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TWENTIETH CENTURY CHANNEL CHANGE OF THE GREEN RIVER IN

CANYONLANDS NATION PARK, UTAH

by

Alexander E. Walker

A thesis submitted in partial fulfillment of the requirements for the degree

of

MASTER OF SCIENCE

in

Watershed Science

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> UTAH STATE UNIVERSITY Logan, Utah

> > 2017

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ABSTRACT

Twentieth Century Channel Change of the Green River in

Canyonlands National Park, Utah

by

Alexander E. Walker, Master of Science

Utah State University, 2017

Major Professor: Dr. John C. Schmidt Department: Watershed Sciences

The lower Green River within Canyonlands National Park has narrowed substantially since the late 1800s, resulting in a narrower channel. Changes to flood magnitude, rate and timing since 1900, driven by increased water storage and diversion in the Green River basin and declines in annual precipitation, were responsible for inset floodplain formation.

Multiple lines of evidence were used to reconstruct the history of channel narrowing in the lower Green River and identify processes of floodplain formation. In the field, stratigraphy, sedimentology and dendrogeomorphology exposed in a floodplain trench were described to identify rate, timing and magnitude of floodplain formation. Channel and floodplain surveys were conducted to determine possible changes in bed elevation. Additionally, I analyzed existing aerial imagery, hydrologic and sediment transport data. I applied these techniques to determine magnitude, timing and processes of floodplain formation at multiple spatial and temporal scales. My investigation shows that the floodplains of the contemporary lower Green River began forming in the late 1930s and continued to form and vertically accrete in the 20th century by inset floodplain formation. During this time period, peak flow and total runoff declined due to climatic changes and water development. Inset floodplains continued to form and vertically aggrade along the lower Green River since the mid-1980s, narrowing the river by an additional 9 %. Analysis of aerial imagery shows that changes to the floodplain identified in the trench occurred throughout the 61 km of river I studied. Non-native tamarisk (*Tamarix spp.*) did not drive channel narrowing, though dense stands stabilized banks and likely promoted sediment deposition. Inset floodplain formation reflects changes to flood magnitude and timing resulting from water development and climate change.

My findings have implications for the long-term management of the riverine corridor within Canyonlands National Park and endangered endemic native fishes – particularly the Colorado pikeminnow (*Ptychocheilus lucius*) and the razorback sucker (*Xyrauchen texanus*). Collaboration with upstream stakeholders and managers is necessary to preserve elements of the flow regime that preserve channel width and limit channel narrowing.

(415 pages)

PUBLIC ABSTRACT

Twentieth Century Channel Change of the Green River in

Canyonlands National Park, Utah

Alexander E. Walker

Since the early 20th century, river channels of the Colorado River basin have narrowed, decreasing available riparian and aquatic habitat. Changes are considered to be the result of three major factors: wide-spread water development, increasing hydroclimate variability and the invasion of non-native tamarisk (*Tamarix spp.*), altering flow regime and sediment supply. Different studies have reached different conclusions about the relative roles of flow regime, sediment supply and tamarisk in causing narrowing.

I investigated channel change in the lower Green River within Canyonlands National Park to describe channel changes in the 20th century and understand the roles of shifting flow regime and changing vegetation communities on 20th century channel narrowing.

The lower Green River within Canyonlands National Park has narrowed substantially since the late 1800s, resulting in narrower channel. Changes to flood magnitude, rate and timing since 1900, driven by increased water storage and diversion in the Green River basin and declines in annual precipitation, was responsible for inset floodplain formation documented in this study.

I used multiple datasets to reconstruct the history of channel narrowing in the lower Green River and identify processes of floodplain formation. In the field, analyses of a floodplain trench were described to identify rate, timing and magnitude of floodplain formation. Channel and floodplain surveys were conducted to determine possible changes in bed elevation. Additionally, I analyzed existing aerial imagery, hydrologic data, and sediment transport data. I applied these techniques to determine how floodplain formation occurred at multiple spatial and temporal scales.

My investigation shows that the floodplains of the contemporary lower Green River began forming in the late 1930s and continued to form in the 20th century by inset floodplain formation. During this time period, peak flow and total runoff declined due to climatic changes and human water development. Since the mid-1980s, inset floodplains continued to develop along the lower Green River since the mid-1980s, narrowing the river by an additional 9.4%. Analysis of aerial imagery shows that changes to the floodplain identified in the trench occurred throughout the 61 km of river I studied. Nonnative tamarisk (*Tamarix spp.*) did not drive channel narrowing, though dense stands stabilized banks and likely promoted sediment deposition. Inset floodplain formation reflects changes to flooding resulting from water development and climate change.

My findings have implications for the long-term management of the lower Green River and endangered endemic native fishes – particularly the Colorado pikeminnow (*Ptychocheilus lucius*) and the razorback sucker (*Xyrauchen texanus*). Collaboration with upstream stakeholders and managers is necessary to preserve elements of the flow regime that preserve channel width and limit channel narrowing.

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Alexander E. Walker

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CHAPTER 1

INTRODUCTION

In three days in mid-July 1869, nine men in three boats rowed the 160-km length of the lower Green River between the mouth of the San Rafael River and its confluence with the Grand River. The group, led by John Wesley Powell, rowed, because "The water is as calm as a lake" (W. C. Bradley journal, July 15, 1869, edited by Darrah, 1947). There were few cottonwood trees (Populus spp.) in the "symmetrically curved and grandly arched" canyons that Powell (1895) named Labyrinth and Stillwater. Although cottonwoods were "scrubby" and "very scarce," "there is in some places a small table that affords a footing for a few willows" (J. C. Sumner journal, July 14, 1869, edited by Darrah, 1947). On the inside of bends, Powell (1895) observed a "long peninsula of willow-bordered meadow" and "the talus at the foot of the cliff is usually covered with dwarf oaks." These observations and subsequent photographs taken by E. O. Beaman in early September 1871 during Powell's second expedition (Figure 1.1), as well as photographs taken in the early 20th century (summarized by Webb et al., 2007) describe a wide active channel with abundant emergent sand bars and lined by "dense willow and greasewood chaparral" (F. M. Bishop journal, September 11, 1871, edited by C. Kelly, 1947) that comprised "a dense jungle of rose-bushes, willows, and other plants" (Dellenbaugh, 1908). The modern channel of the lower Green River is also lined by woody riparian vegetation that forms dense thickets. Although willow and oak are still present, much of the vegetation is non-native tamarisk (*Tamarix spp.*) and today's channel is narrower. There are fewer emergent sand bars, islands, and secondary channels (Webb et al., 2004, 2007).

Riparian and riverine environments play a critical role in providing habitat for threatened and endangered species in the contemporary Colorado River basin (Merritt and Cooper, 2000; Mortenson and Weisberg, 2009; Merritt and Poff, 2010; Keller et al., 2014; Sankey et al., 2015). The dramatically different environments today are responses to three major disturbances, all of which have occurred within the last 150 years: alteration of the hydrologic and sediment regime by dams and impoundments, climatically driven changes in hydrology, and invasion of nonnative tamarisk onto the floodplain and active channel bars.

Dams, diversions, and irrigation withdrawals fragment the Colorado River watershed, disrupting downstream hydrology, sediment supply, and sediment transport characteristics. Flood discharge declines, with the effects reaching hundreds of miles downstream (Graf, 1999). The sediment mass balance of reaches immediately downstream from dams are typically perturbed into sediment deficit, resulting in evacuation of sediment from the bed and sometimes from the banks (Williams and Wolman, 1984; Schmidt and Wilcock, 2008). Concurrently with the construction of dams throughout the watershed, there have been widespread changes to riparian vegetation communities, the most notable being the spread of invasive tamarisk (*Tamarix spp*) (Merritt and Cooper, 2000; Sher et al., 2000; Webb et al., 2007; Auerbach et al., 2013). Today, tamarisk is a dominant component of riparian communities (Friedman et al., 2005).

Assessing the impact of non-native vegetation invasion and basin-wide water impoundment, diversion, and withdrawal is complex, due in part to climatically driven shifts in hydrology during the 20th century. The early 20th century was one of the wettest

periods in the last 450 years (Woodhouse et al., 2006) and during the last century, total annual runoff declined independent of direct and indirect human disturbances to the flow regime. Precipitation remained relatively constant in the 20th and 21st centuries, but increases in temperature contributed to decreasing stream flow and continued temperature increases are expected to drive expected future declines in stream flow (Udall and Overpeck, 2017).

In the Green River, the longest tributary of the Colorado River, construction of large dams, trans-basin diversions, and within-basin diversions for agriculture and other uses altered the flow regime during the last century. Channel narrowing and other geomorphic responses to these flow-regime changes have been documented on different parts of the Green River and its tributaries (Andrews, 1986; Lyons et al., 1992; Allred and Schmidt, 1999; Grams and Schmidt, 2002; Gaeuman et al., 2003; Grams and Schmidt, 2005; Alexander, 2007; Manners et al., 2014). Additionally, tamarisk spread rapidly through the basin in the early to mid-20th century. On the unregulated Yampa River, colonization by tamarisk, in conjunction with a shift in the natural flow regime, facilitated channel narrowing by trapping sediment and reducing floodplain erosion (Manners et al., 2014).

Comparatively little research has been conducted in the most downstream part of the Green River, where it flows through Canyonlands National Park (CNP) (Graf, 1978; Webb et al., 2004; Birken and Cooper, 2006; Webb et al., 2007). Historic channel narrowing is readily evident in this reach. The wide channel with numerous bare sand bars described by the Powell expedition is now a narrower river with fewer in-channel features. The area of backwater habitat has generally decreased, with likely adverse effects on native fish populations (Bestgen and Hill, 2016).

Graf (1978) argued that tamarisk invasion in the 1940s and 1950s in the lower Green River stabilized sand bars and banks and was the primary cause of narrowing. Graf (1978) estimated that the channel narrowed by approximately 27% within CNP between the early 20th century and the 1950s, and he estimated that the channel did not narrow significantly after 1951 despite construction of upstream dams and diversions in the 1960s and 1970s. Subsequent studies questioned these findings (Everitt, 1979; Andrews, 1986; Allred and Schmidt, 1999), linking channel narrowing primarily to changes in peak flow magnitude and timing, but Graf's (1978) work remains influential in highlighting the contribution of riparian vegetation invasion to channel narrowing (Scott et al., 1996; Birken and Cooper, 2006). These findings influence reservoir and nonnative vegetation management strategies (Merritt and Wohl, 2006; Vincent et al., 2009; Manners et al., 2014).

My study in the lower Green River seeks to better understand the magnitude, timing and processes of geomorphic change during the 20th century and in doing so, resolve the differing conclusions of Graf (1978), Andrews (1986), Allred and Schmidt (1999), and Birken and Cooper (2006). To resolve differences in findings, I integrate data collected at the site, cross-section and reach scale on the lower Green River. A multiscale approach has not been previously applied to investigate channel change and offers the ability to create a unified conceptual model of channel change.

The lower Green River flows through CNP and park managers, motivated by goals of ecosystem protection and management for this reach of river, desire a clear understanding of historical geomorphic changes and the mechanisms of such changes. At present, CNP has an incomplete understanding of how invasive vegetation and hydrology influence floodplain formation and channel narrowing. Quantifying rates and timing of narrowing, along with identifying causes of channel narrowing, will provide CNP with detailed information on the geomorphology of the lower Green River to improve future park management policies.

Chapter 2 investigates the history of the lower Green River using multiple lines of evidence to determine the timing and processes of floodplain formation at multiple spatial and temporal extents. Historic channel conditions are analyzed using aerial photographs and repeat channel surveys. A floodplain deposition history is developed using stratigraphic analysis of a floodplain trench, including the dating of floodplain deposits by dendrogeomorphology. Sediment transport and hydrologic data are interpreted to explore linkages between channel change and the drivers of water and sediment supply. An important goal of the work is to determine the history of channel narrowing and the prospects for future narrowing. By combining observations in this study with previous work, I explore whether a unified conceptual model of channel change can be developed for channel change in the Green River.

Chapter 3 presents detail on the stratigraphic, sedimentologic and dendrogeomorphic analyses at a trench excavated on the floodplain of Hardscrabble Bottom inside of CNP. Different floodplain facies defined in the trench are linked to different types of inset floodplain formation. Timing of floodplain formation is determined by using dendrogeomorphic techniques of Friedman et al. (Friedman, Vincent, et al., 2005) to determine ages of floodplain deposits. Where possible, those ages are constrained with available hydrologic data. Methods of tree-ring counting, anatomical changes, and cross-dating used to determine ages of individual beds are

discussed. These analyses identified a new, previously undiscovered, period of floodplain

formation by vertical accretion after 1985.

Chapter 4 concludes the thesis with a discussion of management implications

which arise from this study. Findings from previous chapters are placed within the

context of current reservoir management strategies and conservation polices in the Green

River basin.

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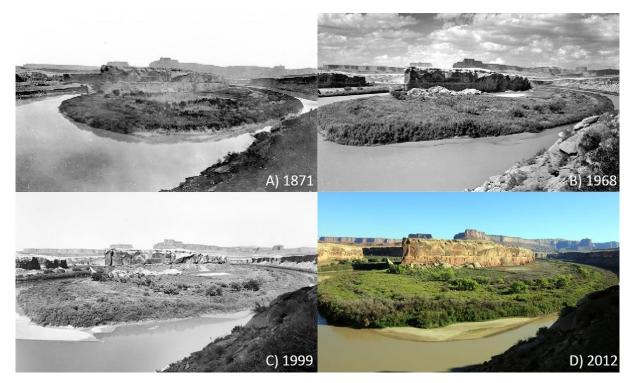


Figure 1.1: A photo match taken at Bonita Bend, on the lower Green River at RM 30, 50 km upstream from the Green-Grand confluence on the right bank at the apex of the bend, looking east. Flow is from left to right. A) Taken by E.O. Beaman on September 9, 1871 during the second John Wesley Powell expedition. B) Taken by E.G Stephens on August 19, 1968 (Stephens and Shoemaker, 1987). C) Taken by Dominic Oldershaw October 13, 1999 D) Taken by Mark E. Miller September 28, 2012. The channel is wide in 1871 and the banks of the bend are vegetated. In 1968, the channel has narrowed; the vegetation next to the water's edge is tamarisk. Channel width remains stable in the 1999 and 2012 photos. A small emergent bar visible in the center of the 1968 is present in 2012. Tamarisk in 2012 shows widespread mortality due to effects of the tamarisk beetle. Dead tamarisk is purplish-brown in the 2012 photo. Photos courtesy of Southwest Biological Science Center, USGS, Flagstaff, AZ.

CHAPTER 2

THE TIMING AND MAGNITUDE OF 20TH CENTURY CHANNEL NARROWING BY INSET FLOODPLAIN FORMATION OF THE LOWER GREEN RIVER IN CANYONLANDS NATIONAL PARK, UTAH¹

ABSTRACT

Channel narrowing of the Green River since the late 1800s is well documented; however, different studies have reached different conclusions on the rate, timing and magnitude of channel change. To understand whether or not the lower Green River continues to narrow, I use aerial imagery, dendrogeomorphology exposed in a 50-m long, 2-m deep trench excavated in the floodplain, sediment transport data and bathymetric surveys. These techniques are applied to the determine magnitude, timing and processes of floodplain formation at multiple spatial and temporal scales. My results show that the contemporary floodplains of the lower Green River began forming in the late 1930s, and continued to form and vertically accrete in the second half of the 20th century. During this time period, peak flow and total runoff declined due to climatic changes and water development. The most recent phase of floodplain formation began during a period of drought that followed the unusually high runoff years from 1983 to 1985. From the mid-1980s to present, active channel width decreased by 9%. Floodplain formation occurs during spring peak floods, which are the only flows large enough to inundate the floodplain. Bed elevation remained constant during the last two decades and changes to the channel were primarily changes in width. Inset floodplain formation within the banks

¹ Coauthored by John C. Schmidt, Paul E. Grams and Johnnie N. Moore

of the previous river channel was the primary mechanism of narrowing and the widespread establishment of invasive tamarisk (*Tamarix spp.*) did not play a primary role in channel narrowing. The most recent episode of channel narrowing reflects changes to flood magnitude and timing resulting from water development and climate change.

2.1 INTRODUCTION

The influences of flow regime and sediment supply are central questions in the study of fluvial geomorphology. Changes to these inputs alter the influx and efflux of transported sediment in a river reach. River channels respond to such changes by modifying channel form to optimize the conveyance of water and sediment so that the mass balance is achieved again (Lane, 1955). Changes in the influx of sediment may be caused by changes in the flow regime, watershed sediment supply, or the grain size of the supply. Changes to flow regime and supply rate may be caused by upstream impoundments or diversions or by watershed response to changes in precipitation, land use, or vegetation.

The style of channel change is affected by factors such as the degree of valley confinement and the characteristics of riparian vegetation that can trap moving sediment and give strength to banks (Tal et al., 2004). Channel change may include changes in many attributes, including bed material size and distribution, cross-section size and shape, planform configuration and channel slope. Cross-sectional changes can occur to both size and shape of river channels; changes to channels size can occur by both width and depth. Channel width is generally adjusted to the magnitude of common floods and when flood magnitude declines, channels narrow (Leopold and Maddock, 1953). Decreasing channel width may occur by a diverse range of morphological adjustments,

including a decrease in flow resulting in channel abandonment, channel incision with no new floodplain formation or inset floodplain formation (see Thorne, 1998 for a review of river width adjustments). Additionally, active mid-channel bars can convert to stable, vegetated islands, reducing active channel width.

Dams and other impoundments often reduce or eliminate floods and divert stream flow, while also trapping the upstream sediment supply, perturbing the mass balance of the downstream regulated river (Schmidt and Wilcock, 2008). Immediately downstream from dams, sediment deficit conditions exist, and sediment evacuation can occur, causing bed incision if the substrate can be entrained by post-dam floods (Schmidt and Wilcock, 2008). Farther downstream from dams, regulated rivers may be in sediment surplus if the magnitude of natural sediment supply exceeds the capacity of the regulated river to transport that sediment (Dean et al., 2016). Dams alter the variability of the annual flow regime, reducing peak flood magnitude, increasing base flows and shifting flood timing.

Changes to the annual flow regime, coupled with declines in total annual flow from climate variability, resulted in channel narrowing within the Green River basin in the 20th century (Williams and Wolman, 1984; Graf, 2006). In the lower Green River, surveys and photographs taken in the 1910s and 1920s demonstrate that the active channel was wide with abundant alternate bars. Today, the active channel is narrow and there are fewer active in-channel bars, channel planform is less complex and floodplains are densely vegetated.

Natural climate variability contributes to declines in total annual flow, often to a greater degree than human water development. Changes to climate in the 20th century in the Colorado River basin decreased total precipitation, resulting in diminished flood

magnitude and a lower total runoff. Evidence of decreased total stream flow and decreased flood flows due to climate have been demonstrated on the San Rafael River, UT (Fortney, 2015), Paria River, AZ (Hereford, 1986; Graf et al., 1991), and Little Colorado River, AZ (Hereford, 1984). Similar trends have been documented for the Green River and Colorado River (Stockton and Jacoby, 1976; Allred and Schmidt, 1999). Hydrologic characteristics of the 20th century do not represent the full range of variability present in the paleohydrologic record (Woodhouse et al., 2016), which documents numerous multi-year droughts with flows less than the lowest years of 20th century runoff (Woodhouse et al., 2010). Anthropogenic climate change has further reduced runoff in the Colorado River basin and climate models project future declines in flow driven by greenhouse gas emissions (Udall and Overpeck, 2017).

Widespread establishment of nonnative tamarisk occurred during a period that coincides with change in the flow and sediment regime of the Green River (Christensen, 1962; Robinson, 1965; DiTomaso, 1998). Tamarisk root systems stabilize stream banks (Hereford, 1984; Everitt, 1993; Friedman et al., 2014), making them more resistant to erosion and scour than native shrubs (Polvi et al., 2014; Griffin et al., 2014), thereby restricting bank erosion and channel widening (Pollen-Bankhead et al., 2009; Jaeger and Wohl, 2011). Above ground, tamarisk stems increase the hydraulic roughness of the floodplain (Manners et al., 2013), and promote overbank deposition by exerting a drag effect on flow (Griffin et al., 2014). Tamarisk establishes in a wider range of flow conditions compared to native vegetation (Auerbach et al., 2013), allowing it to adventitiously colonize and outcompete native vegetation in low flow years and under altered flow regimes (Stromberg et al., 2007). Renewed interest by the National Park Service in the relations among channel narrowing, flow regime change, and riparian vegetation invasion in the lower Green River inspired and funded this study. In this study, 'lower Green River' refers to a 155km reach of river beginning at the mouth of the San Rafael River and ending at the Green-Colorado confluence. Canyonlands National Park (CNP) manages the downstream 76 km of the lower Green River, and the Bureau of Land Management manages the 79 km of this popular recreational river between Green River, UT and CNP. Understanding whether or not the lower Green River continues to narrow or has established a new equilibrium width is important in managing the riparian corridor, backwater habitat for endangered fishes, sandbars for recreational use, and releases from upstream reservoirs. Understanding how changes in width influence the formation and maintenance of backwaters is particularly important because the entire lower Green River is designated critical habitat for the endangered razorback sucker (*Xyrauchen texanus*) and Colorado pikeminnow (*Ptychocheilus lucius*) (U.S. Fish and Wildlife Service, 1994).

2.1.1 Previous research

Previous studies of channel change on rivers with high suspended loads described channel narrowing by deposition of an inset floodplain in the Powder River, MT (Pizzuto, 1994), Rio Grande, TX (Dean and Schmidt, 2011), Colorado River, CO (VanSteeter and Pitlick, 1998; Pitlick and Cress, 2002) and Green River, UT (Grams and Schmidt, 2002; Allred and Schmidt, 1999) due to changing discharge and altered sediment transport regimes. Inset floodplains on these rivers typically form by vertical accretion. Deposition begins on mid-channel or bank-attached bars during periods of relatively low flow, continuing whenever floods carrying high concentrations of fine sediment inundate the aggrading deposit. As sediment is deposited, floodplains vertically accrete, typically forming levees at the channel margin (Ferguson and Brierley, 1999; Pizzuto et al., 2008; Dean et al., 2011). The coarsest suspended sediment is deposited on levees and finer silts and clay deposit in back-basin depressions, or troughs (Pizzuto et al., 2008; Dean et al., 2011). Inset floodplain formation additionally involves colonization of low-elevation bars by vegetation which helps stabilize the bar and promote sediment deposition (Shafroth et al., 2002; Manners et al., 2014).

In the 20th century, channel narrowing by inset floodplain formation occurred along both the Colorado River and the Green River. Research on the Colorado River identified upstream water development (VanSteeter and Pitlick, 1998) and fine sediment deposition by the floods of 1983 and 1984 (Pitlick and Cress, 2002) as causes of inset floodplain formation. In the Green River, upstream from the Yampa River, changes to flow and the resulting channel changes are primarily determined by operations of Flaming Gorge Dam (Grams and Schmidt, 2002, 2005; Alexander, 2007), whereas the regime of the Green River downstream from the Yampa River is additionally affected by diversions in tributaries. Trans-basin diversions constructed on the Duchesne River reduced stream flow by 50% concurrent with an increase in fine sediment supply causing channel narrowing and bed aggradation (Gaeuman et al., 2005). Flow regulation in the headwaters of the San Rafael River decreased flood magnitude and shifted flood timing, resulting in aggradation within the alluvial valley and simplification of channel planform in a formerly wide channel (Fortney, 2015). Channel narrowing is also observed on unregulated rivers. In the unregulated Yampa River tributary, Manners et al. (Manners et al., 2014) demonstrated narrowing by tamarisk invasion into the active channel during

multi-year droughts.

Tamarisk was sparsely distributed along the lower Green River in the 1940s (Clover and Jotter, 1944) and was densely distributed by the 1950s (Christensen, 1962; Graf, 1978). Dense stands of tamarisk are evident in photographs taken in the early 1950s. Today, large areas of tamarisk have been defoliated by the tamarisk beetle (*Diohrada spp.*) and may be dead, but the skeletal woody stems and roots remain.

The first study of channel change in the lower Green River by Graf (1978) concluded that invading tamarisk had trapped and stabilized fine sediment, inducing vertical accretion on formerly active bars, stabilizing banks, and narrowing the channel. All subsequent studies agree that the modern channel is narrower than the channel in the early 20th century, and there is consensus that the invasion of tamarisk on the lower Green River began in the 1930s. Different studies, seeking to clarify some of Graf's (1978) findings, reached different conclusions about when narrowing began, if narrowing eventually stopped or is progressive, and whether tamarisk is the primary cause of narrowing.

Everitt (1979) observed that narrowing occurred during a period of declining stream flow, and he suggested that tamarisk may only have played a passive role in channel narrowing. Andrews (1986) analyzed suspended sediment data measured at Green River, UT and argued that the effective discharge of the Green River had been reduced after completion of Flaming Gorge Dam in 1963. He predicted the equilibrium width of the post-dam river using hydraulic geometry relations for the post-dam effective discharge. Because the Green River in the mid-1980s was still wider than this value, Andrews (1986) predicted further narrowing of the lower Green River. Allred and Schmidt (1999) compiled and analyzed discharge measurement notes that describe the channel cross-section at current and former US Geological Survey (USGS) gage locations near Green River, UT. They concluded that channel narrowing had occurred in two phases, one related to a climatically-induced reduction in total stream flow in the mid-20th century and one related to flood control associated with operations of Flaming Gorge Dam. Their findings were applicable to a 26-km study reach, because the temporal pattern of narrowing that had occurred at the Green River, UT gage had also occurred throughout the Gunnison Valley.

Birkin and Cooper (Birken and Cooper, 2006) dated tamarisk and cottonwood trees and excavated pits in order to describe processes of tamarisk invasion and floodplain formation for a 2 km segment of river centered on Potato Bottom at River Mile (RM)² 37, corroborating the findings of Graf (1978) that the majority of narrowing occurred before 1951. They argued that tamarisk had played an active role in narrowing, with vegetation establishment triggering bar stabilization, sediment accretion, and the attachment of bars and islands to channel banks. They determined channel width remained relatively stable between 1976 and 2002.

In order to provide a quantitative understanding of the rate and timing of channel changes on the Green River in the 20th century as well as describing the relation between stream flow and fluvial geomorphic process, I set out to answer the question: what are the magnitude, timing and processes of channel change in CNP? To answer, I examined multiple data sets to synthesize temporally precise evidence of geomorphic processes from a floodplain trench with spatially robust large-scale channel changes interpreted

² Measured upstream from the Colorado River confluence. The location system of River Miles was established by Herron (1917) and is still used today.

from aerial photos. Ten aerial photograph series, taken between 1940 and 2015, were analyzed to determine channel change in a 61-km study area near the upstream boundary of CNP. In collaboration with partners, I excavated a 50-m long trench through the floodplain. I described the stratigraphy and sedimentology of deposits identified in the trench, dated numerous alluvial deposits using the tamarisk stem-burial dating method (Friedman et al., 2005), and related the timing and sequence of inset floodplain deposition to the flow regime by developing a local stage-discharge rating relation for the trench site.

Hydrologic data from nearby gaging stations were analyzed such that the time sequence of changes in channel width could be compared with flow regime changes. I analyzed components of the flow regime important to inset floodplain formation and to better understand changes to flow regime in the 20th century. I compared and combined historic flow records at Green River, UT with similar data for the San Rafael River to estimate the flow regime of the lower Green River near the trench. To evaluate potential changes to channel bed slope, I supplemented aerial imagery analyses with repeat channel cross-section surveys.

Additionally, I interpreted sediment transport data collected since 2014 by the USGS at Mineral Bottom (RM 55), located 106 km downstream from the Green River, UT gage and 14 km upstream from the trench. My research not only builds on previous studies of channel change of the lower Green River, but also on similar studies elsewhere of the Green River (Lyons et al., 1992; Merritt and Cooper, 2000; Grams and Schmidt, 2002, 2005; Manners et al., 2014) and on other rivers that transport large suspended sediment loads (Dean and Schmidt, 2011; Cadol et al., 2011; Swanson et al., 2011).

2.2 STUDY AREA

The Green River drains 124,600 km², flowing 1,175 km from the Wind River Mountains of Wyoming, through Colorado and Utah, to join the Colorado River in southeastern Utah. Green River, UT is the former site of Gunnison Crossing in Gunnison Valley, 193 km upstream from the Colorado River confluence. In Gunnison Valley, the Green River has carved a wide alluvial valley into the erodible Cretaceous Mancos shale. The only major tributary downstream of Green River, UT, the San Rafael River drains the east side of the Wasatch Plateau (drainage area of 6,255 km²), joining the Green River in Gunnison Valley. A large part of the San Rafael watershed is in the San Rafael Swell and San Rafael Desert where fine sediment yield is high (Fortney, 2015).

Downstream from the San Rafael-Green confluence, the lower Green River carves through progressively older Jurassic to Permian Mesozoic sedimentary rocks, forming canyons. The upstream end of Labyrinth Canyon is approximately 3 km downstream from the San Rafael River where Navajo Sandstone is first exposed at river level. Farther downstream, the cliff-forming Wingate Sandstone and the erodible Moenkopi Formation are exposed. The downstream end of Labyrinth Canyon is approximately 58 km upstream from the Colorado River confluence, where the White Rim Sandstone emerges, followed by the Organ Rock, Cutler, and Elephant Canyon Formations in Stillwater Canyon. The alluvial valley in Stillwater Canyon is narrower than in Labyrinth Canyon, and there are smaller floodplains and terraces. The names of these two canyons were given by John Wesley Powell, who also named the transitional area between the two canyons as Tower Park (Powell, 1895), although this name is infrequently used today. In this study, I use the term "floodplain" to reference flat lying alluvial landforms adjacent to the river channel and inundated by the current flow regime. This definition encompasses two inset floodplains, at different elevations above the river channel, both containing sediment deposited in the current flow regime. We use the term "valley floor" to refer to landforms above floodplains which are never inundated in the present flow regime.

The banks and bed of the lower Green River are alluvial, and primarily composed of fine sediment. Isolated bedrock banks are present. Gravel is scarce or nonexistent on the channel bed, although Pleistocene gravel terrace deposits occur in Labyrinth Canyon (Pederson et al., 2013).

My study area is a 61-km portion of lower Labyrinth Canyon and upper Stillwater Canyon, centered on Tower Park. The study area extends from upstream of Hell Roaring Canyon near River Mile (RM) 57 to near Turks Head at RM 26 (Figure 2.1). The contemporary channel is single-threaded with vertical, vegetated banks, bank-attached active bars, and occasional islands. The floodplain is densely covered by tamarisk and willow (*Salix spp.*). Cottonwoods (*Populus fremontii*) are infrequent, typically mature, and generally located on higher elevation floodplains or the valley floor, above the active channel and floodplain.

The local climate is semi-arid, with 250 mm or less of precipitation annually (Gillies and Ramsey, 2009). The maximum average precipitation of 31 mm occurs in October and minimum average precipitation of 10 mm falls in June. The North American (NA) monsoon is active in southern Utah (Adams and Comrie, 1997; Higgins et al., 1997), but its effects are relatively weak. On average, 45% of yearly precipitation falls from July to October (Western Regional Climate Center, 2017). Flash floods are a minimal contributor to total stream flow of the Green River but are a major mechanism for delivering fine sediment to the river (Andrews, 1986).

Stream flow is measured 100 river km upstream from the study area at RM 120 by the USGS at Green River, UT (gage 09315000, 1885-1899, 1904-present) and within the study area at Mineral Bottom (RM 52, gage 09328920, 2014-present). Stream flow of the San Rafael River is measured near Green River, UT (gage 09328500, 1909-1918, 1945-present) and near its confluence with the Green River (gage 09328910, 2015present). Sediment transport data were collected at Green River, UT between 1941 and 1984 and continuous suspended sediment data using acoustical sensors, calibrated with occasional physical samples, has been collected at Mineral Bottom since 2014 (GCMRC, 2016; Topping and Wright, 2016).

The Green River's annual flow regime is dominated by the spring snowmelt flood. Iorns et al. (1965) demonstrated the key role of Rocky Mountain snowmelt in the flow regime of the Green River by estimating the average annual flow of gaging stations throughout the watershed for water years 1914-1957, just before construction of large dams in the 1960s. They estimated that approximately 61% of the total annual flow measured at Green River, UT entered the Green River from the Rocky Mountains upstream from Greendale, UT or from the Yampa River upstream from Maybell, CO. An additional 24% of the total annual flow was delivered to Green River, UT from the headwaters of the Duchesne and White Rivers. In contrast, less than 2% of the annual flow at Green River, UT was contributed from the Price River and an additional 2% entered from the San Rafael River.

2.3 ESTIMATING THE FLOW OF THE LOWER GREEN RIVER

To evaluate the effects of the San Rafael River on the hydrology of the lower

Green River, I estimated daily discharge at Mineral Bottom for 1909-1918 and 1945-2015 by adding the mean daily stream flow of the Green River and the San Rafael River. The San Rafael gage did not collect discharge between 1918 and 1945. The two gages measure stream flow from 96% of the watershed area upstream from Mineral Bottom; the ungaged 5,392 km² are primarily in the San Rafael Desert, west from the Green River, where precipitation is minimal. Visual inspection of the data show a difference in peak flow timing of one day between the synthesized and Mineral Bottom records. I shifted the estimated flow one day forward so that upstream daily discharges were coincident with Mineral Bottom daily discharge. To evaluate the accuracy of these estimates, I compared the time-shifted estimated daily discharge to the measured mean daily discharge at Mineral Bottom collected since March 2014 (Figure 2.2). The linear fit between the timeshifted synthesized and the observed Mineral Bottom discharge is

Mineral Bottom = 0.996 ± 0.005 Estimated - 17.2 ± 32.7 (1) with an R² of 0.99. Using the estimated record, I extended the record of streamflow at Mineral Bottom to the period 1909-1918 and 1945-2017, covering 98% of days in those two periods.

I compared flow duration curves measured at Green River, UT and estimated for Mineral Bottom. In both time periods, there is no difference between the flow duration characteristics calculated from measured data at Green River, UT and the estimated data at Mineral Bottom (Figure 2.3), because the San Rafael River contributes a relatively small amount of water during most of the year.

2.4 EFFECTS OF MONSOON FLOODS ON THE HYDROLOGY OF THE LOWER GREEN RIVER

The only season when inflow from the San Rafael River can affect flow at Mineral Bottom is during summer and early fall when flash floods sometimes occur in the San Rafael watershed. In order to account for the effect of monsoon floods on floodplain formation, I employed a peaks-over-threshold analysis (Lang et al., 1999; Kidson and Richards, 2005) to construct a partial duration flood frequency series for peak flows between August 1 and November 1 for all years of the synthesized record.

Flow from the main-stem Green River measured at Green River, UT dominates the flow regime at Mineral Bottom. Summer and fall floods rarely contribute a significant portion of flow at Mineral Bottom. For summer and fall months of 2014-2016, 20 of 276 daily discharges from the San Rafael River contributed 5% or more of the daily discharge measured at Mineral Bottom. Estimated summer/fall peak flows at Mineral Bottom exceeded 10,000 ft³/s in 12% of all years (1909-1918, 1945-2017) and no estimated flows have exceeded 13,000 ft³/s since 1951. Under the current flow regime, the only floods which can inundate the floodplain happen during spring snowmelt. In the study area, 98% of the estimated flow at Mineral Bottom comes from the watershed upstream from Green River, UT.

2.5 CHANGES TO THE FLOW REGIME OF THE LOWER GREEN RIVER

I examined the flow record at Green River, UT because there is only a relatively small difference between measured flow at Green River, UT and estimated flow at Mineral Bottom and because the available data at Green River, UT extends back to 1895. Changes in peak discharge magnitude were evaluated by change-point analysis using the nonparametric Pettitt test (Pettitt, 1979) to detect changes in the mean of peak flow distribution (Villarini et al., 2009) at the 5% significance level. Change-point analysis checks for shifts in flow regime, by identifying abrupt changes in the mean or variance of the variable of interest (in this case, peak flows). The Pettitt test allows for detection of changes when the change point time is unknown and is less sensitive to outliers. For each flow period determined by change points, I calculated flood frequency curves (Dalrymple, 1960), mean annual discharge and mean daily discharge. To describe flood frequency, I characterized high and low peak flow years based on whether peak annual flow was greater than the 75th percentile or less than the 25th percentile, respectively, of the average for each period of flow regime. I chose to analyze peak flow magnitude because inset floodplain formation is often linked to changes in flood magnitude and frequency, and it is the same dataset analyzed by Allred and Schmidt (1999).

Allred and Schmidt (1999) distinguished three historic hydrologic flow regimes based on the peak flow record at Green River, UT: 1895-1929, 1930-1962 and after 1963. The Pettitt test I performed identified two changes in the mean of peak flow distributions for the Green River, UT record, 1923 (p=0.015) and 1958 ($p=3.87x10^{-6}$), resulting in 3 periods of flow regime (Table 2.1) different from Allred and Schmidt (1999): 1895-1923, 1924-1958, and 1959-2015 (Figure 2.4). The first break point in 1923 occurs at the end of the early 20th century period of high flows. The second break point, 1958, is the last large flood year prior to the closure of Flaming Gorge Dam.

The 2-year flood peak has progressively declined at Green River, UT since 1895. Between 1895 and 1923, the 2-year flood was 41,200 ft³/s, declining to 28,500 ft³/s from 1924-1958 and to 21,800 ft³/s since 1958 (Figure 2.4), a decline of 47% from 1895-1923. The largest floods since 1958 occurred in 1983, 1984, and 2011, but the magnitude of these floods is less than the magnitude of the 5-year recurrence flood ($54,600 \text{ ft}^3/\text{s}$) of the period before 1923.

High and low peak flow years occur randomly in the first period of flow regime, from 1895 to 1923. After 1923, high and low peak flow years have a tendency to cluster together and clusters tend to follow each other. High flows from 1927-1929 were immediately followed by low peak flow years from 1930-1931. High peak flows in 1983 and 1984 were followed by years of low peak flow from 1989-1992. Isolated years of high and low peak flow occurred in 1986 and 1987, respectively, with moderate peak flows in 1985 and 1988. Generally, 1983-1986 can be classified as a period of high peak flows, and 1987-1992 as a period of low peak flows. Clustering frequency has remained relatively stable since 1924, but the only clusters since 1985 have been multiple years of low peak flow. Clustering of high and low peak flow years does not have any meaningful impact on changes to periods of total annual flow.

