8/16 9:40 AM	6,615.48	6.615	54.923	345.092
11/8/16 9:50 AM	6,615.48	6.615	54.923	345.092
11/8/16 10:00 AM	6,615.48	6.615	54.923	345.092
11/8/16 10:10 AM	6,615.48	6.615	54.923	345.092
11/8/16 10:20 AM	6,615.24	6.615	54.923	345.091
11/8/16 10:30 AM	6,614.58	6.615	54.923	345.090
11/8/16 10:40 AM	6,613.86	6.614	54.923	345.089
11/8/16 10:50 AM	6,612.24	6.612	54.922	345.086
11/8/16 11:00 AM	6,610.20	6.610	54.921	345.082
11/8/16 11:10 AM	6,603.78	6.604	54.920	345.069
11/8/16 11:20 AM	6,596.94	6.597	54.917	345.055
11/8/16 11:30 AM	6,587.76	6.588	54.914	345.037
11/8/16 11:40 AM	6,581.82	6.582	54.912	345.025
11/8/16 11:50 AM	6,576.78	6.577	54.911	345.014
11/8/16 12:00 PM	6,569.94	6.570	54.909	345.001
11/8/16 12:10 PM	6,561.90	6.562	54.906	344.984
11/8/16 12:20 PM	6,552.78	6.553	54.903	344.966
11/8/16 12:30 PM	6,543.60	6.544	54.900	344.947
11/8/16 12:40 PM	6,536.28	6.536	54.898	344.932
11/8/16 12:50 PM	6,532.14	6.532	54.896	344.923
11/8/16 1:00 PM	6,527.34	6.527	54.895	344.914
11/8/16 1:10 PM	6,516.12	6.516	54.891	344.892
11/8/16 1:20 PM	6,509.04	6.509	54.889	344.877
11/8/16 1:30 PM	6,508.14	6.508	54.888	344.874
11/8/16 1:40 PM	6,507.00	6.507	54.888	344.871
11/8/16 1:50 PM	6,503.10	6.503	54.887	344.864
11/8/16 2:00 PM	6,498.96	6.499	54.886	344.856
11/8/16 2:10 PM	6,494.16	6.494	54.884	344.846
11/8/16 2:20 PM	6,486.36	6.486	54.882	344.831
11/8/16 2:30 PM	6,470.82	6.471	54.877	344.800
11/8/16 2:40 PM	6,457.32	6.457	54.872	344.773
11/8/16 2:50 PM	6,443.10	6.443	54.868	344.744

11/8/16 3:00 PM	6,425.70	6.426	54.862	344.709
11/8/16 3:10 PM	6,412.20	6.412	54.858	344.681
11/8/16 3:20 PM	6,398.94	6.399	54.853	344.654
11/8/16 3:30 PM	6,375.60	6.376	54.846	344.608
11/8/16 3:40 PM	6,362.76	6.363	54.842	344.580
11/8/16 3:50 PM	6,351.78	6.352	54.838	344.558
11/8/16 4:00 PM	6,340.80	6.341	54.835	344.535
11/8/16 4:10 PM	6,332.58	6.333	54.832	344.518
11/8/16 4:20 PM	6,323.88	6.324	54.829	344.500
11/8/16 4:30 PM	6,316.32	6.316	54.826	344.485
11/8/16 4:40 PM	6,310.38	6.310	54.825	344.472
11/8/16 4:50 PM	6,309.00	6.309	54.824	344.469
11/8/16 5:00 PM	6,309.00	6.309	54.824	344.468
11/8/16 5:10 PM	6,309.48	6.309	54.824	344.469
11/8/16 5:20 PM	6,310.38	6.310	54.824	344.471
11/8/16 5:30 PM	6,311.28	6.311	54.825	344.473
11/8/16 5:40 PM	6,309.00	6.309	54.824	344.469
11/8/16 5:50 PM	6,308.10	6.308	54.824	344.467
11/8/16 6:00 PM	6,304.86	6.305	54.823	344.461
11/8/16 6:10 PM	6,303.30	6.303	54.822	344.457
11/8/16 6:20 PM	6,302.10	6.302	54.822	344.455
11/8/16 6:30 PM	6,302.10	6.302	54.822	344.454
11/8/16 6:40 PM	6,300.54	6.301	54.821	344.451
11/8/16 6:50 PM	6,300.54	6.301	54.821	344.451
11/8/16 7:00 PM	6,300.78	6.301	54.821	344.452
11/8/16 7:10 PM	6,301.68	6.302	54.821	344.453
11/8/16 7:20 PM	6,305.10	6.305	54.823	344.460
11/8/16 7:30 PM	6,310.14	6.310	54.824	344.470
11/8/16 7:40 PM	6,316.32	6.316	54.826	344.482
11/8/16 7:50 PM	6,321.84	6.322	54.828	344.493
11/8/16 8:00 PM	6,327.78	6.328	54.830	344.505
11/8/16 8:10 PM	6,335.52	6.336	54.832	344.521
11/8/16 8:20 PM	6,342.90	6.343	54.835	344.536
11/8/16 8:30 PM	6,350.22	6.350	54.837	344.551
11/8/16 8:40 PM	6,356.58	6.357	54.839	344.564
11/8/16 8:50 PM	6,362.76	6.363	54.841	344.577
11/8/16 9:00 PM	6,368.28	6.368	54.843	344.588
11/8/16 9:10 PM	6,375.84	6.376	54.845	344.603
11/8/16 9:20 PM	6,381.54	6.382	54.847	344.615
11/8/16 9:30 PM	6,386.58	6.387	54.849	344.625
11/8/16 9:40 PM	6,391.38	6.391	54.850	344.635
11/8/16 9:50 PM	6,397.14	6.397	54.852	344.647
11/8/16 10:00 PM	6,401.94	6.402	54.854	344.657
11/8/16 10:10 PM	6,406.50	6.407	54.855	344.666
11/8/16 10:20 PM	6,412.44	6.412	54.857	344.678
11/8/16 10:30 PM	6,415.68	6.416	54.858	344.685
11/8/16 10:40 PM	6,418.86	6.419	54.859	344.691
11/8/16 10:50 PM	6,422.76	6.423	54.861	344.699

11/8/16 11:00 PM	6,426.66	6.427	54.862	344.707
11/8/16 11:10 PM	6,430.56	6.431	54.863	344.715
11/8/16 11:20 PM	6,433.50	6.434	54.864	344.721
11/8/16 11:30 PM	6,436.26	6.436	54.865	344.727
11/8/16 11:40 PM	6,440.40	6.440	54.866	344.735
11/8/16 11:50 PM	6,444.06	6.444	54.868	344.743
12/8/16 12:00 AM	6,447.48	6.447	54.869	344.750
12/8/16 12:10 AM	6,450.90	6.451	54.870	344.756
12/8/16 12:20 AM	6,454.32	6.454	54.871	344.763
12/8/16 12:30 AM	6,457.98	6.458	54.872	344.771
12/8/16 12:40 AM	6,460.98	6.461	54.873	344.777
12/8/16 12:50 AM	6,463.50	6.464	54.874	344.782
12/8/16 1:00 AM	6,465.54	6.466	54.875	344.787
12/8/16 1:10 AM	6,467.40	6.467	54.875	344.790
12/8/16 1:20 AM	6,469.68	6.470	54.876	344.795
12/8/16 1:30 AM	6,471.96	6.472	54.877	344.800
12/8/16 1:40 AM	6,474.72	6.475	54.877	344.805
12/8/16 1:50 AM	6,477.90	6.478	54.878	344.811
12/8/16 2:00 AM	6,481.14	6.481	54.880	344.818
12/8/16 2:10 AM	6,482.70	6.483	54.880	344.822
12/8/16 2:20 AM	6,484.32	6.484	54.881	344.825
12/8/16 2:30 AM	6,486.60	6.487	54.881	344.829
12/8/16 2:40 AM	6,489.60	6.490	54.882	344.835
12/8/16 2:50 AM	6,492.54	6.493	54.883	344.841
12/8/16 3:00 AM	6,494.64	6.495	54.884	344.846
12/8/16 3:10 AM	6,498.30	6.498	54.885	344.853
12/8/16 3:20 AM	6,500.10	6.500	54.886	344.857
12/8/16 3:30 AM	6,503.34	6.503	54.887	344.863
12/8/16 3:40 AM	6,506.04	6.506	54.888	344.869
12/8/16 3:50 AM	6,508.80	6.509	54.889	344.874
12/8/16 4:00 AM	6,512.04	6.512	54.890	344.881
12/8/16 4:10 AM	6,514.74	6.515	54.890	344.886
12/8/16 4:20 AM	6,518.22	6.518	54.892	344.893
12/8/16 4:30 AM	6,521.88	6.522	54.893	344.901
12/8/16 4:40 AM	6,524.82	6.525	54.894	344.907
12/8/16 4:50 AM	6,528.06	6.528	54.895	344.913
12/8/16 5:00 AM	6,532.14	6.532	54.896	344.922
12/8/16 5:10 AM	6,536.52	6.537	54.897	344.930
12/8/16 5:20 AM	6,539.94	6.540	54.899	344.938
12/8/16 5:30 AM	6,543.12	6.543	54.900	344.944
12/8/16 5:40 AM	6,545.88	6.546	54.901	344.950
12/8/16 5:50 AM	6,548.88	6.549	54.901	344.956
12/8/16 6:00 AM	6,551.82	6.552	54.902	344.962
12/8/16 6:10 AM	6,554.58	6.555	54.903	344.968
12/8/16 6:20 AM	6,557.82	6.558	54.904	344.974
12/8/16 6:30 AM	6,561.66	6.562	54.906	344.982
12/8/16 6:40 AM	6,565.32	6.565	54.907	344.989
12/8/16 6:50 AM	6,569.22	6.569	54.908	344.997

12/8/16 7:00 AM	6,572.46	6.572	54.909	345.004
12/8/16 7:10 AM	6,576.54	6.577	54.910	345.012
12/8/16 7:20 AM	6,581.82	6.582	54.912	345.022
12/8/16 7:30 AM	6,587.34	6.587	54.914	345.034
12/8/16 7:40 AM	6,590.52	6.591	54.915	345.041
12/8/16 7:50 AM	6,594.42	6.594	54.916	345.048
12/8/16 8:00 AM	6,597.84	6.598	54.917	345.055
12/8/16 8:10 AM	6,601.50	6.602	54.918	345.063
12/8/16 8:20 AM	6,602.88	6.603	54.919	345.066
12/8/16 8:30 AM	6,602.88	6.603	54.919	345.066
12/8/16 8:40 AM	6,601.74	6.602	54.919	345.064
12/8/16 8:50 AM	6,601.74	6.602	54.919	345.064
12/8/16 9:00 AM	6,600.60	6.601	54.918	345.062
12/8/16 9:10 AM	6,597.84	6.598	54.917	345.057
12/8/16 9:20 AM	6,594.90	6.595	54.917	345.051
12/8/16 9:30 AM	6,589.86	6.590	54.915	345.041
12/8/16 9:40 AM	6,584.34	6.584	54.913	345.030
12/8/16 9:50 AM	6,578.40	6.578	54.911	345.018
12/8/16 10:00 AM	6,571.08	6.571	54.909	345.003
12/8/16 10:10 AM	6,564.66	6.565	54.907	344.990
12/8/16 10:20 AM	6,557.34	6.557	54.905	344.975
12/8/16 10:30 AM	6,550.92	6.551	54.902	344.962
12/8/16 10:40 AM	6,544.26	6.544	54.900	344.948
12/8/16 10:50 AM	6,531.72	6.532	54.896	344.924
12/8/16 11:00 AM	6,516.12	6.516	54.891	344.893
12/8/16 11:10 AM	6,509.04	6.509	54.889	344.877
12/8/16 11:20 AM	6,502.86	6.503	54.887	344.864
12/8/16 11:30 AM	6,492.54	6.493	54.884	344.844
12/8/16 11:40 AM	6,473.82	6.474	54.878	344.807
12/8/16 11:50 AM	6,459.36	6.459	54.873	344.777
12/8/16 12:00 PM	6,449.10	6.449	54.870	344.755
12/8/16 12:10 PM	6,436.74	6.437	54.866	344.731
12/8/16 12:20 PM	6,424.80	6.425	54.862	344.706
12/8/16 12:30 PM	6,417.00	6.417	54.859	344.690
12/8/16 12:40 PM	6,414.72	6.415	54.858	344.684
12/8/16 12:50 PM	6,413.58	6.414	54.858	344.681
12/8/16 1:00 PM	6,411.30	6.411	54.857	344.677
12/8/16 1:10 PM	6,411.30	6.411	54.857	344.677
12/8/16 1:20 PM	6,411.54	6.412	54.857	344.677
12/8/16 1:30 PM	6,411.30	6.411	54.857	344.677
12/8/16 1:40 PM	6,395.28	6.395	54.852	344.647
12/8/16 1:50 PM	6,375.84	6.376	54.846	344.608
12/8/16 2:00 PM	6,350.22	6.350	54.838	344.557
12/8/16 2:10 PM	6,330.54	6.331	54.831	344.516
12/8/16 2:20 PM	6,313.32	6.313	54.826	344.480
12/8/16 2:30 PM	6,302.10	6.302	54.822	344.457
12/8/16 2:40 PM	6,298.92	6.299	54.821	344.449
12/8/16 2:50 PM	6,304.86	6.305	54.822	344.459