Operations of Flaming Gorge Dam increase base flows during low-flow months. Mean September-February discharge increased by 16%, from 2,580 ft³/s from 1895-1923 to 3,080 ft³/s from 1959-2015 (Figure 2.5). Mean annual flow at Green River, UT declined 32%, from 7,870 ft³/s between 1895 and 1923, to 5,370 ft³/s after 1959 (Figure 2.6). Declines in mean annual flow were lower than peak flow declines because increased base flow contributions made up in part declines in peak flow. The difference between the magnitude of typical flood floods and typical base flows in now less than at any previous time of measurements, because the flood flows are smaller and the base flows are higher. Presently, the unregulated Yampa River contributes most of the volume of the annual spring snowmelt flood, and contributions from other upstream tributaries have decreased (i.e., Gaeuman et al., 2005).

2.6 CHANGES TO CHANNEL WIDTH AND DEPTH

2.6.1 Aerial imagery analysis

I analyzed ten sets of aerial images, spanning 1940-2014, for channel width (Table 2.2). Six series covered the entire study area and two covered most of the study area. The remaining two sets (1976 and 1988) covered a 15-km segment of river between RM 45.5 and RM 36, centered on Fort Bottom. Six orthorectified image sets (1966, 1993, 2002, 2009, 2011, 2014) are available from public sources. The other sets (1940, 1951, 1976, 1988) were rectified by Pinnacle Mapping Technologies (PMT) of Flagstaff in ERDAS IMAGINE using photogrammetric block calibration. The Root Mean Square Error (RMSE) of the images rectified by PMT ranged between 0.2 and 1.5 m, depending on quality and scale of the photo set.

Within the study area, I digitized bank lines manually in ArcGIS at a 1:3,000 scale for each year of aerial imagery. I defined the boundary of the active channel by the abundance of vegetation; therefore, the active channel includes the area inundated by water at the time of each photo, as well as emergent bars that were free of vegetation. I excluded vegetated islands from the active channel. Discharge at the time of each photo series ranged from 1,820 to 3,820 ft³/s, with the exception of the 1993 image set, which was photographed at 13,700 ft³/s. The exact date of photography for the 1966 set is unknown.

Following digitization of the active channel, I calculated changes in reach-

averaged active channel width (RAACW, in m) for each year of available photos (Hughes et al., 2006; Fortney, 2015), in 1-km reaches through division of active channel area (m²) by reach length (m). I estimated total width error (E_w , m) in RAACW calculation using the Mount et al. (Mount et al., 2003) method, that uses two independent error estimates: errors associated with bank line digitization and distortion within images:

$$E_w = \sqrt{2}p + 2\theta \tag{2}$$

where $\sqrt{2}p$ is the error associated with digitizing bank lines as a function of the mean width between repeat bank line digitizations (*p*) in meters. The magnitude of error was similar for both left and right banks, so I compared centerlines that incorporated both left and right banks. For each aerial imagery set, I calculated *p* by repeatedly digitizing bank lines for three 5-km segments, deriving a centerline from each repeated bank line set, and taking the mean distance between centerlines as the *p* for that set. Image distortion error measurements (θ) in meters were derived by calculating the dRMS (Gaeuman et al., 2005) for each year at 10 floodplain locations that could be identified accurately on all image sets, and comparing those positions to an unanalyzed image set from 2011 (Table 2.3).

Prior to the first aerial photo set in 1940, oblique photos show a wide channel in 1871 and 1914 (Webb et al., 2007); in 1914 the average width of the lower Green River was 218 ± 32 m (Herron, 1917). There were no documented changes in width from 1871-1914 (Graf, 1978).

For the entire study area, mean RAACW decreased by 9.4% from 138.2 ± 8.79 m in 1940 to 124.6 ± 5.10 m in 2014 (Figure 2.8A, Table 2.4). Channel width was relatively stable from 1940-1966, then narrowed 5.31 m from 1966-1993. The 1976 and 1988

image sets, covering a 15-km reach centered on Fort Bottom (RM 44.5-36), show the timing of narrowing between 1966 and 1993. RAACW near Fort Bottom was stable from 1966-1988 and narrowing began after 1988. Between 1988 and 1993, channel width near Fort Bottom decreased from 145.89 ± 5.52 m to 134.02 ± 10.12 m (Figure 2.8B, Table 2.5). The entire study area narrowed on average 8.87 m from 1993-2009, to a mean RAACW of 124.8 ± 5.10 m in 2009. This period of floodplain formation occurred in the aftermath of the two largest floods of the recent period - 1983 and 1984. Because timing of narrowing is the same in Fort Bottom and the rest of the study area, we infer that that the channel in our study area remained relatively stable from 1940-1988, and the majority of inset floodplain formation detected from aerial imagery began after 1988. Average channel width did not increase in the years during which the largest floods occurred: 1976-1988 and 2009-2014.

The net change in channel width in any short reach or in the entire study area was the result of inset floodplain formation in some places and floodplain erosion elsewhere (Figure 2.9). Erosion exceeded inset floodplain formation for some of the 1-km reaches in every image set, but those increases in width were outweighed by deposition and inset floodplain formation in other 1-km reaches. Thus, numerous portions of the study area both eroded and deposited over the 75 years of aerial imagery, and some 1-km reaches widened between 1940 and 2014.

As the channel has narrowed, channel width has become more homogenous and is now approximately the same width everywhere. The range of RAACW values remained relatively constant until 1993, when the variability of channel widths began to decline, and continued to decline, reaching the lowest range of variability in 2009. Variability in channel widths increased slightly in 2014, but was still lower than channel width variability from 1940-2002.

The primary process of floodplain formation was conversion of bare sand bars to vegetated floodplains (Figure 2.10). Both bank-attached and mid-channel bars have been converted from bare sand to vegetated floodplains since the 1940s (Figure 2.11). As bars and islands became more densely vegetated, small secondary channels accreted, decreasing active channel area (Figure 2.12). The majority of deposition occurred at bars on the inside of bends and adjacent to existing alluvial floodplains. Bedrock banks of the river remained stable and little new floodplain deposition occurred in these places. Sixty percent of all narrowing that occurred between 1988 and 1993 was due to the conversion of a large sand bar (118,460m²) to floodplain, narrowing RAACW at RM 36.5 by 57 m.

2.6.2 Repeat channel surveys

To assess potential changes in channel bed elevation, I reoccupied channel cross sections near Hell Roaring Canyon (RM 55) and remapped the channel bed around Fort Bottom (RM 40) in collaboration with the USGS Grand Canyon Monitoring and Research Center (GCMRC). Cross-sections near Hell Roaring Canyon were established by the USFWS Upper Colorado River Endangered Fish Recovery Program and surveyed in 1995 and 1996 by Guensch and Schmidt (1996). Channel surveys around Fort Bottom were first conducted in 1998 by the National Park Service and published in a flow model by Gessler and Moser (2001). Re-surveys were performed in 2015 using an Odom CV-100 echo sounder with a 200 kHz transducer inside of the wetted channel combined with an RTK-GPS on the banks. Positioning was by RTK GNSS survey with a local base station set to the coordinate system UTM Zone 12N, North American Datum of 1983 (EPSG 26912). Single beam sonar data was processed at GCMRC to create a digital elevation model (DEM) of the channel bed. Bathymetric data was then merged with Lidar data collected in October 2015 by the state of Utah to produce a combined DEM of the channel and floodplain.

There was no substantial change to channel bed elevation at Hell Roaring Canyon and Fort Bottom between the mid-1990s and 2015. At Fort Bottom, the 1998 survey was conducted when discharge was at 22,500 ft³/s, in 2015, the discharge was 11,800 ft³/s. The large difference in discharge introduces uncertainty in the interpretation when the two surveys are compared (Figure 2.7A). Near Hell Roaring Canyon, the channel bed scoured during high discharges and filled as discharge decreased (Figure 2.7B). Both channel surveys show a minimal change in bed elevation and if any change to bed elevation did occur, it happened within the range of annual scour and fill and consistent, progressive change is undetectable. Though no bed aggradation or incision was detectable, both surveys of the lower Green River clearly show changes in channel width since the early 1990s. The same processes of scour and fill were observed by Allred and Schmidt (1999) during snowmelt flooding and summer low flows at Green River, UT. Because of the limited progressive bed level change at Hell Roaring Canyon and Fort Bottom, I infer that the majority of channel change in our study area was channel narrowing.

2.7 FLOODPLAIN STRATIGRAPHY AND SEDIMENTOLOGY

In August 2015, a 50-m long trench, extending across the entire floodplain, was excavated on the left bank at Hardscrabble Bottom (RM 43). Because aerial photographs only describe the plan view characteristics of the river corridor, it can be difficult to fully

describe the processes by which inset floods form. The trench provides information on the vertical growth of floodplains and mechanisms of inset floodplain formation near the trench site.

The right bank of the river at the trench site is a bedrock canyon wall, and inset floodplain formation is presumed to be confined to the left bank. I mapped floodplain deposits and linked stratigraphic contacts to seven tamarisk trees in the trench. The trees were cut into slabs at each stratigraphic contact, and I analyzed each slab at the USGS lab in Fort Collins, CO for tree age, germination year, and year of burial (Friedman et al., 2005). Deposit age was determined from burial year at each contact. I collected sediment samples from deposits in the trench for grain size distributions. For the oldest deposits in the trench, samples were collected and analyzed for age of deposition by the Utah State University Luminescence Lab. The regenerative-dose procedure for single grain optically stimulated luminesce (OSL) dating was used in anticipation of partial-bleaching issues common of Holocene alluvium.

I estimated the discharge required to inundate each mapped floodplain deposit by calculating a stage-discharge relationship for the river section at the trench by collecting water surface elevations and compared its slope to the slope of the stage-discharge relationship for the Mineral Bottom gage (Figure 2.18). The rating relation at the trench is

$$Q = 1493.2e^{0.6658WSE} \tag{3}$$

where Q is discharge (ft³/s) and WSE is water surface elevation in meters. I coupled these inundation levels with floodplain deposit ages derived from dendrogeomorphology to identify flows which contributed to the accretion of each floodplain deposit.

At Hardscrabble Bottom, the riparian zone is a set of inset floodplains, a higher

elevation tamarisk dominated floodplain (F1) and a lower elevation floodplain with a mixed tamarisk-willow community (F2). A levee and trough are present on both floodplains. Below the surface, there are three major inset deposits. F1 is composed of a vertically accreting levee and trough formation, and an intermediate laterally accreting series of beds. F2 is a vertically accreting levee and trough. The F1 sequence of deposits vertically truncates the edge of the valley floor, and in turn, is vertically truncated by F2 (Figure 2.19).

Levee deposits are coarse rippled cross-laminated sand dominated units, which fine onshore into troughs. Troughs are primarily composed of horizontally laminated siltdominated sediments. The intermediate, laterally accreting deposits are mixed beds of sand and mud. Beds typically fine upward. Sand and mud beds are present throughout the trench at all elevations, and beds near the surface are extensively bioturbated and weathered. Sedimentologic and stratigraphic characteristics of the trench are discussed in detail in Chapter 3.

Sediment samples collected from the floodplain trench and analyzed for grain size show that trench samples are 70% silt-and-clay on average (Figure 2.20). Trench samples are finer than suspended sediment, bed sediment samples and bar sediment samples (Figure 2.14). 25% of samples have a D_{50} of very fine sand and 1% are fine sand. The median grain size of the sand fraction within samples is 0.15 mm – fine sand. The only sand-dominated beds in the trench are in the valley floor. Samples collected from the trench contained small (<10%) proportions of clay, with the exception of samples collected in floodplain troughs. Trough samples are between 4-22% clay, and are much finer on average than all other samples collected from the floodplain. No grains >2 mm were found in the trench. Silt-and-clay is the majority of suspended sediment measured at Mineral Bottom and forms the majority of material in the trench, despite the high amount of sand transport during annual peak flows.

Using sedimentology, stratigraphy and dendrogemorphology, I distinguished additional periods of floodplain formation, unaccounted for in aerial imagery. The oldest tree in the trench germinated in 1939 and thus, the period of floodplain formation I describe using dendrogeomorphology is 1939-2015. A total of four major sequences of floodplain formation were identified: vertical accretion and levee formation from 1939-1952, lateral accretion from 1957-1982, overbank deposition from 1983-2015, and vertical accretion and levee formation from 1985-2015.

Beds in the valley floor dated using OSL are 300 ± 150 and 440 ± 250 years old, and are the oldest deposits in the trench. All other beds identified in the trench are >50 years younger and formed inset of valley floor deposits.

The first period of floodplain formation occurred at the trench site following the recession of high flow in the early 1920s. From 1939-1952, at least 18 m of narrowing and 1.1 m of vertical accretion occurred. Deposits accreted 1.5 m at the levee and 1.0 m in the trough. The 1939-1952 deposits are truncated by unconformable contacts. Following this period, small scale vertical accretion of at least 0.30 m occurred at station 35 from 1953-1982.

At the edge of the 1939-1952 deposits near station 23, the floodplain vertically accreted from 1952-1975. A portion of those deposits eroded in 1975 and an unconformity of 8 years exists in the stratigraphy, until the next record of deposition began in 1983. I identified this sequence of erosion and deposition by repeated

anatomical changes to a buried tamarisk tree (T25-1 in Figure 2.19C), similar to repeated burials and excavations described by Sigafoos (1964) on the floodplains of the Potomac River, VA.

From 1957-1982, tree-ring dating shows F1 grew at least 10 m laterally and 1.25 m vertically. Floodplain accretion occurred by lateral accretion of fining upward mixed sand and silt-and-clay deposits bounded on all sides by distinct unconformable contacts. These deposits exhibit some characteristics of oblique accretion, accreting both laterally and vertically. However, the stratigraphic evidence does not support the definition of oblique accretion introduced by Page et al. (Page et al., 2003) as *"the lateral accumulation of fine-grained floodplain sediment by progradation of a relatively steep convex bank in association with channel migration"* because beds do not prograde. Instead, lateral growth was due to repeated deposition of horizontally laminated, vertically truncated, beds. Erosion in 1975 occurred at a higher elevation than these deposits, and it is likely that some lateral accretion occurred prior to erosion in 1975. Erosion documented in 1975 potentially stripped sediment from both floodplain and channel margin facies in F1.

From 1983-2015, overbank deposition vertically accreted 1 m above the 1939-1952 and 1957-1982 deposits, across all of F1. This deposit contains super critically climbing ripples, indicating rapid deposition, and no significant surface exposure. The peak annual flows with the ability to deposit these large packages were during 1983 and 1984, and I infer that the majority of this vertical accretion occurred in 1983-1984.

From 1985 to 2015, F2 accreted at least 10 m laterally and 2 m vertically, building a new inset floodplain. The upper portion of the floodplain contains beds of

cross-stratified sandy material that forms a natural levee. Formation of F2 began as bankattached bar deposition inset of pre-1985 deposits. From 1985-1986, vertical accretion built 0.45 m of floodplain. In this period, deposits were inundated more than 50% of the time (Figure 2.21). Basal deposits were deposited as part of the active channel. From 1987-1992, F2 vertically accreted 0.60 m. During this period, all annual peak flows were of less than 20,000 ft³/s. Peak discharges during this period were able to deposit sand, but did not erode emergent bars and floodplain. Floodplain formation shifted from deposition on a frequently inundated surface to deposition during episodic, moderate peak flows. Between 1993 and 2004, F2 accreted 0.60 m as the rate of vertical accretion slowed. High peak flows returned in the 1990s, but had decreased effects despite their higher discharges and did not cause increased vertical accretion. The floodplain built slowly after 2004, accreting 0.30 m across the levee and trough from 2004-2015. No evidence exists for floodplain stripping between 2005 and 2015 despite a 44,900 ft³/s flood in 2011, the 3rd highest since 1959 (Figure 2.21). F2 continues to vertically accrete when floods are greater than the 2-year flood $(22,000 \text{ ft}^3/\text{s})$.

2.8 SEDIMENT TRANSPORT AND THE MODERN ACTIVE CHANNEL

The contemporary lower Green River is a sinuous channel with a meandering thalweg alternating between deep pools and shallow crossovers. Bank-attached and midchannel bars are located at bends in the river. These "curvature-driven bars" (Parker and Johannesson, 1989) do not migrate downstream because their locations are controlled by periodic bedrock banks. Bars are primarily composed of sand. I visually observed small gravel deposits at one location, on top of sand bars at the upstream channel margin of a large island at Fort Bottom (RM 41.5). In low velocity backwaters and channel margins, thick deposits of silt-and-clay are present, transitioning to sand at higher elevations. Thin drapes of mud occur in the troughs of bedforms. Erosion and deposition of emergent bars is constant during summer low flow periods (Figure 2.13). Bars are subject to scour and fill during the year, but the location of these bars is consistently in the same place (Figure 2.10-Figure 2.12). Grain sizes from physical samples collected on the surface of bars near Fort Bottom in February 2017 have a median grain size of 0.095 mm – very fine sand (Figure 2.14).

The continuous record of suspended sediment transport at Mineral Bottom (GCMRC, 2016) measured by acoustic sensors since March 2014 provides a precise understanding of the grain sizes in transport during spring snowmelt floods and during the summer/fall monsoon season. These are the two flow regimes that potentially contribute to the formation of inset floodplains and channel narrowing, although high suspended sediment concentration flows must attain a stage sufficient to inundate aggrading bars if inset floodplains are to form. An unknown proportion of sediment is transported as bedload by migrating downstream dunes.

The median suspended sand concentration between March 2014 and June 2017 was 97 mg/L (Figure 2.15A) and the median grain size of suspended sand was very fine sand - 0.11 mm (Figure 2.15B). Suspended sand concentrations increase with increasing discharge (Figure 2.16A), and the median grain size of suspended sand decreases as discharges increases (Figure 2.16B, Figure 2.16C). Sand concentrations increase during the spring snowmelt flood and again during the summer/fall flash floods.

The median suspended silt-and-clay concentration for the same measurement period were much greater than sand concentrations - 310 mg/L (Figure 2.15C). Silt-and-

clay concentrations are highest during the summer and fall months when upstream flash floods occur, but are not controlled by the magnitude of Green River discharge. Silt-andclay concentrations do not increase meaningfully during the spring snowmelt flood (Figure 2.16D). The median suspended silt-and-clay concentration of snowmelt-derived flows in May and June was 850, 1100, and 570 mg/L in 2014, 2015, and 2016, respectively. The median suspended silt-and-clay concentration in August and September was 2400, 410, and 570 mg/L in the same 3 years.

Physical bed sediment samples (n=133) collected as part of Mineral Bottom sediment monitoring (GCMRC, 2016) show the median grain size of bed sand is medium sand - 0.30 mm. Ninety percent of collected bed sediment samples have a median sand grain size between 0.18-0.38 mm, coarser than suspended sand, which 90% of the time were between 0.09-0.19 mm. Bed sediment fines during peak snowmelt flooding and exhibits hysteresis, coarsening from the rising to falling limb of yearly snowmelt peak floods (Figure 2.17).

Grain size distributions comparing samples collected from the trench, in-channel bars, suspended sediment samples, and bed sediment samples show that substantial difference between each set of samples, with little overlap (Figure 2.14). The only two sets of samples with overlapping grain size distributions are suspended sediment samples and in-channel bars. While there appears to be some interaction between the bed, grains in suspension, in channel bars and the floodplain, when comparing grain size distributions, floodplain building material is primarily sourced from finer suspended sediments and little, if not none, sediment in the floodplain is sourced from the bed.

2.9 DISCUSSION

Within the study area, the primary mechanism of inset floodplain formation from 1940-2015 was vertical accretion. Formation began by the accretion of bank-attached bars as part of the active channel. In the trench, accretion of bank-attached bars occurred during periods of relatively low peak flow, preserving the stability of bar deposits throughout the year. Vertical accretion transitioned active channel bars in 1-2 years to an intermittingly inundated floodplain, decreasing channel width. Continued vertical floodplain accretion during our period of record occurred on a yearly timescale when the floodplain was inundated.

Accretion at the channel margin was a secondary process for floodplain growth. Lateral floodplain accretion narrowed the channel with minimal vertical accretion. The other major process of floodplain formation is large scale vertical accretion during large floods. This process of floodplain formation, previously unidentified in the lower Green River, is similar to episodic aggradation of terraces described by Moody and Meade (2008) during a large flood in 1978 on the Powder River, MT. The thickness of large flood deposits is likely influenced by floodplain vegetation, and floodplain stripping may be limited by vegetation (Phillips and Tadayon, 2006; Griffin et al., 2014; Manners et al., 2014). However, flow magnitude may not have reached the threshold for stripping to occur. High flows did not produce floodplain stripping after 1985 and there is no widening associated with recent high flows. Narrowing after 1985 occurred in years of low peak flow.

Processes of channel narrowing by inset floodplain formation are episodic, and the channel changes I documented happened in a small number of years. Channel widths in the study area were stable for most years, even as vertical accretion took place. The relative roles of flow and vegetation in promoting channel narrowing of the lower Green River are complex and it is difficult to fully unwind the contributions of each potential driver. Channel narrowing occurred after both changes in flow regime and establishment of invasive vegetation. Previous studies on the interactions between flow and tamarisk mostly focused upon the differences between non-vegetated and vegetated surfaces, and have not investigated how changes to community composition potentially alter geomorphic process. Tamarisk and native trees were equivalent in promoting floodplain deposition on the San Pedro River in Arizona (Stromberg, 1998), but the dominant woody plants identified by Stromberg (1998) were Fremont cottonwood and the fruticose shrub seepwillow (*Baccharis salicifolia*). How tamarisk influences river form differently than communities of single-stemmed *Salix exigua* is still unknown.

Riparian vegetation communities changed in CNP during the 20th century as tamarisk established, and tamarisk is the dominant riparian species, although increases in the extent of sandbar willow account for much of the vegetation growth after 1976 (Mortenson and Weisberg, 2009). Recently formed floodplains and low elevation benches are mixed tamarisk-willow communities. Riparian vegetation density increased in the 20th century and dense stands of tamarisk and willow presumably influenced floodplain deposition by decreasing velocity of overbank flows and increasing hydraulic roughness (Griffin et al., 2014; Manners et al., 2014)

Flow regime changed at the same time as widespread changes to vegetation communities in the lower Green River, decreasing discharge. The inset floodplain formation I documented matches expected declines in channel width as a response to decreases in total discharge (Leopold and Maddock, 1953; Thorne, 1998). Further, my findings are consistent with other studies that observed channel narrowing as a response to decreasing discharge (Pizzuto, 1994; Allred and Schmidt, 1999).

Tamarisk induced channel narrowing elsewhere in the Green River basin (Manners et al., 2014) and is considered a contributor to channel narrowing at Green River, UT (Allred and Schmidt, 1999). However, there is no direct evidence that channel narrowing in the lower Green River was a response to the establishment of tamarisk. Recent channel narrowing occurred decades after the establishment of tamarisk and changes to width are linked to hydrology, a finding established in this study and others (Allred and Schmidt, 1999; Manners et al., 2014). Nevertheless, increased deposition and floodplain formation in the 20th century was likely due in part to the spread of tamarisk. The establishment of tamarisk on floodplains in years of low peak flow contributed to the creation of dense floodplain vegetation communities, stabilization of banks, and greater floodplain deposition. Thus, changes to the hydrologic regime are the primary cause of inset floodplain formation on the lower Green River.

Inset floodplain formation is not directly linked to changes in flow magnitude. Instead, the stabilization of flood deposits and vertical or lateral floodplain formation is a result of yearly peak flood magnitude. Clustered years of low peak flow initiated floodplain formation, subsequently, in-channel bars vertically accreted and converted to floodplain. The role of high flows is at least partially independent of flow regime, because the most recent phase of narrowing occurred well after a shift in flow regime in 1959, beginning instead in years of low peak flow from 1987-1992. Under this model, lateral channel narrowing will likely occur again during a cluster of low or moderate-tolow peak flow years allowing for bar deposition without erosion, stabilization of inchannel deposits, and conversion of channel to floodplain.

I identified floodplain growth in the second half of the 20th century, with the greatest narrowing taking place after 1985. Birken and Cooper (2006) asserted that channel width (determined from air photos) decreased in this study area by 1-2% from 1976-2002; for the same time period, I found channel narrowing of 13% near Fort Bottom; over the entire study area, the channel narrowed 8% between 1966-2002. Our larger narrowing result is due to our larger study area and more years of aerial imagery. We used 50-km and 15-km portions of river, much larger than the single 2-km reach at Potato Bottom selected by Birken and Cooper (2006). Further, our selected areas covered both stable and active reaches of river. In the 20th century, channel width at Potato Bottom was very stable, and minimal narrowing occurred. The magnitude of change varies by reach of river and study area; however, for both our study area and Fort Bottom reach, we document consistent and substantial changes to width since the 1940s. We do not know if there were changes to channel width in the early 20th century on the lower Green River, however, little change in width occurred at Green River, UT between 1912 and 1928 (Allred and Schmidt, 1999). After 1929, channel width at Green River, UT declined, narrowing approximately 5 m between 1930 and 1939. Because flow regime is the same for Green River, UT and the lower Green River, it is possible that the timing of change is similar at both locations and that changes in width began in the late 1920s.

My description of channel narrowing near Fort Bottom in response to changes in flow regime agrees with the work of Allred and Schmidt (1999) who described a corresponding sequence of narrowing at Green River, UT. It is possible that the Green River near Green River, UT has remained stable since the early 1990s. Future analysis of cross section data (outside the scope of this study) at Green River, UT over the same time range as our recent work (1984-2015) would allow us to determine if the timing of channel change is simultaneous or if an equilibrium state is propagating downstream (*sensu* Andrews, 1986). Comparison of the timing of channel narrowing in the Yampa River (Merritt and Cooper, 2000; Manners et al., 2014) and at Green River, UT will better link changes in channel width for the lower Green River to other locations in the basin, illustrating effects of hydrologic, vegetative and climatic changes on the entire basin.

Anthropogenic and natural changes in hydrology both play important roles in affecting channel form of the lower Green River. Since 1900, climatically driven declines in runoff have been the primary cause of declines in peak flow magnitude. Anthropogenic effects, in particular Flaming Gorge Dam, contribute to changes in flow regime, by decreasing total runoff, decreasing peak flow magnitude, and increasing base flow. Despite the relatively small impact of upstream water development on past channel narrowing, the lower Green River is sensitive to future changes in peak flow magnitude and timing. The low impact of local tributaries and dominance of snowmelt flooding means that changes to peak flow timing and magnitude will influence downstream morphology and will continue to do so in light of future changes, either climatically or anthropogenically driven.

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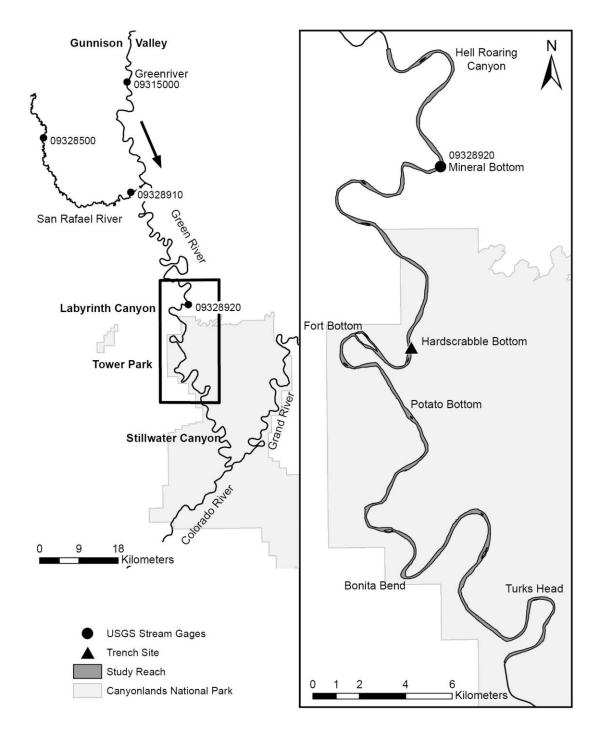
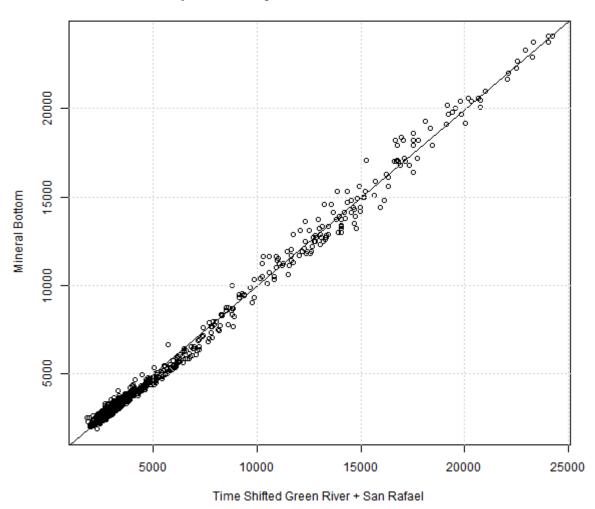


Figure 2.1: Map of the lower Green River and study area. Gages are 09315000 Green River at Green River, UT, 09328500 San Rafael River near Green River, UT, 09328910 San Rafael River at mouth near Green River, UT and 09328920 Green River at Mineral Bottom, UT.



Comparison of Synthetic Flow to Mineral Bottom

Figure 2.2: Comparison of daily discharge values for the time shifted synthetic flow method (Green River + San Rafael) and data collected at Mineral Bottom, UT from March 3, 2014 to February 1, 2017 (n=1006).

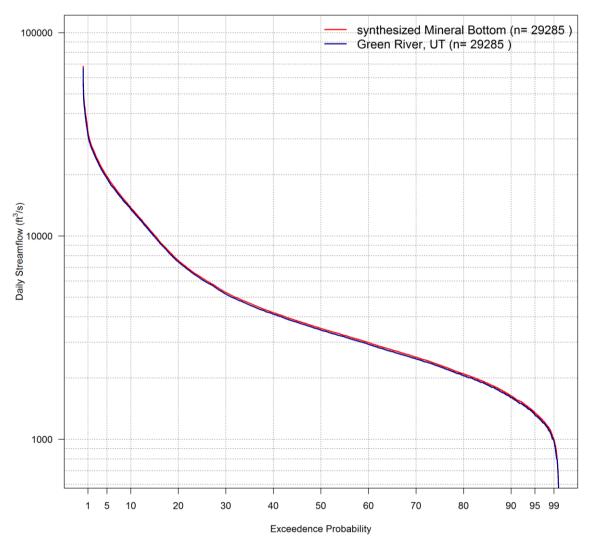


Figure 2.3: Flow duration curves for Mineral Bottom and Green River, UT, comparing pre-(1909-1918) and post-(1950-2015) major river regulation.

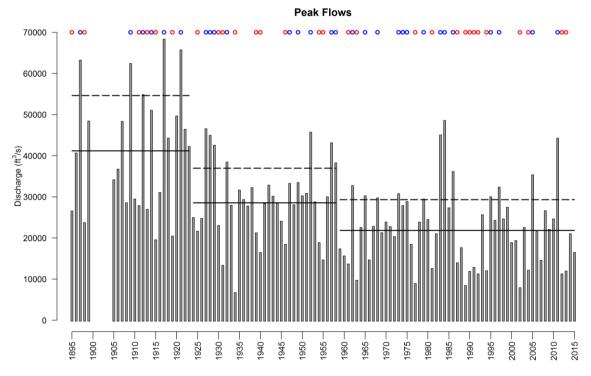


Figure 2.4: Time series of instantaneous annual peak flows at Green River, UT (gage 09315000). The 2-year (solid line) and 5-year (dashed line) recurrence intervals are shown for each period of flow regime determined by the Pettitt test. High (red circles) and low (blue circles) peak flow years are identified as defined in the text.

Mean Daily Discharge

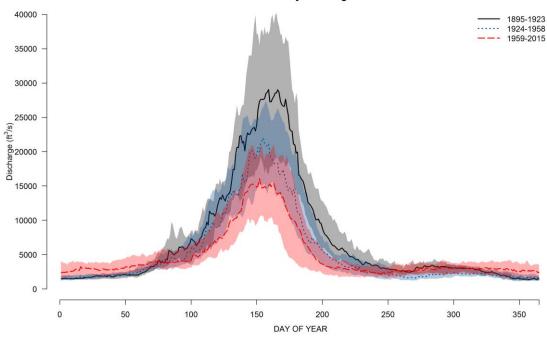


Figure 2.5: Mean daily discharge at Green River, UT for each period of flow regime identified by a Pettitt test of instantaneous annual peak flows. Shaded areas show the interquartile range for each period of flow regime.



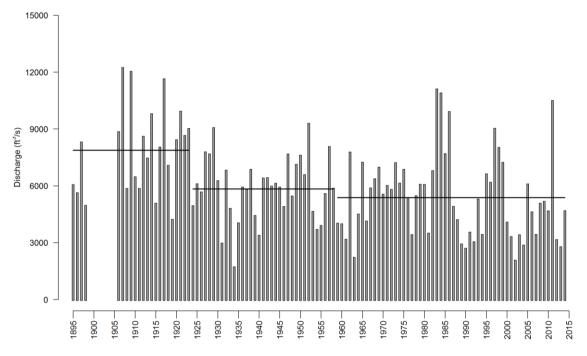


Figure 2.6: Mean annual flows at Green River, UT (gage 09315000) showing mean annual flow for period of flow regime identified by a Pettitt test of instantaneous annual peak flows.

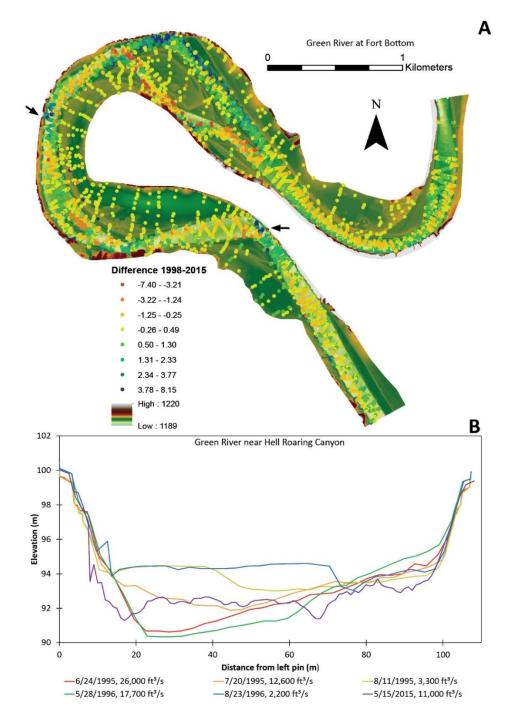


Figure 2.7: A) Results of channel surveys near Fort Bottom, showing large (>3 m) deposition in deep pools at the outside of bends where the channel contacts bedrock (black arrows). This deposition is likely due to differences in discharge between the 1998 and 2015 surveys. Points in A are locations of the 1998 and their color corresponds to the difference between the 1998 and 2015 surveys in meters. B) Comparison of cross-section surveys near Hell Roaring Canyon, showing yearly scour and fill.

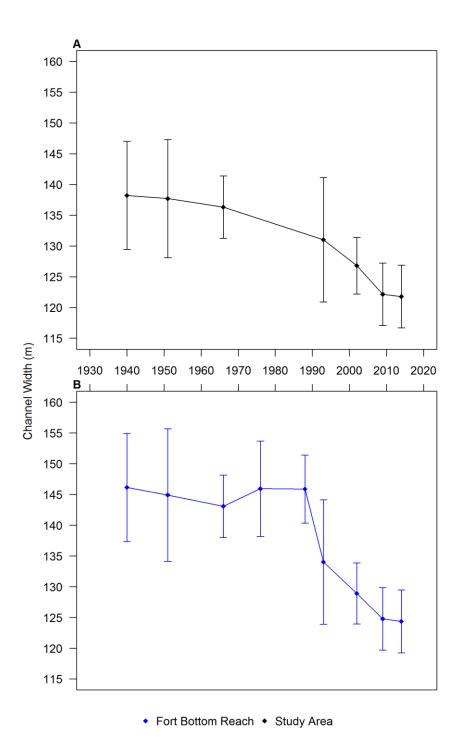


Figure 2.8: Changes in channel width for all years of aerial imagery reach showing A) mean RAACW in the 61 km study area for each year with error bars showing E_w . Maximum RAACW decreased by 63 m from 1988 to 1993, minimum width remained stable from 1940 to 2014 and A) mean RAACW in the 15 km Fort Bottom reach for each year with error bars showing spatial uncertainty (E_w)

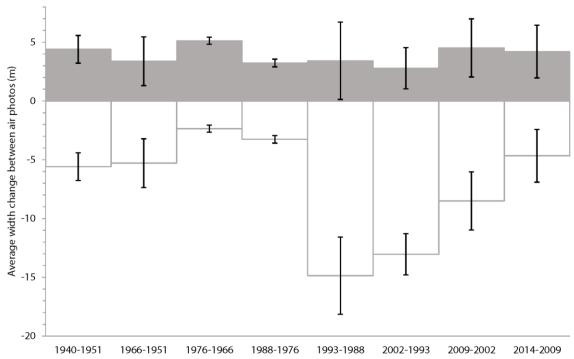


Figure 2.9: Changes in active channel width by floodplain formation (white boxes) and floodplain erosion (gray boxes). Net narrowing over the Fort Bottom reach includes floodplain deposition in every single year, but that deposition is outweighed by a greater amount of erosion. Error bars represent uncertainty associated with active channel boundary digitization ($\sqrt{2}p$) in Table 2.

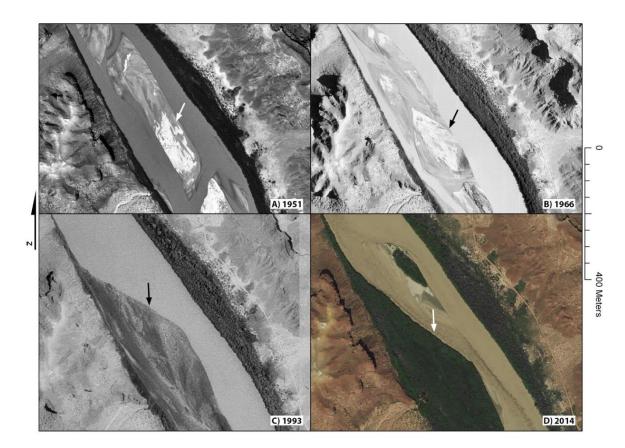


Figure 2.10: Conversion of a bare sand bar to vegetated floodplain at Potato Bottom (RM 36.5). Flow is from top to bottom. An active mid-channel bar in 1951 (A, Q = 2,300 ft³/s) is located in the middle of the channel. The white arrow in A) shows the mid-channel bars. White areas in the picture are higher elevation sands. In 1966 (B, Q = unknown), the black arrow points to an emergent bar on river right. The emergent bar is gone in 1993 (C, Q = 13,700 ft³/s), instead vegetation has established on bank-attached bar (black arrow) in 1993. By 2014, the bar (white arrow) is heavily vegetated and is part of the floodplain (D, Q = 3,820 ft³/s).

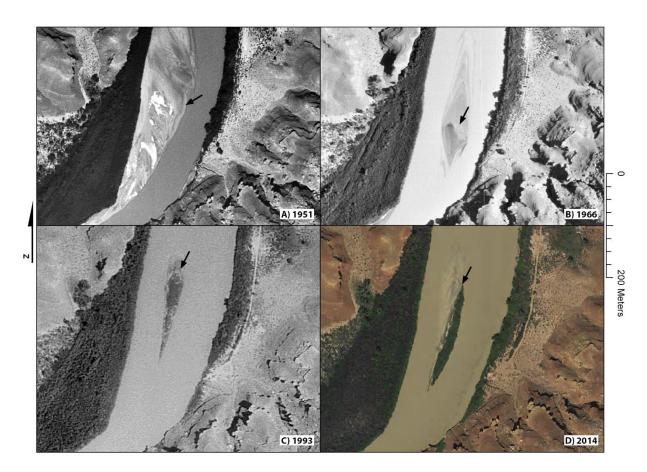


Figure 2.11: Conversion of a mid-channel bar at the downstream end of Hardscrabble Bottom (RM 42.5). Flow is from top to bottom. An emergent bar in 1951 (A, Q = 2,300 ft³/s) shown by the black arrow and a mid-channel bar in 1966 (B, Q= unknown), transitions to a vegetated island by 1993 (C, Q = 13,700 ft³/s) and remains vegetated in 2014 (D, Q = 3,820 ft³/s). The mid-channel bar and island are shown by the black arrow.

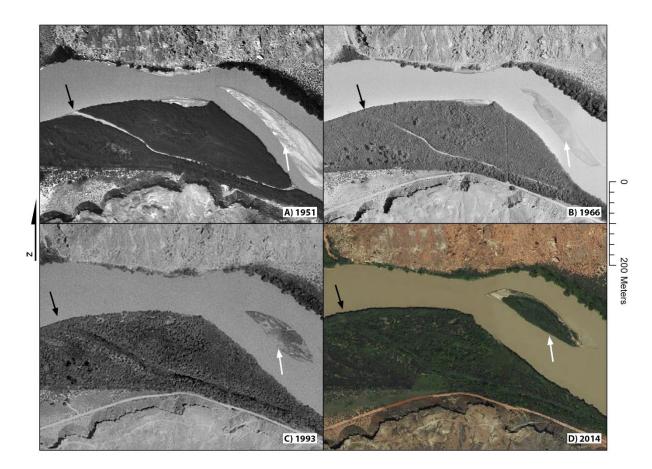


Figure 2.12: Aggradation of a secondary channel at Point Bottom (RM 49). Flow is from right to left. A secondary channel exists in 1951 (A, $Q = 2,300 \text{ ft}^3/\text{s}$), creating a large vegetated island. The open channel is clearly seen at the downstream end of the bar (black arrow). In 1966 (B, Q = unknown), vegetation has established in the upstream and downstream ends of the channel (black arrows). The secondary channel is fully vegetated in 1993 (C, $Q = 13,700 \text{ ft}^3/\text{s}$) and 2014 (D, $Q = 3,820 \text{ ft}^3/\text{s}$) (black arrows). Mid-channel bar conversion immediately offshore of Point Bottom happens at the same time the secondary channel aggrades, converting a bar to vegetated island by 1993 (white arrows).

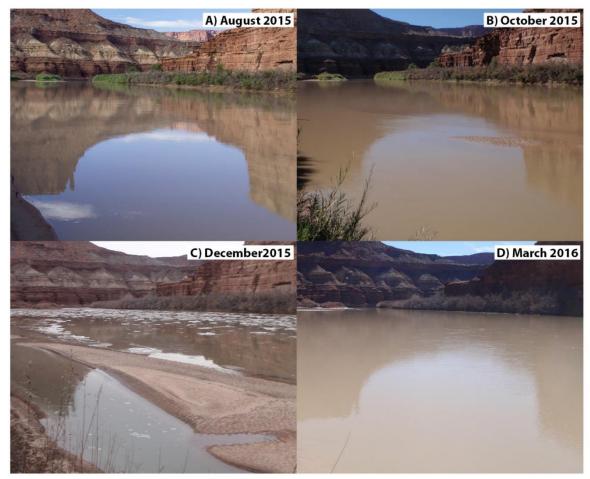
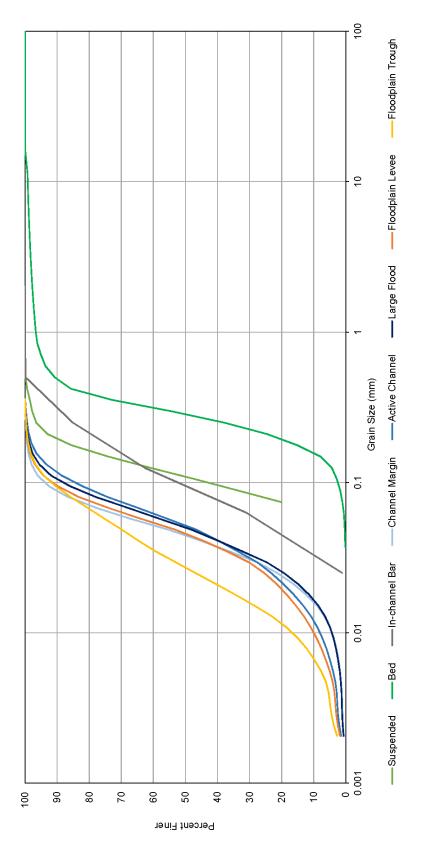
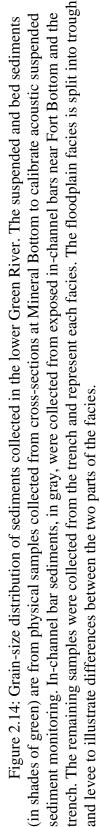


Figure 2.13: A photo match taken at the Hardscrabble trench, showing offshore bar deposition and erosion in summer and fall low flows. Photos are looking downstream. A) Photo taken August 7, 2015 at 2,610 ft³/s, B) Photo taken October 15, 2015 at 2640 ft³/s, C) Photo taken December 6, 2015 at 2,820 ft³/s and D) Photo taken March 2016 at 3,400 ft³/s. Discharge values are from the Mineral Bottom gage. The highest flow in this time period was 6,650 ft³/s on October 20, 2015.





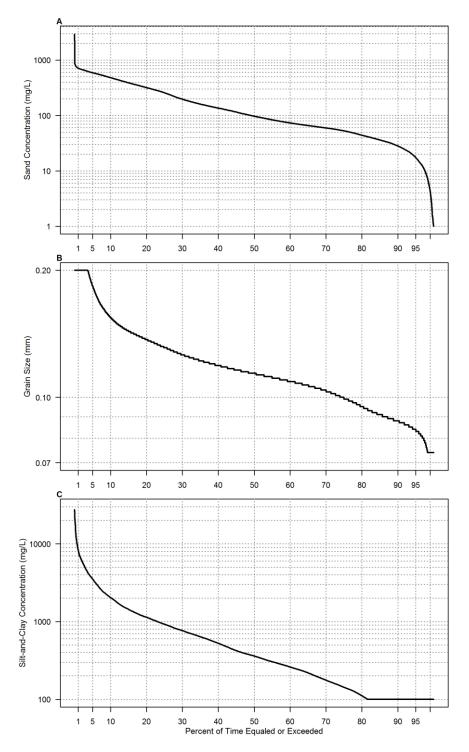


Figure 2.15: Duration curves for A) suspended sand concentration, B) suspended sand median grain size and C) suspended silt-and-clay concentration collected by acoustic sediment monitoring at Mineral Bottom. Concentrations of suspended silt-and-clay are almost an order of magnitude greater than concentrations of suspended sand.

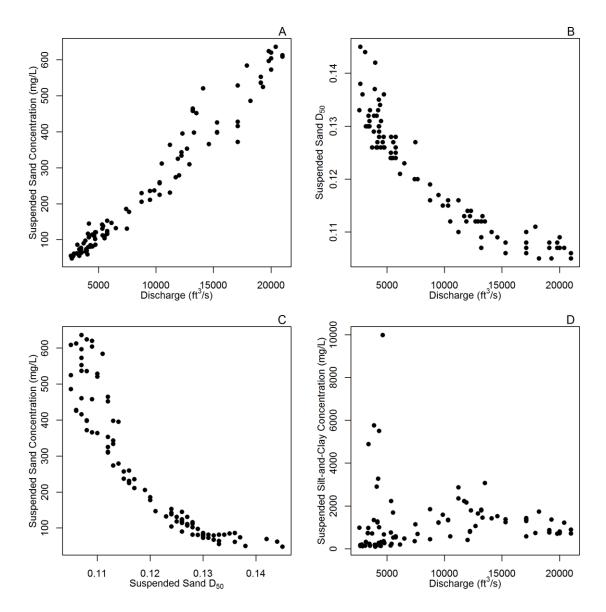


Figure 2.16: Characteristics of physical suspended sediment samples collected by ISCO pump sampler at Mineral Bottom from March 2014-October 2016 (n=133). A) Suspended sand concentrations increase with rising discharge. B) Median suspended sand grains size decreases with increasing discharge. C) Suspended sand decreases in relation to increasing median grain size. D) Suspended silt-and-clay remains relatively constant with increasing discharge.

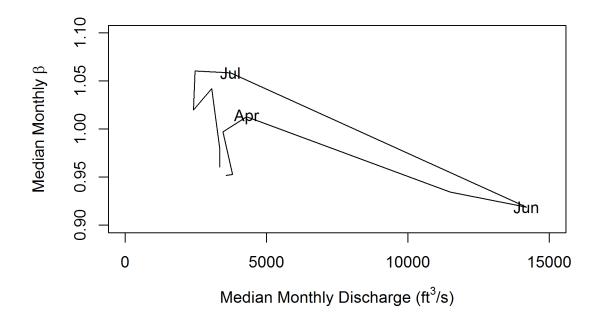


Figure 2.17: Plot of β , a dimensionless measure of bed sediment as function of discharge and suspended sediment. As bed sediment fines, β decreases. The pattern of hysteresis is the same as one described for the Colorado River at Lee's Ferry and in the Grand Canyon before the construction of Glen Canyon Dam (Rubin and Topping, 2001).

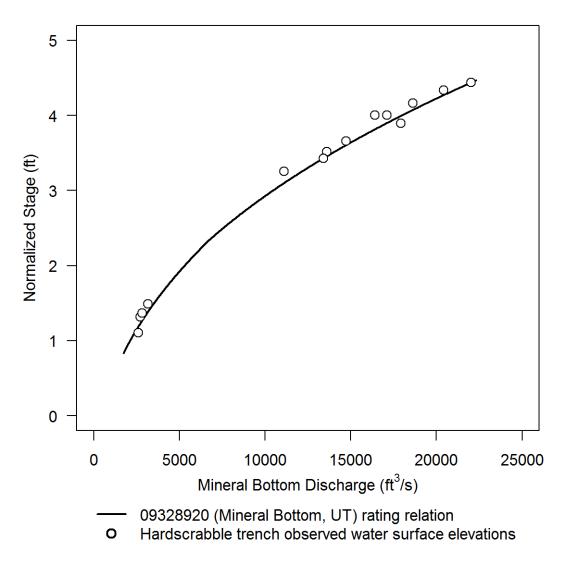


Figure 2.18: Stage-discharge relation at Hardscrabble trench site compared to the USGS rating relation for Mineral Bottom. Stage for both relations is normalized to make comparisons.

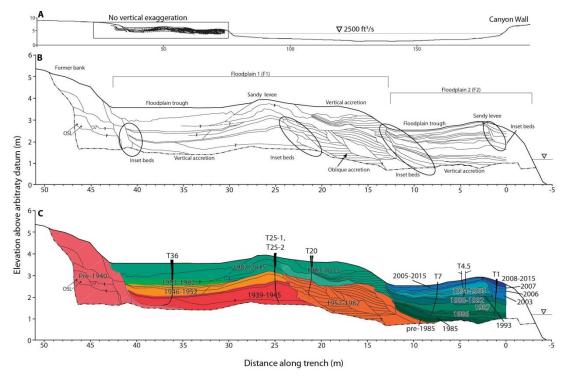


Figure 2.19: Trench stratigraphy and dendrogeomophology. A) Complete cross section profile shown with no vertical exaggeration. The box in A covers the trench and is the location of B, C and D. B) Stratigraphy and major locations within the trench. C) Chronology of deposition determined from tree-ring dating and OSL.

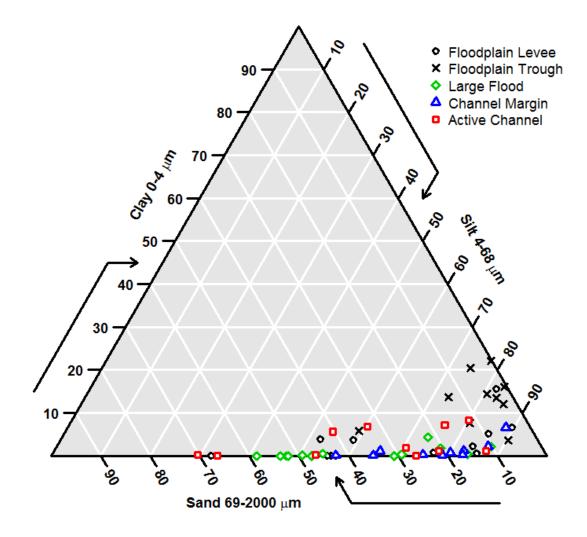


Figure 2.20: Ternary diagram for samples collected from each facies identified in the trench. Floodplain levees and trough are subdivided.

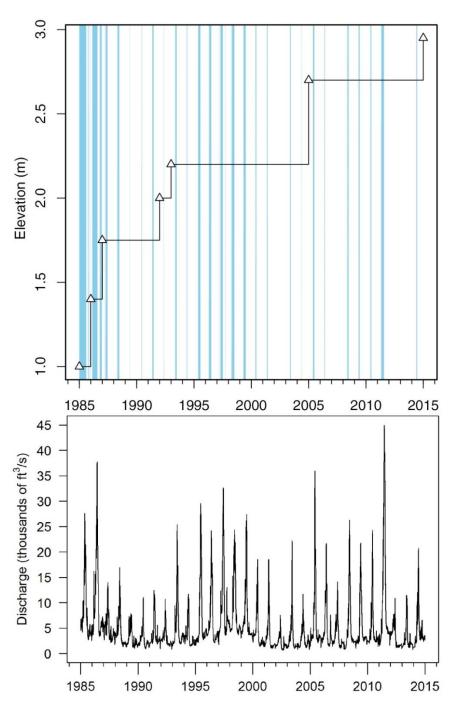


Figure 2.21: Plot of floodplain elevation for post 1985-deposits and daily discharge for same time period (1985-2015). On the upper plot, the elevation of the floodplain is represented by the black line and time when the floodplain was inundated by blue shaded areas. Triangles represent ages of stratigraphic contacts determined by dendrogemorphology aging. For the inset floodplain which formed after 1985, the amount of time it was inundated decreased substantially after 1987, but was still inundated on a 1.5-2 year recurrence interval until 2011.

| Period | Number of Years Mean Annual Flow (ft ³ /s) | Mean Annual Flow (ft ³ /s) | 2-year flood (ft ³ /s) | 5-year flood (ft ³ /s) | P-value of break point* |
|------------------|--|--|--------------------------------------|--------------------------------------|----------------------------|
| 1985-1923 | 23 | 41,200 | 41,200 | 54,600 | |
| 1924-1958 | 34 | 28,500 | 28,500 | 36,900 | 0.015 |
| 1959-2016 | 58 | 22,000 | 21,800 | 29,300 | 3.87x10-6 |
| *Two hreak noint | *Two hreak noints exist 1 in 1924 and 1 in 1959 | 1 in 1959 | | | |

Table 2.1: Flow regime periods identified from Pettitt test

*I wo break points exist, I in 1924 and I in 1959

| | | ,) | | | | | |
|------|---------------|--|------------------|----------------------|-------------------------|-----------------------------------|----------------------------|
| Year | Dates | Agency | Film Type | Approximate Scale | Pixel resolution (m) | Discharge (ft ^{3/s}) | Coverage of study area (%) |
| 1940 | 8/30 | US Department of Agriculture (USDA) | Black & White | 31,680 | 1 | 3,950 | 06 |
| 1951 | 9/19 | US Geological Survey (USGS) | Black & White | 20,000 | 0.5 | 2,300 | 79 |
| 1966 | Unknown | Bureau of Land Management | Black & White | 15,840 | 1 | Unknown | 100 |
| 1976 | 8/31 | National Park Service (NPS) | Color | 12,000 | 0.15 | 3,040 | 28 |
| 1988 | 8/27 | Bureau of Reclamation | Color Infrared | 6,000 | 0.15 | 1,820 | 25 |
| 1993 | 6/14 | NSGS | Black & White | 40,000 | 1 | 13,700 | 100 |
| 2002 | 6/18 and 6/19 | USGS/NPS | Color | 12,000 | 0.84 | 2,370 | 66 |
| 2009 | 8/7 | USDA Aerial Photography Field Office (APFO) | Digital Color | ı | 1 | 3,100 | 100 |
| 2011 | 6/22 | USDA APFO | Digital Color | 1 | 1 | 42,300 | 100 |
| 2014 | 9/11 | USDA APFO | Digital Color | I | 1 | 3,820 | 100 |

Table 2.2: Aerial imagery information

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| Table 2.3 | : Errors associat | ed with channel w | idth measurements fr | om aerial imagery. A | Table 2.3: Errors associated with channel width measurements from aerial imagery. All values are in meters |
|-----------|--------------------|-------------------------|-----------------------------------|-------------------------------|--|
| Year | Width Error (p) | Pixel resolution (R) | Digitization error $(\sqrt{2}pR)$ | Image Distortion Error (0) | Total width error (E _w) |
| 1940 | 1.91 | 1 | 2.7 | 3.04 | 8.79 |
| 1951 | 1.66 | 0.5 | 1.18 | 4.22 | 9.62 |
| 1966 | 1.47 | 1 | 2.07 | 1.5 | 5.08 |
| 1976 | 1.42 | 0.15 | 0.3 | 2.87 | 6.05 |
| 1988 | 1.54 | 0.15 | 0.33 | 1.67 | 3.67 |
| 1993 | 2.32 | 1 | 3.29 | 3.42 | 10.12 |
| 2002 | 1.47 | 0.84 | 1.75 | 1.43 | 4.61 |
| 2009 | 1.75 | 1 | 2.47 | 1.31 | 5.09 |
| 2014 | 1.59 | 1 | 2.24 | 1.43 | 5.1 |

| Diver Vilor - | ter River Mile | 1940 | 1951 | 1966 | rerage Act 1993 | ive Channel 2002 | 2009 | 2014 |
|----------------|----------------|--------|--------|--------|--------------------|---------------------|--------|--------|
| 92.50 | | - | | | | | | |
| | 57.48 | | - | 162.23 | 169.23 | 169.50 | 163.23 | 161.40 |
| 91.50 | 56.86 | - | - | 102.16 | 102.59 | 99.80 | 99.89 | 96.35 |
| 90.50 | 56.23 | - | - | 158.59 | 159.25 | 155.51 | 153.42 | 151.77 |
| 89.50 | 55.61 | - | - | 120.93 | 122.39 | 138.59 | 113.19 | 110.04 |
| 88.50 | 54.99 | - | - | 118.84 | 120.55 | 109.64 | 112.10 | 105.28 |
| 87.50 | 54.37 | 182.02 | - | 172.03 | 174.53 | 169.10 | 167.79 | 164.53 |
| 86.50 | 53.75 | 156.46 | - | 146.54 | 137.13 | 139.47 | 134.51 | 132.82 |
| 85.50 | 53.13 | 113.27 | - | 112.61 | 113.36 | 113.28 | 112.39 | 111.23 |
| 84.50 | 52.51 | 148.59 | 149.51 | 147.06 | 153.00 | 150.57 | 148.34 | 145.34 |
| 83.50 | 51.88 | 122.01 | 126.79 | 119.96 | 116.96 | 112.83 | 106.78 | 108.88 |
| 82.50 | 51.26 | 135.61 | 132.34 | 129.98 | 131.76 | 129.14 | 124.26 | 125.50 |
| 81.50 | 50.64 | 100.62 | 109.01 | 118.54 | 123.20 | 120.53 | 121.28 | 117.60 |
| 80.50 | 50.02 | 117.44 | 116.75 | 117.28 | 121.80 | 118.35 | 118.48 | 116.08 |
| 79.50 | 49.40 | 137.19 | 139.94 | 130.35 | 134.49 | 139.09 | 142.42 | 138.42 |
| 78.50 | 48.78 | 105.03 | 108.38 | 100.55 | 108.21 | 102.75 | 96.49 | 97.73 |
| 77.50 | 48.16 | 109.97 | 110.39 | 111.24 | 111.41 | 105.60 | 102.51 | 99.40 |
| 76.50 | 47.53 | 118.00 | 112.17 | 112.37 | 115.45 | 111.39 | 114.50 | 113.34 |
| 75.50 | 46.91 | 148.93 | 149.32 | | 147.11 | | | |
| | | | | 151.48 | | 138.74 | 131.95 | 134.29 |
| 74.50 | 46.29 | 160.84 | 165.61 | 163.55 | 168.09 | 169.75 | 170.96 | 168.88 |
| 73.50 | 45.67 | 126.57 | 127.93 | 125.54 | 129.65 | 125.36 | 124.67 | 122.36 |
| 72.50 | 45.05 | 122.17 | 110.31 | 114.03 | 117.07 | 113.85 | 115.56 | 113.95 |
| 71.50 | 44.43 | 112.78 | 115.23 | 116.68 | 117.73 | 114.40 | 116.44 | 109.67 |
| 70.50 | 43.81 | 169.04 | 169.90 | 170.51 | 164.40 | 167.13 | 150.32 | 148.30 |
| 69.50 | 43.19 | 141.43 | 142.68 | 139.95 | 141.52 | 121.78 | 121.12 | 116.80 |
| 68.50 | 42.56 | 143.18 | 139.64 | 138.10 | 132.02 | 130.50 | 128.16 | 128.39 |
| 67.50 | 41.94 | 97.21 | 100.25 | 93.94 | 86.89 | 84.96 | 86.82 | 85.20 |
| 66.50 | 41.32 | 173.00 | 174.54 | 170.04 | 167.29 | 161.76 | 158.25 | 152.12 |
| 65.50 | 40.70 | 155.39 | 153.83 | 149.02 | 141.96 | 133.40 | 115.59 | 124.52 |
| 64.50 | 40.08 | 125.94 | 123.69 | 124.75 | 123.29 | 114.61 | 110.04 | 107.95 |
| 63.50 | 39.46 | 149.85 | 148.15 | 143.06 | 137.62 | 135.53 | 128.38 | 129.77 |
| 62.50 | 38.84 | 128.53 | 128.46 | 127.26 | 128.43 | 124.14 | 123.00 | 124.59 |
| 61.50 | 38.21 | 128.35 | 132.11 | 132.93 | 135.32 | 129.96 | 127.73 | 130.19 |
| 60.50 | 37.59 | 121.38 | 118.05 | 117.07 | 118.68 | 113.84 | 113.14 | 111.37 |
| 59.50 | 36.97 | 236.68 | 234.17 | 229.62 | 151.21 | 151.66 | 146.85 | 153.59 |
| 58.50 | 36.35 | 187.18 | 182.61 | 179.36 | 146.88 | 136.20 | 130.34 | 128.99 |
| | | | 126.84 | | | 111.49 | | |
| 57.50 | 35.73 35.11 | 127.86 | | 121.32 | 117.71 154.29 | 145.44 | 103.23 | 105.18 |
| 56.50 | | 180.53 | - | 177.69 | | | 129.02 | 129.20 |
| 55.50 | 34.49 | 131.76 | - | 137.37 | 127.48 | 119.59 | 114.94 | 116.12 |
| 54.50 | 33.86 | 123.77 | - | 121.11 | 119.74 | 113.40 | 109.73 | 110.46 |
| 53.50 | 33.24 | 89.43 | - | 90.08 | 90.94 | 84.95 | 86.52 | 83.03 |
| 52.50 | 32.62 | 133.49 | - | 147.76 | 133.51 | 131.07 | 123.71 | 125.95 |
| 51.50 | 32.00 | 135.29 | 120.67 | 140.33 | 133.38 | 133.47 | 127.77 | 132.86 |
| 50.50 | 31.38 | 104.11 | 100.72 | 101.62 | 97.52 | 99.89 | 92.95 | 92.07 |
| 49.50 | 30.76 | 150.04 | 148.85 | 148.38 | 135.60 | 126.06 | 123.08 | 124.35 |
| 48.50 | 30.14 | 125.40 | 113.83 | 113.82 | 110.31 | 107.30 | 110.26 | 106.42 |
| 47.50 | 29.52 | 209.74 | 198.60 | 196.90 | 153.55 | 133.62 | 127.78 | 126.19 |
| 46.50 | 28.89 | 137.70 | 141.38 | 136.27 | 142.44 | 134.21 | 122.25 | 121.36 |
| 45.50 | 28.27 | 124.56 | 139.18 | 139.26 | 153.42 | 147.54 | 146.03 | 145.77 |
| 44.50 | 27.65 | 135.79 | 128.61 | 119.65 | 130.03 | 127.52 | 110.44 | 113.45 |
| 43.50 | 27.03 | 163.82 | 162.04 | 165.71 | 149.49 | 147.72 | 142.64 | 153.94 |
| 42.50 | 26.41 | 232.05 | 218.11 | 201.05 | 189.37 | 170.22 | 143.42 | 143.67 |
| 41.50 | 25.79 | 172.76 | 238.53 | 251.09 | 183.49 | 183.28 | 150.27 | 146.10 |
| 40.50 | 25.17 | 164.90 | 157.94 | 145.71 | 122.88 | 112.00 | 110.34 | 109.76 |
| 40.50 39.50 | 24.54 | 153.29 | 148.25 | 144.86 | 145.92 | 141.98 | 141.12 | 141.48 |
| 39.50 38.50 | 24.34 23.92 | 135.29 | 148.23 | 132.61 | 143.92 | 133.59 | 133.19 | 136.40 |
| 37.50 | | 106.81 | 101.14 | 99.12 | 99.38 | | 88.66 | |
| | 23.30 | | | | | 91.37 | | 94.01 |
| 36.50 | 22.68 | 112.74 | 105.66 | 106.95 | 106.63 | 104.59 | 99.37 | 105.03 |
| 35.50 | 22.06 | 124.53 | 118.33 | 119.61 | 108.32 | 108.81 | 105.07 | 108.43 |
| 34.50 | 21.44 | 93.55 | 90.91 | 97.70 | 93.25 | 87.85 | 87.32 | 85.25 |
| 33.50 | 20.82 | 127.05 | 126.56 | 126.64 | 119.80 | 118.67 | 118.12 | 117.52 |
| 32.50 | 20.19 | 105.13 | 97.22 | 95.95 | 93.67 | 93.81 | 91.13 | 92.35 |
| 31.50 | 19.57 | 100.96 | 106.52 | 105.01 | 103.61 | 99.08 | 103.34 | 97.59 |
| Median | | 131.76 | 128.61 | 130.16 | 129.84 | 125.71 | 121.20 | 119.48 |
| Mean | | 138.21 | 137.70 | 136.32 | 131.01 | 126.79 | 122.14 | 121.78 |
| Maximum | | 236.68 | 238.53 | 251.09 | 189.37 | 183.28 | 170.96 | 168.88 |
| Minimum | | 89.43 | 90.91 | 90.08 | 86.89 | 84.95 | 86.52 | 83.03 |
| Standard Dev | intion | 31.47 | 33.54 | 31.69 | 23.21 | 22.95 | 20.45 | 20.54 |

Table 2.4: Reach average channel widths by year for the study area. All values are in meters.

- denotes a reach with partial or no aerial imagery coverage

| Table 2.5: Reach average channel widths by year for a 15 km segment of river near Fort Bottom. | average chani | nel widths | by year fo | r a 15 km | segment o | f river nea | r Fort Bott | om. | | |
|--|---------------|------------|------------|-----------|------------|--|-------------|-----------|--------|--------|
| | | | | Re | each Avera | Reach Average Active Channel Width (m) | Channel V | Vidth (m) | | |
| River Kilometer | River Mile | 1940 | 1951 | 1966 | 1976 | 1988 | 1993 | 2002 | 2009 | 2014 |
| 72.5 | 45.0 | 122.17 | 110.31 | 114.03 | 114.31 | 114.53 | 117.07 | 113.85 | 115.56 | 113.95 |
| 71.5 | 44.4 | 112.78 | 115.23 | 116.68 | 117.85 | 114.30 | 117.73 | 114.40 | 116.44 | 109.67 |
| 70.5 | 43.8 | 169.04 | 169.90 | 170.51 | 172.72 | 176.24 | 164.40 | 167.13 | 150.32 | 148.30 |
| 69.5 | 43.2 | 141.43 | 142.68 | 139.95 | 145.56 | 146.40 | 141.52 | 121.78 | 121.12 | 116.80 |
| 68.5 | 42.6 | 143.18 | 139.64 | 138.10 | 139.53 | 138.76 | 132.02 | 130.50 | 128.16 | 128.39 |
| 67.5 | 41.9 | 97.21 | 100.25 | 93.94 | 96.91 | 91.53 | 86.89 | 84.96 | 86.82 | 85.20 |
| 66.5 | 41.3 | 173.00 | 174.54 | 170.04 | 176.75 | 184.75 | 167.29 | 161.76 | 158.25 | 152.12 |
| 65.5 | 40.7 | 155.39 | 153.83 | 149.02 | 153.11 | 157.28 | 141.96 | 133.40 | 115.59 | 124.52 |
| 64.5 | 40.1 | 125.94 | 123.69 | 124.75 | 125.68 | 125.44 | 123.29 | 114.61 | 110.04 | 107.95 |
| 63.5 | 39.5 | 149.85 | 148.15 | 143.06 | 146.06 | 145.28 | 137.62 | 135.53 | 128.38 | 129.77 |
| 62.5 | 38.8 | 128.53 | 128.46 | 127.26 | 129.18 | 129.52 | 128.43 | 124.14 | 123.00 | 124.59 |
| 61.5 | 38.2 | 128.35 | 132.11 | 132.93 | 134.40 | 135.80 | 135.32 | 129.96 | 127.73 | 130.19 |
| 60.5 | 37.6 | 121.38 | 118.05 | 117.07 | 118.83 | 116.66 | 118.68 | 113.84 | 113.14 | 111.37 |
| 59.5 | 37.0 | 236.68 | 234.17 | 229.62 | 234.24 | 231.08 | 151.21 | 151.66 | 146.85 | 153.59 |
| 58.5 | 36.4 | 187.18 | 182.61 | 179.36 | 184.10 | 180.77 | 146.88 | 136.20 | 130.34 | 128.99 |
| Median | | 141.43 | 139.64 | 138.10 | 139.53 | 138.76 | 135.32 | 129.96 | 123.00 | 124.59 |
| Mean | | 146.14 | 144.91 | 143.09 | 145.95 | 145.89 | 134.02 | 128.91 | 124.78 | 124.36 |
| Maximum | | 236.68 | 234.17 | 229.62 | 234.24 | 231.08 | 167.29 | 167.13 | 158.25 | 153.59 |
| Minimum | | 97.21 | 100.25 | 93.94 | 96.91 | 91.53 | 86.89 | 84.96 | 86.82 | 85.20 |
| Standard Deviation | ľ | 34.83 | 34.53 | 33.46 | 34.60 | 35.52 | 20.33 | 20.79 | 17.67 | 18.23 |

CHAPTER 3

DETERMINING FLOODPLAIN FORMATION TIMING AND RATES FROM STRATIGRAPHIC AND DENDROGEOMORPHIC ANALYSES IN CANYONLANDS NATIONAL PARK, UTAH

ABSTRACT

The lower Green River has narrowed since the late 1800s and decreased channel complexity, resulting in a narrow channel with fewer active in-channel bars. I conducted stratigraphic and dendrogeomorphic analyses within a floodplain trench to describe the timing, rate and processes of channel narrowing by inset floodplain formation since 1939. I show that the channel narrowed by vertical and lateral accretion. I identified a major period of channel narrowing by vertical accretion after high peak flow years of 1983 and 1984. Narrowing was initiated by vertical accretion in the active channel, deposited by moderate floods exceeded more than 50% of the time. Vertical accretion continued in subsequent years, converting the floodplain into a periodically inundated surface. Suspended-sediment deposition dominated deposits, resulting in the formation of natural levees and floodplain troughs in both inset floodplains. Rates of deposition were highly variable, ranging from 0.03-0.50 m/yr.

3.1 INTRODUCTION

Understanding the rate, timing, and mechanisms of floodplain development is crucial for documenting the geomorphic history of a river reach. Yet, demonstrating the processes by which floodplain formation occurs is difficult. A variety of methods can be used to document floodplain formation, although no single method may be expected to provide a full set of information. Aerial photography has the advantage of broad spatial coverage, but typically contains large temporal gaps. As a result, intermediate periods of widening during a long period of net channel narrowing cannot be detected. Aerial photography also lacks information on bed and floodplain elevations. Data sets such as DEMs and LiDAR surveys are a source of repeated floodplain elevation data, but also have large temporal gaps and cover a smaller range of time (in the ~20 year range) than aerial imagery. Repeat topographic surveys have been used elsewhere to track processes of floodplain formation (Pizzuto, 1994; Moody et al., 1999); however, as Dean and Schmidt (2011) note, surveys cannot look backward in time and are only as good as the frequency of their collection. In contrast, alluvial stratigraphy can cover a greater period of time, have a high temporal precision, and provide information in areas of little to no historical documentation.

The sediments forming floodplains can record major erosional and depositional events, allowing for identification of floodplain depositional processes. An effective method to describe floodplain stratigraphy is to excavate a trench, perpendicular to the direction of flow, encompassing all geomorphic surfaces of interest. Within a trench, stratigraphic, sedimentologic, and dendrogeomophic interpretations are made to precisely determine the age of floodplain deposits. Together, these techniques can be used to identify timing, magnitude, and processes of floodplain formation. Dendrochronologic techniques have previously been applied in reconstructions of geomorphic processes (Hereford, 1984) but lacked the precision required to determine deposition rates. Improved dating techniques now incorporate anatomical responses to burial, allowing the dating of individual stratigraphic units and determination of floodplain deposition rates (Friedman et al., 2005). Floodplain dendrochronology has been used to study the timing of floodplain deposition in the Southwest, notably on the Rio Grande (Dean et al., 2011), Yampa River (Manners et al., 2014), Rio Puerco (Friedman et al., 2014), San Rafael River (Fortney, 2015) and upper Green River (Alexander, 2007).

In the lower Green River, downstream of Green River, UT, channel narrowing is evident, with native and nonnative riparian vegetation established on formerly active channel bars (Figure 3.1). A wide channel with numerous bare sand bars depicted in oblique photographs taken in the late 1800s and in aerial photographs taken in the 1940s is now a narrower river bordered by a densely vegetated floodplain. In cooperation with the National Park Service, a trench was excavated at a site on the lower Green River within Canyonlands National Park. I described the sedimentology and stratigraphy, and dated floodplain deposits by tree-ring dating. My investigation builds upon previous studies of channel change in the lower Green River (Graf, 1978; Andrews, 1986; Allred and Schmidt, 1999; Birken and Cooper, 2006) and expands the record of change by 13 years.

3.2 STUDY AREA

A trench was excavated on the floodplain at Hardscrabble Bottom, a relatively wide alluvial valley, in Canyonlands National Park (CNP) at river mile (RM) 43.5¹ (Figure 3.2). The Green River is single threaded in the vicinity of the trench with vertical banks and periodic active in-channel bars and islands. At the location of the trench, the

¹ Measured in distance upstream from the Colorado River confluence. This location reference system was established in the 1920s.

channel is relatively stable, with a bedrock canyon wall on river right and alluvial valley on river left. All potential channel change at this location is presumably confined to the left bank. Dense communities of tamarisk *(Tamarix spp.)* and willow (*Salix* spp.) dominate the floodplain vegetation. Cottonwood (*Populus fremontii*) trees are infrequent, typically mature, and generally located on higher floodplain surfaces or terraces. In the case of the study area, I use the term "floodplain" to reference flat lying alluvial landforms adjacent to river channels inundated by the current flow regime. This definition encompasses two floodplains at different elevations, both containing sediment deposited in the current flow regime. I use the term "terrace" to refer to surfaces above floodplains which have never been inundated in the present flow regime.

The Green River has narrowed near our study site since the late 1800s. Near Upheaval Wash, 1 km upstream from our trench, the channel narrowed from a wide channel in 1871 (estimated from Figure 3.1A and aerial imagery to be >270m) to 173m in 1976 and 148m in 2014. At RM 40 near Fort Bottom, channel width declined from 234m in 1914 (Graf, 1978) to 126m in 1976. Channel width declined further to 108m in 2014 (See Chapter 2 for a detailed discussion of channel width changes and the study area). Upstream at Green River, UT, peak flows and total annual flows have declined since the early 20th century and the channel correspondingly narrowed (Allred and Schmidt, 1999). In order to determine the mechanisms and temporal sequence of channel narrowing, this paper presents an evaluation of the floodplain stratigraphy exposed in a trench dug just downstream of Upheaval Wash.