12/8/16 3:00 PM	6,319.74	6.320	54.827	344.488
12/8/16 3:10 PM	6,332.10	6.332	54.831	344.513
12/8/16 3:20 PM	6,345.60	6.346	54.835	344.540
12/8/16 3:30 PM	6,358.20	6.358	54.839	344.566
12/8/16 3:40 PM	6,370.08	6.370	54.843	344.590
12/8/16 3:50 PM	6,384.54	6.385	54.848	344.619
12/8/16 4:00 PM	6,402.18	6.402	54.854	344.655
12/8/16 4:10 PM	6,418.86	6.419	54.859	344.689
12/8/16 4:20 PM	6,434.22	6.434	54.864	344.720
12/8/16 4:30 PM	6,450.66	6.451	54.869	344.754
12/8/16 4:40 PM	6,463.02	6.463	54.873	344.779
12/8/16 4:50 PM	6,476.52	6.477	54.878	344.807
12/8/16 5:00 PM	6,490.50	6.491	54.882	344.835
12/8/16 5:10 PM	6,501.24	6.501	54.886	344.857
12/8/16 5:20 PM	6,512.22	6.512	54.889	344.880
12/8/16 5:30 PM	6,524.58	6.525	54.893	344.905
12/8/16 5:40 PM	6,534.24	6.534	54.897	344.925
12/8/16 5:50 PM	6,541.56	6.542	54.899	344.940
12/8/16 6:00 PM	6,549.30	6.549	54.901	344.956
12/8/16 6:10 PM	6,557.82	6.558	54.904	344.973
12/8/16 6:20 PM	6,564.00	6.564	54.906	344.986
12/8/16 6:30 PM	6,569.46	6.569	54.908	344.997
12/8/16 6:40 PM	6,576.54	6.577	54.910	345.011
12/8/16 6:50 PM	6,584.58	6.585	54.913	345.028
12/8/16 7:00 PM	6,592.56	6.593	54.915	345.044
12/8/16 7:10 PM	6,598.56	6.599	54.917	345.056
12/8/16 7:20 PM	6,605.40	6.605	54.920	345.070
12/8/16 7:30 PM	6,611.82	6.612	54.922	345.083
12/8/16 7:40 PM	6,617.52	6.618	54.924	345.095
12/8/16 7:50 PM	6,624.60	6.625	54.926	345.109
12/8/16 8:00 PM	6,629.88	6.630	54.928	345.120
12/8/16 8:10 PM	6,634.68	6.635	54.929	345.130
12/8/16 8:20 PM	6,639.48	6.639	54.931	345.140
12/8/16 8:30 PM	6,644.52	6.645	54.932	345.150
12/8/16 8:40 PM	6,649.14	6.649	54.934	345.159
12/8/16 8:50 PM	6,653.70	6.654	54.935	345.169
12/8/16 9:00 PM	6,658.74	6.659	54.937	345.179
12/8/16 9:10 PM	6,662.40	6.662	54.938	345.187
12/8/16 9:20 PM	6,666.06	6.666	54.939	345.194
12/8/16 9:30 PM	6,669.48	6.669	54.941	345.201
12/8/16 9:40 PM	6,673.86	6.674	54.942	345.210
12/8/16 9:50 PM	6,678.66	6.679	54.943	345.220
12/8/16 10:00 PM	6,682.08	6.682	54.945	345.227
12/8/16 10:10 PM	6,685.50	6.686	54.946	345.234
12/8/16 10:20 PM	6,689.64	6.690	54.947	345.242
12/8/16 10:30 PM	6,691.92	6.692	54.948	345.247
12/8/16 10:40 PM	6,694.92	6.695	54.949	345.253
12/8/16 10:50 PM	6,696.72	6.697	54.949	345.257

12/8/16 11:00 PM	6,698.58	6.699	54.950	345.261
12/8/16 11:10 PM	6,700.62	6.701	54.951	345.265
12/8/16 11:20 PM	6,702.90	6.703	54.951	345.269
12/8/16 11:30 PM	6,704.28	6.704	54.952	345.272
12/8/16 11:40 PM	6,706.32	6.706	54.952	345.276
12/8/16 11:50 PM	6,708.18	6.708	54.953	345.280
08/13/16 12:00:00 AM	6,709.56	6.710	54.954	345.283
08/13/16 12:10:00 AM	6,711.60	6.712	54.954	345.287
08/13/16 12:20:00 AM	6,714.12	6.714	54.955	345.292
08/13/16 12:30:00 AM	6,715.26	6.715	54.955	345.295
08/13/16 12:40:00 AM	6,716.40	6.716	54.956	345.297
08/13/16 12:50:00 AM	6,718.02	6.718	54.956	345.300
08/13/16 01:00:00 AM	6,719.40	6.719	54.957	345.303
08/13/16 01:10:00 AM	6,720.54	6.721	54.957	345.305
08/13/16 01:20:00 AM	6,721.68	6.722	54.957	345.308
08/13/16 01:30:00 AM	6,722.82	6.723	54.958	345.310
08/13/16 01:40:00 AM	6,723.72	6.724	54.958	345.312
08/13/16 01:50:00 AM	6,725.34	6.725	54.959	345.315
08/13/16 02:00:00 AM	6,726.72	6.727	54.959	345.318
08/13/16 02:10:00 AM	6,727.62	6.728	54.959	345.320
08/13/16 02:20:00 AM	6,728.76	6.729	54.960	345.322
08/13/16 02:30:00 AM	6,729.24	6.729	54.960	345.323
08/13/16 02:40:00 AM	6,729.48	6.729	54.960	345.324
08/13/16 02:50:00 AM	6,730.14	6.730	54.960	345.325
08/13/16 03:00:00 AM	6,731.28	6.731	54.961	345.327
08/13/16 03:10:00 AM	6,733.56	6.734	54.961	345.332
08/13/16 03:20:00 AM	6,736.08	6.736	54.962	345.337

08/13/16 03:30:00 AM	6,737.70	6.738	54.963	345.340
08/13/16 03:40:00 AM	6,738.84	6.739	54.963	345.343
08/13/16 03:50:00 AM	6,740.22	6.740	54.963	345.345
08/13/16 04:00:00 AM	6,741.36	6.741	54.964	345.348
08/13/16 04:10:00 AM	6,742.50	6.743	54.964	345.350
08/13/16 04:20:00 AM	6,743.64	6.744	54.965	345.352
08/13/16 04:30:00 AM	6,744.78	6.745	54.965	345.355
08/13/16 04:40:00 AM	6,745.50	6.746	54.965	345.356
08/13/16 04:50:00 AM	6,746.64	6.747	54.966	345.358
08/13/16 05:00:00 AM	6,747.30	6.747	54.966	345.360
08/13/16 05:10:00 AM	6,748.02	6.748	54.966	345.361
08/13/16 05:20:00 AM	6,748.92	6.749	54.966	345.363
08/13/16 05:30:00 AM	6,749.58	6.750	54.967	345.364
08/13/16 05:40:00 AM	6,750.54	6.751	54.967	345.366
08/13/16 05:50:00 AM	6,752.10	6.752	54.967	345.369
08/13/16 06:00:00 AM	6,753.24	6.753	54.968	345.372
08/13/16 06:10:00 AM	6,754.38	6.754	54.968	345.374
08/13/16 06:20:00 AM	6,757.62	6.758	54.969	345.380
08/13/16 06:30:00 AM	6,759.66	6.760	54.970	345.385
08/13/16 06:40:00 AM	6,761.94	6.762	54.970	345.389
08/13/16 06:50:00 AM	6,764.04	6.764	54.971	345.394
08/13/16 07:00:00 AM	6,765.60	6.766	54.972	345.397
08/13/16 07:10:00 AM	6,767.70	6.768	54.972	345.401
08/13/16 07:20:00 AM	6,769.08	6.769	54.973	345.404

08/13/16 07:30:00 AM	6,771.36	6.771	54.974	345.408
08/13/16 07:40:00 AM	6,775.68	6.776	54.975	345.417
08/13/16 07:50:00 AM	6,779.10	6.779	54.976	345.424
08/13/16 08:00:00 AM	6,782.34	6.782	54.977	345.431
08/13/16 08:10:00 AM	6,783.96	6.784	54.978	345.434
08/13/16 08:20:00 AM	6,784.86	6.785	54.978	345.436
08/13/16 08:30:00 AM	6,785.10	6.785	54.978	345.437
08/13/16 08:40:00 AM	6,785.10	6.785	54.978	345.437
08/13/16 08:50:00 AM	6,785.10	6.785	54.978	345.437
08/13/16 09:00:00 AM	6,785.10	6.785	54.978	345.437
08/13/16 09:10:00 AM	6,784.86	6.785	54.978	345.436
08/13/16 09:20:00 AM	6,783.48	6.783	54.978	345.434
08/13/16 09:30:00 AM	6,780.48	6.780	54.977	345.428
08/13/16 09:40:00 AM	6,775.02	6.775	54.975	345.417
08/13/16 09:50:00 AM	6,767.94	6.768	54.973	345.403
08/13/16 10:00:00 AM	6,759.90	6.760	54.970	345.387
08/13/16 10:10:00 AM	6,749.58	6.750	54.967	345.367
08/13/16 10:20:00 AM	6,737.70	6.738	54.963	345.343
08/13/16 10:30:00 AM	6,724.20	6.724	54.959	345.316
08/13/16 10:40:00 AM	6,709.98	6.710	54.954	345.287
08/13/16 10:50:00 AM	6,694.92	6.695	54.949	345.256
08/13/16 11:00:00 AM	6,676.38	6.676	54.943	345.219
08/13/16 11:10:00 AM	6,654.18	6.654	54.936	345.175
08/13/16 11:20:00 AM	6,631.02	6.631	54.929	345.128

08/13/16 11:30:00 AM	6,607.68	6.608	54.921	345.080
08/13/16 11:40:00 AM	6,583.68	6.584	54.914	345.032
08/13/16 11:50:00 AM	6,559.38	6.559	54.906	344.982
08/13/16 12:00:00 PM	6,530.34	6.530	54.896	344.924
08/13/16 12:10:00 PM	6,503.76	6.504	54.888	344.870
08/13/16 12:20:00 PM	6,481.56	6.482	54.880	344.824
08/13/16 12:30:00 PM	6,456.18	6.456	54.872	344.773
08/13/16 12:40:00 PM	6,439.92	6.440	54.867	344.738
08/13/16 12:50:00 PM	6,422.52	6.423	54.861	344.703
08/13/16 01:00:00 PM	6,401.70	6.402	54.855	344.661
08/13/16 01:10:00 PM	6,394.62	6.395	54.852	344.644
08/13/16 01:20:00 PM	6,384.30	6.384	54.849	344.624
08/13/16 01:30:00 PM	6,376.50	6.377	54.846	344.607
08/13/16 01:40:00 PM	6,360.48	6.360	54.841	344.576
08/13/16 01:50:00 PM	6,350.22	6.350	54.838	344.554
08/13/16 02:00:00 PM	6,335.76	6.336	54.833	344.525
08/13/16 02:10:00 PM	6,322.02	6.322	54.829	344.497
08/13/16 02:20:00 PM	6,315.84	6.316	54.826	344.484
08/13/16 02:30:00 PM	6,313.80	6.314	54.826	344.479
08/13/16 02:40:00 PM	6,298.92	6.299	54.821	344.450
08/13/16 02:50:00 PM	6,279.90	6.280	54.815	344.413
08/13/16 03:00:00 PM	6,259.08	6.259	54.808	344.371
08/13/16 03:10:00 PM	6,252.00	6.252	54.806	344.354
08/13/16 03:20:00 PM	6,250.62	6.251	54.805	344.350

08/13/16 03:30:00 PM	6,257.94	6.258	54.807	344.363
08/13/16 03:40:00 PM	6,259.80	6.260	54.808	344.368
08/13/16 03:50:00 PM	6,261.18	6.261	54.808	344.371
08/13/16 04:00:00 PM	6,267.36	6.267	54.810	344.383
08/13/16 04:10:00 PM	6,267.12	6.267	54.810	344.383
08/13/16 04:20:00 PM	6,264.60	6.265	54.810	344.378
08/13/16 04:30:00 PM	6,263.22	6.263	54.809	344.375
08/13/16 04:40:00 PM	6,260.70	6.261	54.808	344.370
08/13/16 04:50:00 PM	6,257.04	6.257	54.807	344.363
08/13/16 05:00:00 PM	6,254.28	6.254	54.806	344.358
08/13/16 05:10:00 PM	6,250.20	6.250	54.805	344.349
08/13/16 05:20:00 PM	6,241.50	6.242	54.802	344.333
08/13/16 05:30:00 PM	6,235.08	6.235	54.800	344.319
08/13/16 05:40:00 PM	6,232.32	6.232	54.799	344.313
08/13/16 05:50:00 PM	6,229.14	6.229	54.798	344.306
08/13/16 06:00:00 PM	6,229.56	6.230	54.798	344.307
08/13/16 06:10:00 PM	6,233.22	6.233	54.799	344.313
08/13/16 06:20:00 PM	6,237.84	6.238	54.801	344.323
08/13/16 06:30:00 PM	6,239.88	6.240	54.801	344.327
08/13/16 06:40:00 PM	6,244.44	6.244	54.803	344.336
08/13/16 06:50:00 PM	6,251.76	6.252	54.805	344.351
08/13/16 07:00:00 PM	6,262.08	6.262	54.808	344.371
08/13/16 07:10:00 PM	6,272.40	6.272	54.812	344.392
08/13/16 07:20:00 PM	6,284.94	6.285	54.816	344.417

08/13/16 07:30:00 PM	6,295.02	6.295	54.819	344.438
08/13/16 07:40:00 PM	6,306.00	6.306	54.823	344.460
08/13/16 07:50:00 PM	6,315.84	6.316	54.826	344.480
08/13/16 08:00:00 PM	6,325.26	6.325	54.829	344.500
08/13/16 08:10:00 PM	6,333.72	6.334	54.832	344.517
08/13/16 08:20:00 PM	6,341.70	6.342	54.834	344.533
08/13/16 08:30:00 PM	6,348.84	6.349	54.837	344.548
08/13/16 08:40:00 PM	6,357.54	6.358	54.839	344.566
08/13/16 08:50:00 PM	6,365.10	6.365	54.842	344.581
08/13/16 09:00:00 PM	6,374.22	6.374	54.845	344.599
08/13/16 09:10:00 PM	6,382.26	6.382	54.847	344.616
08/13/16 09:20:00 PM	6,388.86	6.389	54.850	344.630
08/13/16 09:30:00 PM	6,395.76	6.396	54.852	344.644
08/13/16 09:40:00 PM	6,402.60	6.403	54.854	344.658
08/13/16 09:50:00 PM	6,409.50	6.410	54.856	344.672
08/13/16 10:00:00 PM	6,415.20	6.415	54.858	344.683
08/13/16 10:10:00 PM	6,420.24	6.420	54.860	344.694
08/13/16 10:20:00 PM	6,426.42	6.426	54.862	344.706
08/13/16 10:30:00 PM	6,431.46	6.431	54.863	344.717
08/13/16 10:40:00 PM	6,437.40	6.437	54.865	344.729
08/13/16 10:50:00 PM	6,442.68	6.443	54.867	344.739
08/13/16 11:00:00 PM	6,446.34	6.446	54.868	344.747
08/13/16 11:10:00 PM	6,450.42	6.450	54.870	344.755
08/13/16 11:20:00 PM	6,454.08	6.454	54.871	344.763

08/13/16 11:30:00 PM	6,457.08	6.457	54.872	344.769
08/13/16 11:40:00 PM	6,460.08	6.460	54.873	344.775
08/13/16 11:50:00 PM	6,463.98	6.464	54.874	344.783
08/14/16 12:00:00 AM	6,466.44	6.466	54.875	344.788
08/14/16 12:10:00 AM	6,470.16	6.470	54.876	344.796
08/14/16 12:20:00 AM	6,473.34	6.473	54.877	344.802
08/14/16 12:30:00 AM	6,476.52	6.477	54.878	344.809
08/14/16 12:40:00 AM	6,480.00	6.480	54.879	344.816
08/14/16 12:50:00 AM	6,482.70	6.483	54.880	344.821
08/14/16 01:00:00 AM	6,485.94	6.486	54.881	344.828
08/14/16 01:10:00 AM	6,489.12	6.489	54.882	344.834
08/14/16 01:20:00 AM	6,491.64	6.492	54.883	344.840
08/14/16 01:30:00 AM	6,494.64	6.495	54.884	344.846
08/14/16 01:40:00 AM	6,499.44	6.499	54.885	344.855
08/14/16 01:50:00 AM	6,503.76	6.504	54.887	344.864
08/14/16 02:00:00 AM	6,509.70	6.510	54.889	344.876
08/14/16 02:10:00 AM	6,517.08	6.517	54.891	344.890
08/14/16 02:20:00 AM	6,522.06	6.522	54.893	344.901
08/14/16 02:30:00 AM	6,525.54	6.526	54.894	344.908
08/14/16 02:40:00 AM	6,529.44	6.529	54.895	344.916
08/14/16 02:50:00 AM	6,536.76	6.537	54.897	344.930
08/14/16 03:00:00 AM	6,547.74	6.548	54.901	344.952
08/14/16 03:10:00 AM	6,559.38	6.559	54.905	344.976
08/14/16 03:20:00 AM	6,571.32	6.571	54.908	345.000