3.3 METHODS

The trench, ~50 m long and with a maximum depth of ~2m, was excavated through the floodplain in August 2015. Stratigraphic units within the trench were mapped and interpreted in the field, and samples from each stratigraphic unit were analyzed for grain size by a LISST-Portable particle size analyzer (Sequoia Scientific, 2016). I collected samples from the trench, the Green River and tributaries for clay minerals analysis by X-ray diffraction to determine the bedrock source of these12 sediments. Ages of deposition for stratigraphic units were determined primarily with dendrochronology using eight tamarisk trees within the trench. I excavated trees and marked each with a nail where it intersected a stratigraphic contact.

Each tamarisk was removed for analysis at the USGS dendrochronology lab in Fort Collins, CO. I cut each tree into slabs and sanded each with sandpaper down to 15 µm. I analyzed each slab under a microscope for changes in tree-ring anatomy following the techniques of Friedman et al. (2005) for tree age, germination year and timing of burial events. The age of each deposit was determined at each stratigraphic contact by counting annual rings from the outermost ring inward. Burial was primarily determined by physical changes in tamarisk; narrower annual rings, increasing xylem size in rings, and decreased clarity of annual ring marking (Friedman et al., 2005). I compared burial timing to each stratigraphic contact to determine the age of each stratigraphic unit.

Multiple trees were dated within the same deposits and I cross-dated between multiple trees in the same deposit to increase the accuracy of floodplain deposit ages. Cross-dating compares growth rings of similar widths or physical characteristics between multiple trees. I applied cross-dating to decrease uncertainty in my ring-counting and better constrain ages of deposition. Additionally, I used cross-dating to date a dead tamarisk in a segment of the trench that did not have any live trees. A dead tree can provide an erroneous age when the tree died prior to being removed from the trench; to accurately date that tree, I related physical characteristics visible in the dead tree to live trees excavated from the trench.

Tamarisk produces distinct annual growth rings and exhibits clear anatomical transformations when buried, making it a viable tree species for dating. For recent sediment deposits of less than 100 years, counting rings is a more accurate floodplain dating method than analysis of ¹⁴C, ²¹⁰Pb and ¹³⁷Cs isotopes and optically stimulated luminescence (OSL) dating. Tree-ring methods can date the burial age of a bed to within a year, making it an effective technique to describe processes of floodplain formations across short time scales. Tree-ring analysis is the most comprehensive and accurate method for dating the majority of alluvial deposits in the trench of the available techniques to date floodplains.

I partially constrained uncertainty in tree-ring dating for some of the deposits in the trench by determining when each deposit was inundated. I calculated inundation frequency by collecting water surface elevations at the trench, and comparing those elevations to discharge measurements at the nearest gage (USGS gage 09328920, Mineral Bottom) to create a stage discharge relationship at the trench. The predictive relationship from data collected at the trench is:

$$Q = 1493.2e^{0.6658WSE} \tag{1}$$

where Q is flow (ft³/s) and WSE is water surface elevation (m). Data from trench watersurface elevations are similar to the stage-discharge relation for Mineral Bottom (Figure 3.3). I used equation 1 to determine when each stratigraphic unit was inundated, and then combined inundation information for each stratigraphic unit with the range of possible deposition ages determined from tree-ring dating to identify deposit age. This method decreased uncertainty in ages of deposition by an average of 2 years.

For the oldest deposits in the trench, samples were collected and analyzed for date of deposition by the Utah State University Luminescence Lab using the regenerative-dose procedure for single-grain optically stimulated luminesce (OSL) dating. OSL dating determines the last time sediment was exposed to sunlight, and thus, the time since deposition. This technique has large uncertainty if sediment has not been totally reset from its previous burial history, or is "partially bleached". Partial bleaching can happen if sediments are carried in turbid water or transported at night and is a common issue when dating fluvial sediments. The single-grain approach corrects for these issues by using the minimum age model of Galbraith and Roberts (2012) and can reliably date fluvial deposits (Rittenour, 2008). Two OSL samples were collected in the lowest, farthest onshore end of the trench in what were assumed to be the oldest deposits.

3.4 RESULTS

Surface topography at the trench site is a set of inset floodplains, a higher elevation tamarisk dominated floodplain (F1) and lower elevation floodplain with a mixed tamarisk-willow community (F2). A levee and trough, onshore of the levee (Figure 3.4B), are present on both flood plains. The F1 levee is located in the middle of F1 at St. 25 and there is less relief above its depression compared to the F2 levee. Offshore of the F1 levee, the floodplain is relatively flat-lying and mostly sandy. A small strip of desert olive (*Forestiera pubescens*) grows at the offshore edge of F1. The F2 levee is higher above the trough compared to the F1 levee and is located at the edge of F2 at Station² (St.) 3.

Below the surface, the trench is composed of 3 major inset deposits, two vertically accreting levee formations and an intermediate laterally accreting series of beds (Figure 3.4B). An additional small inset formed at the offshore edge of the trench at St. 0, 1m above the base of the trench. F1 is capped by a large, laterally continuous vertically accreted unit of sand deposits; F1 is inset into higher terraces. Beds in the terrace are vertically truncated by F1. I interpreted those truncations as a former cut bank. Terrace beds are fine cross-laminated fine sand and muddy fine sand.

Two beds at base of the terrace deposits dated by OSL are 300 ± 150 and 440 ± 250 years old, respectively (Table 3.1). Terrace deposits are the oldest in the trench, substantially older than F1 or F2, and the trench encompasses all 20^{th} century inset floodplain formation. Based on OSL ages, I infer the edge of the terrace was the river bank in the late 1800s and early 1900s.

Individual beds within the trench are mixed sands and muds that fine upward within distinct flood units. Units with a higher proportion of sand are tan or buff in color, are often lighter in color than mud dominated units and typically contain ripple forms. Small beds of sand occur throughout the trench, primarily at higher elevations compared to mud dominated units. Mud units generally contain highly visible laminae of red mud. Beds with a large portion of silt-and-clay are present throughout the trench, though generally, those deposits dominated at lower elevations and shoreward of levees. Generally, levee deposits are rippled cross-laminated fining upward units with a higher

 $^{^{2}}$ Station refers to distance along the trench from the end closest to the river. The trench begins at St. 0 and ends in a terrace at St. 50.

proportion of sand, which fine onshore into a floodplain trough. Trough deposits are primarily composed of fine, silt-dominated laterally continuous sediments with small laterally continuous beds of sand. Beds near the surface of the floodplain are extensively bioturbated and weathered.

I identified four major depositional facies in the trench: (1) floodplain, (2) channel margin, (3) active channel and (4) large flood deposition (Figure 3.4C). Beds were identified by texture, color and sedimentary structures, if present. I additionally used bed shape and bed orientation as an identifier; levee deposits have a convex shape, beds in the trough have a concave shape, and bank-attached bars dip offshore. Boundaries between beds are typically distinct. Unit descriptions for each individual bed interpreted in the trench are organized by facies in Appendix 1.

3.4.1 Floodplain Facies

The floodplain facies represents deposition and floodplain growth by creation of a natural levee and subsequent vertical accretion of both levee and trough. The characteristics of levees and troughs are very distinct from each other. Levees are constructed of coarse cross-laminated, sand dominated, units fining onshore into a floodplain trough (Figure 3.5A and B). Individual beds in the levees typically fine upward. The F1 levee is tan sand, rippled cross-laminated forms migrating onshore. Supercritically climbing ripples are present as well (Figure 3.5B). The F1 levee is capped by the overbank depositional component. In F2, the levee contains tan cross-laminated sand beds that dip onshore and downstream. Sedimentary structures disappear as the levee transitions into the trough.

Trough deposits are primarily fine horizontally laminated silt-and-claydominated laterally continuous sediments with small laterally continuous beds of sand (Figure 3.5C and D). Trough sediments range in color from light gray to tan and distinctive beds of red sediment are present as well (Figure 3.5C). The F2 trough is a series of laminated beds dominated by silt and clay. Periodic layers of red silt-and-clay are present. The F2 trough is deposited above the active channel facies inset of F1. Where the F2 floodplain is deposited against older F1 sediments, it dips offshore. More silt-andclay is present in the F1 trough compared to the F2 trough, and layers are thinner (Figure 3.5C and D).

Levees and troughs have different grain sizes and sedimentary structures and could possibly be classified as different facies. However, since the formation of the levee means a resultant trough will form as well and levees and troughs occur together, I chose to treat them as a single facies.

3.4.2 Channel Margin Facies

This facies is indicative of deposits at the edge of a channel where sediment is regularly deposited and eroded. Texture consists of mixed sand and silt-and-clay, fining upward, bounded by unconformable contacts (Figure 3.6). Deposits are a series of inset beds, sharply truncated on all sides, generally dipping offshore (Figure 3.6B). Thin laminae of red silt-and-clay are present in multiple beds. The channel margin component truncates the F1 levee and the F1 floodplain facies and is truncated by F2 deposits. Boundaries are diffuse and consist of multiple small inset beds. The composition of beds varies, from sand to beds of laminated sand and mud (Figure 3.6C). Sand beds are rippled cross-laminated units, climbing onshore or offshore, and downstream (Figure 3.6D). I

observed multiple sedimentary structures not seen elsewhere in the trench, including flame structures near station 18 (Figure 3.6A) and a 3D bedform at St. 15.

3.4.3 Active Channel Facies

The active channel facies represents vertical deposition and floodplain formation within the active channel at the time of deposition. Beds are vertically accreted against channel margin deposits, 0.20 to 0.60 m thick and composed of mixed sand to fine sand or silt-and-clay (Figure 3.7A). Beds are horizontal or dip slightly offshore. Contacts are conformable. Sand and silt-and-clay are typically mixed within beds, occasionally, beds are composed of rippled cross-stratified sand. The active channel facies lies under the floodplain facies, forming the base of F2. A low-elevation deposit of cross-laminated sand is present at the base; it is deposited against older channel margin sediments and dips offshore (Figure 3.7B). I interpret this bed as a former bank-attached bar deposited inset of F1. Above this are massive, fining upward beds of sand and mud. This is the only lower elevation location in the trench where sand or sand dominated beds are present.

3.4.4 Large Flood Facies

This facies is indicative of floodplain building though vertical accretion during large floods. This facies forms the upper 1-1.5m of F1 sediments. Beds are primarily horizontally laminated, vertically accreting tan or red sands, brecciated in the upper 0.5-1m (Figure 3.7C and D). In F1 above the floodplain trough, deposits are mostly brecciated red sand and silt-and-clay. Brecciated portions contain isolated, small organic horizons near the surface (Figure 3.7D). At the offshore edge of F1, complete flood cyclothems, or rhythmites, of fine sands fining upward into silt-and-clay, are present.

Above the F1 levee are supercritically climbing ripples, migrating onshore and downstream. The offshore edge of the facies is truncated by F2 deposits.

3.4.5 Grain Size

The majority of sediment samples measured by the LISST-Portable were siltdominated; samples were 70% silt on average. The only samples with a proportion of sand greater than 90% are in the terrace where OSL samples were collected. The active channel, channel margin and large flood facies have similar median grain sizes: 0.05mm, 0.05mm, and 0.07mm respectively. In the floodplain component, levee samples have a median sand grain size of 0.05mm. The finest samples are in the floodplain trough and have a median sand grain size of 0.02mm. Trough samples are on average 13% clay; all other locations in the trench 5% or less clay. The mean sand percentage is 8% in troughs; all other facies and floodplain levees have mean sand proportions of between 22-37%. No gravel is present in the trench. The median grain size collected for each facies is finer than the median grain size of suspended sediment, bed sediment and bar sediment physical samples (Figure 3.9)

Clay mineral analysis shows that differences in chemical composition mirror differences in color (Table 3.2). Red clays are primarily illitic, and are locally sourced, correlating with samples collected from Upheaval Wash, 1 km upstream from the trench. Darker, gray beds of clay contain fractions of smectite, and share physical characteristics with samples collected from the Green River and in the Price River. The majority of deposits in the trench are transported from upstream sources, but horizontal laminae of red sediment present in the trench demonstrate that locally sourced material is part of inset floodplains.

3.4.6 Timing and Rate of F1 Growth

The higher elevation F1 is composed of three different facies, the floodplain component, channel margin component and overbank deposition component. From St. 25 to St. 43, a levee and trough form the bottom half of trench deposits. These deposits are sharply truncated by the channel margin component at St. 25. I interpret this as a former cut bank and channel margin. Above both the floodplain and channel margin components, the large flood deposition facies forms the upper 1m of the profile. Treering dating at St. 25 indicates a stratigraphic unconformity of 31 years between the floodplain component and overbank depositional component. I dated beds using buried tamarisk and cross-dated multiple tamarisk trees in F1 to increase accuracy, including a dead tree that germinated in the channel margin facies.

I documented small annual growth rings in 1983 and 1984 (Figure 3.10) in all trees excavated from F1. The small annual growth rings were preceded and followed by two large rings relative to the 1983-1984 growth rings. This sequence of large, small, large, growth rings is repeated in all four trees recovered from F1. Three of the four trees displayed scar tissue in a single growth ring, presumably due to insect damage. The damaged annual growth ring precedes the 1983 growth rings by 8 years in each of the three trees. Importantly, scar tissue was present in the dead tree, allowing for cross dating. I used the consistent size of annual growth rings from 1981-1986 and scar tissue in 1975 to better constrain the accuracy of tree-ring dating in F1.

The levee and trough of the floodplain in F1 accreted 1m from 1939-1952 (Figure 3.4C) and continued to accrete at an unknown rate until 1975, when a portion of the floodplain was eroded, creating an unconformity in floodplain stratigraphy. In the trough, vertical accretion continued without erosion from 1953-1982. I identified the

unconformity by anatomical changes of a tree in the levee at St. 25. The tree showed evidence of burial, a release from burial by an erosion event and then a reburial (Figure 3.11), a sequence similar to burial of an ash tree on the floodplains of the Potomac River described by Sigafoos (1964). The conversion of buried stem wood to unburied root wood is easily identifiable for the slab in 1952, with a conversion back to stem wood visible after 1975. The tree was then buried again in 1983 and new growth after that point was root wood. Erosion in 1975 was confined to the levee, as a tamarisk tree excavated 11m further onshore in the trough (St. 36) showed no evidence of erosion, vertically accreting 1.5 m from 1939-1982.

Lateral accretion of the channel margin facies from 1957-1982 narrowed the channel by at least 10 meters and accreted the floodplain vertically 1.25m. The temporal resolution for ages of the active channel deposits is relatively coarse because only one tree was excavated, and it was rotted at the center under the ground surface. Thus, we were only able to get the germination year of the tree, 1957, at the base of the active channel component. The overbank depositional component above the active channel component is obliquely continuous and we dated that sequence with other trees in F1. The oldest age of the overbank depositional component in F1 is 1983, providing an upper limit for the ages of active channel deposits.

From 1983-2015, formation of the large flood facies vertically accreted F1 1m. The beds are sandy, super-critically climbing ripple-stratified, indicating rapid deposition. I interpret this to mean floodplain deposition occurred within a small number of clustered years or a single year. Analyzing hydrologic records, high flows with the ability to deposit these large packages were during 1983 and 1984. Thus, I infer that the majority of vertical deposition on top of floodplain and active channel components occurred in 1983-1984, accreting at a rate of 0.50 m/yr.

3.4.7 Timing and Rate of F2 Growth

Two facies form F2 in the trench: the active channel component and the floodplain component. The floodplain component vertically accreted above the active channel component and both facies extend the entire width of the floodplain. We dated three tamarisk trees, at St. 1, St. 4.5 and St. 7. I was unable to cross-date between stems, resulting in uncertainty of \pm 2 years for deposit ages from tree-ring dating in the floodplain (Figure 3.12). Part of this uncertainty is due to position of the trees in F1. Trees in in the tough were buried at a later date than trees located at the levee. Constructing a chronological stratigraphic sequence requires interpolating between trees using lateral continuous stratigraphy and resolution can decline when creating a chronology for an entire sequence of deposits. Thus, some portions of the trench are dated more precisely than others and developing dates for the entire cross section required a decrease in temporal resolution and application of additional lines of evidence in addition to data from individual trees. Accounting for uncertainty, beds at the base of the floodplain are no older than 1985.

The active channel facies began deposition in 1985 as a bank-attached bar, deposited against channel margin deposits. When deposited, these beds were part of the active channel, and were inundated for greater than 50% of the time. From 1985-1986, the floodplain vertically accreted 0.23 m/yr as part of the active channel. After 1986, the amount of time floodplains were inundated decreased, and the top of the floodplain was infrequently inundated from 1987-1993. No levees were present in the active channel deposits.

After 1993, the floodplain component began to form, vertically accreting 0.12 m/yr during yearly peak flows. The rate of deposition decreased in the mid-1990s to 0.05 m/yr and the floodplain vertically accreted in this time period to an elevation where it was no longer inundated by yearly peak flows. Subsequently, the rate of deposition decreased again from 2004-2015 to 0.03 m/yr. No evidence of floodplain stripping was documented despite a 44,900 ft³/s flood in 2011, the 3rd highest flood of record since 1960.

3.5 DISCUSSION

Depositional processes observed in the trench range from deposition under regular inundation in the active channel to infrequent inundation and episodic deposition on the floodplain. Key characteristics of active channel deposition are inset beds, dipping offshore, composed of fine sediment. Floodplain deposits are distinguished by a smaller median grain size, and distinctive levee and trough sequences. Channel margin deposits are primarily identified by sharp truncations of beds in the facies on all sides and the key characteristic of large flood deposits are thick beds of horizontally laminated fine sands.

Formation of F1 and F2 occurred by a sequence of vertically and laterally accreting processes which represent different states of floodplain formation by deposition of suspended sediment. Multiple occurrences of the floodplain component show two possible channel margins at the site, one at F1 from 1939-1952 and one in F2 from 1993-2015. The majority of channel narrowing occurred in the earlier stages of floodplain formation under active channel processes. In F2, deposits transition from active channel to levee formation. That transition does not occur in the excavated F1 deposits. It is likely that the transition to floodplain happened below the base of the trench. Levee deposits are possibly due to a change in the suspended sediment relationship as deposits vertically accreted or increasing hydraulic roughness from rising vegetation density post-1985.

Germination years of tamarisk trees excavated from the trench (1940, 1957, 1985 and 1988) matched to within two years cohorts identified by Birken and Cooper (2006) – 1938, 1958, 1984 and 1986. The similarity in establishment years supports my tree-ring dating and deposition timing. I was unable to directly relate individual sediment deposits between floodplain investigations due to insufficient detail in previous work.

Similar to studies on the Powder River, MT (Moody et al., 1999; Moody and Troutman, 2000) and at Green River, UT (Allred and Schmidt, 1999) frequency of floodplain inundation declined as inset floodplain deposits vertically accreted over time. Unlike those studies, I describe an additional stage of floodplain formation, large flood deposition, during the rare flow years of 1983 and 1984, which deposited sediment uniformly across F1. Presumably, continued vertical accretion of the post-1985 floodplain will increase the elevation of F1, depositional events will become less frequent in future years, and the rate of vertical accretion will decrease until floodplain deposition solely occurs during rare years of high peak flow .

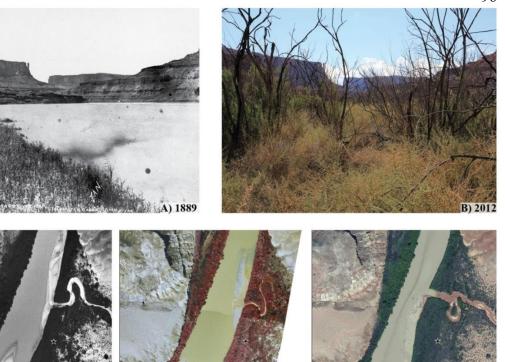
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D) 1988

Figure 3.1: Comparison of repeat photos and aerial photos at Upheaval Wash (RM 44) in A) 1889, taken by F.A. Nims showing a wide channel and channel narrowing and in B) 2012, showing floodplain growth and tamarisk defoliated by the tamarisk beetle. Aerial imagery of the same location (photo location marked by a star) in C) 1951 shows that much of the channel narrowed prior to the mid-20th century, remaining stable in D) 1988, and narrowing again prior to E) 2014.

0

* Photo Location

C) 1951

E) 2014

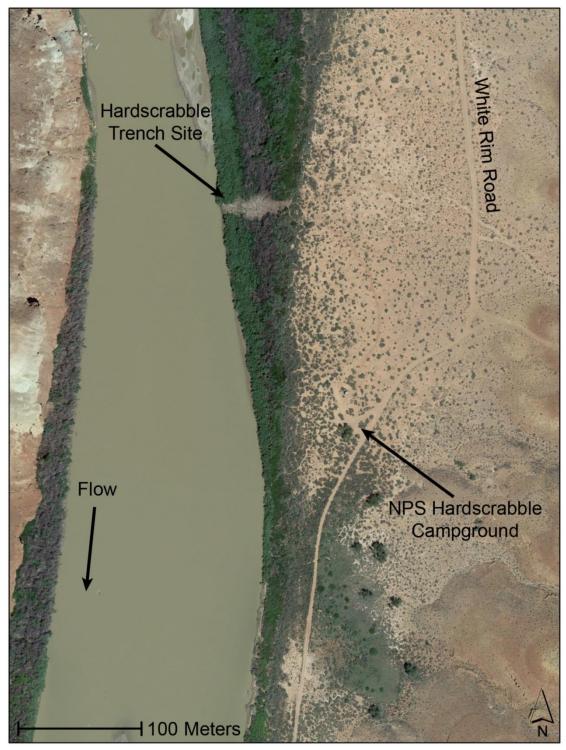


Figure 3.2: Aerial photograph taken in July of 2015, showing the trench site with cleared vegetation and immediate landmarks at Hardscrabble Bottom.

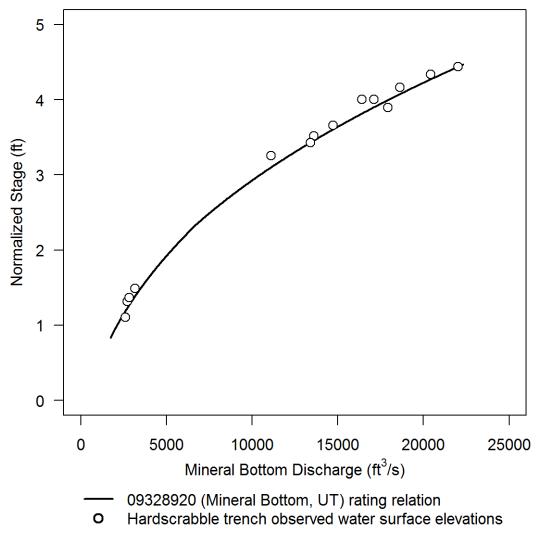


Figure 3.3: Stage discharge relation at Hardscrabble trench site compared to the USGS rating relation for discharge at Mineral Bottom. Stage at both sites is normalized to an arbitrary elevation to make direct comparisons easier.

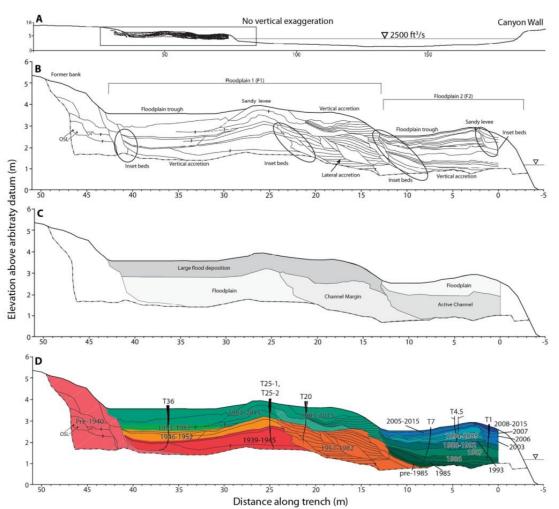


Figure 3.4: Trench stratigraphy and dendrogeomophology. A) Complete cross section profile shown with no vertical exaggeration. The box in A covers the trench and is the location of B, C and D. B) Stratigraphy and major features of the trench. The major inset beds are shown by the black circles. C) Major depositional facies identified in the trench. D) Locations of tamarisk trees removed from the trench and the timing of deposition resulting from tree-ring dating and OSL sampling.

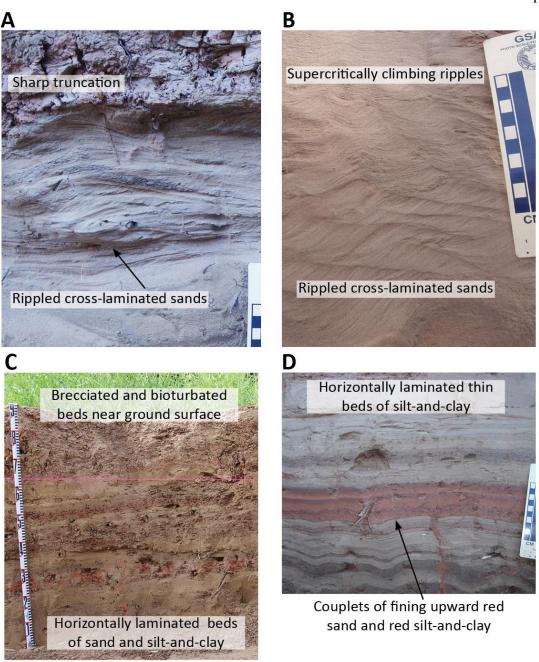


Figure 3.5: Typical sedimentological characteristics observed in floodplain deposits. A) Rippled cross-laminated sand migrating onshore, truncated sharply at top by mud. Mud-dominated beds occur periodically in the F2 levee, but are not dominant. B) Sand beds in the F1 levee. In addition to rippled cross-laminated sand migrating onshore, supercritically climbing ripples were present, showing evidence of rapid deposition. In C), the F2 trough, horizontally laminated beds of sand and mud are present, with distinctive beds of red mud. The F1 trough, D), is dominated by mud and contains few beds of sand. Presumably, red sands and muds are locally sourced.

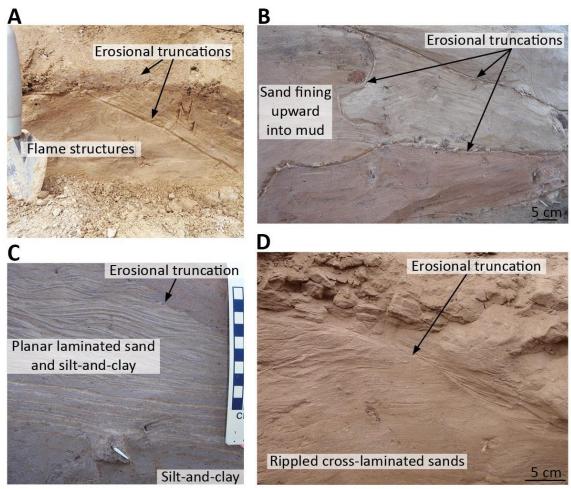


Figure 3.6: Sedimentological characteristics of the channel margin facies. A) Sharp, unconformable truncations which we interpreted as erosional boundaries. A flame structure, indicative of rapid deposition and soft sediment deformation. B) Repeated erosional truncations and sand fining upward into mud. C) Mud converting to laminated sand and mud, then transitioning to cross-laminated sand and muds, truncated at the top by mud. D) Cross-laminated sands, sharply truncated by cross-laminated sands.

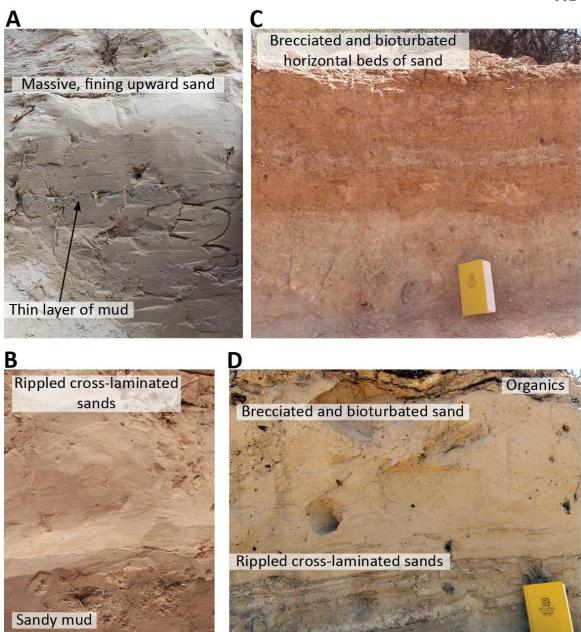
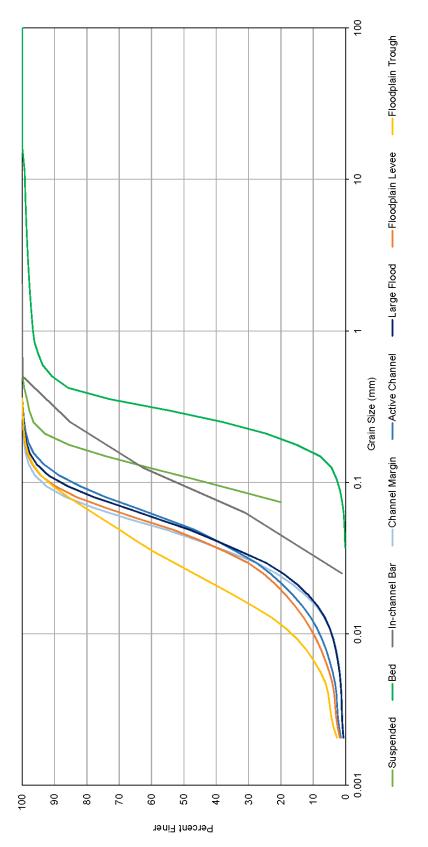


Figure 3.7: Sedimentological characteristics of the active channel and large flood facies. A) Massive, fining upward sand beds, divided by a thin layer of mud. Deposits in the floodplain conversion component generally have more mud than the floodplain component. Sedimentary structures are present (B), but are less frequent. In the overbank depositional component, sands and muds are brecciated and bioturbated near the surface. C) Horizontal beds of sand and red sand. D) Rippled cross-laminated sands at the base of the overbank depositional facies transition to brecciated and bioturbated sand at the top. Layers of organic soil horizons are present at the top of the facies near St. 25.



acoustic suspended sediment monitoring. In-channel bar sediments, in gray, were collected from exposed in-channel bars near Fort Bottom and the trench. The remaining samples were collected from the trench and represent each facies. The sediments (in shades of green) are from physical samples collected from cross-sections at Mineral Bottom to calibrate Figure 3.8: Grain-size distribution of sediments collected in the lower Green River. The suspended and bed floodplain facies is split into trough and levee to illustrate differences between the two parts of the facies.

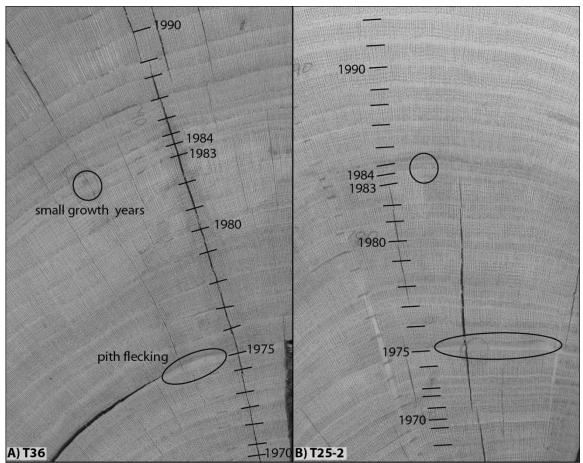


Figure 3.10: Example of cross-dating between trees. A) is a slab from T36, located in the F1 trough. Marks represent annual growth years. The sequence of pith flecking and small annual growth years is the same for A) and B), T25-2. These similar events improve tree-ring dating and decrease uncertainty in floodplain deposit ages.

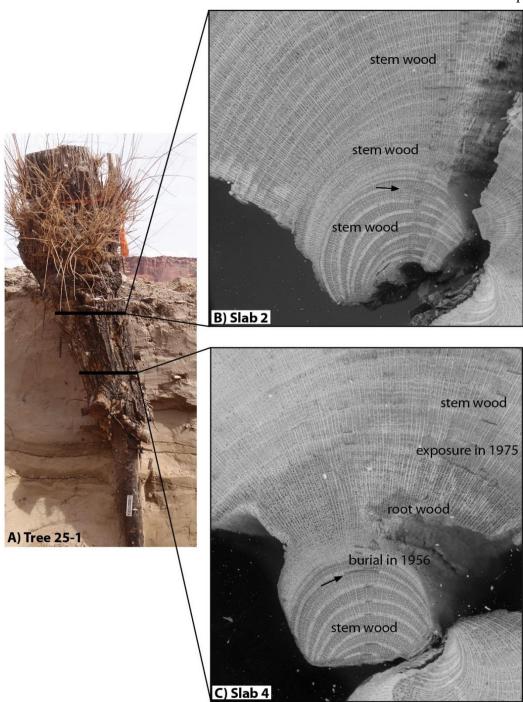


Figure 3.11: Burial and re-burial described in T25-1. The arrows in B) and C) point to the same growth year in both slabs. Slab 2 (B), near the surface, was never buried and its center is entirely stem wood. Slab 4 (C), at a lower elevation was initially buried in 1956, converting stem wood to root wood. The stem of the tree was re-exposed (likely due to floodplain erosion) in 1975 and the anatomy of the tree responded, adding stem wood. The tree was buried again in 1983.

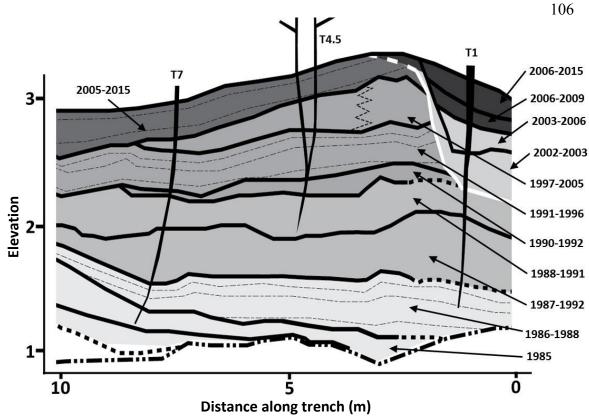


Figure 3.12: Close up of F2 segment of trench showing uncertainty in tree-ring dating of sediments. The ages of beds in F2 overlap due to the differing burial dates for T4.5 in the levee and T7 in the trough. All deposition in F2 occurred in 1985 or later. The uncertainty shown here was constrained with the stage discharge relation in Figure 3.3 to produce the ages of deposition discussed in text and shown in Figure 3.4D.

| | 2σ | 10 | 10 |
|---|--|---|---|
| | OSL age ± 2σ (ka) | 0.30±0.15 | 0.44 ± 0.25 |
| | 0D^ (%) | 71.4±15.9 | 75.2 ± 17.8 |
| | $D_E \dagger \pm 2\sigma$ (Gy) | 0.69±0.33 | 0.91 ± 0.50 |
| | Dose Rate (Gy/ka) | 2.32±0.10 0.69±0.33 71.4±15.9 0.30±0.15 | 2.05±0.09 0.91±0.50 75.2±17.8 0.44±0.25 |
| tomation. | Number of grains* | 65 (2000) | 150200 63 (1900) |
| cence Age Int | Grain Size (mm) | .150200 6 | .150200 |
| ble 3.1: Optically Stimulated Luminescence Age Information. | $\begin{array}{llllllllllllllllllllllllllllllllllll$ | 1.67 | : 1.76 |
| ble 3.1: Optica | Sample | HRD-OSL-1 1.67 | HRD-OSL-2 1.76 |

N 4 ł . • ł ÷ ł ÷ ş Table 3.1: Or *Number of grains used in age determination, total grains measured in parentheses

†Equivalent dose calculated by the minimum age model of Galbraith and Roberts (2012) ^Overdispersion represents variance in D_{E,} an OD large than 20% may indicate scatter by depositional or post-depositional processes

| ation by weight percent | Calcite Dolomite Dolomite Dol. Dol. Dol. Total Carbonate Pyrite Gypsum Hematite Chlorite group g | 6 4 3 12 0 1 1 0 45 5 2 48 12 55 illitic | 5 3 1 9 0 1 0 7 49 8 1 42 54 51 smeetitic | 5 5 3 12 0 0 1 0 51 4 1 44 11 49 illitic | 10 3 2 15 1 0 0 3 51 4 1 44 48 49 smeetitic | 7 4 3 <i>1</i> 4 0 0 0 2 59 2 2 37 47 41 interned IS | 5 2 6 12 0 0 1 0 61 2 1 36 10 39 illitic | <i>I</i> 4 1 0 0 6 68 4 2 | 9 4 3 16 0 0 0 3 65 4 1 30 36 35 intermed IS | 5 4 2 10 0 0 2 0 48 4 2 46 9 52 illitic | 8 7 1 15 0 0 0 2 56 5 2 37 42 44 interned IS | 95 0 0 | 3 0 3 5 0 0 0 0 96 0 1 3 ND 4 ND | 2 2 2 2 5 0 0 0 92 0 1 7 <5 8 illitic | 16 2 1 19 0 0 0 1 94 1 1 4 43 6 interned IS | 5 3 1 9 0 0 0 92 1 0 7 <5 8 illitic | Ank. or exc-Ca Dol. = Ankerite or excess-Ca dolomite Illite+Smectite group = total dioctahedral 2:1 layer clay: illite, mixed-layer illite-smectite, smectite, and possibly mica. Biotite group = total trioctahedral 2:1 layer clays: biotite, phlogopite, biotite/vermiculite, trioctahedral smectites Serpentine group = total trioctahedral 1:1 layer clay: serpentine-type minerals and berthierine Kaolinite group = total dioctahedral 1:1 layer clay: kaolinite, dickite, nacrite, halloysite |
|--|--|--|--|--|---|--|--|----------------------------------|--|---|--|---------------|----------------------------------|---------------------------------------|---|-------------------------------------|---|
| | | 45 | 49 | 51 | 51 | 59 | 61 | 68 | 65 | 48 | 56 | 95 | 96 | 92 | 94 | 92 | ctite, ite, tr thieri te |
| | | 0 | 7 | 0 | ю | 2 | 0 | 9 | б | 0 | 2 | 0 | 0 | 0 | 1 | 0 | lite-sme ermicul and ber alloysit |
| | Hematite | - | 0 | μ | 0 | 0 | μ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 'er ill jte/v srals ite, h |
| | unsdAÐ | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | d-lay biot mine nacr |
| | Pyrite | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | mixe opite -type ckite, |
| rcent | Lotal Carbonate | 12 | 9 | 12 | 15 | 14 | 12 | 14 | 16 | 10 | 15 | 6 | 5 | S | 19 | 9 | : illite, , phlog pentine nite, di |
| ght pe | Ank. or exc-Ca Dol. | 3 | 1 | ω | 7 | ю | 9 | 0 | б | 7 | 1 | ю | б | 0 | 1 | 1 | nite r clay viotite y: serj kaoli |
| by wei | Dolomite | 4 | ю | 5 | ю | 4 | 2 | 4 | 4 | 4 | 7 | 0 | 0 | 7 | 7 | 3 | a dolor :1 laye: clays: ł yer clay: sr clay: |
| tion | Calcite | 9 | 5 | 5 | 10 | ٢ | 5 | × | 6 | 5 | ∞ | ю | ю | 0 | 16 | 5 | ess-C liral 2 ayer :1 laye |
| forme | əzalooigalA | 2 | 5 | 7 | 4 | 9 | 7 | 8 | 9 | 7 | ю | 1 | - | 1 | б | 4 | or exc ctahec [2:1] bdral] ral 1:5 |
| RD in | K-feldspar | 7 | 9 | 8 | 9 | 8 | 6 | 8 | 8 | L | 9 | 10 | 10 | 11 | б | 4 | erite (al dio hedra octahe tahed |
| als X | Quartz | 23 | 20 | 28 | 23 | 29 | 37 | 32 | 31 | 27 | 31 | LL | 81 | 75 | 67 | 75 | = Ank = tot riocta tal trio |
| Jlay miner | bləi'i ni rolo') | Red | Grey | Red | Tan/Grey | Tan/Grey | Red | Grey | Grey | Red | Grey | Red | Red | Red | Grey | Grey | Ca Dol trite group up = total t group = tot .oup = tota |
| Table 3.2: Clay minerals XRD information b | ang sigmes | 10.7C-Red | 10.7C-Grey | 10.7 Cup | 8.7 Gsub | $10.7 \mathrm{F}$ | 34.0X | 34.0Y | 34.0W | 34.0Z | GR1 | UPH1 | UPH2 | UPH3 | PRI | PR2 | Ank. or exc-Ca Dol. = Ankerite or excess-Ca Illite+Smectite group = total dioctahedral 2: Biotite group = total trioctahedral 2:1 layer c Serpentine group = total trioctahedral 1:1 layer Kaolinite group = total dioctahedral 1:1 layer |

CHAPTER 4

CONCLUSIONS

The lower Green River substantially narrowed in the 20th century, based on analysis of aerial imagery, stratigraphy and dendrogeomorphology, hydrologic data and channel cross-section surveys. Narrowing occurred as increasing water development decreased peak flow magnitude and raised baseflow magnitude. Changes to flow regime reduced the amount of sediment transported, decreased the area of regularly inundated channel and scours less vegetation than in the early 20th century. These processes all contributed to floodplain formation, resulting in channel narrowing. Climatically driven declines in precipitation and increases in temperature decreased total annual runoff during the same time period, contributing to narrowing. Channel narrowing occurred in several phases in the 20th century, beginning in the 1930s and continuing in the 21st century. Decreases in channel width happened after a change in flow regime or in a period of low flow following multiple years of peak flow. The primary mechanism of narrowing was vertical accretion, forming floodplains inset within older floodplain deposits. Decreases in width also occurred by the conversion of mid-channel bars to islands and the abandonment of side channels. Establishment of non-native tamarisk in the lower Green River may have promoted floodplain formation by stabilizing banks and inducing greater deposition.

Decreased channel widths in the lower Green River results in channel simplification because the variability of width decreases and multi-threaded channels are reduced to single channels. Channel complexity may be a proxy for fish habitat (Schmidt and Brim Box, 2004), and simplification of the lower Green River may represent a decrease to available fish habitat (Bestgen and Hill, 2016). To restore channel heterogeneity, future management strategies must be focused upon preserving the current snowmelt flood magnitude, coupled with management of both native and non-native riparian vegetation.

4.1 MANAGEMENT RECOMMENDATIONS

In order to limit channel narrowing and potentially restore a more active channel, I recommend multiple management strategies for Canyonlands National Park: a) collaboration and partnership with upstream water managers and fisheries managers on a flow regime beneficial for CNP, and b) active management of native and non-native riparian vegetation.

4.1.1 Collaboration and partnership with upstream water managers, fisheries managers and other invested parties

Currently, flow regime in the middle Green River, downstream of FGD, is managed to benefit endangered fish species, the Colorado pikeminnow (*Ptychocheilus lucius*) and the razorback sucker (*Xyrauchen texanus*). Maintaining the geomorphic attributes of the channel produced by the natural flood regime and preserving the natural hydrograph is a priority for managers in the middle Green River (Bestgen, 2015; Bestgen and Hill, 2016). These management plans focus on native fishes in the middle Green River and do not extensively consider the lower Green River. Additionally, current flow regime plans do not take into account other aspects of the river corridor, such as the restoration of riparian cottonwoods (Scott and Miller, 2017). Contemporary channel widths and emergent bars are maintained by the current flow regime, and preserving the current flow magnitude and timing will help to preserve channel width and limit channel narrowing. Increasing the frequency and augmenting the magnitude of peak floods are the future steps most likely to increase channel heterogeneity and widen the channel. In the absence of increasing flows, and predicted future declining annual runoff, preserving as much of the current flow regime as possible and reducing the number of consecutive years of low peak annual flow will be an effective method to limit inset floodplain formation.

Flow regime in the lower Green River is determined by the upstream natural hydrograph of the Yampa River and controlled flow releases from Flaming Gorge Dam (Iorns et al., 1965; Andrews, 1986; Allred and Schmidt, 1999). Those two inputs are the largest contributors to the hydrograph at Mineral Bottom. The annual Yampa River snowmelt flood contributes the majority of water in the middle and lower Green River during the April-June spring runoff season. Controlled releases from Flaming Gorge Dam (FGD) provide most of the water flowing through the lower Green River during late summer, fall and winter. If more water is diverted or impounded from the Yampa River basin, a greater portion of the flow would come from the upper Green River, increasing dependence on controlled releases to maintain the current hydrology of the lower Green River. The full powerplant and bypass capacity of FGD is 8,600 ft³/s, limiting the ability of reservoir releases to fully replace a natural hydrograph. The inability of FGD to replicate the pre-dam hydrograph means that peak flow magnitude is largely dependent upon unregulated flows from the Yampa River basin.

Increased water development in the Yampa River basin has the potential to change the magnitude and timing of stream flow through the lower Green River and CNP. Changes would likely decrease peak flow magnitude, the timing of peak floods and the quantity of water delivered downstream, affecting geomorphic form and process. Currently, there are no plans for large scale dams or trans-basin diversions in the Yampa River basin, but increasing population and greater energy extraction is projected to decrease total runoff in the coming decades (Yampa/White/Green Basin Roundtable, 2015). The importance of Yampa River flows for the maintenance of native fishes is well understood by managers (Bestgen, 2015), creating an opportunity for collaboration.

The detailed investigation I undertook to describe timing of channel narrowing and processes of floodplain formation provides an understanding of how the lower Green River responds to change in flood magnitude and consecutive years of high or low flow. Current conditions maintain a channel with numerous active in-channel bars. To preserve the current level of channel form, snowmelt floods with a magnitude greater than 22,000 ft³/s (the 2-year flood) and duration of a week should occur at least 1 out of 3 years. A flood of this type will fully inundate in-channel features and partially inundate floodplains. Flood duration of a week is long enough for sediment to be eroded or deposited and in-channel features to be reworked. The current flow regime supports floods with this recurrence interval and does not require any shifts in the hydrologic operations of FGD. Larger floods are dependent upon natural snowmelt in the Yampa River basin and targeting specific discharges, durations, and recurrence intervals is infeasible. An environmental flow agreement that augments Yampa River floods with releases from FGD may be possible to maximize flood magnitude in high runoff years, but research focused specifically on environmental flows is needed.

Future conditions of the lower Green River are susceptible to further declines in peak flood magnitude and fewer large floods. Processes of floodplain formation show new floodplains forming in repeated years of low peak flows. A new phase of channel narrowing is probable if multiple years occur with a peak flow less than 15,000 ft³/s, similar to the post-1985 narrowing I described for the lower Green River. Current and future flow regime cannot be controlled within the boundaries of CNP, and will require collaboration with upstream stakeholders.

Maximizing a beneficial flow regime within CNP will require working closely with upstream water and fisheries managers to craft a plan which benefits the largest number of conservation stakeholders. Future work should involve applying this study and others investigating the geomorphologic characteristics of the Green River (Allred and Schmidt, 1999; Grams and Schmidt, 2002, 2005; Alexander, 2007; Manners et al., 2014) to update previous environmental flow studies (Richter and Richter, 2000; Bestgen, 2015) with the long term goal of developing an integrated conservation plan for the middle and lower Green River. Fortunately, the objectives of preserving geomorphic form and endangered fish recovery are complementary. Preserving channel heterogeneity enhances aquatic habitat, and maintaining the current flow regime assists recruitment of endangered fishes while preserving active in-channel bars.

4.1.2 Active management of native and non-native vegetation

The spread of invasive tamarisk may have altered the magnitude of floodplain formation, but did not affect the timing of channel narrowing detailed in this thesis. Thus, the efficacy of vegetation removal will be dependent upon the magnitude of subsequent snowmelt floods. Despite the widespread defoliation of tamarisk caused by the tamarisk beetle, dead stems are still present and will mediate fluvial landforms and riparian vegetation communities for the foreseeable future. Both invasive and native vegetation should both be cleared from emergent and low-elevation bars to create substrate which can be easily reworked during snowmelt floods, because the lowest portions of the inset floodplains in CNP are covered with willow, rather than tamarisk. For the goal of clearing new substrate, management of both species is the same, because both provide physically trap sediment and stabilize landforms. Clearing dead and live vegetation will create new substrate which can be modified by peak flows, but the rate of channel adjustment after vegetation removal will depend on flow magnitude, timing and duration in the years following removal.

To maximize the effects of vegetation removal, clearing of vegetation should be timed to early spring and/or early fall. Early spring removal will create bare substrate for snowmelt floods to rework. An early fall removal will clear seedlings, preventing new cohorts of vegetation from stabilizing bars. Clearing mature tamarisk will require complete removal of the tree and root system, because merely cutting trees to the ground surface will not increase bank erosion until the stump and root system decompose (Jaeger and Wohl, 2011). Because vegetation removal is labor-intensive and infeasible for the entire lower Green River, clearing will ideally be focused at locations where the flow of the river will have the greatest effect; for example, at the outside of bends and the location of former in-channel bars.

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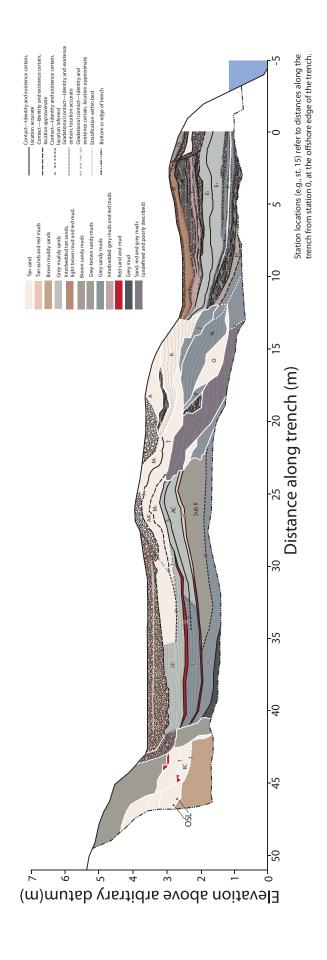
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APPENDICES

APPENDIX A. SUPPLEMENTAL STRATIGRAPHIC AND SEDIMENTOLOGICAL DATA



Description of stratigraphic units within the Hardscrabble trench

Floodplain Facies

<u>A</u>: Light brown blocky and crumbly mud and some very fine sand, organics present, faint horizontal beds of sand offshore from station 6 including 2 distinct sand layers near st. 5, discontinuous due to brecciation, no sand beds onshore from station 6, mostly mud st. 6-st.9. Some sand st. 9-12 but no bedding. Base of unit is a prominent red mud. Basal contact of A over B is wavy and sharp to diffuse. Basal contact of A over C is diffuse, includes root casts and rip up clasts (may be mud cracks).

<u>B:</u> Trough cross-laminated and laminated tan very fine sand grading onshore to muddy very fine sand; near st.3, lower half of unit is primarily horizontal laminations, upper half of unit is super critically climbing and trough cross-laminated ripples; near st. 4.5, may be evidence of multiple flood cycles evidenced by multiple sequences of horizontal laminations grading upward into ripples; ripples are symmetrical and asymmetrical (including upstream migrating ripples), muddy sand on shore from st. 5 has no ripples. Basal contact with C is sharp, irregular.

<u>C</u>: Alternating beds of grey mud that includes some red fines interbedded with very fine tan sand. Proportion of mud in unit increases onshore. Five distinct beds near st.6, three layers of grey sandy mud with sandy beds between; near st.12, unit is 3 layers with no sandy beds and large amounts of red mud are present. At least 2 brecciated beds in unit, at base and 5cm below top of unit. Trough cross-laminated ripples both onshore and offshore in sand beds at st. 3. Clay layers show evidence of cracking infilled with red muds. Basal contact st.3-st. 12 is abrupt, smooth; onshore of st. 12, contact is diffuse.

<u>D:</u> Trough cross-laminated tan very fine sand with organics in troughs primarily migrating onshore and downstream at st.3 grading onshore to laminated sand at st. 6. Basal contact over E1 is abrupt, smooth.

<u>Q1:</u> Brown fine sandy mud clearly separated and horizontally layered into at least 3 coarsening upward beds. Top of unit is a 5-7 cm bed of brown mud and organics. Upper boundary is ground surface, basal contact over Q2 is clear, slightly wavy, dipping offshore. Brecciation visible at base of Q1.

<u>Between Q1/Q2</u>: Lenticular bed of tan fine sands 2-3 cm thick, with abrupt, wavy upper contact and abrupt, wavy, conformable lower contact.

<u>Q2:</u> Brown, brecciated fining upward sandy mud with weakly visible horizontal layers. Abrupt, wavy, upper contact, basal contact over Q3 is clear, wavy.

<u>Q3:</u> Beds of trough cross-laminated coarsening upward tan sands migrating downstream above bed of light brown muddy sand. Lens of brown mud visible in tan sand, at least 4 horizontal beds visible in muddy sand. Contact between beds is sharp, wavy. Basal contact over Q4 is clear, smooth. Unit dips offshore, rising up in elevation onshore and pinching out at surface near station 1.5.

<u>Q4:</u> At least 2 sub-horizontal layers of brown sandy mud brecciated in part layered above a 2-3 cm thick layer of clean light tan sand and a layer of partly brecciated dark tan muddy sand. Beds in unit are coarsening upward. Unit dips offshore, possible on-lapping

transgressive sequence of beds, truncates all units located onshore of Q4. Pinches out at ground surface near st. 2. Basal contact is abrupt, wavy.

<u>S/AB2-4</u>: Bed of sandy mud, coarsening upward into supercritically climbing ripples migrating offshore and downstream. Basal contact is abrupt, smooth. Offshore edge is sharply truncated, onshore edge is unknown.

<u>U:</u> Three beds of red sandy mud fining upward to red mud. Unit is 9 cm thick at st. 37, thinning offshore and pinching out at st. 30, thinning onshore and pinching out at st. 41 against IIC. Contact at top is abrupt, smooth, basal contact over ZC is abrupt, smooth.

<u>ZC</u>: Horizontally laminated grey-dark grey muds, with periodic 1-2 cm beds of red mud. Very similar to ZB, but contains a greater proportion of clay. No grading observed in beds, instead they alternate. Truncates against sands at st. 42, pinches out at st. 30, basal contact over U is abrupt, smooth.

<u>YV</u>: Horizontally laminated grey-dark grey muds, similar to ZC, but contains a greater proportion of clay and thicker layers including a 6-8 cm red mud layer. Basal contact unknown, below floor of trench.

Active Channel Facies

<u>E1:</u> Grey muddy very sand fining upward with faint horizontal laminations. Basal contact over E2 is abrupt, smooth, marked by a 2 cm bed of grey mud.

<u>E2</u>: Three horizontally laminated beds of featureless grey very fine muddy sand individually fining upward to mud. Basal contact over F is diffuse, smooth.

<u>F</u>: Beds of very fine sandy mud with 1 sand bed, fining laterally into beds of grey mud vertically interbedded with red mud. Single 20-cm thick sand layer extends from st.3-st.12. Rip up clasts and brecciation visible throughout in each mud bed. Basal contact over G is diffuse, smooth from st. 3-st.9, abrupt, smooth st. 9-st. 12.

<u>G</u>: Trough cross laminated tan/buff very fine sand primarily migrating onshore and downstream. There are two fining upward sequences. Basal contact over H is clear and smooth.

<u>H:</u> Brown-grey sandy mud, structureless, fining upward twice in layer. Basal contact over undefined lower unit is diffuse, but becomes more clear onshore.

Channel Margin

<u>J</u>: Abrupt upper and lower boundaries, composed of layered sands and muds, potentially coarsening upwards.

<u>N</u>: Unit with sharp base and top composed of well-defined sand and mud layers. Isolated bedforms and lenses and thin layers of red mud present. Bed is divided by 3D bedform of trough cross-laminated sand climbing onshore and downstream.

<u>O:</u> Trough cross-laminated very fine sand unit with sharp upper and unknown lower boundary, unit dips offshore, layers within unit are flat. Grades from red at bottom to grey on top.

<u>P</u>: Bounded sharply on top and at base and truncated sharply on shoreward side by O. generally coarsens upward from mud to very fine sand and silt; laminar bedding at base, critically onshore climbing ripple structures in middle, massive at top.

Large Flood

<u>K:</u> Tan unit with sharp top and base, composed of very fine sand and mud rhythmites, extending onshore beginning 13 meters shoreward of channel edge.

L: Tan unit with abrupt top and base composed of trough cross-laminated very fine sand with indistinct direction of climb.

<u>M1:</u> Tan unit with sharp upper boundary, composed of massive very fine sand; inclusions of clasts of red and grey clay.

<u>M2/AA':</u> Laminar tan very fine sand grading upward into supercritically climbing ripples moving onshore and downstream. Upper contact is diffuse, wavy, defined by material that was broken/brecciated in place. Unit is truncated on offshore side by erosional contact. Unit grades into ZA/ZB onshore near st. 30.

<u>ZB:</u> Horizontally laminated tan sandy muds and grey-dark grey muds, with periodic 1-2 cm beds of red mud. No grading observed in beds, instead they alternate. Truncates against sands at st. 42, pinches out at st. 30, basal contact over U is abrupt, smooth.

Valley Floor

<u>IIC/OSL</u>: Beds of fine sand to very fine sandy mud, well sorted and trough crosslaminated in parts. Truncated sharply on the offshore side by ZA, ZB, ZC and YV. Basal contact and shoreward contact unknown. Upper contact is a gradual transition into brecciated beds at surface.

| | | Mana Cisa | Ctondord Deviction | 010 | 540 | 010 | 090 | 104 | 000 | 0101000 | Cited Alia and and and | Cite Datio | Cile Malinese | Total Concentration |
|---------------------------------------|-----------|-------------------|--------------------|------------------|-------------------|-----------------|-------------------|-------------------|-------------------|----------------|------------------------|------------|---------------------|----------------------|
| Stratigraphic Unit | Station | microns | microns | microns | microns | microns | microns | microns | microns | | cm ² | | ul/l | u// |
| U | 0.7 | 11.681 | 21.56 | 2.565 | 4.507 | 12.298 | 15.146 | 28.635 | 36.828 | 5.905 | 516.532 | 0.977 | 254.824 | 260.706 |
| C | ŝ | 41.169 | 83.521 | 8.888 | 12.396 | 41.096 | 64.234 | 148.821 | 182.238 | 7.227 | 280.017 | 0.638 | 231.561 | 362.899 |
| Ľ | ŝ | 43.209 | 94.048 | 7.287 | 11.137 | 47.392 | 73.942 | 168.678 | 206.363 | 10.148 | 519.334 | 0.605 | 364.362 | 602.303 |
| A | m | 46.494 | 92.255 | 8.881 | 12.59 | 53.925 | 83.78 | 165.926 | 201.678 | 9.434 | 313.408 | 0.573 | 241.147 | 420.624 |
| 0 0 | m | 56.197 | 26.452 | 32.747 | 37.765 | 58.028 | 63.619 70.000 | 82.737 | 91.978 | 1.943 | 127.834 | 0.768 | 321.863 | 419.356 |
| <u>م</u> ر | n m | 63.4U3 64.812 | 167.20 167.25 | 24.614 | 40.195 | 64.07 66.957 | 74.357 | 67.424 | 109.192 | 5.148 2.148 | C01.151 | 0.617 | 225.654 | 4.25.4/1 3.65.896 |
| 8 | e | 64.866 | 38.837 | 32.56 | 37.481 | 67.56 | 75.89 | 102.973 | 116.353 | 2.331 | 99.456 | 0.596 | 223.508 | 375.313 |
| E2 | œ | 64.444 | 37.155 | 31.285 | 40.096 | 70.091 | 77.377 | 101.124 | 113.825 | 2.473 | 147.664 | 0.575 | 292.461 | 508.852 |
| ٥ | e | 82.461 | 34.901 | 51.273 | 57.971 | 82.707 | 89.703 | 114.939 | 127.555 | 1.75 | 122.526 | 0.376 | 234.219 | 623.07 |
| E1 | m | 81.138 | 52.248 | 24.641 | 38.894 | 99.131 | 110.336 | 142.577 | 156.855 | 4.478 | 81.063 | 0.319 | 97.83 | 307.12 |
| τu | 8.7 | 34.026 | 67.496 25.884 | 6.044 | 9.011 | 40.393 | 58.162 12 566 | 117.195 | 142.604 42.0F | 9.623 | 191.301 | 0.685 | 131.1 | 191.405 206 F 03 |
| | סת | 13 / 02 | 30.684 24.151 | 0 2 503 | 4 0 2 2 | 12.020 | 13.207 | 29.132 | 20.24 | 6 705 | 4/1.998 501 203 | 0.90 | 250 AA6 | 200.005 |
| | n 01 | 23.735 | 52.257 | 5.671 | 7.969 | 23.518 | 31.457 | 76.189 | 101.99 | 5.547 | 183.856 | 0.838 | 130.718 | 155.963 |
| E2 | 6 | 36.145 | 31.106 | 15.018 | 19.427 | 38.675 | 44.674 | 66.154 | 77.09 | 2.975 | 172.638 | 0.894 | 272.222 | 304.512 |
| A | 6 | 35.76 | 74.922 | 6.707 | 9.766 | 39.868 | 60.572 | 129.086 | 158.062 | 9.031 | 377.984 | 0.663 | 264.225 | 398.566 |
| E1 | 6 | 44.487 | 36.377 | 18.519 | 24.417 | 48.554 | 55.677 | 80.547 | 93.213 | 3.006 | 226.543 | 0.807 | 383.913 | 475.517 |
| т (| б о | 44.376 | 49.717 | 15.053 | 20.499 | 49.72 | 58.925 | 92.413 | 110.582 | 3.914 | 115.258 | 0.745 | 156.344 | 209.899 |
| 0 | 6 | 80.479 | 32.974 | 51.044 | 58.091 | 82.014 | 88.558 | 111.831 | 121.619 | 1.735 | 154.089 | 0.388 | 289.268 | 745.3 |
| υu | 10.7 | 9.139 16 897 | 12.347 AA 656 | 0 2 731 | 2.583 | 10.121 | 12.487 22.064 | 22.452 61 524 | 28.115 86.662 | 8 079 | 496.898 3.45 72 | 0.998 | 202.44 | 202.765 204.448 |
|) ц | 10.7 | 21.301 | 40.679 | 5.25 | 7.542 | 22.496 | 29.227 | 60.599 | 79.348 | 5.567 | 352.453 | 0.891 | 247.128 | 277.476 |
| - | 15 | 39.112 | 47.237 | 14.881 | 19.148 | 39.917 | 48.145 | 82.87 | 102.769 | 3.235 | 355.48 | 0.808 | 488.702 | 604.852 |
| _ | 15 | 41.044 | 34.475 | 19.056 | 23.022 | 41.054 | 47.665 | 72.464 | 85.64 | 2.501 | 465.473 | 0.855 | 867.762 | 1014.434 |
| z | 15 | 41.347 | 39.368 | 17.584 | 21.788 | 42.081 | 49.702 | 78.661 | 94.188 | 2.827 | 151.945 | 0.824 | 255.731 | 310.266 |
| z | ដេះ | 40.699 | 34.214 | 17.444 | 22.575 | 43.64 | 50.309 | 72.999 | 84.896 | 2.884 | 221.697 | 0.854 | 368.608 | 431.839 |
| zc | t t | 168.26 | 34.903 36.473 | 21.637 | 33.204 30.258 | 54.8b1 | 60.869 67 219 | 83.47.2 91 127 | 101 507 | 2.202 | 261 703 | 0.701 | /11.842 /130 32 | 519.78/ 676.473 |
| |) K | 966 576 | 48.843 | 28,388 | 35 603 | 20.904 | 81 767 | 116562 | 134 243 | 2.88 | 522 135 | 0.538 | 968,008 | 1799 707 |
| . 4 | ¥ د | 70.415 | 50.296 | 31.018 | 38.099 | 74.9 | 84.904 | 120.988 | 139.369 | 2.737 | 357.337 | 0.507 | 687.42 | 1356.513 |
| × | 5 | 72.217 | 46.076 | 34.325 | 42.189 | 75.783 | 84.791 | 117.606 | 134.754 | 2.47 | 211.268 | 0.497 | 422.567 | 850.074 |
| ¥ | 15 | 75.868 | 46.544 | 36.077 | 45.123 | 79.631 | 88.923 | 121.592 | 138.267 | 2.465 | 214.499 | 0.451 | 412.973 | 915.06 |
| 0 | 18 | 20.331 | 26.683 | 6.405 | 9.263 | 22.234 | 26.707 | 44.239 | 55.209 | 4.169 | 130.222 | 0.954 | 106.211 | 111.383 |
| × | 81 | 32.292 | 32.345 | 13.048 | 16.959 | 34.682 | 40.141 | 61.6 | 73.035 | 3.076 | 279.092 | 0.908 | 373.68 | 411.595 |
| ۹. : | 99 S | 45.23 | 28.072 | 22.799 | 27.515 | 46.699 | 53.123 | 74.041 | 84.059 | 2.33 | 142.596 | 0.849 | 303.182 | 356.914 |
| z | 89 ¢ | 47.056 | 33.949 22 022 | 22.568 | 27.428 | 48.083 | 55.152 cc 02.2 | 80.27 | 92.974 | 2.444 | 216.237 102 077 | 0.81 | 450.531 205 040 | 556.467 400 776 |
| TW | 9 99 | 51.496 | 43.479 | 22.378 | 28.156 | 53,859 | 61.83 | 92.378 | 108.379 | 2.763 | 423.488 | 0.732 | 817.462 | 1116.347 |
| _ | 18 | 56.36 | 36.95 | 28.407 | 33.644 | 57.669 | 64.917 | 90:509 | 103.244 | 2.285 | 151.386 | 0.72 | 354.734 | 492.533 |
| ٩ | 18 | 67.953 | 40.059 | 34.416 | 41.203 | 70.553 | 78.51 | 106.84 | 119.476 | 2.281 | 244.633 | 0.563 | 540.308 | 959.961 |
| ď | 19 | 60.137 | 33.218 | 32.767 | 38.38 | 62.254 | 69.037 | 92.244 | 102.883 | 2.107 | 121.658 | 0.685 | 284.037 | 414.949 |
| M1 | 19 | 63.794 | 70.274 | 22.904 10.555 | 29.925 | 66.24 26.35 | 79.284 | 135.289 F8 64F | 168.294 75 520 | 3.461 2.025 | 280.559 106.66 | 0.573 | 461.897 | 806.413 250.500 |
| > × | 21.7 | 65.032 | 35.967 | 34.621 | 61.6.61 40.897 | 67.137 | 32.000 74.591 | 99.293 | 112.188 | 2.154 | 120.9 | 0.612 | 277.55 | 453.33 |
| ٨ | 25 | 36.459 | 31.147 | 13.707 | 18.775 | 41.107 | 47.734 | 69.692 | 80.559 | 3.482 | 290.632 | 0.877 | 407.991 | 465.447 |
| SUBR | 26 | 18.611 | 22.419 | 6.157 | 8.418 | 19.49 | 24.043 | 43.453 | 53.536 | 3.905 | 242.732 | 0.967 | 189.872 | 196.42 |
| SUBR | 26 26 | 21.313 | 35.374 20.24 | 7.217 | 9.805 72 767 | 20.971 | 25.549 | 50.292 60.706 | 68.778 91106 | 3.54 2.442 | 303.357 | 0.914 | 251.748 202 765 | 275.316 235.820 |
| n 🗠 | 26 | 46.817 | 32.192 | 20.973 | 27.043 | 50.998 | 57.817 | 81.037 | 91.922 | 2.757 | 202.832 | 0.798 | 379.055 | 474.857 |
| M2/AA' | 27 | 70.356 | 32.328 | 38.87 | 47.515 | 73.887 | 79.973 | 101.338 | 112.94 | 2.057 | 151.082 | 0.528 | 334.774 | 634.163 |
| zc | 8 | 11.344 | 15.116 | 2.511 | 4.349 | 12.259 | 15.221 | 28.465 | 35.168 | 6.062 | 211.349 | 0.995 | 104.426 | 104.918 |
| ZB | 8 | 16.161 | 22.283 | 3.053 | 5.886 | 18.546 | 23.874 | 42.269 | 50.766 | 7.818 | 401.885 | 0.975 | 247.782 | 254.084 |
| ZC | ¥ 2 | 22.204 | 39.906 35.035 | 5.715 0.075 | 8.341 | 23.349 | 30.223 26.775 | 61.631 | 78.981 | 5.289 | 377.64 | 0.891 | 278.541 160 FF 2 | 312.737 |
| 97 | the state | 23.454 070 h f | 28.U28 34 E.EE | 6/0.6 012 c | 5 2 2 2 | 067.91 | C//.87 | 47.30 707.05 | 91100 | 1/1.5 | 1/8/U13 | 0.945 | 7 CC. DQ1 | 720.121 |
| ZZ | 8 14 | 33.285 | 49.966 | 8.432 | 12.544 | 37.207 | 46.855 | 85.988 | 107.123 | 5.557 | 111.109 | 0.795 | 106.332 | 133.686 |
| Z | 42 | 53.882 | 36.737 | 24.612 | 32.349 | 59.05 | 66.329 | 91.106 | 102.541 | 2.695 | 151.835 | 0.709 | 279.955 | 394.645 |
| IIC | 47 | 46.938 | 26.534 | 24.517 | 30.199 | 49.565 | 55.192 | 73.617 | 82.868 | 2.251 | 140.398 | 0.853 | 308.449 | 361.585 |
| Manually Sieved Stratigraphic Unit | Station | <25 um (g) | >25 um (g) | >63 um (g) | >125 um (g) | >250 um (g) | >500 um (g) | >2000 um (g) | mass IN (g) | mass OUT (g) | | | | |
| OSL US | 45 | 0.9 | 35.4 | 194.1 | 303 | 25.3 | 0.1 | 0 | 561 | 558.8 | I | | | |
| | | | | I | I | i | i | | I | i | | | | |