08/14/16 03:30:00 AM	6,582.06	6.582	54.912	345.022
08/14/16 03:40:00 AM	6,591.24	6.591	54.915	345.041
08/14/16 03:50:00 AM	6,598.98	6.599	54.918	345.057
08/14/16 04:00:00 AM	6,608.58	6.609	54.921	345.076
08/14/16 04:10:00 AM	6,615.00	6.615	54.923	345.090
08/14/16 04:20:00 AM	6,621.90	6.622	54.925	345.104
08/14/16 04:30:00 AM	6,629.22	6.629	54.927	345.118
08/14/16 04:40:00 AM	6,634.02	6.634	54.929	345.129
08/14/16 04:50:00 AM	6,639.48	6.639	54.931	345.140
08/14/16 05:00:00 AM	6,646.14	6.646	54.933	345.153
08/14/16 05:10:00 AM	6,652.32	6.652	54.935	345.166
08/14/16 05:20:00 AM	6,658.74	6.659	54.937	345.179
08/14/16 05:30:00 AM	6,663.78	6.664	54.939	345.189
08/14/16 05:40:00 AM	6,668.34	6.668	54.940	345.199
08/14/16 05:50:00 AM	6,673.14	6.673	54.942	345.208
08/14/16 06:00:00 AM	6,677.70	6.678	54.943	345.218
08/14/16 06:10:00 AM	6,680.94	6.681	54.944	345.224
08/14/16 06:20:00 AM	6,684.84	6.685	54.945	345.232
08/14/16 06:30:00 AM	6,689.16	6.689	54.947	345.241
08/14/16 06:40:00 AM	6,693.78	6.694	54.948	345.250
08/14/16 06:50:00 AM	6,699.72	6.700	54.950	345.262
08/14/16 07:00:00 AM	6,706.14	6.706	54.952	345.275
08/14/16 07:10:00 AM	6,711.60	6.712	54.954	345.286
08/14/16 07:20:00 AM	6,715.50	6.716	54.955	345.295

08/14/16 07:30:00 AM	6,718.92	6.719	54.957	345.302
08/14/16 07:40:00 AM	6,723.06	6.723	54.958	345.310
08/14/16 07:50:00 AM	6,727.38	6.727	54.959	345.319
08/14/16 08:00:00 AM	6,731.04	6.731	54.960	345.326
08/14/16 08:10:00 AM	6,735.42	6.735	54.962	345.335
08/14/16 08:20:00 AM	6,738.18	6.738	54.963	345.341
08/14/16 08:30:00 AM	6,740.70	6.741	54.964	345.346
08/14/16 08:40:00 AM	6,742.74	6.743	54.964	345.350
08/14/16 08:50:00 AM	6,743.88	6.744	54.965	345.353
08/14/16 09:00:00 AM	6,743.88	6.744	54.965	345.353
08/14/16 09:10:00 AM	6,743.88	6.744	54.965	345.353
08/14/16 09:20:00 AM	6,743.88	6.744	54.965	345.353
08/14/16 09:30:00 AM	6,743.64	6.744	54.965	345.353
08/14/16 09:40:00 AM	6,742.98	6.743	54.964	345.351
08/14/16 09:50:00 AM	6,742.02	6.742	54.964	345.349
08/14/16 10:00:00 AM	6,739.50	6.740	54.963	345.345
08/14/16 10:10:00 AM	6,735.84	6.736	54.962	345.337
08/14/16 10:20:00 AM	6,731.04	6.731	54.961	345.328
08/14/16 10:30:00 AM	6,724.20	6.724	54.959	345.314
08/14/16 10:40:00 AM	6,716.88	6.717	54.956	345.299
08/14/16 10:50:00 AM	6,707.94	6.708	54.953	345.282
08/14/16 11:00:00 AM	6,697.20	6.697	54.950	345.260
08/14/16 11:10:00 AM	6,686.64	6.687	54.946	345.239
08/14/16 11:20:00 AM	6,673.86	6.674	54.942	345.213

08/14/16 11:30:00 AM	6,661.50	6.662	54.938	345.188
08/14/16 11:40:00 AM	6,652.80	6.653	54.935	345.170
08/14/16 11:50:00 AM	6,636.78	6.637	54.930	345.138
08/14/16 12:00:00 PM	6,622.32	6.622	54.926	345.109
08/14/16 12:10:00 PM	6,609.30	6.609	54.922	345.082
08/14/16 12:20:00 PM	6,587.76	6.588	54.915	345.039
08/14/16 12:30:00 PM	6,567.66	6.568	54.908	344.998
08/14/16 12:40:00 PM	6,550.02	6.550	54.902	344.962
08/14/16 12:50:00 PM	6,533.28	6.533	54.897	344.928
08/14/16 01:00:00 PM	6,514.98	6.515	54.891	344.891
08/14/16 01:10:00 PM	6,500.34	6.500	54.886	344.861
08/14/16 01:20:00 PM	6,476.34	6.476	54.879	344.813
08/14/16 01:30:00 PM	6,471.06	6.471	54.877	344.799
08/14/16 01:40:00 PM	6,455.70	6.456	54.872	344.770
08/14/16 01:50:00 PM	6,434.22	6.434	54.865	344.727
08/14/16 02:00:00 PM	6,416.58	6.417	54.859	344.691
08/14/16 02:10:00 PM	6,401.70	6.402	54.854	344.660
08/14/16 02:20:00 PM	6,381.54	6.382	54.848	344.620
08/14/16 02:30:00 PM	6,363.24	6.363	54.842	344.582
08/14/16 02:40:00 PM	6,355.26	6.355	54.839	344.564
08/14/16 02:50:00 PM	6,341.28	6.341	54.835	344.537
08/14/16 03:00:00 PM	6,325.50	6.326	54.830	344.505
08/14/16 03:10:00 PM	6,310.80	6.311	54.825	344.475
08/14/16 03:20:00 PM	6,296.64	6.297	54.820	344.446

08/14/16 03:30:00 PM	6,284.52	6.285	54.816	344.421
08/14/16 03:40:00 PM	6,265.98	6.266	54.810	344.384
08/14/16 03:50:00 PM	6,253.38	6.253	54.806	344.358
08/14/16 04:00:00 PM	6,247.68	6.248	54.804	344.345
08/14/16 04:10:00 PM	6,243.30	6.243	54.803	344.335
08/14/16 04:20:00 PM	6,238.50	6.239	54.801	344.326
08/14/16 04:30:00 PM	6,234.12	6.234	54.800	344.317
08/14/16 04:40:00 PM	6,229.32	6.229	54.798	344.307
08/14/16 04:50:00 PM	6,226.80	6.227	54.797	344.302
08/14/16 05:00:00 PM	6,225.00	6.225	54.797	344.298
08/14/16 05:10:00 PM	6,225.00	6.225	54.797	344.297
08/14/16 05:20:00 PM	6,224.76	6.225	54.797	344.297
08/14/16 05:30:00 PM	6,225.00	6.225	54.797	344.297
08/14/16 05:40:00 PM	6,225.66	6.226	54.797	344.299
08/14/16 05:50:00 PM	6,227.52	6.228	54.797	344.302
08/14/16 06:00:00 PM	6,230.70	6.231	54.798	344.308
08/14/16 06:10:00 PM	6,235.50	6.236	54.800	344.318
08/14/16 06:20:00 PM	6,240.78	6.241	54.802	344.328
08/14/16 06:30:00 PM	6,247.44	6.247	54.804	344.342
08/14/16 06:40:00 PM	6,253.38	6.253	54.806	344.354
08/14/16 06:50:00 PM	6,259.32	6.259	54.808	344.366
08/14/16 07:00:00 PM	6,267.78	6.268	54.810	344.383
08/14/16 07:10:00 PM	6,277.20	6.277	54.813	344.402
08/14/16 07:20:00 PM	6,285.18	6.285	54.816	344.418

08/14/16 07:30:00 PM	6,293.22	6.293	54.819	344.435
08/14/16 07:40:00 PM	6,303.06	6.303	54.822	344.454
08/14/16 07:50:00 PM	6,313.80	6.314	54.825	344.476
08/14/16 08:00:00 PM	6,323.88	6.324	54.828	344.497
08/14/16 08:10:00 PM	6,333.48	6.333	54.832	344.516
08/14/16 08:20:00 PM	6,343.56	6.344	54.835	344.537
08/14/16 08:30:00 PM	6,352.50	6.353	54.838	344.555
08/14/16 08:40:00 PM	6,360.96	6.361	54.840	344.572
08/14/16 08:50:00 PM	6,369.18	6.369	54.843	344.589
08/14/16 09:00:00 PM	6,378.12	6.378	54.846	344.607
08/14/16 09:10:00 PM	6,385.68	6.386	54.848	344.623
08/14/16 09:20:00 PM	6,392.10	6.392	54.851	344.636
08/14/16 09:30:00 PM	6,400.08	6.400	54.853	344.652
08/14/16 09:40:00 PM	6,406.02	6.406	54.855	344.665
08/14/16 09:50:00 PM	6,413.34	6.413	54.857	344.679
08/14/16 10:00:00 PM	6,417.24	6.417	54.859	344.688
08/14/16 10:10:00 PM	6,423.42	6.423	54.861	344.700
08/14/16 10:20:00 PM	6,428.70	6.429	54.862	344.711
08/14/16 10:30:00 PM	6,434.22	6.434	54.864	344.722
08/14/16 10:40:00 PM	6,440.40	6.440	54.866	344.735
08/14/16 10:50:00 PM	6,446.34	6.446	54.868	344.747
08/14/16 11:00:00 PM	6,451.14	6.451	54.870	344.757
08/14/16 11:10:00 PM	6,456.42	6.456	54.871	344.767
08/14/16 11:20:00 PM	6,460.98	6.461	54.873	344.777

08/14/16 11:30:00 PM	6,465.54	6.466	54.874	344.786
08/14/16 11:40:00 PM	6,469.92	6.470	54.876	344.795
08/14/16 11:50:00 PM	6,474.00	6.474	54.877	344.803
08/15/16 12:00:00 AM	6,479.28	6.479	54.879	344.814
08/15/16 12:10:00 AM	6,483.84	6.484	54.880	344.823
08/15/16 12:20:00 AM	6,488.88	6.489	54.882	344.833
08/15/16 12:30:00 AM	6,493.26	6.493	54.883	344.842
08/15/16 12:40:00 AM	6,496.68	6.497	54.885	344.850
08/15/16 12:50:00 AM	6,499.86	6.500	54.886	344.856
08/15/16 01:00:00 AM	6,502.86	6.503	54.887	344.862
08/15/16 01:10:00 AM	6,506.52	6.507	54.888	344.870
08/15/16 01:20:00 AM	6,509.04	6.509	54.889	344.875
08/15/16 01:30:00 AM	6,511.56	6.512	54.889	344.880
08/15/16 01:40:00 AM	6,514.74	6.515	54.890	344.886
08/15/16 01:50:00 AM	6,517.26	6.517	54.891	344.892
08/15/16 02:00:00 AM	6,521.64	6.522	54.893	344.900
08/15/16 02:10:00 AM	6,524.58	6.525	54.894	344.906
08/15/16 02:20:00 AM	6,528.24	6.528	54.895	344.914
08/15/16 02:30:00 AM	6,531.90	6.532	54.896	344.921
08/15/16 02:40:00 AM	6,535.62	6.536	54.897	344.929
08/15/16 02:50:00 AM	6,538.56	6.539	54.898	344.935
08/15/16 03:00:00 AM	6,542.94	6.543	54.900	344.944
08/15/16 03:10:00 AM	6,546.78	6.547	54.901	344.951
08/15/16 03:20:00 AM	6,551.82	6.552	54.902	344.962

08/15/16 03:30:00 AM	6,557.34	6.557	54.904	344.973
08/15/16 03:40:00 AM	6,560.76	6.561	54.905	344.980
08/15/16 03:50:00 AM	6,564.42	6.564	54.906	344.987
08/15/16 04:00:00 AM	6,567.42	6.567	54.907	344.994
08/15/16 04:10:00 AM	6,570.18	6.570	54.908	344.999
08/15/16 04:20:00 AM	6,572.70	6.573	54.909	345.004
08/15/16 04:30:00 AM	6,575.64	6.576	54.910	345.010
08/15/16 04:40:00 AM	6,578.88	6.579	54.911	345.017
08/15/16 04:50:00 AM	6,582.06	6.582	54.912	345.023
08/15/16 05:00:00 AM	6,585.06	6.585	54.913	345.029
08/15/16 05:10:00 AM	6,587.52	6.588	54.914	345.035
08/15/16 05:20:00 AM	6,590.28	6.590	54.915	345.040
08/15/16 05:30:00 AM	6,591.90	6.592	54.915	345.044
08/15/16 05:40:00 AM	6,593.52	6.594	54.916	345.047
08/15/16 05:50:00 AM	6,595.80	6.596	54.917	345.051
08/15/16 06:00:00 AM	6,598.74	6.599	54.918	345.057
08/15/16 06:10:00 AM	6,602.22	6.602	54.919	345.064
08/15/16 06:20:00 AM	6,604.92	6.605	54.920	345.070
08/15/16 06:30:00 AM	6,608.58	6.609	54.921	345.077
08/15/16 06:40:00 AM	6,611.82	6.612	54.922	345.084
08/15/16 06:50:00 AM	6,615.48	6.615	54.923	345.091
08/15/16 07:00:00 AM	6,619.80	6.620	54.924	345.100
08/15/16 07:10:00 AM	6,623.70	6.624	54.926	345.108
08/15/16 07:20:00 AM	6,628.08	6.628	54.927	345.117

08/15/16 07:30:00 AM	6,632.16	6.632	54.928	345.125
08/15/16 07:40:00 AM	6,635.82	6.636	54.930	345.133
08/15/16 07:50:00 AM	6,639.96	6.640	54.931	345.141
08/15/16 08:00:00 AM	6,641.58	6.642	54.932	345.145
08/15/16 08:10:00 AM	6,643.14	6.643	54.932	345.148
08/15/16 08:20:00 AM	6,643.86	6.644	54.932	345.149
08/15/16 08:30:00 AM	6,643.86	6.644	54.932	345.150
08/15/16 08:40:00 AM	6,643.62	6.644	54.932	345.149
08/15/16 08:50:00 AM	6,643.62	6.644	54.932	345.149
08/15/16 09:00:00 AM	6,642.72	6.643	54.932	345.147
08/15/16 09:10:00 AM	6,641.10	6.641	54.931	345.144
08/15/16 09:20:00 AM	6,638.34	6.638	54.931	345.139
08/15/16 09:30:00 AM	6,634.92	6.635	54.930	345.132
08/15/16 09:40:00 AM	6,630.36	6.630	54.928	345.123
08/15/16 09:50:00 AM	6,622.32	6.622	54.926	345.107
08/15/16 10:00:00 AM	6,615.24	6.615	54.923	345.093
08/15/16 10:10:00 AM	6,607.92	6.608	54.921	345.078
08/15/16 10:20:00 AM	6,598.74	6.599	54.918	345.060
08/15/16 10:30:00 AM	6,588.24	6.588	54.915	345.038
08/15/16 10:40:00 AM	6,578.16	6.578	54.911	345.018
08/15/16 10:50:00 AM	6,566.28	6.566	54.908	344.994
08/15/16 11:00:00 AM	6,556.86	6.557	54.904	344.974
08/15/16 11:10:00 AM	6,549.12	6.549	54.902	344.958
08/15/16 11:20:00 AM	6,532.86	6.533	54.897	344.927

08/15/16 11:30:00 AM	6,514.08	6.514	54.891	344.889
08/15/16 11:40:00 AM	6,497.58	6.498	54.885	344.855
08/15/16 11:50:00 AM	6,487.74	6.488	54.882	344.834
08/15/16 12:00:00 PM	6,463.98	6.464	54.875	344.788
08/15/16 12:10:00 PM	6,441.96	6.442	54.868	344.743
08/15/16 12:20:00 PM	6,416.10	6.416	54.859	344.691
08/15/16 12:30:00 PM	6,396.42	6.396	54.853	344.650
08/15/16 12:40:00 PM	6,381.54	6.382	54.848	344.619
08/15/16 12:50:00 PM	6,377.88	6.378	54.846	344.609
08/15/16 01:00:00 PM	6,366.90	6.367	54.843	344.588
08/15/16 01:10:00 PM	6,349.08	6.349	54.837	344.553
08/15/16 01:20:00 PM	6,332.34	6.332	54.832	344.519
08/15/16 01:30:00 PM	6,325.92	6.326	54.830	344.504
08/15/16 01:40:00 PM	6,324.36	6.324	54.829	344.500
08/15/16 01:50:00 PM	6,324.54	6.325	54.829	344.500
08/15/16 02:00:00 PM	6,329.16	6.329	54.830	344.509
08/15/16 02:10:00 PM	6,333.72	6.334	54.832	344.518
08/15/16 02:20:00 PM	6,332.82	6.333	54.832	344.517
08/15/16 02:30:00 PM	6,333.00	6.333	54.832	344.517
08/15/16 02:40:00 PM	6,336.00	6.336	54.833	344.523
08/15/16 02:50:00 PM	6,328.44	6.328	54.830	344.509
08/15/16 03:00:00 PM	6,309.90	6.310	54.825	344.473
08/15/16 03:10:00 PM	6,286.32	6.286	54.817	344.427
08/15/16 03:20:00 PM	6,277.38	6.277	54.814	344.406

08/15/16 03:30:00 PM	6,260.94	6.261	54.809	344.374
08/15/16 03:40:00 PM	6,245.58	6.246	54.804	344.342
08/15/16 03:50:00 PM	6,229.80	6.230	54.799	344.310
08/15/16 04:00:00 PM	6,208.50	6.209	54.792	344.268
08/15/16 04:10:00 PM	6,202.80	6.203	54.790	344.253
08/15/16 04:20:00 PM	6,199.56	6.200	54.789	344.246
08/15/16 04:30:00 PM	6,195.00	6.195	54.787	344.237
08/15/16 04:40:00 PM	6,192.24	6.192	54.786	344.231
08/15/16 04:50:00 PM	6,190.68	6.191	54.786	344.228
08/15/16 05:00:00 PM	6,187.68	6.188	54.785	344.222
08/15/16 05:10:00 PM	6,183.36	6.183	54.783	344.213
08/15/16 05:20:00 PM	6,183.36	6.183	54.783	344.213
08/15/16 05:30:00 PM	6,181.98	6.182	54.783	344.210
08/15/16 05:40:00 PM	6,181.74	6.182	54.783	344.209
08/15/16 05:50:00 PM	6,185.64	6.186	54.784	344.217
08/15/16 06:00:00 PM	6,191.58	6.192	54.786	344.228
08/15/16 06:10:00 PM	6,197.28	6.197	54.788	344.240
08/15/16 06:20:00 PM	6,207.12	6.207	54.791	344.259
08/15/16 06:30:00 PM	6,218.58	6.219	54.794	344.282
08/15/16 06:40:00 PM	6,225.00	6.225	54.796	344.296
08/15/16 06:50:00 PM	6,232.32	6.232	54.799	344.311
08/15/16 07:00:00 PM	6,239.64	6.240	54.801	344.326
08/15/16 07:10:00 PM	6,246.30	6.246	54.803	344.339
08/15/16 07:20:00 PM	6,253.62	6.254	54.806	344.354

08/15/16 07:30:00 PM	6,261.60	6.262	54.808	344.370
08/15/16 07:40:00 PM	6,271.44	6.271	54.811	344.390
08/15/16 07:50:00 PM	6,282.66	6.283	54.815	344.413
08/15/16 08:00:00 PM	6,293.22	6.293	54.818	344.434
08/15/16 08:10:00 PM	6,304.20	6.304	54.822	344.457
08/15/16 08:20:00 PM	6,314.04	6.314	54.825	344.477
08/15/16 08:30:00 PM	6,323.16	6.323	54.828	344.495
08/15/16 08:40:00 PM	6,331.44	6.331	54.831	344.512
08/15/16 08:50:00 PM	6,340.56	6.341	54.834	344.531
08/15/16 09:00:00 PM	6,347.88	6.348	54.836	344.546
08/15/16 09:10:00 PM	6,355.68	6.356	54.839	344.562
08/15/16 09:20:00 PM	6,362.76	6.363	54.841	344.576
08/15/16 09:30:00 PM	6,369.18	6.369	54.843	344.590
08/15/16 09:40:00 PM	6,377.22	6.377	54.846	344.606
08/15/16 09:50:00 PM	6,382.26	6.382	54.847	344.616
08/15/16 10:00:00 PM	6,388.20	6.388	54.849	344.628
08/15/16 10:10:00 PM	6,393.00	6.393	54.851	344.638
08/15/16 10:20:00 PM	6,398.46	6.398	54.853	344.649
08/15/16 10:30:00 PM	6,403.74	6.404	54.854	344.660
08/15/16 10:40:00 PM	6,407.64	6.408	54.856	344.668
08/15/16 10:50:00 PM	6,413.16	6.413	54.857	344.679
08/15/16 11:00:00 PM	6,415.86	6.416	54.858	344.685
08/15/16 11:10:00 PM	6,419.52	6.420	54.860	344.693
08/15/16 11:20:00 PM	6,423.42	6.423	54.861	344.700

08/15/16 11:30:00 PM	6,427.08	6.427	54.862	344.708
08/15/16 11:40:00 PM	6,430.98	6.431	54.863	344.716
08/15/16 11:50:00 PM	6,434.88	6.435	54.865	344.724
08/16/16 12:00:00 AM	6,438.06	6.438	54.866	344.730
08/16/16 12:10:00 AM	6,441.54	6.442	54.867	344.737
08/16/16 12:20:00 AM	6,445.44	6.445	54.868	344.745
08/16/16 12:30:00 AM	6,448.62	6.449	54.869	344.752
08/16/16 12:40:00 AM	6,451.80	6.452	54.870	344.758
08/16/16 12:50:00 AM	6,454.56	6.455	54.871	344.764
08/16/16 01:00:00 AM	6,457.56	6.458	54.872	344.770
08/16/16 01:10:00 AM	6,460.08	6.460	54.873	344.775
08/16/16 01:20:00 AM	6,462.12	6.462	54.873	344.780
08/16/16 01:30:00 AM	6,464.64	6.465	54.874	344.785
08/16/16 01:40:00 AM	6,466.68	6.467	54.875	344.789
08/16/16 01:50:00 AM	6,469.44	6.469	54.876	344.794
08/16/16 02:00:00 AM	6,471.48	6.471	54.876	344.799
08/16/16 02:10:00 AM	6,474.96	6.475	54.878	344.805
08/16/16 02:20:00 AM	6,476.76	6.477	54.878	344.809
08/16/16 02:30:00 AM	6,478.62	6.479	54.879	344.813
08/16/16 02:40:00 AM	6,482.04	6.482	54.880	344.820
08/16/16 02:50:00 AM	6,485.70	6.486	54.881	344.827
08/16/16 03:00:00 AM	6,489.36	6.489	54.882	344.835
08/16/16 03:10:00 AM	6,491.88	6.492	54.883	344.840
08/16/16 03:20:00 AM	6,494.16	6.494	54.884	344.845

08/16/16 03:30:00 AM	6,496.20	6.496	54.884	344.849
08/16/16 03:40:00 AM	6,498.54	6.499	54.885	344.854
08/16/16 03:50:00 AM	6,500.34	6.500	54.886	344.857
08/16/16 04:00:00 AM	6,502.20	6.502	54.886	344.861
08/16/16 04:10:00 AM	6,505.38	6.505	54.887	344.867
08/16/16 04:20:00 AM	6,507.18	6.507	54.888	344.871
08/16/16 04:30:00 AM	6,510.18	6.510	54.889	344.877
08/16/16 04:40:00 AM	6,512.46	6.512	54.890	344.882
08/16/16 04:50:00 AM	6,514.56	6.515	54.890	344.886
08/16/16 05:00:00 AM	6,517.26	6.517	54.891	344.892
08/16/16 05:10:00 AM	6,519.54	6.520	54.892	344.896
08/16/16 05:20:00 AM	6,521.88	6.522	54.893	344.901
08/16/16 05:30:00 AM	6,524.40	6.524	54.894	344.906
08/16/16 05:40:00 AM	6,526.20	6.526	54.894	344.910
08/16/16 05:50:00 AM	6,528.24	6.528	54.895	344.914
08/16/16 06:00:00 AM	6,530.58	6.531	54.896	344.919
08/16/16 06:10:00 AM	6,533.76	6.534	54.897	344.925
08/16/16 06:20:00 AM	6,536.76	6.537	54.898	344.931
08/16/16 06:30:00 AM	6,539.70	6.540	54.899	344.937
08/16/16 06:40:00 AM	6,543.60	6.544	54.900	344.945
08/16/16 06:50:00 AM	6,547.50	6.548	54.901	344.953
08/16/16 07:00:00 AM	6,550.26	6.550	54.902	344.959
08/16/16 07:10:00 AM	6,553.68	6.554	54.903	344.966
08/16/16 07:20:00 AM	6,559.14	6.559	54.905	344.976

08/16/16 07:30:00 AM	6,563.76	6.564	54.906	344.986
08/16/16 07:40:00 AM	6,568.98	6.569	54.908	344.996
08/16/16 07:50:00 AM	6,573.12	6.573	54.909	345.005
08/16/16 08:00:00 AM	6,574.98	6.575	54.910	345.009
08/16/16 08:10:00 AM	6,576.36	6.576	54.910	345.012
08/16/16 08:20:00 AM	6,576.36	6.576	54.910	345.012
08/16/16 08:30:00 AM	6,576.36	6.576	54.910	345.012
08/16/16 08:40:00 AM	6,576.12	6.576	54.910	345.012
08/16/16 08:50:00 AM	6,574.02	6.574	54.910	345.008
08/16/16 09:00:00 AM	6,570.36	6.570	54.909	345.001
08/16/16 09:10:00 AM	6,563.28	6.563	54.906	344.987
08/16/16 09:20:00 AM	6,549.30	6.549	54.902	344.960
08/16/16 09:30:00 AM	6,534.90	6.535	54.897	344.931
08/16/16 09:40:00 AM	6,518.88	6.519	54.892	344.898
08/16/16 09:50:00 AM	6,506.28	6.506	54.888	344.872
08/16/16 10:00:00 AM	6,491.40	6.491	54.883	344.842
08/16/16 10:10:00 AM	6,474.00	6.474	54.878	344.807
08/16/16 10:20:00 AM	6,458.46	6.458	54.873	344.775
08/16/16 10:30:00 AM	6,446.34	6.446	54.869	344.750
08/16/16 10:40:00 AM	6,430.98	6.431	54.864	344.719
08/16/16 10:50:00 AM	6,415.44	6.415	54.859	344.688
08/16/16 11:00:00 AM	6,403.98	6.404	54.855	344.664
08/16/16 11:10:00 AM	6,393.66	6.394	54.852	344.643
08/16/16 11:20:00 AM	6,379.50	6.380	54.847	344.614

08/16/16 11:30:00 AM	6,368.28	6.368	54.843	344.591
08/16/16 11:40:00 AM	6,353.40	6.353	54.839	344.561
08/16/16 11:50:00 AM	6,338.52	6.339	54.834	344.531
08/16/16 12:00:00 PM	6,325.02	6.325	54.829	344.504
08/16/16 12:10:00 PM	6,308.10	6.308	54.824	344.470
08/16/16 12:20:00 PM	6,293.88	6.294	54.819	344.440
08/16/16 12:30:00 PM	6,276.24	6.276	54.814	344.405
08/16/16 12:40:00 PM	6,262.08	6.262	54.809	344.376
08/16/16 12:50:00 PM	6,245.58	6.246	54.804	344.342
08/16/16 01:00:00 PM	6,230.70	6.231	54.799	344.312
08/16/16 01:10:00 PM	6,214.02	6.214	54.794	344.278
08/16/16 01:20:00 PM	6,194.58	6.195	54.787	344.239
08/16/16 01:30:00 PM	6,186.78	6.187	54.785	344.221
08/16/16 01:40:00 PM	6,184.92	6.185	54.784	344.216
08/16/16 01:50:00 PM	6,178.56	6.179	54.782	344.204
08/16/16 02:00:00 PM	6,175.32	6.175	54.781	344.197
08/16/16 02:10:00 PM	6,174.84	6.175	54.780	344.195
08/16/16 02:20:00 PM	6,174.66	6.175	54.780	344.195
08/16/16 02:30:00 PM	6,165.24	6.165	54.778	344.177
08/16/16 02:40:00 PM	6,162.06	6.162	54.776	344.170
08/16/16 02:50:00 PM	6,160.44	6.160	54.776	344.166
08/16/16 03:00:00 PM	6,151.32	6.151	54.773	344.149
08/16/16 03:10:00 PM	6,143.94	6.144	54.771	344.134
08/16/16 03:20:00 PM	6,143.04	6.143	54.770	344.131