Hardscrabble Trench sediment size distributions LISS T-Portable 123

| | ļ | 8 | ļ | | | | | | | | | I |
|-----------------------|----------|--|----------------|-------------|----------|----------|-----------------|---------------------------|---------------|---------------|---------|-------------|
| Stratigraphic Unit | Station | Stablon Volume concentration per state Stass.[JN] Stablon 2005, 243, 243, 243, 244, 243, 546, 65, 726, 92, 10,56, 15,83, 15,15, 12,80, 21,12, 24,95, 24,16, 24,85, 17,36, 17,55, 24,89, 1 Stablon 2005, 243, 243, 243, 244, 243, 556, 65, 726, 92, 10,56, 15,83, 15,15, 12,80, 21,12, 24,95, 24,16, 24,75 | 67.65 | 14 | DE DP | 111 41 | 131 56 | 155 36 183 47 | 21666 255 | 85 307 | 13 356 | 50 |
| U | 0.7 | 7 8.156 5.324 3.589 3.654 7.005 11.931 13.99 15.394 17.321 18.976 20.276 21.369 17.84 16.143 14.014 11.944 9.161 6.956 5.244 3.807 2.755 1.874 1.476 7 | 2.755 | | | | 0.806 | 0.536 0.279 | | | - | |
| U | ŝ | 2,731 1,813 1,248 1,29 2,514 4,541 6,014 7,069 8,815 11,19 14,132 17,395 18,143 18,565 18,082 17,311 16,402 14,122 13,086 13,412 13,825 15,049 | 13.82 | | | | 19.772 | 19.358 15.927 | 12.066 7.529 | 29 5.18 | 4.367 | ~ |
| L < | mr | 5 007 4409 2509 251 254 8932 10833 1218 1425 1555 19065 101 3305 4439 25008 5594 2664 2387 2244 22496 2215 2322 258 1 5 001 440 140 140 140 140 140 140 140 140 | 22.21 | | | | 32.14 26 6F7 | | 26.014 17.775 | | | 66 |
| ג ני | n m | 01179 2020 505 5109 686:1 2010 1 2020 1 2021 1 2021 2 2010 1 2021 2 2020 2 20 | 14.cl 71 31 | | 4 () | • • | 79.02 | | | × C | PT0.0 8 | + 0 |
| 0 0 | m | 0.027 0.02 0.017 0.022 0.058 0.167 0.403 0.61 1.075 2.051 3.794 6.342 9.053 12.093 15.461 9.437 29.211 29.557 31.59 39.288 41.781 36.102 | 39.82 | · ~ | | | 23.616 | | , ., | m | | |
| в | æ | 0 0 0 0 0 0 0 0 0.002 0.004 0.013 0.06 0.26 0.891 2.2 4.016 6.71 10.048 23.855 24.826 30.234 51.735 55.774 1 | 55.77 | | ~ | | 12.072 | | 1.135 0.474 | 4 0.272 | - | ~ |
| 8 | ŝ | 0 0 0 0 0 0 0 0 0 0 0 002 0.006 0.022 0.106 0.48 1.654 3.523 5.991 9.312 12.43 2.6473 2.5288 2.8516 46.214 49.509 59.834 4.2661 | 49.50 | | 1 | , | 16.002 | | 0 | | | - |
| 2 | mr | 2.317 3.565 5.091 6.486 7.909 9.588 12.507 19.191 24.968 36.585 60.539 78.401 88.765 67.463 . | | | | | 21.004 | 9.616 | 1.921 0.895 | 5 0.54 | | |
| 2 12 | n a | 0 0.00 0.00 0.03 0.048 0.548 0.501 2.792 4.583 1.5-34 1.5-21 2.5.202 5.503 5.503 5.504 0.501 1.5021 1.5-21 2.52 0.0011 1.755 3.108 5.386 7.013 7.380 7.188 6.600 6.600 6.723 5.503 7.653 11.787 17.707 9.8451 3.783 7.83 7.83 7 | | | | | | 4 0 | | | | n - |
| lı | 5.8 | - 60/61 ΤΡΟ-02 ΔΥ/ΤΑ 10/17 ΕΟΓΛΙ 6270 ΑΓΤΟ 1000 ΦΕΓΛ 400/ ΤΟΡΙ 1000 ΦΕΓΛ 4000 ΦΕΓΛ 4000 ΦΕΓΛ 4000 ΦΕΓΛ 4000 ΦΕΓΛ 16471 1851 11 1651 10 1250 1259 1259 1250 1250 1250 1252 1255 1255 1255 1255 | | | | | | 7.688 | | | | |
| : 0 | 6 | 8.8458 5151 3181 3037 5819 10/075 11/58 12/28 14/667 14/0/6 14/556 11/28 986 898 9839 7235 5546 44/22 3549 2761 2/271 1/771 1/58 | | | | | | 1.449 | | 17 0.258 | | . 9 |
| U | 6 | 7 7.858 4.862 3.068 2.988 5.803 10.27 12.452 13.965 16.075 18.019 19.666 21.15 18.391 17.229 15.529 13.961 11.526 9.066 7.101 | | | | | 1.628 | 1.42 1.087 | 0.807 0.484 | | - | 4 |
| L | 6 | 2.285 1.549 1.093 1.143 2.174 3.706 4.336 5.115 6.014 7.08 8.267 9.509 9.328 9.343 9.052 8.757 8.353 7.36 6.821 6.606 6.159 5.628 5.118 | | | | | | 2.866 | <u> </u> | | - I | 4 |
| E2 | 6 | 0724 0.507 0.372 0.399 0.779 1.464 2.148 2.644 3.534 4.936 6.92 9.423 12.807 16.231 20.127 25.592 35.441 35.02 33.89 31.485 22.737 15.023 9.127 | | | | | | 1.576 | 0.484 0.259 | | | 2 9 |
| 4 L | ס פ | | | | | | | 18.242 | ., c | | | 5 U |
| 1 I | n 61 | 11, 000 0000 0000 0000 0000 0000 0000 0 | | | | | | 3.92 | | L3 0.754 | | о и о |
| U | 6 | 0072 0.034 0.015 0.01 0.017 0.038 0.08 0.122 0.212 0.396 0.72 1.208 2.148 3.105 4.336 6.697 12.436 17.358 29.263 63.084 108.316 168.525 147.982 | | | | | | 19.396 | - | | | 00 |
| υ | 10.7 | 24.977 8.845 5.163 3.026 2.795 5.439 9.799 11.802 13.171 14.863 15.906 16.222 16.226 12.348 10.785 9.091 7.678 5.574 3.974 2.601 1.418 0.678 0.245 0.097 | | | | | | 0.002 (| | | Ĩ., | |
| C | 10.7 | 14.187 5.613 3.527 2.262 2.21 4.198 7.211 8.495 9.381 10.552 11.46 12.066 12.562 10.799 10.204 9.434 8.956 8.12 7.268 6.792 6.497 6.162 5.699 5.44 | | | | | | 2.951 | | | | |
| ш | 10.7 | 11.444 4.666 3.018 1.99 1.981 3.766 6.542 8.061 9.138 10.771 12.637 14.68 16.883 17.059 17.565 17.502 17.566 17.386 15.258 13.766 12.611 10.736 8.782 7.198 | | | | | | 1.4 | | 92 0.291 | ÷. | 2 |
| _ · | 15 | 6.278 2.245 1.288 0.744 0.661 1.288 2.457 3.687 4.674 6.455 9.29 13.448 18.99 2.6.876 33.827 40.159 48.421 60.699 55.091 51.48 50.433 42.121 34.77 27.068 | | | | | | 10.241 | | | | 4 1 |
| _ : | 15 | 2.47 0.868 0.498 0.283 0.255 0.515 1.184 2.261 3.215 5.178 8.935 15.319 24.661 39.252 53.446 66.772 80.291 1.65.293 108.599 104.929 80.645 59.07 40.162 | | | | | | 8.759 | | | | <u>ل</u> |
| z | 15 | | | | | | | 3.767 | | | | oo <i>r</i> |
| zz | 1 t | 1917, POLSE STUDE VELICE ENDOUR PASE INTERPIEMENT PASE VOLTE LOSS VIENT PASE VIENT PAS | | | | | | 3.148 2.050 | | | | |
| 2 0 | 15 | 2767 143 0.06 0.518 0.475 0.865 1272 2.522 3128 4151 5.587 7.381 9426 1159 1594 159 1505 1252 34 339 4315 59403 84318 92.095 88.345 88.286 | | | | | | 7.36 | 1.593 0.774 | | | |
| • 4 | 15 | 2.236 0.672 0.341 0.166 0.131 0.265 0.667 1.415 2.126 3.635 6.564 11.456 18.381 27.706 36.915 63.019 94.796 102.836 1.22.356 11.356 199.216 234.585 213.504 | | | | 4 176.78 | | 69.348 | | | | |
| ٨ | 15 | 0.119 0067 0.037 0.034 0.079 0.233 0.589 0.945 1.765 3.536 6.766 11.591 17.589 24.052 31.528 42.52 67.896 73.147 88.019 125.839 148.709 179.9 165.793 | | | | 3 140.77 | | 59.661 | | | 1.1 | |
| × | 15 | 0.062 0.034 0.019 0.017 0.038 0.107 0.263 0.418 0.773 1.539 2.934 5.027 7.921 11.151 15.2 21.741 37.512 43.544 56.159 85.183 103.356 125.858 112.665 | | | | 5 91.053 | | 33.833 | | | | ~ |
| × (| 15 | 0031 0017 0009 0008 002 0062 0171 0.287 0572 1249 2.605 4.795 7.731 00992 14.835 20.816 35.426 40.382 51.636 22.855 105.613 140.338 1301.43 | | | | 3 110.20 | | 41.258 | | | | |
| D 2 | 81 9 | 1455 U51 U50 U50 U50 U50 U50 U50 2495 5495 4547 4547 455 055 051 051 051 051 051 051 051 051 0 | | | | 0.956 | | 0.388 | | | | |
| ∠ ۵ | 18 | 0.647 0.37 0.105 0.013 0.024 0.243 0.243 0.254 0.251 0.214 0.121 0.214 0.242 0.243 0.242 0.242 0.242 0.242 0.244 0.242 0.242 0.244 | | | | 8.776 | | 2.202 | | | | a |
| . z | 18 | 0.718 0.254 0.154 0.059 0.079 0.156 0.35 0.712 1.103 1.695 3.004 5.275 8.647 1.4451 2.0389 2.751 3.8383 60.816 61.774 70.597 85.798 46.235 30.489 | | | | 18.885 | | 5.437 | | | | |
| ٩ | 18 | 1.05 0.381 0.219 0.123 0.104 0.192 0.398 0.701 0.968 1.507 2.53 4.286 6.92 11.979 16.957 22.954 32.177 50.914 53.592 58.108 65.09 54.808 42.353 27.03 | | | | 16.002 | | 4.325 | | | | 2 |
| Σ | 18 | 2.341 0.86 0.505 0.295 0.268 0.536 1.192 2.171 3.002 4.633 7.529 12.028 18.093 26.769 35.569 45.898 61.97 94.401 101.017 113.509 134.085 125.127 109.918 80.36 | | 310.001 121 | | 54.793 | | 19.578 | | | | 2 |
| | 18 | 0016 0006 0004 0003 0003 0008 0028 0039 0158 0343 0842 2002 4147 7357 11058 15845 22467 41408 45163 5268 70826 662 60258 9367 | | 60.258 | | 24.677 | 12.632 | | | | - | |
| < 0 | 18 | 007 0.033 0010 0.006 0.006 0.013 0.013 0.013 0.129 0.224 0.472 1.032 2.477 4.703 8.119 1.2081 17.288 17.752 48.257 5.027 4.644 116.813 14.4864 153615 120.391 0.000 0.000 0.000 0.000 0.000 0.000 0.013 0.012 0.012 0.012 0.012 0.012 0.012 0.012 0.012 0.012 0.012 0.012 0.01 | | 46 153.61 | | 1 85.348 | | | | | | |
| γΣ | 19 | | | 4 75.387 | | 57.614 | | 35.388 26.162 | 20.479 14.1 | 14.188 11.358 | | 22 |
| > | 21.5 | 2441 1.136 0.793 0.581 0.628 1.24 2.313 3.354 4.139 5.597 8.04 11.751 16.6 20.825 23.099 23.668 22.838 21.984 17.098 13.903 12.048 9.66 7.676 6.026 | | 7.676 | | 4.674 | , | | | | · · | 2 |
| × | 21.7 | 0.245 0.077 0.04 0.019 0.014 0.026 0.026 0.179 0.309 0.575 1.052 1.787 3.339 5.122 7.612 1.232 2.3.901 29.889 40.892 2.457 70.404 73.291 53.447 | | 04 73.291 | | 33.696 | | , . | <u> </u> | | - I | |
| Y SUBP | 22 94 | 5.23 264 1242 1244 1257 1546 1717 1342 1267 1349 14541 1342 1557 13428 1257 12425 33422 4761 20139 12582 401302 12719 12719 1252 1252 12712 12710 1 | | 3 5556 | | 9.569 | 4.62 | 2.304 1.059 0.163 0.05 | 0.543 0.259 | | | |
| SUBR | 26 | 2002 2001 2012 2012 2012 2012 2012 2012 | | 6.21 | | 4.641 | | 2.493 1.415 | | | | |
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| | | Gilit | n | | | 1 | 1 and | M | | > | 50% | 4 | | | 75 | are | | | 0 | Sa | nd | | | | | | | | | | T |
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| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | | Station 9 Strat Column | |
|-------|-----|--|-----|
| 1 | | | |
| | | Top 0 8 01 - Breacided and booky Alex Walker | |
| A | 200 | DE The Includes organics on top layer | 1 |
| A | 1 | 100 Del-Diffuse + delicult to see All contact 200 | |
| | 2 | = Mud | |
| | 175 | Layer a anchering sand I must feel | Be |
| | 11 | | u |
| C | | Bottom of laver is poundail las | |
| 4 | | the clay layer that shows | |
| | 150 | | - |
| | | + + + + + + sharp result C/F. boundary spre dom how | 1 |
| En | Es | Sent in foreign and the sent in foreign seen were also bed at | ip |
| | | -rinker bed which dou'des Eg/Ez - grey av | d |
| | 125 | | 1 |
| F2 | Nº1 | - Sequence appears to coarsen upware | 15 |
| | | - sequence appears to coarsen upwave - shalp, regular E2/F contact | |
| F | 100 | - Brece lated layers of greymill, red much and small | an |
| | | - Ripper throughout layers of greymith, red mind and small of send Reds are similar but as dear as in C - Ripper throughout layer, Climbing wedge sets - Sequence fines upward 2 | |
| G | | - Kippes throughout layer, Elimbing wedge sets | 34 |
| | 25 | Sequence fines upward 2 | x |
| | 47 | 18 in wit w/ lower trong 1 | ay |
| | | -GIH contact sharp, regular, erosional de trice | ins |
| H | | - Sandy much w/ organic rich grey in old and tom se | |
| | 50 | -Determativers possible as well as vellas bels Botham of A well defined by them types of red int | 1 |
| Undet | 1 | Bothem of H vell debred by this live of red int | 1 |
| Unit | | Formpess, dominited by mil all grey mil | - |
| | | Mud with dominated by clay (estimate > 75% clay) | |
| | 25 | - Clay is not untarmin is low stritutions of red oil to | n |
| Unde | 2 | seen in unit. Steel blue as well. | |
| | | - Highly coherve, had to small w/ thankel. Cractors uten dur | ee |
| | | - day Ebu has layer sampled for ARD analysis. | - |
| | | Mud >50% >50% Sand Mud Band | t |
| | | Mull Sand W/Sand w/Mud | |

| | 0 - | ainsize | mud | 263 | mud/w | >50% sand 1 | lω | iand | strat column |
|---|-------|------------|-----------|--------------|---|--------------|-------------|-----------------------------|--|
| | | · | ~ ~ ~ | | 1 P | | | * | Undefined layers are specific to this Station 12 |
| 4 | | | - * | | • • • | | n | | |
| | 20 - | | | - | ÷ | uno | e ruleo ; | e are not | evident |
| | | | • | | | | lefined. | - may co | stain contacts that |
| | | | | • • | × × · · | | | Jarlou and m | s sizes of sand grains |
| | 40 - | | | | A \ | | | - Packa | ge with layers of |
| | 110 | | | | | i | | | |
| | | 1 | | | Sharp et | osional, was | ry | cdSt | |
| | a. | | | | Undefi | ned, | | layers mixed | 1 in, defining contacts ly identified |
| | 60 - | | | | > diffuse. | erosional ca | ntact. | - Unit of mo | stly sand with other |
| | | 1 | | | ' | | | | |
| | | | 1 2 - | | | : | A | - bi be | use contact is clear, howen comes subjective past St. 12 |
| _ | 80 - | | | · | | - | Contact | - 0 | nit of poorly sorted sed. o structures observed use contact is clear, hower comes subjective post st. 12 |
| | | Fr. | | | | . 1 > W | auy, erosia | hal sharp - U | nit of poorly sorted cal |
| | | | | | ! | | | G OU die | d package with Hiving word sequences hipple structures observed retion and type unclear alt of an clu control curl |
| | 100 | 1 | • • • | | + | | * * * | C - 20 | word sequences |
| | | 4.4.4 | 1 r sharp | erostand | contact | | | np clasts and - San | |
| | | AM | T > diff | use crossion | d contact, rips | up clasts - | - Gray C | lay with red . | niked in |
| | 120 - | 1000 | | | E2 | | | tineng upword a | erents in both |
| | | | | | > mud layer | - separating | UnitE. | Stripes of fire | -2 very similar hure separa or of mud r unaterial, or, a series of errors in both |
| | | 1.1.1 | | | E. | | | | 7 |
| | 140 - | XXXXXXI | 1 a diffe | rse conta | id, appears e | rosional: | - | may be mud c extensively | rack features but unit is rewa |
| | | AN | C | | | | - | thin layers of | sand are observed but ver |
| | | WXXXI | 1 to | ot casts | | | - | Dayers of gr | ay clay with red fines |
| | 160 - | 3.000 | B -> diff | use conta | ct, rip updo | sts and | | | |
| | | AMA A | | | | | | | |
| | | ANA | A | | - San | d may be | intermixe | ed but no defini | clasts, roots and organics the layers are poserved |
| | 180 - | The series | | | | reworked | l'layer | of mud, rip up | clasts, roots and organics |
| 4 | | XXXX | Du Du | ff/veg. | | | | | |
| | | | | 21258 | en la | | | JIGION | 12 Strat Column |
| | | | | | | | | (LII | |

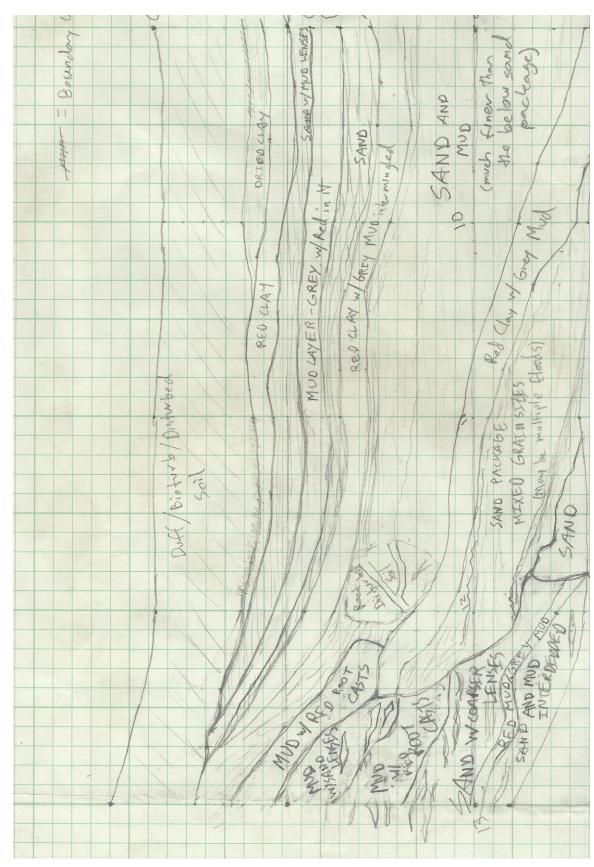
| | | | CI 1 01 |
|-------|--------|--|--------------------|
| | 200 - | TO A = a -Brecelated moderial close to ground Station 6 | Strat Colum |
| | | a Burface | |
| | | DO Mostly mud, Sand Inter-budded. | |
| 1 | | A - and rest a A Make specte appresent | |
| | 10 | | |
| | 180 - | diffuse, crossing contact | Ra |
| | | - Transition from UI UU2, U2 | fine sand |
| | | B2 - loss of right structures, planar l | i dua |
| | | the state way of the state of t | |
| | 11.0- | = 3 layers of gray mud/w red fi contact + rip up clusts with fine sand | hes inter-bedded |
| | 160 | = = = conduct + rip up closes with fine sand | |
| | | | crack features the |
| | 1 | F=- + + + + + + + + + + + + + + + + + + + | |
| | | Finite the state of the state o | throughout unit |
| | 1114 - | | |
| | 140 - | suniform, sharp contact fire grained sand, we | ell a dat |
| | | | n. Porter |
| | | - planar lamihae | 1 1. |
| | | recostonal contact - Majority sand, s | small portlan of |
| | 120 - | | |
| | 15 | Fires upward - no structure ob: | |
| 1 s | - | ······································ | served |
| 00 | | marker bed, thin layer of clay splittling | unitE |
| 4 | | manufacture sea the sad on the | |
| Heigh | 100 - | - Mostly sond with small as | 1. 1.11 |
| the | | | tion of sill |
| | 1-17- | included | |
| | | Ed = no observable structure | 101 |
| | | | In Sand |
| | 80 - | n de la companya de l | |
| | | | 1 |
| | 48- | | |
| | | 0 | |
| | | diffuse contact right classis - the day we can all the | |
| | 60 - | right chasts - Unsorted package of clay, silt, and fire sand | |
| | | - Fine red sedwart mixed with clay layers | |
| | 41 | F - Rip up clasts and proves mud fayers alterna | te with |
| | | very fire sand | |
| | | | |
| | 40 | Erosional diffuse Contract Rippled Sand large | |
| | | Prostor Contact | |
| | A. | | |
| | | G not well sorted, R | re sand mixed in |
| | 10 | | |
| | 20 - | way contact | |
| | | Mud layer colored | |
| | | structure undetermined | |
| | | | |
| _ | 0- | | |
| | 0 | | |
| | 0 | ainsize mud 250% and 250% sand sand | |

| 7 | | | | |
|--------|-------|--|----------------------------------|---------------------------|
| | | | | |
| | | Station Il Stre | t Column | |
| | | | | |
| | | » Distance from start of tree | ich (daunsloße end) = 11 m | |
| | | -> Column includes layers fro | m Berch to Ground Surface | |
| | | | | |
| | | GS clev. = 2.644 m Column height = 0.935 | 10 Cell = -2.640 | 1 |
| | | | 0.10- | - |
| | | -> Mud denotes a mixture or of siltand clay | male remined amounts | |
| | | 5 | | |
| | | | | |
| | | | | |
| | 100 - | | | |
| | | 3502AN BA | and day grant. | |
| | | A STATE | 2 | S Bisturbaled |
| | 80- | 10 Rolling | | 41101 |
| | | | Featureless mud sand layers ~ | (ripple) |
| | | 50282 10 V. | | = Fluidad Badforms |
| M | | The state of the s | Pop mud layers mixed | (plana, r) |
| [cm] | 60 - | 20×0.11 10 8000 | at day | t> Dip angle (degrees) |
| | | | Layers of mud with some | |
| height | | E | 5° bed forms | |
| - | 40- | | | |
| | | J. Jos F - Bioturba | ed red clay, possible old grand | |
| | | 1 0.00 00 Surface | e or outwash | 1. 11 11 1 |
| | 200 | | features, erosion | its with allowing |
| | 20- | | > G is ripple form at n | ud sand interfaces, layer |
| | | | narrows uphill | |
| | | 1 20° | Mostly feature less layer of mud | |
| | 0 - | 1 2 du | | |
| | | Mud >50% Muc | >50% Sand Send | |
| | | with Sand | 250% Sand Sand | |

| Image: Style Another Style Borne Style Borne Style Image: Style Borne Style Borne Style Style Image: Style Borne Style Style Style Image: Style Borne Style |
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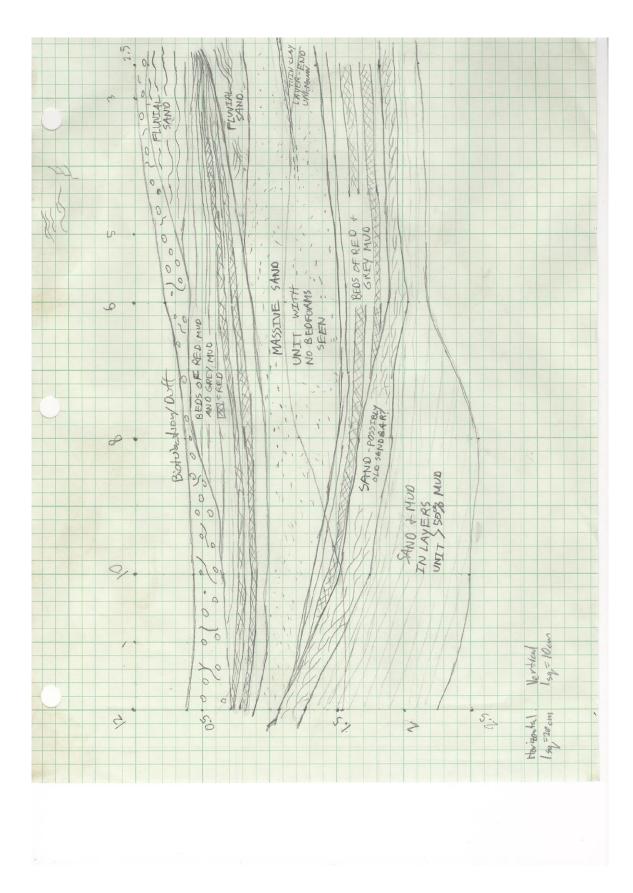
| | 200 - | 100000 | -> T |) and thus | vege | fathre | deb | rls | | 51 | ation | 5 Stra | t Colur |
|------|-------------|---------------------------|--|-------------------|-----------------|---------------|----------------|----------|--|------------------------------------|----------|-------------|---------------|
| | | NA 1 | | | | | | | | 01 | ~ 1011 | | u coluro |
| | | 1118 | | | | | 1 546 | face | | 7 | Distance | from st | talt of |
| | 180 - | 1 1 2 | | Richt | boted | grous | 10 | | eas | | | numslope en | |
| | 10 | | L | Bishu 3° clau | 1. rei | d mi | Leo . | | | 6 | F | 1 | |
| | | A | 13-3 | 5 | Hom | cont | vet | | | 7 | From a | Bottom (T | Hace to |
| | | 10 010 | | () | aric | | | | | | Trench | Dation (1 | 0) |
| | 160 - | NC 0 Y | | | | | | | | | GSela | 1.= 2.44 | 2 m |
| | 10 | 2 | | | | | | | | | | | |
| | | 12 Auril | | | | | | | | | | u. = 3.30 | 15 m |
| | | 10 | | | De. | | • • | | | Flucial : | TRal | ev. = 4.43 | 6 |
| | Artin | | d' | - | * | | 2 | æ. | | 12-30 | i Ver | w 1. 1.31 | 2 |
| - | 140 - | | - | | | | - | | | | | 2 | 4.480 |
| | | 2605 4.3 | H= -3° | Bioturs | | | ay | 1 | | | Auto | -01 | 2.442 |
| | | 121:00 | | | | T | | 10-3 | bins obse | rud mix n rued but n to show | ay be | | 1.000 |
| | | 001 2 | 12-3 | Biot | spate | d red | clau of se | hd | too thin | to show | Col | inn height= | 1.908m |
| | 120 - | | | | | | | | a Flui | ful deposit | 2 | | 3.805 |
| | | · · · · · · · · · | | | | · · | man | p. | 3º most | W deposition | h mad | | - 2.442 |
| | | PPS.PE | | 3° 8 | | | | | | logers | | | 0.863 |
| TE | | 1011.03 | 13- | 2 2 | 101-0- | | ier u | 3 | | | | Bench högh | += 0,863 |
| Cu | 100 - | | 1 | | | ··· | - (| | | - 1 14 | | Bench | |
| ight | | | | | ~ | | | | | sand with | | Bisturb | rated |
| to | | and the second second | | The second second | and and a state | the states of | and the second | K | ->10 | d layers mixed in, | | Flurial B | |
| | Barrow Anno | | And the second s | | | | | | and the second s | Jethams | -La | (ripples | s) |
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| | | | | | . ~ | | 1 | | | contact | L | | |
| | | 0.12 | | | | | | | | | 1 | > Dip an | gle (degrees, |
| | 60- | (Inter-) | | | 1. | 1 1 | | in al | layer | | | (T) mea | upslope |
| _ | | 1 (-1) | | | | | | | | | | | |
| | | a). } | L | 2/0 | | | | | mixed in, | | | * Mud d | |
| | | 1. 104 | 12 | -1 | P | | | | t visible | | | | ndetern had |
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| | 40 - | 12 2 | | | | | | | | | | | |
| | | 0 05 | | | | | - | - | | | | | 1. |
| | | 1 | | | | | | 10 | | 1230 | Fluvial | Sords w | ith stron |
| | 0.2 | the the parts | | | | | . / | interest | | 123 | ripple | torms, a | ppears to |
| | 20 - | Call Barris | | | | | | | | 19 84 | Fine | upwards | |
| | | Calles and | / | | Mud | laye | 5 | | | | | | |
| | | Mar Aller | 1> | 5° | | 0 | | | | | | | |
| | | Contraction of the second | | | | | | | | | 1 | | |
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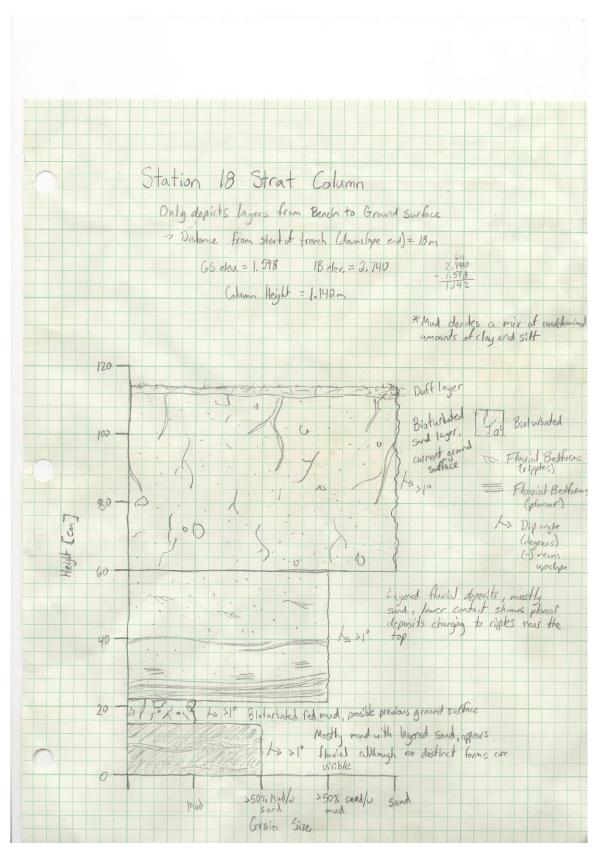




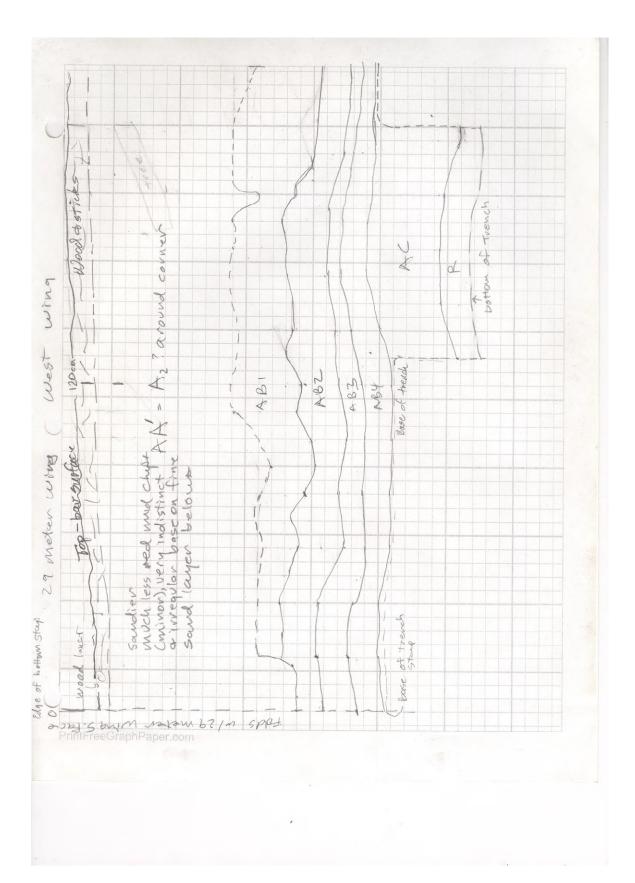
| 4 | | |
|--------|-------|---|
| | | Station 11 Strat Column |
| | | = Distance from start of trench (dawslope end) = 11m |
| | | > Column includes layers from Bench to Ground Surface |
| | | - CS clev. = 2.644 m 18 elev. = 3.576 m 3.1576 Column height = 0.932 m 932 cm -2.644 0.932 |
| | | > Mud denotes a mixture of undetermined amounts of silt and clay |
| | 10.0 | |
| | 100 - | Bisturbated clay ground Pro Richard |
| | | D. C. D. |
| | 80 - | 10 12 2 Blotwooded red clay 10 Teatweless mud sand layers mud sand layers fluxial Bedforms (ripple) |
| 1 | | 15 - 21 21 2 As 1° Bisturbaled red clay |
| [cm] | 60 - | " to the to 50 Biburbard red day to Dip angle (deeper |
| height | | Layers of mud with some Sand mixed in no detectable bed-forms |
| | 40 - | |
| | | 2 0.0, 05 to 100 Swifnee or entrash |
| | 20 - | Large sand pockets with allevial features, erosional unconformities shoul t> 15° ripple form at mid sand interfaces, laye |
| | | macrows uphill Martin to 200 Mostly feature less layer of mud |
| | 0 - | |
| | | Mud >50% Mud >50% Sand Sand with Sand with mod |

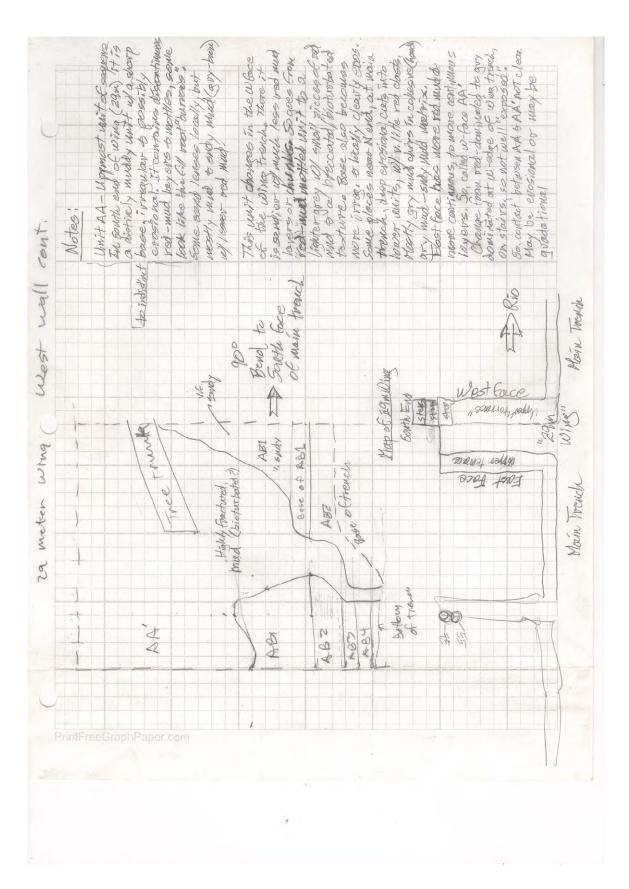
| | | - | + | - | | | - | - | | | | | - | | +++ | | | | | | | + | | | |
|------|---|----------|----------------|------|-----|----------|-------|-------|-------|-------|------|------|-------|-----|---------------------|--------|-------|-------|--------|--------|--------|--------|--------|--------|-------------|
| 922 | /15 | | | | | | | | | | 5 | la | 4101 | 4 | 15 5 | Str | at | 6 | plur | nn | | | | | 225 Alex |
| 005 | tito | sour and | 200 | de | 1ER | - | 000 | 284 | D. 17 | s, | 1.00 | 1 | C.101 | 00 | lorga | Sec. | | | | | | | | | Wal |
| 123 | 0 | -77 | | | 5.1 | | | 2 | 501 | 1 | 1 | - | Blog | . 4 | cy, brol | hen | 6 br | recia | Hee | 1 40 | pla | we | v | | U-nc |
| | | Ale . | 1:5 | 3 | 6. | the line | 1 1 1 | 5. 24 | A | | | - | Larg | e | r sand c | lasts | se | en | inn | ewor | rbed | (m | atri | x | |
| 1 | 6. | ~ A.I. | 1 | | 0 | | ~ | 2 | -5 | ncu | no; | inne | egula | r | A/K | conta | t | -e | rosia | ona | 1 | | | | |
| 200 | | int | | | - | | 1 | | 11 | - | | | 1 | + | - layer | red | fire | 2 50 | nds | an | d | me | e | | |
| | | 200 | arm and the se | 1.1 | - | - | | | | | 1 | - | | 1 | - pactes | ges | Tray | er | si | n UN | ta | over | av t | o ho | |
| 15 | | | | a | | - | | | | | | 2 | | T | - packed Finel | ing v | rpwc | und | | 1 0 10 | | T | | - ve | |
| | - | 10- 4 | | 1 | " | Ge. | - | _ | | . 2 | - | | | | - layer | s av | e la | ami | nour | | | | | | |
| 175 | 1 1 | 6. | 122 | 10. | - | | | ~ | - | - | | 1 | K | < | = Bottor | | | pa | re | 624 | he | 103 | Ional | | |
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| 150 | 5 | | * * | - | - | - | 12. | 1 | | 1 | | - | | | | 1 | | , | | | | | | | |
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| | 4 7 | | | | - | - | | | | - | | | T | + | -layer | rel n | Sand | 5 + | m | ds | | | | 1 | |
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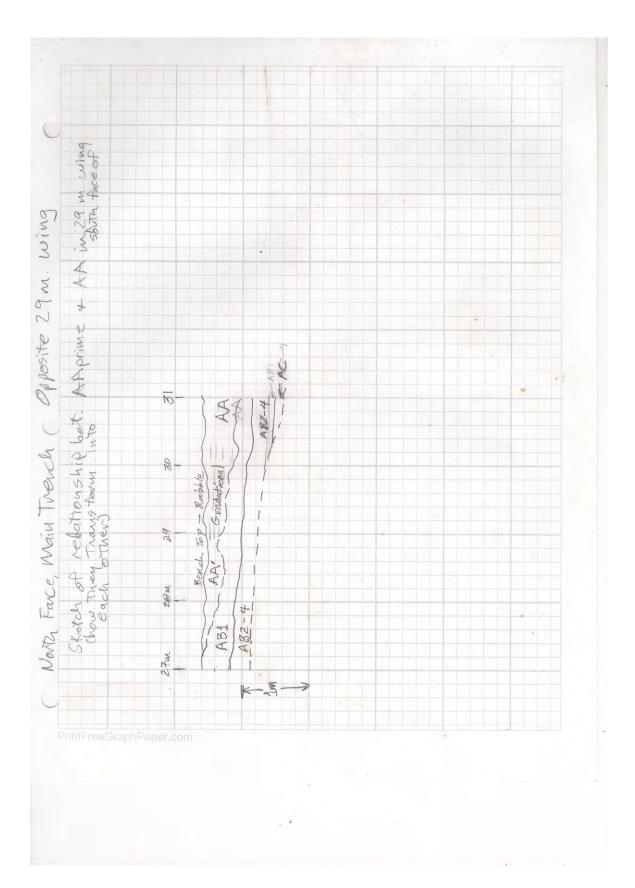


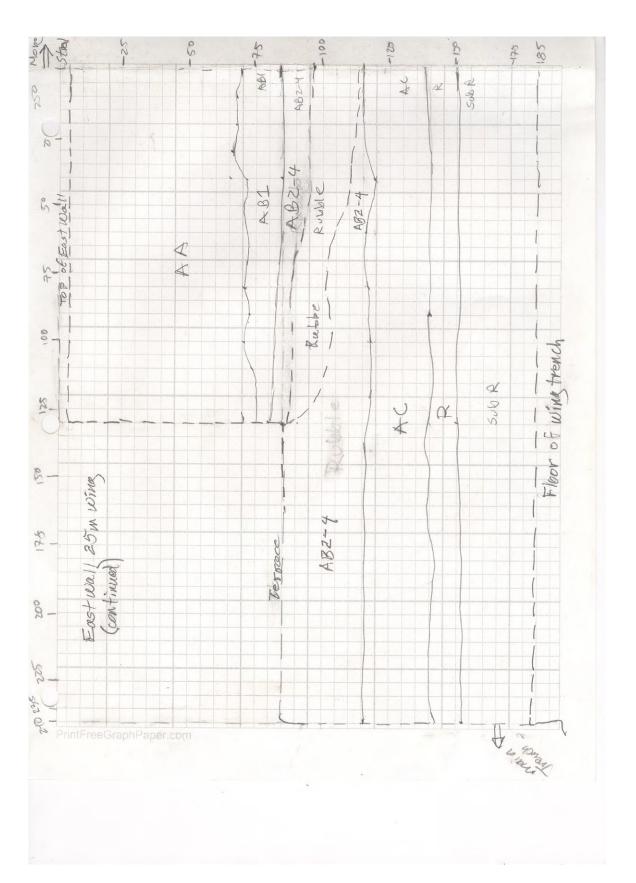


| | Green River HasdScrabble Trench | Station 18 | 9/22/15 Noter by Angus Varighan |
|--------------------------|------------------------------------|--|---|
| 2.3 Or _A " | | Crown's surface. Actual. Frindle, Pine sun) -30-40%, clasts of clasts preasult toworks - sharp crossinal contra | y at 2.45 m with no structure. Contains yellow/white sand. Gome rel clay top of with Blocky, Irecciment |
| "L" 2M | - A A A | Friable five obvioubly clin | sand deposit. Right forms present, not aling in one direction I befined, boesn't open to be exocional |
| ٣K * | | - Interbedded five sand grading upwards into more - Top of unit quite cohes. | and eloy. Bottom 10 cm dominantly clay, sand, with some gray (silt/clay?) laminations. |
| "M" 1.5 | Law | | Some place, more diffuse in athers. Boundary wavy ray of M" im (anasire). ~10-20% clusts, (subcounded to angulas) - can dram. Unit contains a 3-5 cm thick red day layer From stations 18-20 gilt/clay. Predominantly clay |
| "N ₂ " | Tou | incides bottooth A unit, grades up inantly finely lanninated fine for | NO MO SANG COMINANIN. IIP "> CM |
| ім "О" "Р" | Thu Very strue | 3 cm thick gray clay, shop eranand in the thickst continuous layer lying , three sand and silt. Alternates tures, Ripples climb offshore, criti | contact know sharp but variably view catest above. on top it "O" Catalog for miner knows of smal between luminor bedding and ripplet on shoreword cally - Poetrage truncated sharply suber by "O" |
| 0.5 | | | |
| 0, | Mud >50% Mud W/sml | >5.0% Sand Sand W/mud | |