08/16/16 03:30:00 PM	6,139.14	6.139	54.769	344.123
08/16/16 03:40:00 PM	6,133.44	6.133	54.767	344.112
08/16/16 03:50:00 PM	6,133.20	6.133	54.767	344.111
08/16/16 04:00:00 PM	6,125.88	6.126	54.765	344.097
08/16/16 04:10:00 PM	6,126.12	6.126	54.765	344.096
08/16/16 04:20:00 PM	6,126.12	6.126	54.765	344.096
08/16/16 04:30:00 PM	6,126.36	6.126	54.765	344.096
08/16/16 04:40:00 PM	6,127.92	6.128	54.765	344.099
08/16/16 04:50:00 PM	6,129.12	6.129	54.766	344.102
08/16/16 05:00:00 PM	6,128.88	6.129	54.766	344.102
08/16/16 05:10:00 PM	6,128.40	6.128	54.765	344.101
08/16/16 05:20:00 PM	6,126.36	6.126	54.765	344.097
08/16/16 05:30:00 PM	6,126.12	6.126	54.765	344.096
08/16/16 05:40:00 PM	6,127.74	6.128	54.765	344.099
08/16/16 05:50:00 PM	6,130.02	6.130	54.766	344.104
08/16/16 06:00:00 PM	6,140.28	6.140	54.769	344.123
08/16/16 06:10:00 PM	6,146.70	6.147	54.771	344.137
08/16/16 06:20:00 PM	6,149.94	6.150	54.772	344.144
08/16/16 06:30:00 PM	6,154.50	6.155	54.774	344.153
08/16/16 06:40:00 PM	6,162.30	6.162	54.776	344.168
08/16/16 06:50:00 PM	6,168.66	6.169	54.778	344.181
08/16/16 07:00:00 PM	6,175.32	6.175	54.780	344.195
08/16/16 07:10:00 PM	6,182.22	6.182	54.783	344.209
08/16/16 07:20:00 PM	6,190.68	6.191	54.785	344.226

08/16/16 07:30:00 PM	6,199.38	6.199	54.788	344.244
08/16/16 07:40:00 PM	6,208.74	6.209	54.791	344.263
08/16/16 07:50:00 PM	6,220.44	6.220	54.795	344.286
08/16/16 08:00:00 PM	6,232.08	6.232	54.799	344.310
08/16/16 08:10:00 PM	6,242.16	6.242	54.802	344.330
08/16/16 08:20:00 PM	6,250.38	6.250	54.805	344.347
08/16/16 08:30:00 PM	6,259.32	6.259	54.808	344.366
08/16/16 08:40:00 PM	6,267.36	6.267	54.810	344.382
08/16/16 08:50:00 PM	6,275.82	6.276	54.813	344.399
08/16/16 09:00:00 PM	6,284.52	6.285	54.816	344.417
08/16/16 09:10:00 PM	6,291.60	6.292	54.818	344.432
08/16/16 09:20:00 PM	6,298.68	6.299	54.820	344.446
08/16/16 09:30:00 PM	6,305.58	6.306	54.823	344.460
08/16/16 09:40:00 PM	6,312.42	6.312	54.825	344.474
08/16/16 09:50:00 PM	6,317.46	6.317	54.826	344.485
08/16/16 10:00:00 PM	6,322.98	6.323	54.828	344.496
08/16/16 10:10:00 PM	6,328.44	6.328	54.830	344.507
08/16/16 10:20:00 PM	6,333.72	6.334	54.832	344.518
08/16/16 10:30:00 PM	6,341.28	6.341	54.834	344.533
08/16/16 10:40:00 PM	6,346.08	6.346	54.836	344.543
08/16/16 10:50:00 PM	6,351.78	6.352	54.838	344.554
08/16/16 11:00:00 PM	6,356.40	6.356	54.839	344.564
08/16/16 11:10:00 PM	6,359.34	6.359	54.840	344.570
08/16/16 11:20:00 PM	6,362.76	6.363	54.841	344.577

08/16/16 11:30:00 PM	6,367.38	6.367	54.843	344.586
08/16/16 11:40:00 PM	6,372.84	6.373	54.844	344.597
08/16/16 11:50:00 PM	6,377.22	6.377	54.846	344.606
08/17/16 12:00:00 AM	6,383.16	6.383	54.848	344.618
08/17/16 12:10:00 AM	6,390.00	6.390	54.850	344.632
08/17/16 12:20:00 AM	6,394.62	6.395	54.851	344.642
08/17/16 12:30:00 AM	6,398.28	6.398	54.853	344.649
08/17/16 12:40:00 AM	6,400.56	6.401	54.853	344.654
08/17/16 12:50:00 AM	6,402.84	6.403	54.854	344.659
08/17/16 01:00:00 AM	6,406.26	6.406	54.855	344.666
08/17/16 01:10:00 AM	6,409.02	6.409	54.856	344.671
08/17/16 01:20:00 AM	6,410.40	6.410	54.857	344.674
08/17/16 01:30:00 AM	6,413.16	6.413	54.858	344.680
08/17/16 01:40:00 AM	6,415.68	6.416	54.858	344.685
08/17/16 01:50:00 AM	6,418.38	6.418	54.859	344.690
08/17/16 02:00:00 AM	6,422.04	6.422	54.860	344.698
08/17/16 02:10:00 AM	6,425.04	6.425	54.861	344.704
08/17/16 02:20:00 AM	6,427.56	6.428	54.862	344.709
08/17/16 02:30:00 AM	6,430.74	6.431	54.863	344.716
08/17/16 02:40:00 AM	6,433.98	6.434	54.864	344.722
08/17/16 02:50:00 AM	6,436.50	6.437	54.865	344.727
08/17/16 03:00:00 AM	6,440.16	6.440	54.866	344.735
08/17/16 03:10:00 AM	6,444.24	6.444	54.868	344.743
08/17/16 03:20:00 AM	6,447.90	6.448	54.869	344.750

08/17/16 03:30:00 AM	6,451.14	6.451	54.870	344.757
08/17/16 03:40:00 AM	6,455.04	6.455	54.871	344.765
08/17/16 03:50:00 AM	6,457.80	6.458	54.872	344.771
08/17/16 04:00:00 AM	6,460.98	6.461	54.873	344.777
08/17/16 04:10:00 AM	6,463.26	6.463	54.874	344.782
08/17/16 04:20:00 AM	6,465.54	6.466	54.875	344.786
08/17/16 04:30:00 AM	6,468.54	6.469	54.875	344.792
08/17/16 04:40:00 AM	6,471.96	6.472	54.877	344.799
08/17/16 04:50:00 AM	6,474.96	6.475	54.878	344.806
08/17/16 05:00:00 AM	6,477.90	6.478	54.879	344.812
08/17/16 05:10:00 AM	6,480.66	6.481	54.879	344.817
08/17/16 05:20:00 AM	6,483.42	6.483	54.880	344.823
08/17/16 05:30:00 AM	6,486.18	6.486	54.881	344.828
08/17/16 05:40:00 AM	6,487.98	6.488	54.882	344.832
08/17/16 05:50:00 AM	6,490.26	6.490	54.883	344.837
08/17/16 06:00:00 AM	6,492.54	6.493	54.883	344.841
08/17/16 06:10:00 AM	6,495.54	6.496	54.884	344.847
08/17/16 06:20:00 AM	6,497.82	6.498	54.885	344.852
08/17/16 06:30:00 AM	6,500.82	6.501	54.886	344.858
08/17/16 06:40:00 AM	6,502.86	6.503	54.887	344.862
08/17/16 06:50:00 AM	6,505.14	6.505	54.887	344.867
08/17/16 07:00:00 AM	6,508.56	6.509	54.888	344.874
08/17/16 07:10:00 AM	6,510.90	6.511	54.889	344.879
08/17/16 07:20:00 AM	6,513.36	6.513	54.890	344.884

08/17/16 07:30:00 AM	6,514.08	6.514	54.890	344.885
08/17/16 07:40:00 AM	6,514.32	6.514	54.890	344.886
08/17/16 07:50:00 AM	6,514.32	6.514	54.890	344.886
08/17/16 08:00:00 AM	6,514.08	6.514	54.890	344.886
08/17/16 08:10:00 AM	6,514.08	6.514	54.890	344.886
08/17/16 08:20:00 AM	6,513.84	6.514	54.890	344.885
08/17/16 08:30:00 AM	6,512.46	6.512	54.890	344.883
08/17/16 08:40:00 AM	6,511.08	6.511	54.889	344.880
08/17/16 08:50:00 AM	6,509.70	6.510	54.889	344.877
08/17/16 09:00:00 AM	6,508.38	6.508	54.888	344.874
08/17/16 09:10:00 AM	6,504.72	6.505	54.887	344.867
08/17/16 09:20:00 AM	6,500.10	6.500	54.886	344.858
08/17/16 09:30:00 AM	6,495.06	6.495	54.884	344.848
08/17/16 09:40:00 AM	6,487.50	6.488	54.882	344.833
08/17/16 09:50:00 AM	6,478.38	6.478	54.879	344.815
08/17/16 10:00:00 AM	6,466.92	6.467	54.875	344.792
08/17/16 10:10:00 AM	6,458.22	6.458	54.872	344.774
08/17/16 10:20:00 AM	6,448.86	6.449	54.869	344.755
08/17/16 10:30:00 AM	6,436.50	6.437	54.866	344.730
08/17/16 10:40:00 AM	6,422.52	6.423	54.861	344.702
08/17/16 10:50:00 AM	6,406.74	6.407	54.856	344.670
08/17/16 11:00:00 AM	6,392.76	6.393	54.851	344.641
08/17/16 11:10:00 AM	6,374.46	6.374	54.846	344.605
08/17/16 11:20:00 AM	6,348.36	6.348	54.837	344.553

08/17/16 11:30:00 AM	6,332.10	6.332	54.832	344.519
08/17/16 11:40:00 AM	6,311.04	6.311	54.825	344.476
08/17/16 11:50:00 AM	6,293.64	6.294	54.819	344.440
08/17/16 12:00:00 PM	6,279.24	6.279	54.815	344.411
08/17/16 12:10:00 PM	6,260.94	6.261	54.809	344.374
08/17/16 12:20:00 PM	6,244.20	6.244	54.803	344.340
08/17/16 12:30:00 PM	6,236.22	6.236	54.801	344.322
08/17/16 12:40:00 PM	6,219.72	6.220	54.795	344.290
08/17/16 12:50:00 PM	6,198.00	6.198	54.789	344.246
08/17/16 01:00:00 PM	6,188.16	6.188	54.785	344.224
08/17/16 01:10:00 PM	6,174.84	6.175	54.781	344.198
08/17/16 01:20:00 PM	6,154.26	6.154	54.774	344.157
08/17/16 01:30:00 PM	6,148.80	6.149	54.772	344.143
08/17/16 01:40:00 PM	6,131.82	6.132	54.767	344.111
08/17/16 01:50:00 PM	6,116.94	6.117	54.762	344.080
08/17/16 02:00:00 PM	6,108.72	6.109	54.759	344.062
08/17/16 02:10:00 PM	6,100.02	6.100	54.756	344.045
08/17/16 02:20:00 PM	6,093.36	6.093	54.754	344.031
08/17/16 02:30:00 PM	6,082.86	6.083	54.751	344.010
08/17/16 02:40:00 PM	6,078.72	6.079	54.749	344.000
08/17/16 02:50:00 PM	6,062.04	6.062	54.744	343.969
08/17/16 03:00:00 PM	6,056.76	6.057	54.742	343.956
08/17/16 03:10:00 PM	6,057.24	6.057	54.742	343.956
08/17/16 03:20:00 PM	6,051.72	6.052	54.741	343.945

08/17/16 03:30:00 PM	6,045.30	6.045	54.739	343.933
08/17/16 03:40:00 PM	6,037.32	6.037	54.736	343.917
08/17/16 03:50:00 PM	6,034.56	6.035	54.735	343.910
08/17/16 04:00:00 PM	6,025.38	6.025	54.732	343.893
08/17/16 04:10:00 PM	6,018.54	6.019	54.730	343.878
08/17/16 04:20:00 PM	6,016.02	6.016	54.729	343.872
08/17/16 04:30:00 PM	6,013.50	6.014	54.728	343.867
08/17/16 04:40:00 PM	6,011.46	6.011	54.728	343.863
08/17/16 04:50:00 PM	6,005.52	6.006	54.726	343.851
08/17/16 05:00:00 PM	6,005.70	6.006	54.726	343.851
08/17/16 05:10:00 PM	6,005.52	6.006	54.726	343.850
08/17/16 05:20:00 PM	6,005.28	6.005	54.725	343.850
08/17/16 05:30:00 PM	6,004.32	6.004	54.725	343.848
08/17/16 05:40:00 PM	6,006.66	6.007	54.726	343.852
08/17/16 05:50:00 PM	6,008.22	6.008	54.726	343.856
08/17/16 06:00:00 PM	6,011.22	6.011	54.727	343.861
08/17/16 06:10:00 PM	6,018.30	6.018	54.729	343.875
08/17/16 06:20:00 PM	6,029.52	6.030	54.733	343.897
08/17/16 06:30:00 PM	6,034.80	6.035	54.735	343.909
08/17/16 06:40:00 PM	6,043.26	6.043	54.738	343.926
08/17/16 06:50:00 PM	6,052.20	6.052	54.740	343.944
08/17/16 07:00:00 PM	6,058.80	6.059	54.743	343.958
08/17/16 07:10:00 PM	6,066.36	6.066	54.745	343.973
08/17/16 07:20:00 PM	6,075.96	6.076	54.748	343.992

08/17/16 07:30:00 PM	6,086.76	6.087	54.752	344.014
08/17/16 07:40:00 PM	6,095.46	6.095	54.754	344.032
08/17/16 07:50:00 PM	6,104.82	6.105	54.757	344.051
08/17/16 08:00:00 PM	6,112.62	6.113	54.760	344.067
08/17/16 08:10:00 PM	6,121.74	6.122	54.763	344.085
08/17/16 08:20:00 PM	6,130.02	6.130	54.766	344.102
08/17/16 08:30:00 PM	6,138.48	6.138	54.768	344.120
08/17/16 08:40:00 PM	6,145.32	6.145	54.771	344.134
08/17/16 08:50:00 PM	6,151.74	6.152	54.773	344.147
08/17/16 09:00:00 PM	6,158.16	6.158	54.775	344.160
08/17/16 09:10:00 PM	6,164.10	6.164	54.777	344.172
08/17/16 09:20:00 PM	6,173.28	6.173	54.780	344.190
08/17/16 09:30:00 PM	6,183.36	6.183	54.783	344.211
08/17/16 09:40:00 PM	6,190.20	6.190	54.785	344.225
08/17/16 09:50:00 PM	6,195.00	6.195	54.787	344.235
08/17/16 10:00:00 PM	6,201.18	6.201	54.789	344.248
08/17/16 10:10:00 PM	6,206.70	6.207	54.791	344.259
08/17/16 10:20:00 PM	6,211.02	6.211	54.792	344.268
08/17/16 10:30:00 PM	6,216.78	6.217	54.794	344.280
08/17/16 10:40:00 PM	6,222.24	6.222	54.796	344.291
08/17/16 10:50:00 PM	6,227.94	6.228	54.797	344.302
08/17/16 11:00:00 PM	6,232.80	6.233	54.799	344.312
08/17/16 11:10:00 PM	6,237.84	6.238	54.801	344.323
08/17/16 11:20:00 PM	6,243.30	6.243	54.802	344.334