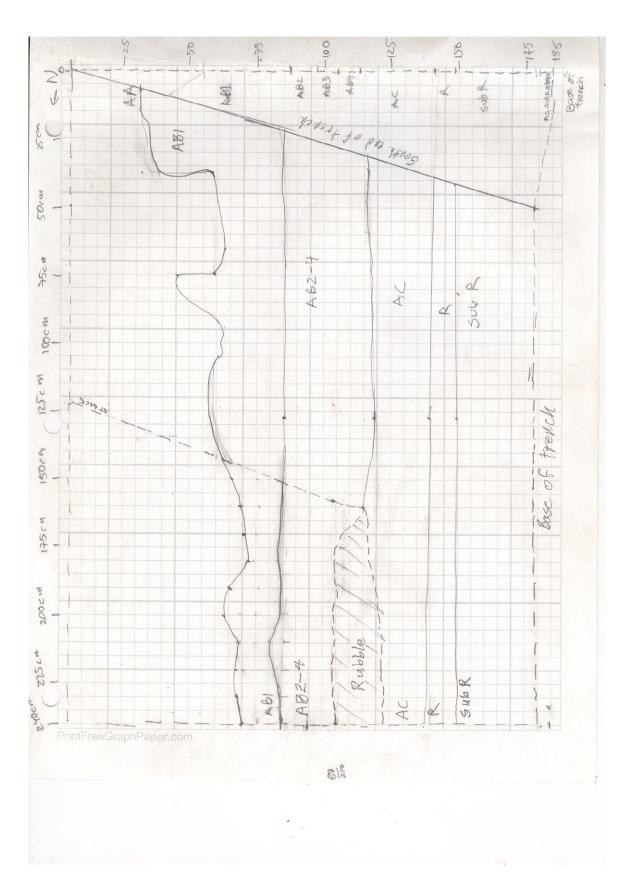


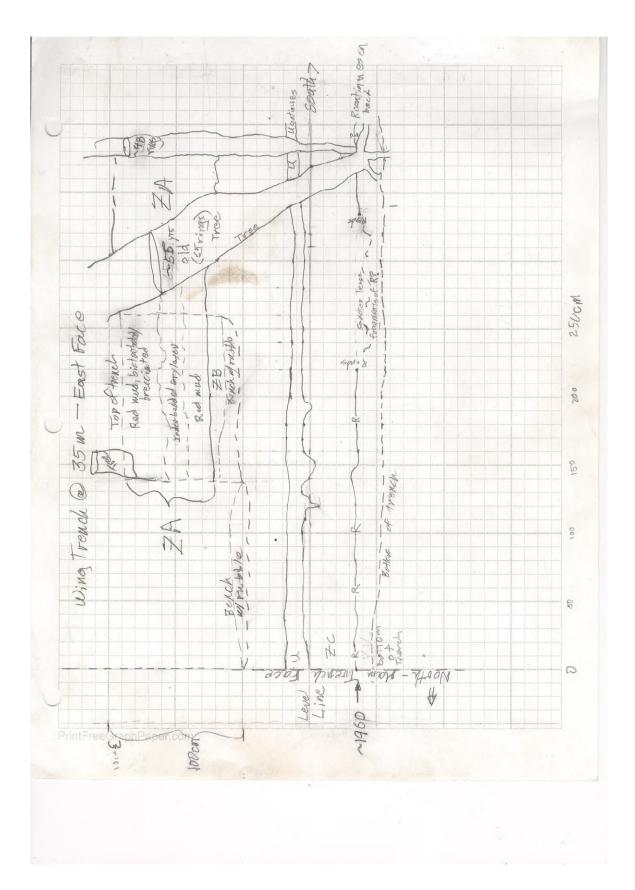


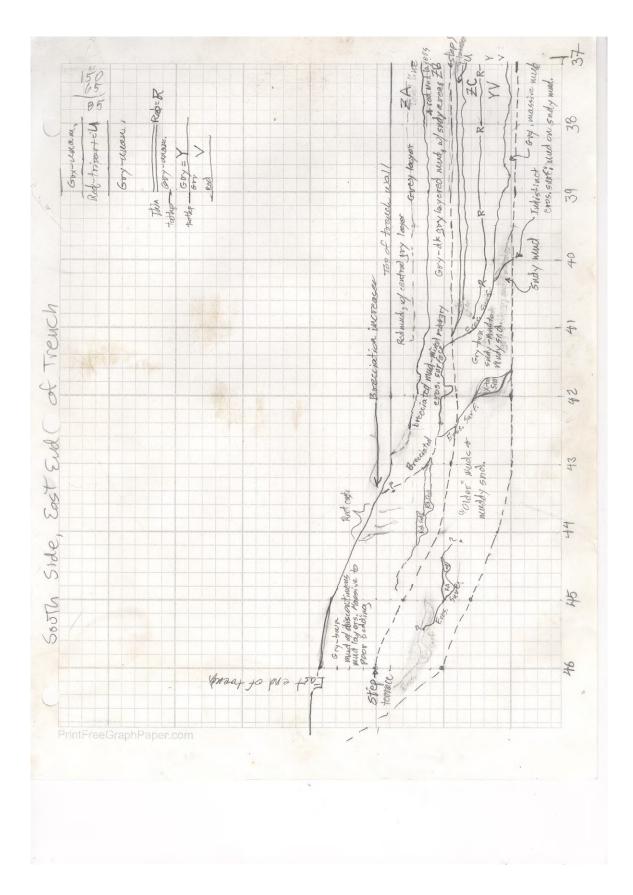


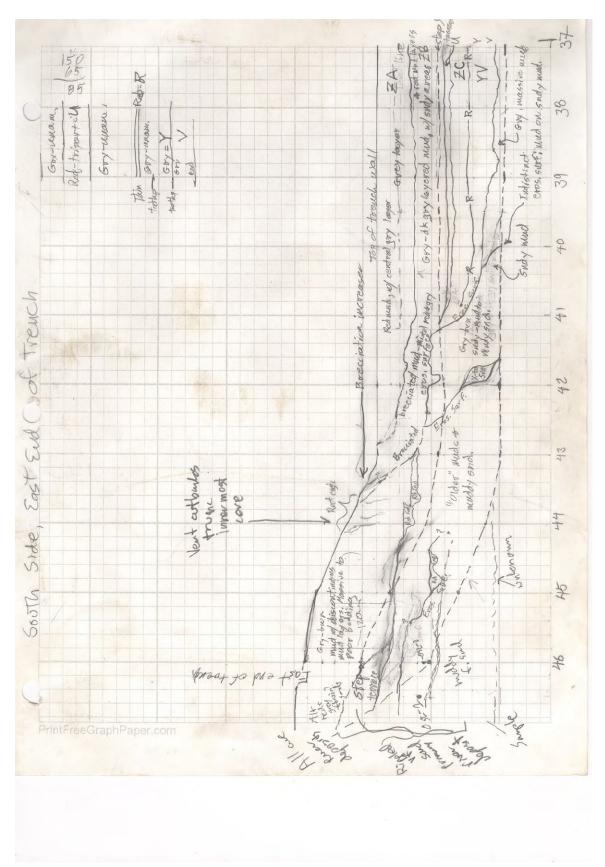


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| E | - | | | | Wond | 707 | 291 airo" | м | | | | N | |
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| | | | | 1000 | M | CUT | - Con | Deve. | | | - | 2 | |
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| | | ø | SHON IN red | (met) | Red wottle | di | | | Filer | red un | ottles! | 13 | |
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| un. v.E. snd | | - | | <u>.</u> | | 11 | tool | - | | | | go | |
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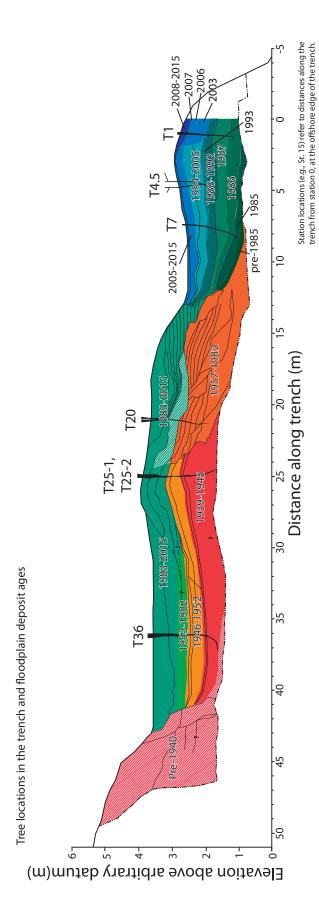


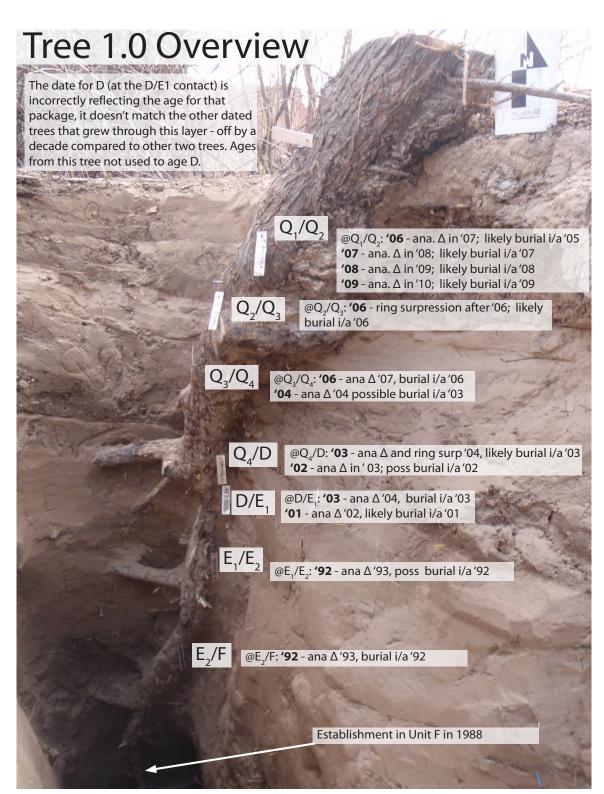






APPENDIX B. DENDROGEOMORPHIC DATA





Tree stil stretch 45900 ĺ Gem GS 6cm 1-1 06-09 Q_{1}/Q 12cm Sch ь 06 1cm 1-2 Q2/Q3 7.Scm 8cm -1-3 $\int_{-\infty}^{\infty} \lambda_{ij}$ 2 63 . 1-4. 6cm Q3/Q4 9cm 1-5. 7cm O3 13 1-6 Scm Qy/D. Fim No ol 1-7 4cm [DIE 140m

-01 1-8 Sem E. /Ez Fem 1-9 Scm 1-10 6,Scm 92 Scm 1-11 6 cm 1-12 Ben 1-13 -D-6cm E2./F. 7.5cm 1-14 1-15 8cm 7cm 90-1-16 6cm 1-17 Gen 70 1-18A 1-18B 6cm 6cm 1-19 1-20

155

00 b

dj

Ring Reader: Alex Wallcer site ID: Hardscrabble Tree ID: 1.0

Reading Date: G/7/16Collection Date: June 2015 Slab ID: ES April 2016 Slab ID: 5

enter-valios?

Ring Counts/Notes:

File Name:

of radii measured

2011

Series ID:

Wood anatomy change notes:

2015: buter most ving read 2012: rel large 2011: rel large 2010: vel small 2009: volyn xyl band 2008: midyn: xyl band 2007: mid yr xyl band 2006, zoos;, 2004: Mid yr xyl band 2003: 10 2002: midyrayl band 2001: vel large 2000: rel large 1999; . 1998:

1997: rel large

1996, faint midy xyl band 1995: O y pith

| Ring Reader: A (| ex Walk | ei |
|------------------|----------|----|
| Site ID: Hard | scrubble | |
| | | |

| Reading Date: $6/t/16$ | |
|------------------------|------|
| Collection Date: June | z015 |
| Slab ID: | |

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2015: outermost ring read 1996 indd yr, xyl bad 2012: rel large (is tall notato rel lare? 2011: rel large 1995: O-1 pith 2010: rel small, wid yo xyl bad 2009: rel lorge, wed yo xyl bad ; and s ifa 2010, pers burral i/a 2009 2008: mid yr xyl bard 2007 vel large, midyr xyl band 2006; vel large, mid yo xylem band 2005: rel large 2004: rel large, mid yo self bard 2003: mid yr xyl band 2002: mid yr xyl band 200 1: is this possibly a wild you will bound? wid boord rel large 2000 : rel large 1999 int torge 1998: 1997: vel large

Ring Reader: Alex Walter Site ID: Hardsonbble Tree ID: 10

Reading Date: 6/7-/16 Collection Date: June 2015

Slab ID: Q1/Q2

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

Stor Park 2014 : outermost ring read 2013: somi vellarge 2011: vellarge 2010: vel small, rid yr xyl band 2009: mid yr xyl band 2008: mid yr xyl band 2.007" 2006, vel large 2005: nel large 2004: wdyr xyl bad 2003', 2002: mid you all band 2001 ; vel large 2000: vel large 1998; 1997 rel lorge. 1996: Faint mid yr xyl band

1996: traint min yr xyl ban 1995: O w/ p1th - A-second stein w/pith can be seen mitting the top of this stals

ana D in '07, '08, '09, '07 ' 10 Whely burnel i/a '06, '07, '08, or 1'09

ASEE DIHER SHEETX Ring Reader: Alex Walker Reading Date: 6/7/16Site ID: Hourdscrabble Collection Date: Jure 2015 Slab ID: Q/Q2 Tree ID: 1.Q Ring Counts/Notes: -A second stem m/ pith File Name: chen be seen within the top of two slab. # of radii measured Series ID: Wood anatomy change notes: 2014: outer most ving read :2012's vel lange 1995: rel large 2011 nel large 1994! vel lange (nid yol Xyl?) 2010; rel small (about sinc size as 12) 1993: 0 -/ pith 2009: rel large 2008: rel small 2007: rel large 2006: Kl Small 2005: rel large 2a 2004's rel large 2009: vel large minudyr xyl band 2001. 2000: mid yr xyl band, ret small compared to surrounding 1999 / rel large 1998: rel large 1997: 1996:

Ring Reader: Alex Walker Site ID: Hardscrabble

Tree ID: 10

(

ť

Reading Date: 6/7/16 Collection Date: Jove 2013 Slab ID: Q2/Q3

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 2014: outermost ring read 2011: vellarge 2010: vel small 2009: vel lange wid yr xyl band 2008: wid yr xyl band 2006: vel lange; ring suppression after '06; likely burne 1/n 2005: vol lange; ring suppression after '06; likely burne 1/n 06 2005: vel large 2004: mid yr xyl band 2003; 2002: wdyr xyl band 2001: vel large 2000: rel large 1999: 1998: vel small 1997: rel large e 1996: innermost ring read 199 13 12 0

Ring Reader: Alex Walker Site ID: Hardschabble Tree ID: しの

Reading Date: 6/7/2015 Collection Date: Jure 2015 Slab ID: 7

I think that the stens switch

from the previous slab to this one

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2014; outer most why read

2012: vel large 2011. rel large 2010; relimall 2009: mild yr xyl band 2008; mid yr xyl band 2007: mid yo kyl band 2006: rel large MAD ila 2007; poss buine ila 2000 2005: vel large 2004: faint mid yr xyl band 2003: vet large 2002: mid yr xyl band 2001. rel large 2000: rel large 1999: 1998: wed yr xyl band 1997: iel large 1996: 199 Simmermost ung read, rotted inside of this rug, 45 nostly rotted out no O seen +994" in her vost ning read, wasty volled, no @ seen

Ring Reader: Alex Walter Reading Date: 6/7/16 Site ID: Hardscrubble Collection Date: June 2015 -some of the radius show better evidence of burial than others, oren burial than others, oren here pencil tres spens to show bural the best to show bural Tree ID: 1.0 Slab ID: 3 **Ring Counts/Notes:** File Name: # of radii measured Series ID: Wood anatomy change notes: 2014: outer most wing read 2012: vel longe 2011: vel longe 2010: rel grad band, and 4'10, possible bural i/a 109 2007: widyr xyl band, i 2006: vel large ; ring supp. and man offer 'DG; likely build it 'OG 2005: vel large 2004: vet small, midyr xyl band 2003: 2002: Wdyr Xyl band 2001: rel large 2000: rel large 1999; rel large 1998; 1996: Begin rot; damage sustained to stem i/a 15/146 a ar mist 15 14 $_{FL}(f) = f$ 43 (192 WO 691

162

Ring Reader: Alex Walter Site ID: Howdscrabbe

Tree ID: 1,0

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Reading Date: 6/7/16 Collection Date: June 2015 Slab ID: 4

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2010: Outer nost ving road 2009: nel lange 2009: nel lange 2006: rel lange, ana 1 OK, Ilkely burial i/a 06 2005: rel large 2004: mid yr xyl band

2003: ret smally mid yo ng/ bund 2002: mid yr xyl band 2001: mid yr xyl band 2000: rel lange

ret los

19999:

1998: 1997; vel small

1996: indistruct on some portions of circumference 1994: mod yr xyl band the formation

1991: Ow/pith, mostly volled

Ring Reader: Alex Walker Site ID: Hardscrabble Tree ID:).O

Reading Date: 6/8/16 Collection Date: June 2015 Slab ID: 5

potential other stem on this slab

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2007: outer most ving read 2006: rel longe, and 1'07, likely burial i/a '06 2005: rel longe tand '00, pors. burial i/a '06 2004: viday, xyl band 2004: viday, xyl band 2002: mid yr xyl band 2000: vel larse 1998: 1998: 1998: 1998: rel small 1998: rel small 1994: mid yr xyl band 1993: putially volled 1992: partially volled

1991: O w/ pith

Ring Reader: Alex Walker Site ID: Hardscrabble Tree ID: 1.0

Reading Date: 6/7/16 Collection Date: June 2015 Slab ID: Q3/Q4

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 2010, aternost ring read

2006: rel large , and A '06; poss burial i/a '06 2005: rel large; and A '06; poss burial i/a '06 2004: rel small comp to 06+05, font mid yr xyl band 2003: vel large ; anal ; on; poss bural i/n '03 2002: midyr xyl band 2001: rel large 2000: rel large 1999: vet lovge 1998: vel small 1997: rel smallinner nost vind read volkel inside of this & hard 1996: vet small. 1975; inner most bing read betom this, wing are no Hed and pretininary somewhat unknown and uncertain 994 11) rel-longe 1992; nel lorge 9911: rel lorge 990; Om/pitt

Act 6 in half &

Ring Reader: Alex Wonther Site ID: Hardscrabble Tree ID: 1.0

Reading Date: 6/8/16 Collection Date: June 2015 Slab ID: 6 A

Ring Counts/Notes:

4974 - X

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 2007: outermost ring read 2006: iel large

2005: vel lange 2004: rel small, vuld yr kyl band, and A. 05, pos burial i 2003: vel lange, and 104, poss burial Va. 103 2002: mid yn xyl band 2001: vel lange 1999: vel lange 1997: vel lange 1995: vel small 1995: vel small 1994: vel small, mid yr xyl band 1992: mid yn xyl band 1992: rel lange 1991: O w/ pith

Ring reader: Alex Walher Site ID: Hardscrabble Tree ID: 1,0

Reading Date: 6/17/16Collection Date: crt 6/2015reroved 1/2016Slab ID: 68

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

2004: Oxtermost ving read 2003: Hing surp + and A '04, likely bornal i/a '03 2002: mid yr xyl band i and b m '03 i rishin (/a 2002) 2000: 1999: 1998: 1998: 1997: rel large 1996: rel small 1994: vel small, mid yr xyl band 1993: rel small 1993: rel large (1992: 1991: Ow/pith Ring Reader: Abere Walber Site ID: Hand scrabble Tree ID: 1.0 Reading Date: 6/9/16 Collection Date: June 2015 Slab ID: 7

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2004: other rost ring recel 2003: rel large, and A + ring surp 04, burial i/a '03 2002: mid yr xyl band 2001: rel large 2000: rel large - mid yr xyl band 1998: rel large 1997: rel large 1996: rel small 1994: mid yr xyl band > I think that this is 59/50 a rew ving 1993: rel large 1991: O w/ pith 1990: mid yr xyl band 1981: O w/ pith

Ring Reader: Alex Walken Site ID: Hard Sciel 64 Tree ID: 1.0

Reading Date: 6/8/16 Collection Date: June 2013 Slab ID: Qy/D

Ring Counts/Notes:

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2004: Ordenmost ving read 2003: rel large, and I + ring surp '04, libeley borrial 1/a '03 2002: mid yr xyl band i and in '03; poss burind ila '02 2000: rel large 2000: rel large - mid yr xyl band? 1998 1997: rel large 1996: rel small 1995: rel small 1994: mel small, mid yr xyl band - possible new ming? lodes like a talse ring factler 1993: rel large 1992: rel large 1991: O w/ pitth 1998; 1998; 1996; 1992: rel large

Pen A. Valler 6/15/16

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Ring Reader: Bradley Colleff

Site ID: Hard Scrabble

Tree ID:

Reading Date: 6/9/16Collection Date: June 2013 Slab ID: $P/E_1 - A$

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2004: Outer most ring read 2003: and 1'04, bartal i/a '03 2002: Wild in xyl. band 2000: rel lange 2000: rel lange ind yr xyl band 1999: 1998: 1997: 1996: rel small 1995: rel small 1995: rel small 1992: rel lange comp to '94 1992: rel lange comp to '94 1991: O w/ pith 1990: wid xyl band bar tradius 1999: O w/ Dith

Ring Reader: Abex Voillier Site ID: Hordsumbble

Tree ID: \

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 2004. arter nost ring read 2005: outer most ving read and It ving surp, burial 1/a '03 2002: outermost ring read 2001: ana A'OZ, possible burial 1/a '01 2000: vel large, mid yr xyl band 1999: mid yo xyl band, vel large 1998: vel large 19977: 1 1996; vel small 1995; bel small, 1994 mid yr xyl band 1993 : relsmall comp to "95/94 1992 :... mid yo kyl bad 1992 1. 1991: Ow/ pith 1990; mid yr xyl barl 1989; O w/pith large

Reading Date: 6/10/15

\$ - poss soul the bottom of this \$

Slab ID: WE, -B

Collection Date: June 2013

Ring Reader: Alex Wolfeer Site ID: Hand scrabble Tree ID: 1.0

Reading Date: 6/17/16 É Collection Date: CUt Jure 2015 removed Apr 2016 Slab ID:

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2004. Outermost ving read 2003 i ving sup '04 burled i/a '03 2002: Not seeing the wid yr ryl spetterd dove 2001: and a '02, liktly burled i/a '01 2000: 1999: rel large 1998: 1996: rel small comp to '97 1995: rel small 1994: rel small 1994: rel small 1993: rel small, mid yr ryl barl 1992: rel large

1990: O wpith

Site ID: Hard Scrabble

Tree ID: 1. O

Reading Date: 6/19/16 Collection Date: June 2015

Slab ID: 🔗

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2004: Over nost ring read 2003: and viringson 04, burned i/a 103 2001: and 102, thele burned i/a 101 2000: Rel. large, null yr xyl bound 1999: burd yr xyl band - Carrot + decreasing rel large 1998: Rel. Range 1998: Rel. Small 1999: Rel Small - V small, almost surp w/ 97 1995: Rel Small - V small, almost surp w/ 97 1999: Rel Small - V small, almost surp w/ 97 1999: Rel Small - V small, almost surp w/ 97 1999: Rel Small - V small, almost surp w/ 97 1999: Rel Small - V small, almost surp w/ 97 1999: Rel Small - V small, almost surp w/ 97 1999: Rel Small - V small, almost surp w/ 97 1999: Rel Small - V small, almost surp w/ 97 1999: Rel Small - V small, almost surp w/ 97 1991: Rel Small - V small, almost surp w/ 97 1992: Rel Small - V small, almost surp w/ 97 1992: Rel Small - V small, almost surp w/ 97 1993: Law Small - V small on another i are i ar Site ID: Hurd Scrabble

Tree ID: 1.0

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Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2001: Outer most ring read 2000: 1999 : I Dow't H 1998; Rel. Large these can be easily determined 1997: Rel. Small 1991; 1993: Rd. Snall 1994: hel. Small 1993: Rel. Small 1992 Outermost ing read 1900: Rel. small, wed yor xyl band 1987: vel lose, wdyr xyl band o'n I vadius 1988: O W/ pith

Reading Date: 6/9/16

Collection Date: June 2015

Slab ID: E, /E,

I like this one better 2004: Outer wost ring 2003: our H OH, burn 2002. (2001'. vel large and to2 poss bourd -2000: vel large, med yo xyl band 1999: vel large 1998. 1997! 1996: rel small 1995: 1994: 1993; 1992: mid yr xyl band 1991: anad in '93; poss burine 1/192

1990: O wpith

Rev Alex W 6/10/16

Ring Reader: Bradley Gillette Site ID: Haid Sciebble Tree ID: 1.0

Reading Date: (, /9/16 Collection Date: June 2015 Slab ID: 9

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2001: Outerman Fing read 2002: 1998: Rel. Large 1998: Rel. Large 1996: 1996: 1996: 1996: 1996: 1996: 1996: 1996: 1996: 1996: 1996: 1996: 1997: Rel. Small 1998: Rel. Large 1972: Faint much yr xy 1 band, nel small comp to <91 ; and s '93; likely burnl i/a '92 1991: rel lange no my band some

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partien Alex W. 6/10/16

Ring Reader: Bradley Collette. Site ID: Hard Scrabble

Tree ID: 1,0

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Reading Date: 6/9/16 Collection Date: June 2.015

Slab ID: 10

Ring Counts/Notes;

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

200 !! Outer must fing need 2000: 1989: 1998: Rel. Large 1997; 1998: Rel. Stall 1997: 1998: Rel. Stall 1994: Rel. Stall 1994: Duter nost vir

1944: kd. Snall 1944: kd. Snall 1993: Rd. Snall 1993: Rd. Snall 1993: Rd. Laye compto '92 1992: rel small-still a faint wel yr xyl band ; and '93; 11.14 build ila '92 1991: rel lange, faint ruld yr xyl band on I radius ; and '92; poss bural ila '92 1990: O w/ pith: Ring reader: Alex Walker Site ID: Hardscrabble Tree ID: 60 Reading Date: 6/17/16 Collection Date: June 2015 Slab ID: 12-B

-Steves may switch here 4I actually think that the stems weet @ this slab

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

1994: Outer nost ving read 1993: rel small, and 194, tikety buriat ita 193 1992: rel small, and 194, tikety buriat ita 193 1991: rel large, no wid yr xyl band seen 4 innermost ving read, rotted inside of this point by pith visible but rotted

[at least '88 & can be inferred]

Site ID: Hard Scoubble

Tree ID: 1,0

Reading Date: 6/9/16

Collection Date: June 2015

Slab ID: 11

how that or

surp al

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2001: Outer most ring recot 2000; 19999 : 1998: Rel. Laige 1997: 1996: Rel Joine 1995: Ret. Small 1994; Pel. Small 1993. Rel. Swell 1999: Duter most ring read, ving 1993: rel small

Stem shows damage but pith is still visible, shows damage all the way to core.

ALABT SCRIP

1993: rel small, no xyl band seen i mad '93; ideal brind i/a 92; also, Damage 1991: rel large, fair + xyl band ned yn, mwred i/a 192 1990: Ow/ pith 'poss anad #n '92; poss brind i/a '91

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Site ID: Hard Stable

Tree ID: 1.0

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 12001: Objer mar ring read 2000: Rel. Small 1998: Rel. Laye 1998: Rel. Laye 1998: Rel. Laye 1998: Rel. Small 1998: Rel. Small 1999: Rel. Small 1994: Outenmost wirs neucl 1993: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '92) 1992: rel small form A + ring surp '93, likely (ourial i/a '93) 1992: rel small form A + ring surp '93, likely (ourial i/a '93) 1992: rel small form A + ring surp '93, likely (ourial i/a '93) 1993: rel small form A + ring surp '93, likely (ourial i/a '93) 1994: rel small form A + ring surp '93, likely (ourial i/a '93) 1995: rel small form A + ring surp '93, likely (ourial i/a '93) 1997: rel small form A + ring surp '93, likely (ourial i/a '94) 1998: rel small form A + ring surp '93, likely (ourial i/a '94) 1998: rel small form A + ring surp '93, likely (ourial i/a '94) 1998: rel small form A + ring surp '93, likely (ourial i/a '94) 1998: rel small form A + ring surp '93, likely (ourial i/a '94) 1998: rel small form A + ring surp '93, likely (ourial i/a '94) 1999: rel small for

Reading Date: 6/9/14

Slab ID: 12-A

Collection Date: June 2015

- Second stem seen

- pith gove

Site ID: Hard Scrabble

Tree ID: 1,0

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 1999', Outer Most Ping read 1998: Rel. Smith 1997: 1996: Rat. Large 1995: Rel. Small 1994:

1994; Outernosting read 193: velsmall; and + rmg rup 94 1992 i rel small, mid yr xyl baul-taint, am & + ving surp 13 il Suralifa 92 1991: vel large, faint mid yr xyl band i poss bwial ila 191 1990: Inner nost way read, mostly volted, possible addil wing added here, hard to see O w/pith Tat least 188 @ can be inferred]

Reading Date: 6/9/16

Slab ID: 13

Collection Date: June 2015

-> still possible that stems

Switched in 12-4, 12-13, 13

-> stem damage, impacting pith and making it hand to read

perseved Alex W. 6/10/16

Site ID: Hard Scrabble

Tree ID: 40

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Reading Date: 6/9/16 Collection Date: June 2015

Slab ID: E2/F

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 1999 ! Outer most ring read 1998: 1997! Rel. Large 1995! Rel. Large 1995! Rel. Small 1993: Twoor most ring read, royed out below this

1994: outer nost ving read 1993: vel small 1992: rel small, and 1'93, burial i/a'92 1991: rel large, wedyr xyl band, inner most ring read 1990? some wood visible, O rotted and gone [poss Owl pith @ 1918]

Site ID: Hard Scrabble

Tree ID: 1.0

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1994 OUKIMOS INg read 1993: vel small 1992; Rel. Smill, ana & 193, burnal 1/a 92 1991: Rel. Large, mid yor xyl band; pring supp. in '92; poss burial ila '9/ 1990? Innermost ring red, & rotteil ad gone, ~200% of wood iside & 191 Is visible, small amout a pitts seen.

Reading Date: 6/10/16

Slab ID: 14

Collection Date: June 2015 Slab ID: 14 removed ATV 2016

- poss add it when we

['88 O w/ pith]

Ring Reader: Bradley Collette Reading Date: 6/10/16 Site ID: Hard Scrubble Collection Date: June 2015 Tree ID: 10 Slab ID: 15 - Two other stens can **Ring Counts/Notes:** he seen in this slab. File Name: They do not appear to extend # of radii measured down ward - Substantial damage Series ID: Wood anatomy change notes: 1992: outermost mig read 1991: rel small 1990: rel small 1989: mid yv xyl band, vel large 1988: Inner mest any read ; fossibly another ring further in but the for makes it hard to tell Ovotted, totally gove 1994: outermost ring read these 1993: rel small _____ place out on I radius 1992: rel small, mod you est band jona 2'93, burral 1/a 192 1991; inrermost ring read, interior rotted, mid yor xyl band ; ring supp in '42, Illely burne i/a '91 1990? Pith rothed + gove '68 Q, possible visable

Ring Reader: Bradley Whethe

Site ID: Hard Scrabble

Tree ID: 1, D

Reading Date: 6/10/16 Collection Date: June 2015 Slab ID: 16

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 1992. Outer more ring read 1991: rel small pinches out on Iradius 1990: Rel. Small 1987: Inner more ring read, too rotted further in to see any rings, mid yr xyl band 1988: Ow/ with, mostly rotted however

1992: Determost ring read 1991: rel large, what you xyl bound, and 192, burnal if a '91 1990? some stern wood is wisible, as well as pitts, but the center is rotted ad cannot be read.

Site ID: Hard Scalble

Tree ID: 1.0

Reading Date: 6/16/16 Collection Date: June 2015 Slab ID: 17

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1991: Outermost My tead

1990' Rel. Sport

1989: possible mid yr Xyl bond, innermost ring read. Rot has removed any rings further in.

Ring Reader: Biadley Collette Site ID: Hard Scrabble Tree ID: 1.0 Reading Date: 6/10/16 Collection Date: June 2015 Slab ID: 18 A

Ring Counts/Notes:

File Name:

of radii measured

Letween 1990 + 1991.

Series ID:

Wood anatomy change notes:

1992: Outes most ring read 1991: 1990: Rel. small 1989: Ret. Large, mid years XYI bund 1988: O W/ Pirh

19912: order rost ving read 1991: rel large, and 4 92, buriat i/a '91 1990: rel small, and 2 '91, burial i/a 90, had to read '90/al boundary on riv/Hiple 1989: rel large 1988: O w/ pith - thigh uncertainty on H of years, possibly ± 1 - year

Site ID: Hard Scrabble

Tree ID: 10

Reading Date: G/10/11 Collection Date: June 2015 Slab ID: 18 B

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1992: OURSMOST Ning Dead 1991: 1990: Kel. Small 1989: Rel. Laye 1984: OW/ Pirk

1989: 1055 mady rylbard, outermost 1987. Orpity

1997: autermost ring read 1997: anas in 1913 likely burial i/a '90 itiny ring in 1990 1989: rel large, bad 11 '90, burial 1/a 1897

1988: O Wpith

Ring Reader: Bradley Collette Site ID: Hard Scrabble

Tree ID: 10

Reading Date: 6/10/16 Collection Date: June 2015 Slab ID: 19

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1991! Outer most 1 ing read 1990: Rel. Small 1989: Rel. loge, mid year Xyl band 1988: O W/ pith

1990: Outermost ving read ; they a merged with '91 1990-timy , ban, ana 1917, burial i/a '90 1988 Or/pith Ring Reader: Bradley LilleHC. Site ID: Hard Scrabble Tree ID: 1.0

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

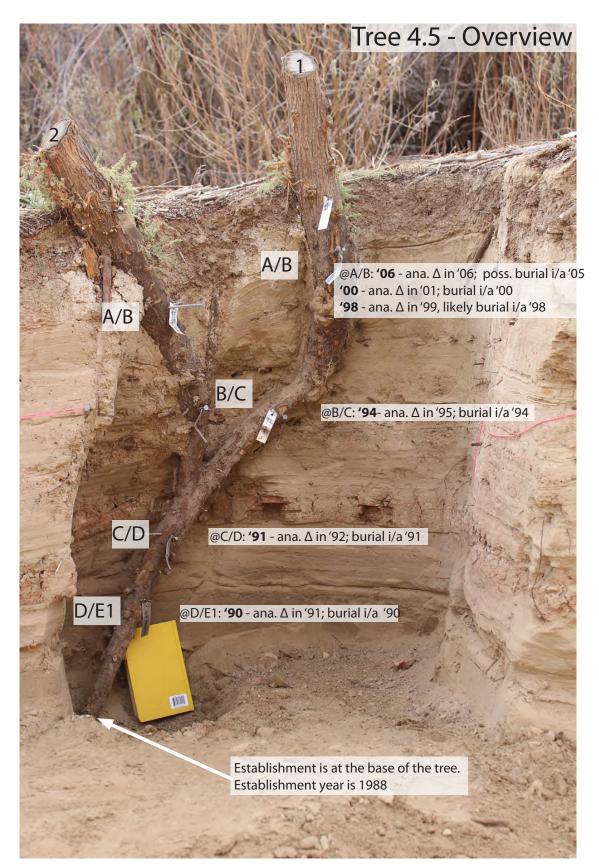
Wood anatomy change notes:

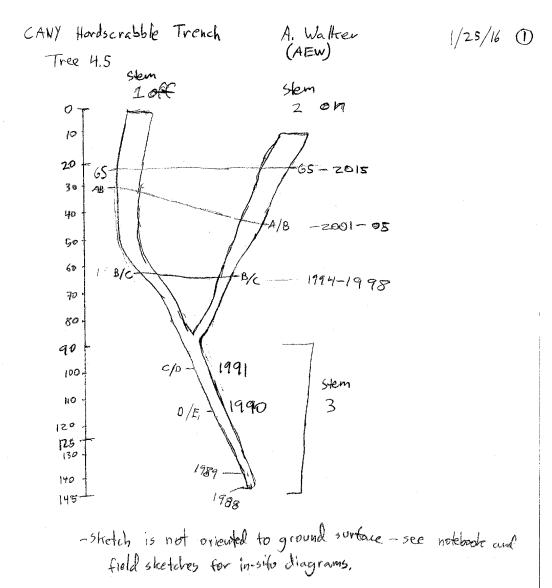
1991: OUter mussor muy 1990: Act. Small 1989: Med year XVI band 1988: Rel. Lovge, O W/ pith

1988 Establishment

Reading Date: 6/10/16 Collection Date: June 2015 Slab ID: 20

All root, germ/establish in Slob 19

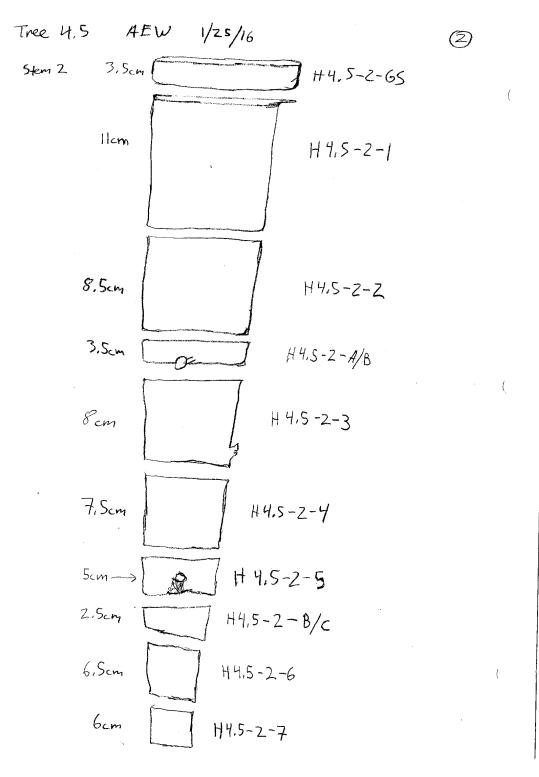


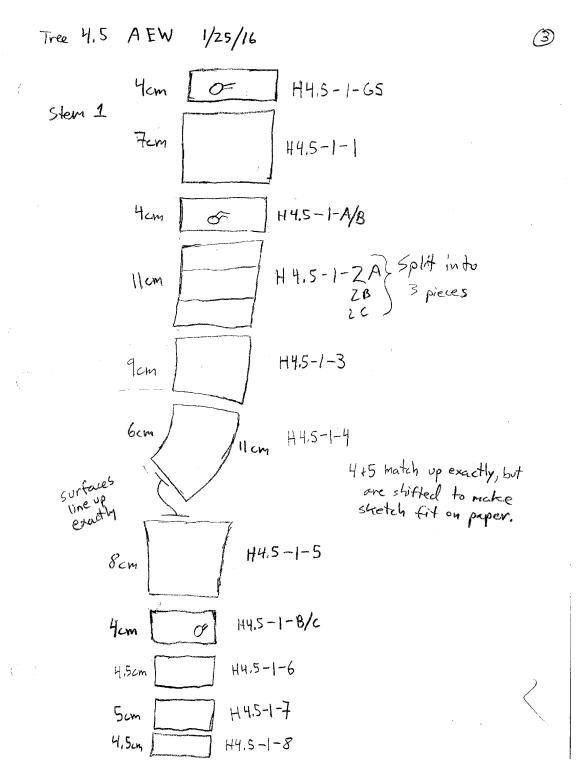


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Free 4.5 AEW
$$\sqrt{25/16}$$
 Lowen thee
steins 1+2 combine
of top of thus
from $H4.5-1$ stretch
6cm $H4.5-2$
4cm $H4.5-2$
4cm $H4.5-2$
4cm $H4.5-3$
3.5cm $H4.5-9/E$
7cm $H4.5-9/E$
7cm $H4.5-4$
5.5cm $H4.5-5$
5cm $H4.5-4$
4.5.5
5cm $H4.5-2$
4.5.5
5cm $H4.5-5$
5cm $H4.5-7$
4cm $H4.5-7$
4cm $H4.5-7$
4cm $H4.5-7$
4cm $H4.5-7$