08/17/16 11:30:00 PM	6,248.10	6.248	54.804	344.343
08/17/16 11:40:00 PM	6,251.10	6.251	54.805	344.350
08/17/16 11:50:00 PM	6,257.94	6.258	54.807	344.363
08/18/16 12:00:00 AM	6,261.84	6.262	54.808	344.372
08/18/16 12:10:00 AM	6,265.02	6.265	54.810	344.378
08/18/16 12:20:00 AM	6,269.40	6.269	54.811	344.387
08/18/16 12:30:00 AM	6,273.72	6.274	54.812	344.396
08/18/16 12:40:00 AM	6,277.62	6.278	54.814	344.404
08/18/16 12:50:00 AM	6,282.90	6.283	54.815	344.414
08/18/16 01:00:00 AM	6,286.56	6.287	54.817	344.422
08/18/16 01:10:00 AM	6,289.32	6.289	54.817	344.428
08/18/16 01:20:00 AM	6,291.84	6.292	54.818	344.433
08/18/16 01:30:00 AM	6,293.46	6.293	54.819	344.436
08/18/16 01:40:00 AM	6,294.60	6.295	54.819	344.439
08/18/16 01:50:00 AM	6,298.26	6.298	54.820	344.446
08/18/16 02:00:00 AM	6,301.20	6.301	54.821	344.452
08/18/16 02:10:00 AM	6,304.62	6.305	54.822	344.459
08/18/16 02:20:00 AM	6,309.66	6.310	54.824	344.469
08/18/16 02:30:00 AM	6,313.80	6.314	54.825	344.477
08/18/16 02:40:00 AM	6,316.08	6.316	54.826	344.482
08/18/16 02:50:00 AM	6,318.84	6.319	54.827	344.488
08/18/16 03:00:00 AM	6,321.12	6.321	54.828	344.493
08/18/16 03:10:00 AM	6,325.26	6.325	54.829	344.501
08/18/16 03:20:00 AM	6,327.78	6.328	54.830	344.506

08/18/16 03:30:00 AM	6,332.10	6.332	54.831	344.515
08/18/16 03:40:00 AM	6,335.76	6.336	54.832	344.522
08/18/16 03:50:00 AM	6,338.76	6.339	54.833	344.528
08/18/16 04:00:00 AM	6,342.18	6.342	54.835	344.535
08/18/16 04:10:00 AM	6,344.94	6.345	54.835	344.541
08/18/16 04:20:00 AM	6,346.74	6.347	54.836	344.545
08/18/16 04:30:00 AM	6,348.36	6.348	54.837	344.548
08/18/16 04:40:00 AM	6,351.78	6.352	54.838	344.555
08/18/16 04:50:00 AM	6,354.30	6.354	54.838	344.560
08/18/16 05:00:00 AM	6,356.82	6.357	54.839	344.565
08/18/16 05:10:00 AM	6,359.82	6.360	54.840	344.571
08/18/16 05:20:00 AM	6,363.00	6.363	54.841	344.578
08/18/16 05:30:00 AM	6,366.24	6.366	54.842	344.584
08/18/16 05:40:00 AM	6,369.18	6.369	54.843	344.590
08/18/16 05:50:00 AM	6,374.22	6.374	54.845	344.600
08/18/16 06:00:00 AM	6,377.46	6.377	54.846	344.607
08/18/16 06:10:00 AM	6,382.44	6.382	54.848	344.617
08/18/16 06:20:00 AM	6,386.10	6.386	54.849	344.625
08/18/16 06:30:00 AM	6,390.72	6.391	54.850	344.634
08/18/16 06:40:00 AM	6,393.66	6.394	54.851	344.640
08/18/16 06:50:00 AM	6,396.42	6.396	54.852	344.646
08/18/16 07:00:00 AM	6,397.32	6.397	54.852	344.648
08/18/16 07:10:00 AM	6,400.56	6.401	54.853	344.654
08/18/16 07:20:00 AM	6,401.94	6.402	54.854	344.657

08/18/16 07:30:00 AM	6,403.74	6.404	54.855	344.661
08/18/16 07:40:00 AM	6,402.18	6.402	54.854	344.658
08/18/16 07:50:00 AM	6,403.08	6.403	54.854	344.660
08/18/16 08:00:00 AM	6,399.84	6.400	54.853	344.654
08/18/16 08:10:00 AM	6,396.00	6.396	54.852	344.646
08/18/16 08:20:00 AM	6,394.38	6.394	54.852	344.642
08/18/16 08:30:00 AM	6,392.52	6.393	54.851	344.639
08/18/16 08:40:00 AM	6,389.58	6.390	54.850	344.633
08/18/16 08:50:00 AM	6,386.10	6.386	54.849	344.626
08/18/16 09:00:00 AM	6,385.68	6.386	54.849	344.625
08/18/16 09:10:00 AM	6,379.74	6.380	54.847	344.613
08/18/16 09:20:00 AM	6,377.64	6.378	54.846	344.609
08/18/16 09:30:00 AM	6,372.42	6.372	54.845	344.598
08/18/16 09:40:00 AM	6,366.90	6.367	54.843	344.587
08/18/16 09:50:00 AM	6,365.28	6.365	54.842	344.583
08/18/16 10:00:00 AM	6,359.10	6.359	54.840	344.571
08/18/16 10:10:00 AM	6,349.08	6.349	54.837	344.552
08/18/16 10:20:00 AM	6,345.18	6.345	54.836	344.543
08/18/16 10:30:00 AM	6,338.28	6.338	54.834	344.529
08/18/16 10:40:00 AM	6,332.58	6.333	54.832	344.517
08/18/16 10:50:00 AM	6,324.12	6.324	54.829	344.501
08/18/16 11:00:00 AM	6,318.18	6.318	54.827	344.488
08/18/16 11:10:00 AM	6,312.00	6.312	54.825	344.476
08/18/16 11:20:00 AM	6,309.00	6.309	54.824	344.469

08/18/16 11:30:00 AM	6,300.78	6.301	54.821	344.453
08/18/16 11:40:00 AM	6,295.02	6.295	54.820	344.441
08/18/16 11:50:00 AM	6,286.56	6.287	54.817	344.424
08/18/16 12:00:00 PM	6,283.80	6.284	54.816	344.418
08/18/16 12:10:00 PM	6,278.34	6.278	54.814	344.407
08/18/16 12:20:00 PM	6,269.64	6.270	54.811	344.390
08/18/16 12:30:00 PM	6,260.46	6.260	54.808	344.371
08/18/16 12:40:00 PM	6,252.00	6.252	54.806	344.354
08/18/16 12:50:00 PM	6,248.34	6.248	54.804	344.346
08/18/16 01:00:00 PM	6,238.02	6.238	54.801	344.326
08/18/16 01:10:00 PM	6,233.70	6.234	54.800	344.316
08/18/16 01:20:00 PM	6,214.92	6.215	54.794	344.280
08/18/16 01:30:00 PM	6,201.42	6.201	54.789	344.252
08/18/16 01:40:00 PM	6,194.76	6.195	54.787	344.237
08/18/16 01:50:00 PM	6,187.02	6.187	54.785	344.221
08/18/16 02:00:00 PM	6,169.14	6.169	54.779	344.187
08/18/16 02:10:00 PM	6,159.54	6.160	54.776	344.166
08/18/16 02:20:00 PM	6,148.80	6.149	54.772	344.144
08/18/16 02:30:00 PM	6,133.92	6.134	54.768	344.115
08/18/16 02:40:00 PM	6,125.64	6.126	54.765	344.097
08/18/16 02:50:00 PM	6,117.90	6.118	54.762	344.081
08/18/16 03:00:00 PM	6,110.10	6.110	54.760	344.065
08/18/16 03:10:00 PM	6,105.72	6.106	54.758	344.055
08/18/16 03:20:00 PM	6,095.46	6.095	54.755	344.035

08/18/16 03:30:00 PM	6,081.00	6.081	54.750	344.007
08/18/16 03:40:00 PM	6,080.10	6.080	54.750	344.003
08/18/16 03:50:00 PM	6,077.16	6.077	54.749	343.997
08/18/16 04:00:00 PM	6,068.46	6.068	54.746	343.980
08/18/16 04:10:00 PM	6,057.00	6.057	54.743	343.957
08/18/16 04:20:00 PM	6,044.40	6.044	54.739	343.932
08/18/16 04:30:00 PM	6,057.00	6.057	54.742	343.953
08/18/16 04:40:00 PM	6,067.08	6.067	54.745	343.974
08/18/16 04:50:00 PM	6,081.48	6.081	54.750	344.002
08/18/16 05:00:00 PM	6,092.04	6.092	54.753	344.025
08/18/16 05:10:00 PM	6,098.40	6.098	54.755	344.038
08/18/16 05:20:00 PM	6,108.06	6.108	54.758	344.057
08/18/16 05:30:00 PM	6,104.82	6.105	54.758	344.053
08/18/16 05:40:00 PM	6,105.96	6.106	54.758	344.055
08/18/16 05:50:00 PM	6,112.38	6.112	54.760	344.067
08/18/16 06:00:00 PM	6,119.22	6.119	54.762	344.081
08/18/16 06:10:00 PM	6,125.88	6.126	54.764	344.094
08/18/16 06:20:00 PM	6,126.60	6.127	54.765	344.097
08/18/16 06:30:00 PM	6,127.92	6.128	54.765	344.099
08/18/16 06:40:00 PM	6,130.02	6.130	54.766	344.104
08/18/16 06:50:00 PM	6,134.34	6.134	54.767	344.112
08/18/16 07:00:00 PM	6,137.34	6.137	54.768	344.118
08/18/16 07:10:00 PM	6,148.80	6.149	54.772	344.140
08/18/16 07:20:00 PM	6,160.68	6.161	54.775	344.164

08/18/16 07:30:00 PM	6,164.82	6.165	54.777	344.174
08/18/16 07:40:00 PM	6,173.94	6.174	54.780	344.192
08/18/16 07:50:00 PM	6,184.26	6.184	54.783	344.212
08/18/16 08:00:00 PM	6,189.54	6.190	54.785	344.224
08/18/16 08:10:00 PM	6,194.10	6.194	54.787	344.234
08/18/16 08:20:00 PM	6,197.76	6.198	54.788	344.241
08/18/16 08:30:00 PM	6,200.94	6.201	54.789	344.248
08/18/16 08:40:00 PM	6,205.98	6.206	54.790	344.258
08/18/16 08:50:00 PM	6,213.12	6.213	54.793	344.272
08/18/16 09:00:00 PM	6,223.38	6.223	54.796	344.292
08/18/16 09:10:00 PM	6,228.18	6.228	54.798	344.303
08/18/16 09:20:00 PM	6,232.08	6.232	54.799	344.311
08/18/16 09:30:00 PM	6,245.82	6.246	54.803	344.337
08/18/16 09:40:00 PM	6,247.86	6.248	54.804	344.343
08/18/16 09:50:00 PM	6,255.90	6.256	54.806	344.359
08/18/16 10:00:00 PM	6,257.70	6.258	54.807	344.363
08/18/16 10:10:00 PM	6,267.36	6.267	54.810	344.382
08/18/16 10:20:00 PM	6,269.16	6.269	54.811	344.387
08/18/16 10:30:00 PM	6,272.40	6.272	54.812	344.393
08/18/16 10:40:00 PM	6,279.48	6.279	54.814	344.407
08/18/16 10:50:00 PM	6,281.52	6.282	54.815	344.412
08/18/16 11:00:00 PM	6,288.42	6.288	54.817	344.425
08/18/16 11:10:00 PM	6,295.26	6.295	54.819	344.439
08/18/16 11:20:00 PM	6,298.92	6.299	54.821	344.447

08/18/16 11:30:00 PM	6,300.06	6.300	54.821	344.450
08/18/16 11:40:00 PM	6,302.58	6.303	54.822	344.455
08/18/16 11:50:00 PM	6,306.48	6.306	54.823	344.463
08/19/16 12:00:00 AM	6,308.76	6.309	54.824	344.467
08/19/16 12:10:00 AM	6,312.00	6.312	54.825	344.474
08/19/16 12:20:00 AM	6,314.70	6.315	54.826	344.479
08/19/16 12:30:00 AM	6,317.70	6.318	54.827	344.485
08/19/16 12:40:00 AM	6,320.88	6.321	54.828	344.492
08/19/16 12:50:00 AM	6,326.40	6.326	54.829	344.503
08/19/16 01:00:00 AM	6,333.00	6.333	54.831	344.516
08/19/16 01:10:00 AM	6,334.86	6.335	54.832	344.521
08/19/16 01:20:00 AM	6,336.90	6.337	54.833	344.525
08/19/16 01:30:00 AM	6,338.28	6.338	54.833	344.528
08/19/16 01:40:00 AM	6,346.08	6.346	54.836	344.542
08/19/16 01:50:00 AM	6,345.36	6.345	54.836	344.542
08/19/16 02:00:00 AM	6,347.46	6.347	54.836	344.546
08/19/16 02:10:00 AM	6,349.26	6.349	54.837	344.550
08/19/16 02:20:00 AM	6,349.74	6.350	54.837	344.551
08/19/16 02:30:00 AM	6,350.88	6.351	54.837	344.553
08/19/16 02:40:00 AM	6,352.92	6.353	54.838	344.557
08/19/16 02:50:00 AM	6,354.54	6.355	54.839	344.561
08/19/16 03:00:00 AM	6,355.92	6.356	54.839	344.564
08/19/16 03:10:00 AM	6,357.96	6.358	54.840	344.568
08/19/16 03:20:00 AM	6,360.48	6.360	54.840	344.573

08/19/16 03:30:00 AM	6,363.48	6.363	54.841	344.579
08/19/16 03:40:00 AM	6,367.14	6.367	54.843	344.586
08/19/16 03:50:00 AM	6,369.18	6.369	54.843	344.590
08/19/16 04:00:00 AM	6,372.42	6.372	54.844	344.597
08/19/16 04:10:00 AM	6,374.22	6.374	54.845	344.601
08/19/16 04:20:00 AM	6,376.74	6.377	54.846	344.606
08/19/16 04:30:00 AM	6,380.16	6.380	54.847	344.613
08/19/16 04:40:00 AM	6,381.78	6.382	54.847	344.616
08/19/16 04:50:00 AM	6,383.64	6.384	54.848	344.620
08/19/16 05:00:00 AM	6,386.34	6.386	54.849	344.625
08/19/16 05:10:00 AM	6,388.86	6.389	54.850	344.630
08/19/16 05:20:00 AM	6,391.86	6.392	54.851	344.636
08/19/16 05:30:00 AM	6,394.38	6.394	54.851	344.642
08/19/16 05:40:00 AM	6,397.14	6.397	54.852	344.647
08/19/16 05:50:00 AM	6,399.66	6.400	54.853	344.652
08/19/16 06:00:00 AM	6,399.84	6.400	54.853	344.653
08/19/16 06:10:00 AM	6,401.46	6.401	54.854	344.656
08/19/16 06:20:00 AM	6,402.84	6.403	54.854	344.659
08/19/16 06:30:00 AM	6,404.22	6.404	54.855	344.662
08/19/16 06:40:00 AM	6,405.60	6.406	54.855	344.665
08/19/16 06:50:00 AM	6,407.16	6.407	54.856	344.668
08/19/16 07:00:00 AM	6,407.88	6.408	54.856	344.669
08/19/16 07:10:00 AM	6,409.26	6.409	54.856	344.672
08/19/16 07:20:00 AM	6,411.78	6.412	54.857	344.677

08/19/16 07:30:00 AM	6,412.68	6.413	54.857	344.679
08/19/16 07:40:00 AM	6,412.68	6.413	54.857	344.679
08/19/16 07:50:00 AM	6,413.34	6.413	54.858	344.681
08/19/16 08:00:00 AM	6,413.82	6.414	54.858	344.682
08/19/16 08:10:00 AM	6,413.82	6.414	54.858	344.682
08/19/16 08:20:00 AM	6,413.82	6.414	54.858	344.682
08/19/16 08:30:00 AM	6,413.58	6.414	54.858	344.681
08/19/16 08:40:00 AM	6,413.58	6.414	54.858	344.681
08/19/16 08:50:00 AM	6,413.58	6.414	54.858	344.681
08/19/16 09:00:00 AM	6,413.34	6.413	54.858	344.681
08/19/16 09:10:00 AM	6,413.34	6.413	54.858	344.681
08/19/16 09:20:00 AM	6,413.34	6.413	54.858	344.681
08/19/16 09:30:00 AM	6,413.16	6.413	54.858	344.680
08/19/16 09:40:00 AM	6,412.20	6.412	54.857	344.679
08/19/16 09:50:00 AM	6,410.82	6.411	54.857	344.676
08/19/16 10:00:00 AM	6,407.64	6.408	54.856	344.670
08/19/16 10:10:00 AM	6,405.84	6.406	54.855	344.666
08/19/16 10:20:00 AM	6,403.32	6.403	54.855	344.661
08/19/16 10:30:00 AM	6,403.32	6.403	54.854	344.660
08/19/16 10:40:00 AM	6,403.32	6.403	54.854	344.660
08/19/16 10:50:00 AM	6,396.66	6.397	54.852	344.648
08/19/16 11:00:00 AM	6,390.00	6.390	54.850	344.634
08/19/16 11:10:00 AM	6,385.44	6.385	54.849	344.625
08/19/16 11:20:00 AM	6,379.50	6.380	54.847	344.613

08/19/16 11:30:00 AM	6,365.10	6.365	54.842	344.585
08/19/16 11:40:00 AM	6,354.30	6.354	54.839	344.563
08/19/16 11:50:00 AM	6,350.64	6.351	54.838	344.554
08/19/16 12:00:00 PM	6,341.94	6.342	54.835	344.537
08/19/16 12:10:00 PM	6,330.54	6.331	54.831	344.514
08/19/16 12:20:00 PM	6,316.98	6.317	54.827	344.487
08/19/16 12:30:00 PM	6,302.58	6.303	54.822	344.458
08/19/16 12:40:00 PM	6,289.74	6.290	54.818	344.432
08/19/16 12:50:00 PM	6,279.24	6.279	54.815	344.410
08/19/16 01:00:00 PM	6,265.74	6.266	54.810	344.383
08/19/16 01:10:00 PM	6,248.82	6.249	54.805	344.349
08/19/16 01:20:00 PM	6,234.12	6.234	54.800	344.319
08/19/16 01:30:00 PM	6,215.40	6.215	54.794	344.281
08/19/16 01:40:00 PM	6,196.38	6.196	54.788	344.243
08/19/16 01:50:00 PM	6,187.02	6.187	54.785	344.222
08/19/16 02:00:00 PM	6,165.00	6.165	54.778	344.179
08/19/16 02:10:00 PM	6,145.80	6.146	54.772	344.140
08/19/16 02:20:00 PM	6,129.12	6.129	54.766	344.105
08/19/16 02:30:00 PM	6,117.18	6.117	54.762	344.080
08/19/16 02:40:00 PM	6,108.24	6.108	54.759	344.061
08/19/16 02:50:00 PM	6,104.40	6.104	54.758	344.053
08/19/16 03:00:00 PM	6,094.32	6.094	54.755	344.033
08/19/16 03:10:00 PM	6,078.06	6.078	54.750	344.001
08/19/16 03:20:00 PM	6,063.18	6.063	54.745	343.971

08/19/16 03:30:00 PM	6,041.88	6.042	54.738	343.928
08/19/16 03:40:00 PM	6,039.60	6.040	54.737	343.921
08/19/16 03:50:00 PM	6,036.42	6.036	54.736	343.914
08/19/16 04:00:00 PM	6,025.86	6.026	54.732	343.894
08/19/16 04:10:00 PM	6,021.72	6.022	54.731	343.884
08/19/16 04:20:00 PM	6,012.60	6.013	54.728	343.866
08/19/16 04:30:00 PM	6,001.62	6.002	54.725	343.845
08/19/16 04:40:00 PM	5,994.72	5.995	54.722	343.830
08/19/16 04:50:00 PM	5,990.82	5.991	54.721	343.821
08/19/16 05:00:00 PM	5,988.12	5.988	54.720	343.816
08/19/16 05:10:00 PM	5,986.02	5.986	54.719	343.811
08/19/16 05:20:00 PM	5,984.22	5.984	54.719	343.807
08/19/16 05:30:00 PM	5,984.22	5.984	54.719	343.807
08/19/16 05:40:00 PM	5,984.22	5.984	54.719	343.807
08/19/16 05:50:00 PM	5,984.46	5.984	54.719	343.807
08/19/16 06:00:00 PM	5,984.46	5.984	54.719	343.808
08/19/16 06:10:00 PM	5,984.64	5.985	54.719	343.808
08/19/16 06:20:00 PM	5,985.36	5.985	54.719	343.809
08/19/16 06:30:00 PM	5,989.26	5.989	54.720	343.817
08/19/16 06:40:00 PM	5,994.72	5.995	54.722	343.827
08/19/16 06:50:00 PM	5,998.86	5.999	54.723	343.836
08/19/16 07:00:00 PM	5,999.10	5.999	54.723	343.837
08/19/16 07:10:00 PM	6,001.86	6.002	54.724	343.842
08/19/16 07:20:00 PM	6,005.52	6.006	54.725	343.850

08/19/16 07:30:00 PM	6,011.46	6.011	54.727	343.861
08/19/16 07:40:00 PM	6,017.88	6.018	54.729	343.874
08/19/16 07:50:00 PM	6,026.10	6.026	54.732	343.891
08/19/16 08:00:00 PM	6,035.46	6.035	54.735	343.910
08/19/16 08:10:00 PM	6,043.74	6.044	54.738	343.927
08/19/16 08:20:00 PM	6,052.20	6.052	54.740	343.944
08/19/16 08:30:00 PM	6,059.94	6.060	54.743	343.960
08/19/16 08:40:00 PM	6,068.88	6.069	54.746	343.978
08/19/16 08:50:00 PM	6,076.20	6.076	54.748	343.993
08/19/16 09:00:00 PM	6,084.24	6.084	54.751	344.009
08/19/16 09:10:00 PM	6,090.66	6.091	54.753	344.023
08/19/16 09:20:00 PM	6,096.84	6.097	54.755	344.035
08/19/16 09:30:00 PM	6,103.02	6.103	54.757	344.048
08/19/16 09:40:00 PM	6,108.48	6.108	54.759	344.059
08/19/16 09:50:00 PM	6,114.00	6.114	54.761	344.070
08/19/16 10:00:00 PM	6,120.84	6.121	54.763	344.084
08/19/16 10:10:00 PM	6,126.36	6.126	54.765	344.095
08/19/16 10:20:00 PM	6,130.26	6.130	54.766	344.104
08/19/16 10:30:00 PM	6,134.34	6.134	54.767	344.112
08/19/16 10:40:00 PM	6,138.24	6.138	54.768	344.120
08/19/16 10:50:00 PM	6,142.14	6.142	54.770	344.128
08/19/16 11:00:00 PM	6,147.84	6.148	54.772	344.139
08/19/16 11:10:00 PM	6,153.60	6.154	54.773	344.151
08/19/16 11:20:00 PM	6,157.50	6.158	54.775	344.159

08/19/16 11:30:00 PM	6,161.82	6.162	54.776	344.168
08/19/16 11:40:00 PM	6,165.00	6.165	54.777	344.175
08/19/16 11:50:00 PM	6,168.48	6.168	54.778	344.182

APPENDIX I. MANN-WHITNEY *U* TEST SAMPLE SETS TO COMPARE NORMAL AND DROUGHT CONDITIONS

Max Sap Flow	
Median July	1079.47
Median August	888.76
July n	14
August n	14
U (July)	178
U (August)	18
U	18
z (0.05)	55
Outcome	**different**

Date	Row Labels	Max Sap Flow	Rank	Points
2016/07/08	Wet	1007.94	15	11
2016/07/09	Wet	1033.24	13	12
2016/07/10	Wet	916.39	19	8
2016/07/13	Wet	893.70	21	7
2016/07/14	Wet	1063.73	9	14
2016/07/15	Wet	1090.47	6	14
2016/07/16	Wet	1152.91	2	14
2016/07/17	Wet	1124.59	4	14
2016/07/18	Wet	1050.78	10	14
2016/07/19	Wet	1107.02	5	14
2016/07/20	Wet	1087.06	7	14
2016/07/22	Wet	1071.87	8	14
2016/07/24	Wet	1189.25	1	14
2016/07/25	Wet	1137.45	3	14
2016/08/06	Dry	1016.99	14	3
2016/08/07	Dry	1049.05	11	4
2016/08/08	Dry	1036.02	12	4
2016/08/09	Dry	996.20	16	2
2016/08/10	Dry	841.19	24	0
2016/08/11	Dry	790.55	25	0
2016/08/12	Dry	775.08	26	0
2016/08/13	Dry	878.79	22	0
2016/08/14	Dry	932.93	18	2
2016/08/15	Dry	941.67	17	2
2016/08/16	Dry	852.19	23	0
2016/08/17	Dry	898.74	20	1
2016/08/18	Dry	720.71	28	0
2016/08/19	Dry	729.17	27	0

Average Temperature	
Median July	17.529
Median August	17.077
July n	14
August n	14
U (July)	127
U (August)	69
U	69
z (0.05)	55
Outcome	**same**

Date	Row Labels	Average Temperature	Rank	Points
2016/07/08	Wet	16.686	20	6
2016/07/09	Wet	17.388	16	8
2016/07/10	Wet	17.676	11	9
2016/07/13	Wet	15.442	22	5
2016/07/14	Wet	15.055	24	4
2016/07/15	Wet	17.581	12	9
2016/07/16	Wet	19.747	5	12
2016/07/17	Wet	17.222	18	7
2016/07/18	Wet	17.406	15	8
2016/07/19	Wet	22.456	1	14
2016/07/20	Wet	20.157	2	14
2016/07/22	Wet	17.478	14	8
2016/07/24	Wet	18.781	8	11
2016/07/25	Wet	19.226	6	12
2016/08/06	Dry	17.507	13	7
2016/08/07	Dry	18.851	7	10
2016/08/08	Dry	17.359	17	4
2016/08/09	Dry	15.130	23	1
2016/08/10	Dry	16.351	21	2
2016/08/11	Dry	14.785	26	0
2016/08/12	Dry	14.792	25	0
2016/08/13	Dry	16.795	19	3
2016/08/14	Dry	18.513	10	9
2016/08/15	Dry	18.574	9	9
2016/08/16	Dry	19.988	3	12
2016/08/17	Dry	19.849	4	12
2016/08/18	Dry	14.742	27	0
2016/08/19	Dry	13.075	28	0

Average Humidity	
Median July	73.09
Median August	74.09
July n	14
August n	14
U (July)	96
U (August)	100
U	96
z (0.05)	55
Outcome	**same**

Date	Row Labels	Average Humidity	Rank	Points
2016/07/08	Wet	83.97	4	12
2016/07/09	Wet	86.88	2	13
2016/07/10	Wet	82.18	6	11
2016/07/13	Wet	81.68	7	11
2016/07/14	Wet	81.56	8	11
2016/07/15	Wet	63.65	22	3
2016/07/16	Wet	56.51	28	0
2016/07/17	Wet	64.88	20	3
2016/07/18	Wet	64.25	21	3
2016/07/19	Wet	63.16	23	3
2016/07/20	Wet	71.75	17	5
2016/07/22	Wet	78.36	9	11
2016/07/24	Wet	74.44	13	8
2016/07/25	Wet	61.15	25	2
2016/08/06	Dry	60.20	27	1
2016/08/07	Dry	61.39	24	2
2016/08/08	Dry	82.56	5	12
2016/08/09	Dry	66.68	18	6
2016/08/10	Dry	74.34	14	7
2016/08/11	Dry	84.70	3	13
2016/08/12	Dry	91.49	1	14
2016/08/13	Dry	76.33	10	8
2016/08/14	Dry	72.63	16	7
2016/08/15	Dry	74.50	12	8
2016/08/16	Dry	66.16	19	6
2016/08/17	Dry	60.70	26	1
2016/08/18	Dry	73.83	15	7
2016/08/19	Dry	75.58	11	8

Average Net Radiation	
Median July	173.30
Median August	151.91
July n	11
August n	12
U (July)	96
U (August)	36
U	36
z (0.05)	24
Outcome	**same**

Date	Row Labels	Average Net Radiation	Rank	Points
2016/07/08	Wet	223.47	2	11
2016/07/09	Wet	N/A	N/A	N/A
2016/07/10	Wet	N/A	N/A	N/A
2016/07/13	Wet	N/A	N/A	N/A
2016/07/14	Wet	132.71	18	4
2016/07/15	Wet	165.19	13	8
2016/07/16	Wet	173.30	9	9
2016/07/17	Wet	171.56	10	9
2016/07/18	Wet	166.75	12	8
2016/07/19	Wet	198.55	6	11
2016/07/20	Wet	106.63	20	3
2016/07/22	Wet	210.94	4	11
2016/07/24	Wet	198.88	5	11
2016/07/25	Wet	211.70	3	11
2016/08/06	Dry	186.47	8	6
2016/08/07	Dry	151.47	16	2
2016/08/08	Dry	87.342	22	0
2016/08/09	Dry	229.18	1	11
2016/08/10	Dry	N/A	N/A	N/A
2016/08/11	Dry	N/A	N/A	N/A
2016/08/12	Dry	91.859	21	0
2016/08/13	Dry	152.34	15	2
2016/08/14	Dry	192.25	7	6
2016/08/15	Dry	169.14	11	4
2016/08/16	Dry	154.27	14	2
2016/08/17	Dry	136.92	17	2
2016/08/18	Dry	79.446	23	0
2016/08/19	Dry	127.36	19	1

Average Wind Speed	
Median July	0.33025
Median August	0.27707
July n	14
August n	13
U (July)	132
U (August)	50
U	50
z (0.05)	50
Outcome	**same**

Date	Row Labels	Average Wind Speed	Rank	Points
2016/07/08	Wet	0.33126	11	9
2016/07/09	Wet	0.28488	17	9
2016/07/10	Wet	0.32286	13	9
2016/07/13	Wet	0.47148	2	12
2016/07/14	Wet	0.28829	15	9
2016/07/15	Wet	0.27347	23	4
2016/07/16	Wet	0.34599	9	9
2016/07/17	Wet	0.37326	6	11
2016/07/18	Wet	0.32924	12	9
2016/07/19	Wet	0.41300	4	12
2016/07/20	Wet	0.33472	10	9
2016/07/22	Wet	0.28742	16	9
2016/07/24	Wet	0.31839	14	9
2016/07/25	Wet	0.45988	3	12
2016/08/06	Dry	0.27707	20	1
2016/08/07	Dry	0.27830	19	1
2016/08/08	Dry	0.27558	21	1
2016/08/09	Dry	0.36958	7	10
2016/08/10	Dry	N/A	N/A	N/A
2016/08/11	Dry	0.21829	27	0
2016/08/12	Dry	0.22880	26	0
2016/08/13	Dry	0.24030	25	0
2016/08/14	Dry	0.27122	24	0
2016/08/15	Dry	0.27900	18	1
2016/08/16	Dry	0.27458	22	1
2016/08/17	Dry	0.38210	5	11
2016/08/18	Dry	0.55121	1	14
2016/08/19	Dry	0.35522	8	10

Average Change in Circumference	
Median July	0.3873
Median August	0.4700
July n	14
August n	14
U (July)	77
U (August)	119
U	77
z (0.05)	55
Outcome	**same**

Date	Row Labels	Average Change in Circumference	Rank	Points
2016/07/08	Wet	0.5307	6	11
2016/07/09	Wet	0.5304	7	11
2016/07/10	Wet	0.2593	28	0
2016/07/13	Wet	0.3760	20	3
2016/07/14	Wet	0.3219	24	1
2016/07/15	Wet	0.3950	18	3
2016/07/16	Wet	0.3427	22	2
2016/07/17	Wet	0.3024	25	1
2016/07/18	Wet	0.2922	26	1
2016/07/19	Wet	0.4396	14	6
2016/07/20	Wet	0.5007	9	10
2016/07/22	Wet	0.5606	4	12
2016/07/24	Wet	0.5831	2	13
2016/07/25	Wet	0.3797	19	3
2016/08/06	Dry	0.4273	16	8
2016/08/07	Dry	0.4742	12	9
2016/08/08	Dry	0.3222	23	4
2016/08/09	Dry	0.4336	15	8
2016/08/10	Dry	0.2690	27	1
2016/08/11	Dry	0.3441	21	5
2016/08/12	Dry	0.4987	10	9
2016/08/13	Dry	0.5911	1	14
2016/08/14	Dry	0.5610	3	13
2016/08/15	Dry	0.5207	8	10
2016/08/16	Dry	0.4658	13	9
2016/08/17	Dry	0.5555	5	12
2016/08/18	Dry	0.4265	17	8
2016/08/19	Dry	0.4956	11	9

Minimum of Circumference	
Median July	344.5900
Median August	344.3020
July n	14
August n	14
U (July)	162
U (August)	34
U	34
z (0.05)	55
Outcome	**different**

Date	Row Labels	Minimum of Circumference	Rank	Points
2016/07/08	Wet	344.5959116	8	13
2016/07/09	Wet	344.5840184	9	13
2016/07/10	Wet	344.6663016	5	14
2016/07/13	Wet	345.0095443	1	14
2016/07/14	Wet	344.7190274	3	14
2016/07/15	Wet	344.4234498	14	10
2016/07/16	Wet	344.339417	18	8
2016/07/17	Wet	344.452313	11	12
2016/07/18	Wet	344.3910748	16	9
2016/07/19	Wet	344.2827601	22	6
2016/07/20	Wet	344.3368328	19	8
2016/07/22	Wet	344.7061959	4	14
2016/07/24	Wet	344.7822632	2	14
2016/07/25	Wet	344.645925	7	13
2016/08/06	Dry	344.4235525	13	5
2016/08/07	Dry	344.3408585	17	3
2016/08/08	Dry	344.6468835	6	9
2016/08/09	Dry	344.2217303	23	0
2016/08/10	Dry	344.4110565	15	4
2016/08/11	Dry	344.4515826	12	5
2016/08/12	Dry	344.4565274	10	6
2016/08/13	Dry	344.3066247	20	1
2016/08/14	Dry	344.2973254	21	1
2016/08/15	Dry	344.2100226	24	0
2016/08/16	Dry	344.0961101	25	0
2016/08/17	Dry	343.8481484	27	0
2016/08/18	Dry	343.9532937	26	0
2016/08/19	Dry	343.8070645	28	0

Average of Soil Moist Surface	
Median July	0.100
Median August	0.042
July n	14
August n	14
U (July)	196
U (August)	0
U	0
z (0.05)	55
Outcome	**different**

Date	Row Labels	Average of Soil Moist Surface	Rank	Points
2016/07/08	Wet	0.105	6	14
2016/07/09	Wet	0.114	2	14
2016/07/10	Wet	0.108	4	14
2016/07/13	Wet	0.115	1	14
2016/07/14	Wet	0.110	3	14
2016/07/15	Wet	0.107	5	14
2016/07/16	Wet	0.102	7	14
2016/07/17	Wet	0.098	8	14
2016/07/18	Wet	0.094	9	14
2016/07/19	Wet	0.089	11	14
2016/07/20	Wet	0.084	14	14
2016/07/22	Wet	0.084	13	14
2016/07/24	Wet	0.094	10	14
2016/07/25	Wet	0.087	12	14
2016/08/06	Dry	0.045	15	0
2016/08/07	Dry	0.044	16	0
2016/08/08	Dry	0.044	17	0
2016/08/09	Dry	0.043	18	0
2016/08/10	Dry	0.043	19	0
2016/08/11	Dry	0.042	20	0
2016/08/12	Dry	0.042	21	0
2016/08/13	Dry	0.042	22	0
2016/08/14	Dry	0.042	23	0
2016/08/15	Dry	0.041	24	0
2016/08/16	Dry	0.041	25	0
2016/08/17	Dry	0.041	26	0
2016/08/18	Dry	0.041	27	0
2016/08/19	Dry	0.041	28	0

Average of SoilMoist30	
Median July	0.076
Median August	0.037
July n	14
August n	14
U (July)	196
U (August)	0
U	0
z (0.05)	55
Outcome	**different**

Date	Row Labels	Average of SoilMoist30	Rank	Points
2016/07/08	Wet	0.063	13	14
2016/07/09	Wet	0.080	6	14
2016/07/10	Wet	0.085	3	14
2016/07/13	Wet	0.092	1	14
2016/07/14	Wet	0.088	2	14
2016/07/15	Wet	0.085	4	14
2016/07/16	Wet	0.081	5	14
2016/07/17	Wet	0.078	7	14
2016/07/18	Wet	0.074	8	14
2016/07/19	Wet	0.070	9	14
2016/07/20	Wet	0.066	10	14
2016/07/22	Wet	0.062	14	14
2016/07/24	Wet	0.064	12	14
2016/07/25	Wet	0.064	11	14
2016/08/06	Dry	0.043	15	0
2016/08/07	Dry	0.042	16	0
2016/08/08	Dry	0.041	17	0
2016/08/09	Dry	0.040	18	0
2016/08/10	Dry	0.039	19	0
2016/08/11	Dry	0.038	20	0
2016/08/12	Dry	0.037	21	0
2016/08/13	Dry	0.037	22	0
2016/08/14	Dry	0.036	23	0
2016/08/15	Dry	0.036	24.5	0
2016/08/16	Dry	0.036	24.5	0
2016/08/17	Dry	0.036	26	0
2016/08/18	Dry	0.035	27	0
2016/08/19	Dry	0.035	28	0

Average of SoilMoist60	
Median July	0.038
Median August	0.037
July n	14
August n	14
U (July)	122
U (August)	42
U	42
z (0.05)	55
Outcome	**different**

Date	Row Labels	Average of SoilMoist60	Rank	Points
2016/07/08	Wet	0.032	28	0
2016/07/09	Wet	0.033	27	0
2016/07/10	Wet	0.033	26	0
2016/07/13	Wet	0.038	9.5	10
2016/07/14	Wet	0.038	9.5	10
2016/07/15	Wet	0.038	9.5	10
2016/07/16	Wet	0.038	9.5	10
2016/07/17	Wet	0.038	9.5	10
2016/07/18	Wet	0.038	9.5	10
2016/07/19	Wet	0.038	9.5	10
2016/07/20	Wet	0.038	9.5	10
2016/07/22	Wet	0.038	3	14
2016/07/24	Wet	0.039	1.5	14
2016/07/25	Wet	0.039	1.5	14
2016/08/06	Dry	0.038	9.5	3
2016/08/07	Dry	0.038	9.5	3
2016/08/08	Dry	0.038	9.5	3
2016/08/09	Dry	0.038	9.5	3
2016/08/10	Dry	0.038	16	3
2016/08/11	Dry	0.038	17	3
2016/08/12	Dry	0.037	18	3
2016/08/13	Dry	0.037	22	3
2016/08/14	Dry	0.037	22	3
2016/08/15	Dry	0.037	22	3
2016/08/16	Dry	0.037	22	3
2016/08/17	Dry	0.037	22	3
2016/08/18	Dry	0.037	22	3
2016/08/19	Dry	0.037	22	3

Average of SoilMoist90	
Median July	0.045
Median August	0.043
July n	14
August n	14
U (July)	154
U (August)	42
U	42
z (0.05)	55
Outcome	**different**

Date	Row Labels	Average of SoilMoist90	Rank	Points
2016/07/08	Wet	0.039	28	0
2016/07/09	Wet	0.039	27	0
2016/07/10	Wet	0.041	26	0
2016/07/13	Wet	0.045	7.5	14
2016/07/14	Wet	0.046	3	14
2016/07/15	Wet	0.046	2	14
2016/07/16	Wet	0.046	1	14
2016/07/17	Wet	0.045	4.5	14
2016/07/18	Wet	0.045	4.5	14
2016/07/19	Wet	0.045	7.5	14
2016/07/20	Wet	0.045	7.5	14
2016/07/22	Wet	0.045	7.5	14
2016/07/24	Wet	0.045	11	14
2016/07/25	Wet	0.045	10	14
2016/08/06	Dry	0.044	12	3
2016/08/07	Dry	0.043	17.5	3
2016/08/08	Dry	0.043	17.5	3
2016/08/09	Dry	0.043	17.5	3
2016/08/10	Dry	0.043	17.5	3
2016/08/11	Dry	0.043	17.5	3
2016/08/12	Dry	0.043	17.5	3
2016/08/13	Dry	0.043	17.5	3
2016/08/14	Dry	0.043	17.5	3
2016/08/15	Dry	0.043	17.5	3
2016/08/16	Dry	0.043	17.5	3
2016/08/17	Dry	0.043	23	3
2016/08/18	Dry	0.043	24	3
2016/08/19	Dry	0.042	25	3

Average of SoilMoist120	
Median July	0.054
Median August	0.050
July n	14
August n	14
U (July)	196
U (August)	0
U	0
z (0.05)	55
Outcome	**different**

Date	Row Labels	Average of SoilMoist120	Rank	Points
2016/07/08	Wet	0.053	11.5	14
2016/07/09	Wet	0.053	13	14
2016/07/10	Wet	0.053	10	14
2016/07/13	Wet	0.056	2.5	14
2016/07/14	Wet	0.056	2.5	14
2016/07/15	Wet	0.056	2.5	14
2016/07/16	Wet	0.056	2.5	14
2016/07/17	Wet	0.056	5	14
2016/07/18	Wet	0.055	6	14
2016/07/19	Wet	0.054	7	14
2016/07/20	Wet	0.054	8	14
2016/07/22	Wet	0.053	9	14
2016/07/24	Wet	0.053	11.5	14
2016/07/25	Wet	0.052	14	14
2016/08/06	Dry	0.051	15	0
2016/08/07	Dry	0.051	16	0
2016/08/08	Dry	0.050	17	0
2016/08/09	Dry	0.050	21	0
2016/08/10	Dry	0.050	21	0
2016/08/11	Dry	0.050	21	0
2016/08/12	Dry	0.050	21	0
2016/08/13	Dry	0.050	21	0
2016/08/14	Dry	0.050	21	0
2016/08/15	Dry	0.050	21	0
2016/08/16	Dry	0.050	25	0
2016/08/17	Dry	0.050	26	0
2016/08/18	Dry	0.049	27	0
2016/08/19	Dry	0.049	28	0

APPENDIX J. DEUTERIUM DATA

0 - 20 cm

Campaign 1	Campaign 2	Campaign 3	Campaign 5
-102.56	-105.02	-103.94	-92.26
-104.21	-105.44	-90.49	-19.46
-104.00	-97.90	-87.75	-28.02
-101.82	-95.38	0.00	-91.13
-105.65	-92.32	-59.13	-20.44
-104.39	-94.98	0.00	-27.93

20 - 40 cm

Campaign 1	Campaign 2	Campaign 3	Campaign 5
-106.93	-113.22	-120.12	-92.10
-106.16	-104.26	0.00	-107.28
-106.00	-105.88	-110.93	-104.21
-108.78	-103.56	-99.37	-91.19
-104.17	-105.67	-83.83	-107.37
-105.93	-101.64	-94.08	-104.20

40 - 80 cm

Campaign 1	Campaign 2	Campaign 3	Campaign 5
-111.42	-108.10	-117.92	-109.09
-109.79	-107.73	-104.12	-116.00
-109.98	-108.86	-124.17	-105.07
-108.57	-111.71	-126.00	-109.13
-108.35	-110.99	0.00	-117.00
-105.42	-108.06	-126.84	-105.06

80 - 120 cm

Campaign 1	Campaign 2	Campaign 3	Campaign 5
-112.93	0.00	0.00	0.00
-114.20	-0.02	-111.19	-79.89
-115.21	-0.40	-0.02	0.00
-112.11	-0.60	-0.40	0.00
-113.60	-0.80	-0.60	-79.91
-112.78	-0.90	-0.80	0.00

Tree Tissue

Campaign 1	Campaign 2	Campaign 3	Campaign 5
-111.87	-110.70	-95.59	-113.56
-113.00	-107.82	-89.86	-112.48
-105.55	-106.95	-32.55	-44.70
-116.46	-120.12	48.95	-106.12
-116.71			
-120.01			