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offhore

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Ring reader: AEW Site ID: Hardscrabble Tree ID: 4,5-1

Reading Date: 1/29/16 Collection Date: June 2015 Slab ID: H4.5-1-65

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

JS 2015 i portral band- anly xylein present JS 2013 : mid year band (False ring) split lindo Zyns - 12 + 13 ZOIN: Rel large 2008: Midyean xylein band JS 2004 : rel small & pinones out i on 1 radius

1999-2000: Rel lange

1996: Midyear xylen band 1995: Rel. small, modyean sylen bad pinches out on 1 radius 1994: O w/ piffs

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Ring reader: AEW Site ID: Hardsrabble Tree ID: 4.5-1

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes: 2015: Partial growth only

2011 : Rel large

SS 2008: Midyear xylem band; small Js 2004; small & pMches out on 1 radius 1999: + 2000: Rel large 1998: Rel small 1996: Midyear xylem band, rel large

1994: Ow/pith

Reading Date: 1/29/16 Collection Date: Jure 2015 Slab ID: +14.5-1-1 Ring reader: $A \in W$ Site ID: Hardscrabble Tree ID: U, 5 - 1 Reading Date: $\sqrt{29}/16$ Collection Date: June 2015 Slab ID: H4.5 - 1 - $\frac{1}{4}/8$

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes: 2015: Pon Nial growth-only mylem visible

2011: Rel large 2010: Midyear Xylem band

2006-9! Rel small. OG: poss burral i/a 2006-an 12 06, burral 1/2 .05? 2006 ring supported OG: poss burral i/a 2006-an 12 06, burral 1/2 .05? JS 2002: ana SM 2003 and ring suppressed beginning in 2003; likely burral i/a ba

1999 and 2000: Rel large

1998: Nidyear xylem band 1997: Pel small 1996: Midyear Xylem band, rel large 1995: Midyear Xylem band 1994: O w/pith X

Ring reader: AEW Site ID: Hardscrabble Tree ID: 4.5-1

Reading Date: 1/29/16 Collection Date: June 2015 Slab ID: H4.5-1-24 Tap

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

2011: Rel large, outermost ring read 2010: Midyear xylem band 2008-2010 Rel small-ring surpression: possible burial i/a 2006 35 2002: and she 2003; likely burial i/a 2007 Iggg ad 2000: Rel large

1998: Midyean Xylem band 1997: Pelsmall 1996: Midyeax Xyl band 1995: Pelsmall, midyn Xyl band 1994: Qu/pith Ring reader: J.S. Site ID: Hardscrabble Tree ID: 4.5-1

Reading Date: 3/20/16 Collection Date: June 2015 Slab ID: H4.5-1-2A Bottom

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

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Wood anatomy change notes:

Between the top and bottom of this slab, there is a stem switch. Above this, switace, the stem read here does not persist. If This bottom surface stem can be fairly confidently dated to 1994 with at least one additual over ring w/pith obscured by rot. 7.006-2010 - ring surpression: possible burlad 2004 - velsmall 2000 - and AM 2001 ; pos buill i/a 2000 2000 - large 1999 - Strange midys xyl band 4 1998 - 11 11 1994 - rel large (((1994) - rel large 1995: Rel small 1996: Rel Imae 1995: Rel small 1995: Pil Imae 1995: Pil Imae 1995: Pil Imae 1995: Pil Imae Damage Sustamed M/BeFor '93 That may have killed This stem, leading to the response of the stem above this point, in 1994

Ring reader: AEW Site ID: Handscrabble Tree ID: H4.5-1

Reading Date: 1/29/16 Collection Date: June 2015 Slab ID: 14.5-1-2B

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

2011: Rel longe 2010: Mulyeon xylem band 2006-10: Rel small, indistinct, ring suppression: 2006-10: Rel large 2000: and in 01, likely burded in 00 1999: Midyr xyl band, strange wdyr xylem band 1997: Rel small 1996: Nidyr xyl band 1995: Rel small 25 (1994: darge, w/ stem damage 35 (1993): Met partian cartams pith and at least 1 year Awly possibly 91/92

Ring reader: AEW Site ID: Hardschabble Tree ID: 4.5-1

Reading Date: 1/29/16 Collection Date: Jone 2015 Slab ID: 144.5-1-20

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Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

2006-10: Rung Surpresson; poss bunial 2006: Outer most ring read, wing surpression: poss bundat 2000: Rel Varge and drin OI, litely burial 1/a 50 7999: Rel Varge, midyr xyl band

1998: Middle xylem land 1997: Rel small 1996: Rol lavor

1996; fel large midge syl band 1995: fel small 1994; Ret large

(1993) same rotten interior; possible 193 () w/pith more than 1 year is rot core

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Ring reader: AEW site ID: Hordscrabble Tree ID: 4.5-1

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Reading Date: 1/29/16 Collection Date: Jure 2013 Slab ID: 144.5-1-3

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes: 2011: Rel large 2005-2010: Ring surpression; possible burnat in for 2005; 2006: Duter most Mig read

SS 2005: Bel lorger ring surp in '06, and 106, possible borket i/a '05 2003: ana A in '03, possible burned i/a '02

1998: Rel large Midyr xyl band; and A in 1999, poss built i/a 1998 1998: Rel large Midyr xyl band; and A in 1999, poss built i/a 1998 1997: Rel small 1996: Rel large 1995: Rel small

· 55 1994: - Rel large la Partinge 1993 For) 1992 Owl pith (For) Æ

Ring reader: Alex Walker Site ID: Hadscrabble Tree ID: 4:5-1

Reading Date: $\frac{3}{23}/16$ Collection Date: June 2015 Slab ID: #4,5-1-4

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

Outer rings extremely indistanct a hand to read

2005 : adamost wing read, and too possoured it a '05 and too 2005 : adamost wing read, and toos possoured it a '04 2000; Rel longe 1999; Rel large 1998; ana 1 '99, poss burkal 1/a 98 1997: Relsmall 1996: Pel large 1995: Relsmall, multipr sylem band 1994: Rel. large ((1993): rot; Spossibly more years they two in ro Hed core.

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Ring reader: A Walken Site ID: Hadscrabble Tree ID: 4.5-1 Reading Date: $3/2 \frac{2}{16}$ Collection Date: June 2013 Slab ID: 44.5 - 1 - 5

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes: Outer nings indistinct - voot

2001: altermost wag read 2000: Rel large 1999: Anna in 2000, possible burlal i/a 99, vel large 1998: ana A in '99, possible burial i/a '98 1997+1999: hand to read these rings 1996: Pel lorge 1995: Pel small 1994: Rel large (1993) vot, O uporth LI think there are more years in the rot core, back to 1990 on 1991, (1992) rot (1291) ow/pith, rot

Ring reader: A. Walker Site ID: Hordsrabble Tree ID: 4.5-1

Reading Date: 3/24/16 Collection Date: June 2015 Slab ID: 18/C

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

. Wood anatomy change notes: Duter rmgs root used

2000: outer wast wing verel, rel tange 1999: Pet loorge 1996-1998: Ping surpression 1995: ana 21 in 196 Hiely buried in/a 195) ana A in 95, likely buried i/a '94, ring sup

1994: Rel large (1993): Visible on Ledge, mostly rotted (1992): Rot, Outpith

Blittlib low on atom too rotted to make form judgements on these ages

Ring reader: A. Walker Site ID: Hardscrabble Tree ID: 4,5-1

Reading Date: 3/24/16 Collection Date: Jure 2013 Slab ID: 6

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

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Wood anatomy change notes:

Outer rings root wood

1996: Outer ring read 1995: Felsmall 1994: Fellorge, and at ring sup 95 likely burial 94 1993: Rotted on most radius (1997): Rotted on most radius, pith appears visible, possible rear rings-had to tell if they are take or real, as there is a lot of rot in the interior

| Ring reader: A. Wa. Iker | Re |
|--------------------------|-----|
| Site ID: Hardscrabble | Сс |
| Tree ID: 4,5-1 | Sla |

Reading Date: 3/24/16 Collection Date: Jure 2015 Slab ID: 7-

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

outer rings root wood

1994: Outer most ring read, rel large, and 1 95, likely burdal in 94 1992: 1991: 1990: Possible Galse ring 1989: 1988: 0 / pith

207

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Ring reader: A. Walter Site ID: Hardscrabble Tree ID: 4.5-1 Reading Date: 3/24/16 Collection Date: Jure 2015 Slab ID: 8

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

Wood anatomy change notes: Outer ring root

1994: Outer most ming read, rel lorge ana A in '95, likely burdal i/a '94 1993: Relignall 1992 1991: assymetrical width of year in slab, very large on I radius [1990 1989 1988: O w/ pith false rings seen in slab 7 not apponent in slab 8, 1990 is adual growth year

oushave

Ring reader: AEW Site ID: Hord scrabble Tree ID: 4,5-2 Reading Date: 1/28/16 Reviewed J.s. Collection Date: June 2015

Slab ID: 65

Ring Counts/Notes: File Name: # of radii mea Series ID: Wood anatomy chai 2015 : Pinches or 2013 : Midgeon a 2013 : Midgeon a 2013 : Midgeon a 2013 : Midgeon a Market All and All a

2011 : Pel large 2010: Milyear xylein band 2006-10: Rel small, Fing son pressioni, poss burlat 1999-00: Rel large 1996: Midyeon xylein band 1995: Mideay xylein band

1994: Ow/pith, mid-yr xylen bard

Ring reader: AEW Site ID: Hordscrabble Tree ID: 4.5-2

Reading Date: 1/28/16 Reviewed JS Collection Date: June 2015

Slab ID: 1

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

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Wood anatomy change notes: 2015 Indistinct your din 2013 Midyear Xylembord split into 12+13 2011 Rel large 2010 Mid-late year Xylem band 2009: Midycar Xylem band 2007-10 fel small 2008: Midyeon xylem band 2006 200,5 Midyeon xylem band 2000: Kel lange 1999 Rel Jange 1996 Midyean Xylem band 1995 Midyean Xylem band 1994 Midyoon Xylam band 1993 0 w/ pith

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Ring reader: AFW Site ID: Hardscrabble Tree ID: 4.5-2

Reading Date: 1/28/16 Collection Date: Jone 2015 Slab ID: 2

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes: Duter layers indistinct

2011 Rel large "ring sup, and 2006-10: Rel Small, and A in 06", possible burial i/a "05-ring sup

2005: Midyear Xylem band, medium size

2000: Rel lange 1999: Rel lange 1996 : Midyear xylem band 1995: " 1993: @ w/ pith (

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rent Ring reader: AEW Site ID: Hardscrabble Tree ID: 4,5-2

AEWrevised: 3/22/16 Reading Date: 1/28/16 Collection Date: June 2015 Slab ID: 3 -Top

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

Duter vings in distinct 2012: Ret torge 2006-10: Rel small, and in '06, librely burial i/a '05 2006: Midyear xylem band 30001: Rel large in 2001. Likely burial N/a '00 1999: Rel large 1995: Rel small 1995: Rel small 1995: Rel small

1994: Faint midyean xylem band 1993: Ow/pith

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Ring reader: AEW Site ID: Hardscrabble Tree ID: 4,5-2

Reading Date: 1/28/16 Collection Date: June 2015 Slab ID: A/B

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

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Wood anatomy change notes: 2007: outer nost n'ny read 2006 2005: ana 11 in 66, likely bureal in/a '05, ning sup , wdyr ryken bul

2002 ; checking (splitting) consistently to end af '01, beginning '02. Pass. burial 1999-2000: Al large

 $= \frac{1}{\sqrt{2}} - \frac$

1998: Rel large 1997: Rel small 1996: Rel large 1995: Pelsmall 1994: Midyear Xylem band

1993: Ow/pith

 \checkmark

Ring reader: AEWSite ID: Hardsrabble Tree ID: 4.5-2

Fevised AFW 3/22/16 Reading Date: 1/28/16 Collection Date: June 2015 Slab ID: 4

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

Outer vings indistinct - unreadable 2005: Outermost ring read (could be 106) 2003-05: Indistant, had to read 2001: and A in BI, litecty burial i/a BO 2000: rel large 1998: Late year sylen band 1997: Rel small 1996: fel large

1995; Rel small 1994: nidyeon sylen band, rel lange 1993: O Wpith Ring reader: AEW Site ID: Hardscrabble Tree ID: 4.5-2

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

outer nort rings difficult to read 2006 Outer most ring read 2001-06: Pel small, hand to define -2000: and a 'in'01, fiftedy burial igh 300 1999+2000: rel large 1998: Midyeor xylem band 1994: Midyeor xylem band 1993: O w/ pith; 1993, ring increased in diameter relative to the 1993 increased in diameter relative to the 1993 increased in diameter relative 1995 & 1997: rel small

fourement 3/22/16

Slab ID: 5

Reading Date: 1/2.8/16

B/C, cuts across a

Collection Date: June 2015

- Contact between 5 and top of

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Ring reader: A. Walker Site ID: Hordscrabble Tree ID: 4,5-2

Reading Date: 3/25/16 Collection Date: June 2015 Slab ID: D/C Bottom

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

2000 : Outenmost ring read 1999: 1998: 1996: ana 197, Ukely 1/a 96 1996: rel large 1995: rel small 1994: rel large 1993: wdyean xylem band 1992: 1991: Ow/ pith

Ring reader: A Walker Site ID: Hordscrabble

Reading Date: 3/23/16 Collection Date: June 2015 Slab ID: B/c

Top

Ring Counts/Notes:

Tree ID: 45-2

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

outer rings indistinct - root wood

tend > could be 1997 2001: outermost ving read of 2000: Rel brye, ana A in Ol, iburial i/a 80 1999: Rel lorge, and a state the second 1997: Mid-yr xylum band, ana a in 98, likely burral in 97:8 1997; Pel small, and to 198, por boriality 197 1996: Rel large 1999: Rel small 1994: Rel large, midgever aylem bard (1993; fel large . 1992: Bel small, partially rotted (1991): Not, Ou/pith rotted increase relative to Ou/pith somewhere below 92 in voted area

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Ring reader: A. Walker
Site ID: Hordscrabble
Tree ID: 4.5-2
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Reading Date: 3/23/16 Collection Date: June 2015 Slab ID: 6

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes: outer rings indistinct -> root and ring surpression

2001: outer most why read 2000: Rel large 1999: Rel large 1998: Faint mid-year xylen band, not usible on all vadii 1997: Rel small 1996: Rel large, 1995: Rel small, and I in '96, possible boursal in '95 - This could be moved 1994: Mid year xylem band, Rel large 1993: Rel large 1993: Rel large 1991: O m/pith

| Ring rea | der: A. Walter |
|----------|----------------|
| Site ID: | Hardscrabble |
| Tree ID: | 4.5-2 |

Reading Date: 3/23/16 Collection Date: Jure 2015 Slab ID: 7

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

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1.1 120

Wood anatomy change notes:

outer ways - way supression road wood

2000: Ret Inge 1949-1948 ; Hard to define - wing

1995: and Arin 767 pointer burlet in 957 acter most ring read 1994: Rel large, widyear xy Em band, and 2 95, Tikely burled '94 1992: 0 1991: O m/ pith A This is the point where stems 1+2 meet and
become a single branch A1+2 meet and
become a single branch ARing reader: A WalkerReading Date: 3/24/16Site ID: HordscrabbleCollection Date: Jure 2015Tree ID: 4.5Slab ID: 1Ring Counts/Notes:Slab ID: 1

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

Stem 1

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1991: Order most ring read, rel large ana 1 92, possible burral i/a 91 asymmetrical ring shape + width

1990: Asymmetrical rel small

1989;

1988: 0 4 pith

Stem Z

Outer rings root 1994: Outer nost rmg read rudgeer xylem band ana a '95 likely burid 1/2 '94 1993:

1992:

1991: 0 w/ pith

Reading Date: 3/24/16 Collection Date: June 2015 Slab ID: Stem 1 Bottom

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

1991; Outer nost ring read 1990: Asymmetrical in shape, rel large 1989: Assymmetrical, smaller, months false ring 1988: O w/ pith

Ring reader: A. Walher Site ID: Hard swabble Tree ID: 4.5

Reading Date: 3/24/16 Collection Date: June 2015 Slab ID: フ

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

אל Wood anatomy change notes: Duter אוש איסטל Wood

There is some uncertainty here, as 1+2 do not match up exactly and don't show an easy to follow transition

1993: outer most ving read, shows assymetrical growth, post damase 1992: 1997: ana 1 '92, burral i/a 91. Damage apparent stating in 92 Midyean Xylen band, rel large, asymultrial 1990: some asymmetry mid year xylen band 1989; dense wood w/small pores 1988: O w/ pith

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Ring reader: A Walter Site ID: Hardsevabble Tree ID: 4.5

Reading Date: 3/25/16 Collection Date: Jure 2015 Slab ID: 3

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

outer ving root

1992: Obter vins verd, partially not 1991: rel large, nudyr xylein band, ana 192, burial i/a 191 1990: midyear xylein band, part rot 1989: slight asymmetry, part rot, dense wood, small pores 1988: Out pith, part rot

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| Ring reader: A. Walker |
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| Site ID: Hardsc rabble |
| Tree ID: 4,5 |

Reading Date: 3/25/16 Collection Date: Jure 2015 Slab ID: 4

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

1991: Outer most ring read 1990: and A '90, likely borrial 1/a 89, very surall 1989: dense wood, small pores 1988: O w/pith (

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Ring reader: A Walker Site ID: Hardscrabble Tree ID: 4,5

Reading Date: 3/24/16 Collection Date: Jure 2015 Slab ID: C/p

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

Outer rings root 1993: Outer most ving read, had to define after this point 1992 1991: Ana A in 92 likely burial i/a 91, midyr band preches oct on 2 damage begins in 92 1990 1989: Midyr xylem band, small pores + dense wood 1988: O w/ pith

Ring reader: A. Welker Site ID: Hardscrabble Tree ID: 4,5

Reading Date: 3/25/16 Collection Date: June 2015 Slab ID: 0/E,

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

1992: Outer ring read

1991: Asymmetrical shape

1990: ana 191, likely burial i/a 90, much nore symmetrical compared to 91 + 92

1989: Symmetrical, dense wood, small pores 1988: On/pith Ring reader: A. Walter Site ID: Hordscrabble Tree ID: 4,5

Reading Date: 3/25/16 Collection Date: Jure 15 Slab ID: 5

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

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Wood anatomy change notes:

1991: Outer most ring read

1990: Hidyor xylam band and A in 90 likely burdal i/a 89 pinches out on I radius 1989: dense wood, small pores 1988: O w/ pith

| Ring reader: A. Walker |
|------------------------|
| Site ID: Hardscrabble |
| Tree ID: 4,5 |

Reading Date: 3/25/16 Collection Date: June 2015 Slab ID: 6

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

1991: Outer must ring read

1990:

A Minings are symmetrical in this slab

1989: ona A '90, littely burial i/a 89, danse wood, small pores 1988: O v/ pith Ring reader: A, Welleer Site ID: Hardsonbble Tree ID: 4,5

Reading Date: 3/25/16 Collection Date: June 2015 Slab ID: 7

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

1990: outer ving read 1989: ana 190, burial : /a 89 1988: O w/ pith

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Ring reader: A. Walker Site ID: Handscrabble Tree ID: 4.5

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

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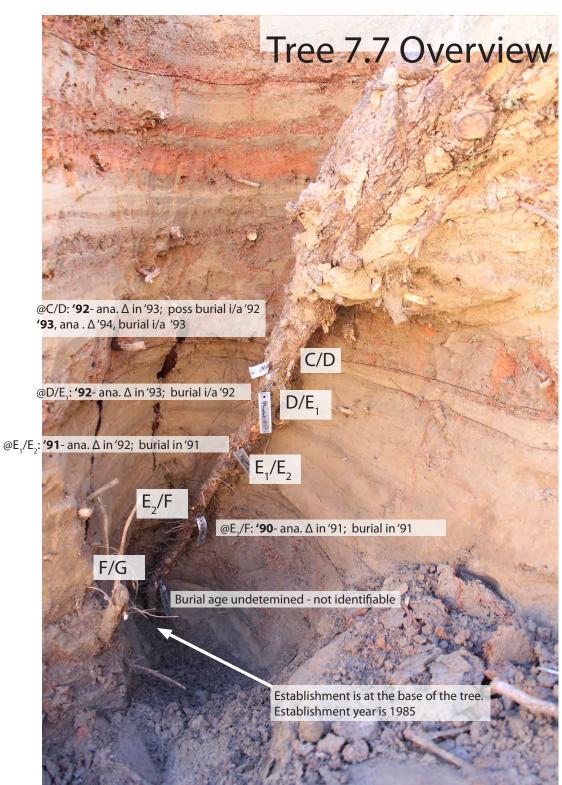
Wood anatomy change notes:

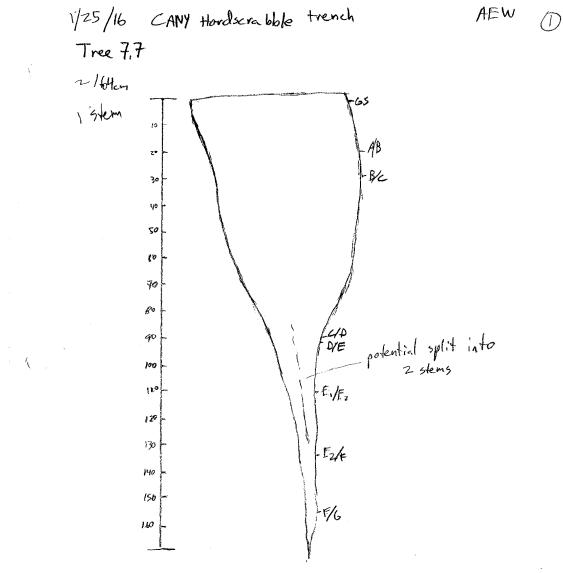
1990: outer ring read 1989: ana A 90 bursal i/a 189 1988: O m/pith

Germantion in 1988 att two slab

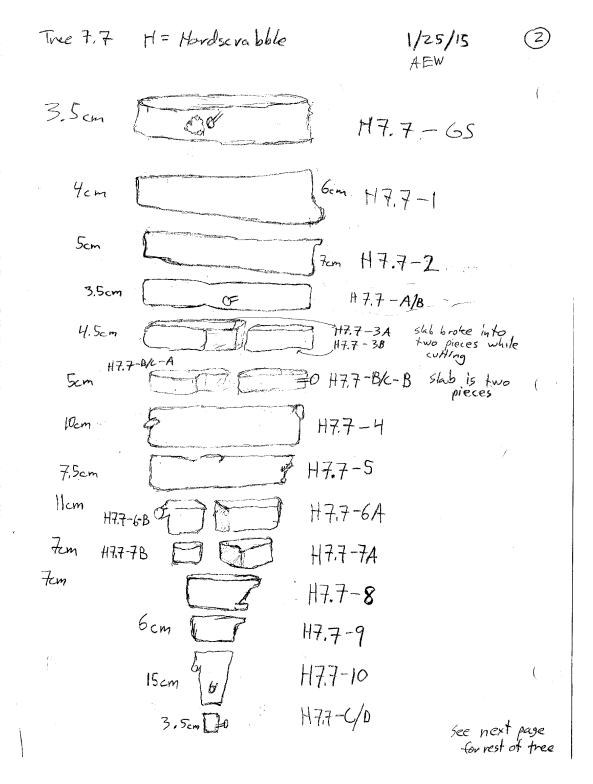
Reading Date: 3/25/16 Collection Date: June 2015 Slab ID: 8 8/12/16 90551ble 190551ble Wedvology to have Wedvology to ha







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$$4 \text{Lm}$$
 $H7.7 - D/E_1$
 $Tree 7.7$
 (3)

 6Cm
 $H7.7 - 11$
 1 slab
 $1/2 \text{ slabs}$
 $1/2 \text{ slabs}$
 5.5cn
 $H7.7$
 $H7.7 - 128$
 2 slabs
 $A \text{Elw}$
 4.5cn
 $H7.7 - 128$
 2 slabs
 $A \text{Elw}$
 4.5cn
 $H7.7 - 17$
 1 slab
 $1/2 \text{ slabs}$
 4.5cn
 $H7.7 - 128$
 2 slabs
 $A \text{Elw}$
 4.5cn
 $H7.7 - 17$
 1 slab
 1 slab
 11.5 cm
 $H7.7 - 16$
 5 cm
 $H7.7 - 16$
 5 cm
 $H7.7 - 17$
 1 slab
 1 slab
 5.5 cm
 $H7.7 - 17$
 3.5 cm
 $H7.7 - 16$
 5 cm
 $H7.7 - 17$
 3.5 cm
 $H7.7 - 18$

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4. 4

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Site ID: Hundscrubble

Tree ID: H7.7

Reading Date: 1/27/16 Collection Date: Remember ZOIS

Slab ID: GS Bottom

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

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Wood anatomy change notes:

2015 - large uplen, possible midy xyl band vel large midy: xylem band rel, small nota yr xylem band 2011 2006 midyer syl band 2004 - rel large 2003 - rel large 2002 vel small (med?), will yr xyl band 2001 - rel large 2000 - fount will yor xyl band

1995 - mid yr xyl band, damage to tree in lyn 1993 - midyr xyl band 1992 - rel small, pinches out on Ivadius 1991 1990 - O y pith

Ring reader: Alex Walker Site ID: Hordscrabble Tree ID: H7,7

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

Reading Date: 5/2/16 Collection Date: June 2015 Slab ID: H7,7-1 Top

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Ring reader: JS/ Site ID: Hardsoabble Tree ID: H7.7 Reading Date: 3/22/16 Collection Date: June 2015 Slab ID: 147.7 - 1 Bottom

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

1990-0 w/pith

238

| Ring rea | ter: Abex Walter | |
|----------|------------------|--|
| Site ID: | Hardscrabble | |
| Tree ID: | 7.7 | |

Reading Date: 5/2/15 Collection Date: June 2015 Slab ID: 2

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

2011 - rel large 2010 - mid year xyl band , ana A in 097 possible but 1208? 2006 -2004-2003 - rel 2002 - rel small, widy - xyl bad 2001 - vellarge 2000 - rel large 1999 - rel large 1994-1 1-(1993- pel large, fant undyn xyl barl 1990-0 w/ pith

Ring reader: Abex Walker (55) Site ID: Havd scrabble Tree ID: 7.7

Reading Date: 5/2/16 Collection Date: June 2015 Slab ID: AB

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File Name:

of radii measured:

Series ID:

Tree ID: 7.7

Ring Counts/Notes:

Wood anatomy change notes: (A)

Slab 3 appears to have File Name: two stems on top, with only # of radii measured: @ base + below slabs. The Series ID: evidence foints towards a switching of stens at this point. Year 1992 is a question marken either a year or a fake ring-currently inknown bideckled it was a year (2011-rel large 2010 - mid year xyl band 2009 - rel small 2008 - mid year syl bound and 1'09, poss borial i/a 208 \$16/15 2007 - rel small 2005 - vellange, ana A in 06; tike / burial i/a 05 2004 - vellange 2002-rel small, mud year xyl bound 2001 - rel large, faint wedge xyl band 1999 - rel large

Reading Date: 5/2/16

Slab ID: 3 , A + BTop

Collection Date: Jove 2015

1993 - mid yr xyl band, vel large

1990- O u/pitts, rotted and hand to tell ulvely stem is star the one being followed

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Ring reader: Alex Walker Site ID: Hord scrabble Tree ID: 7.7

Reading Date: 5/5/16 Collection Date: June 2015 Slab ID: 3-Bo Hom

s., s.

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

Wood anatomy change notes: Ð

2011 - rel large 2010 - wd yr xyl band 2009 - rel small 2005 - ana 1.06, 1. burlal 1/a 05 2005 - ana 1.06, 1. burlal 1/a 05 2004 - rel large 2003 - rel large 2002 - rel small nudyr xyl band 2001 - rel large 2000 - rel large 1999 -1998 -1994 -1993 - midyr xyl band 1992 -1991 - mostly rotted, innermost ring read

Ring reader: Alex Walter Site ID: Hard surabble Tree ID: 7.7

Reading Date: 5/2/16Collection Date: Jure 2015 Slab ID: 4 - 10 p

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

2011-ret large 2010-outermost ring read 2006 - ana A in DG; likely burrial i/a '05

2002 - rel small, rid yr xyl band 2001 - rel large 2000 - rel large, mid yr xyl band 1999 - rel large

1993 - mid yr xyl band

1991 - Inner most ning read, rotted inside of this

243

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Ring reader: Alex Walker Site ID: Hardscrabble Tree ID: 7.7

File Name:

of radii measured:

Series ID:

Wood anatomy change notes: 2014 - outer vost ving read

2011-rel large 2010 2009-rel small 2008-wed yv xyl band 2005-ana & in O6, burial i/a 05, rel large 2003-rel large 2002-rel small, mid yv xyl band 2001-rel large, mid yv xyl band 2001-rel large 2002-rel large 1999-rul large 1999-rul large 1998-wi unge 1998-wi unge 1993-mid yr xyl band 1993-mid yr xyl band 1993-mid yr xyl band 1993-mid yr yr band 1993-rollarge 1991-ioner most ving red overy thry older -rottlech, od small

Reading Date: 5/2/16Collection Date: Jone 2015 Slab ID: $\beta/c = \overline{10}\rho$ Ring reader: Hardscrabble (S) Site ID: Alex We lber Tree ID: 7.7.

Reading Date: 5/4/16 Collection Date: June 2015 Slab ID: B/C -Bottom

Ring Counts/Notes:

File Name:

of radii measured:

Wood anatomy change notes:

Series ID:



2011-vel longe 2010 - midye xyl band 2009-vel smill

2005 - vellarge, an 12.06, bursal i/a 105 2004 2003 2002 - rel small, mid yr xyl band 2001 - vel large 2000-rel large 1999-rel large

1993 - midyr xylband, vel large 1992-innermost ring read, will you syl hand, nostly votted, inside of two pound, inner rings are totally rotfed

Ring reader: Alex Waltcan Site ID: Hardsenabbb Tree ID: 7.7

Reading Date: 5/2/16 Collection Date: Jone 2015 Slab ID: 5

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

2009-outernost wag read, indistinct after two -rookwood 2004-ana A in 105, possible burial i/a 104-Ithak this is 86/65 when 2002-vudyr xyl band, rel small 2001-vel large

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Ringreader: Alex Walker (JS) Reading Date: 5/2/16 (Site ID: Hardscrabble Collection Date: Jure 2015 Tree ID: 77 Slab ID: 64

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

2009 - outernost ving read, soucht distinct in rever years transforg to indistinct 2006 - ana A '07, Hitely burnel 1/a 106 2005 - ana A '06, pox burnal 1/a '05 2002-rel small, mid yn xyl band 2001 - vel large 2000 - vel large, wed yr xyl bound 1999 - vel large 1998 - med yor xyl band, rel large

1993 - rud yr xyl band, inrevuost ning read, rings are rotted out in earlier years

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Invisible Cotres (

File Name:

Series ID:

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of radii measured:

Wood anatomy change notes:

Ring reader: Alex Walker (JJ) Site ID: Hardscrabble Tree ID: 7.7

Reading Date: 5/2/16 Collection Date: June 2015 Slab ID: 7-top 5/2 # 2006 onwords, xyl 15 wide + looks tyle root, xyl shrinks but then begins to widen from 02 back to 95. A burial, then an excavation.

2006-outermost ving read 2005 - ana A in '06, likely burial i/a 85 2002 - rel small, wid yr xyl boand This needs resarding to validate and A observations 2001 - rel lorge 2000-vellarge, mid yr xyl band 1999-vellarge 1998- mid yr xyl band 1996 - molyr xy/band JS 1994-ana d'95, possible burral i/a 194 1993 - mid yr xy/baud 1992 - norow early yr xylen bud for This annual growth 1990 - dama informe - 1990 the set 1989 - incomplete ring; pot (1

Ring reader: Alex Walker (JS) Site ID: Hardscrabble Tree ID: 7,7

Reading Date: 5/4/16 Collection Date: Jore 2015 Slab ID: 7- Lo Hom

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

2006- outer nost ving read, industried beyond this point, ving surp. 2003- reliage 2003- reliant, widgen xyl band 2001-vel large 2000- reliange, widge xyl hand 1998-nodyr myl band 1998-nodyr myl band 1992- Midge Xyl band, sure wilth) as 7-top, and 194, poss bursal 1992 1992- Intervost rug read, incomplete ring, rot; Jamege i/ororom) 1990 O w/portial gith visible, either 87/88, rigs under due to rot

Ring reader: Alex Walker (JS) Site ID: Hardswabble Tree ID: 7.7

Reading Date: 5/2/16 Collection Date: Jure 2015 Slab ID: 8-top

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

2005-oxternost ving read 2004-front, and in 05, fikely boriet 1/a 05 rellarge 2003-fronter, rel large 2002-relsmall, wild yr xyl band, but franter than above 2001-rel large 2000-rel large

1994-mat 95, tilety bortal ita 94 1993, mid yr xyl band; anad '94, likely bural ila '93 1992- inner most ving read, inner core rotted beyond 1990- damag riparond 1990 Possible goes to '87, but nostly conjecture post-'92

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Ring reader: Alex Whithen (JS) Site ID: Havdsarabble Tree ID: 7.7

Reading Date: 5/4/16 Collection Date: Jule 2015 Slab ID: 8-67m

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

1

Wood anatomy change notes:

251

Ring reader: Alex Walton (JS) Site ID: Hordscrabble Tree ID: 7.7

Reading Date: 5/2/16Collection Date: J_{VVC} 2015 Slab ID: 9

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

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Wood anatomy change notes:

1991- pinches out on Iradius

1990 - midyr xyl band

1989-rel lorge

1988-

They gy - soften most king read, root beyond this point 1993 - midyr xyl boud -outernost ring read ana 199, Luvial i/a 193 1992-mdyr xyl band

1987 - O w/ pith complete pith visible, but pantial not

252

Ring reader: Abex Walker (JS) Site ID: Hadscrabble Tree ID: 7-7

Reading Date: S/3/16 Collection Date: Jure 2015 Slab ID: //D

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

ana 1'94, berial i/a '93 1993 - Duter most ving read, voot wood past 1994, mudyr xyl band 1992 - sm nudyr xyl band 1991-1990-widyr xyl band 1989-rel large 1988 -

1987 - O w/pith

Ring reader: Alex Walker (JS) Reading Date: 5/3/16 Site ID: Hardscrabble Collection Date: Jure Tree ID: 7.7

Collection Date: Jure 2015 Slab ID: C/D

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

1993- outer most wing read, and 194 buried 1/2 193 1992 - checking in layer-begins here + extends out and 193, buried 1992 1991-1990-mid yr xyl band 1989 - Rel large 1988-1987= invernost ring read, ro Hed inside of this point, possible O w/ pith night in this ring layer.

Ring reader: Alex Walker (JS) Site ID: Hard scrabble Tree ID: 77

Reading Date: 5/3/16Collection Date: June CO15 Slab ID: D/E_1

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Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

1992-Outernost ving read, and 4'93, bunali/a 192 1991-1990-midyr xyl band 1989-rel lorge 1988-innermost ring read 1987-wood usible inside of 1988, pith not usible

By Contractor and

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Ring reader: Alex Walker (JS) Site ID: Hordscrabble Tree ID: 7.7

Reading Date: 5/3/16 Collection Date: Jure 2015 Slab ID: 11

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

1993 - outermost ving read 1992 - and A'93, borrial 1/2 - 92 and '93; burnli/a '92 1991 - ana A '92, borrat 1/a '91 1990 - midyo my 1 bard, tanker than above 1989 - rel large 1988 - innermost ring read

1987-rotted beyond this point, possible Orpith in this year, no ving read for 1987

| Ring read | der: Abex Walter | (JS) |
|-----------|------------------|------|
| Site ID: | Hardsarab ble | |
| | 7.7 | |

Reading Date: 5/3/16 Collection Date: June この15 Slab ID: 1 こ

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

1993-outer most wing read

1992 - ana A '93, burral i/a '92 1991 - ana A '93, triberty tourial i/a -92 1990 - midyr xyl band-faint band 1989 1988 -inner most ring read, rotted past this point, very little of the very present Ow/pith unknowing

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Ring reader: Alex Walker (II) Site ID: Hourdscrabble Tree ID: 7,7

Reading Date: 5/3/16 Collection Date: June 2015 Slab ID: E, E

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File Name:

of radii measured:

Series ID:

Estendy voted, hard to identify vingstages due to high amount of not

1992-outer nost ving read, and 173 bourd i/a 92 1991 - ana A -92, Pourial i/a '91 1990 - rel lorge, assymethrizal 1989-rellarge, twick by vot 1988- invervost Ning read

Ring reader: Alex Walker $(\mathcal{I}\mathcal{I})$ Site ID: Hordscrabble Tree ID: 7,7

Reading Date: 5/4/16 Collection Date: June 2015 Slab ID: 13

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

1991 - outernost ving read, and 1'92, burial i/a '91 1990-ana A "91, titely burnal i/a "90 - and the 1989-1988 - innernost ring read, rotted in any older years inside of the point

259

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Ring reader: Abx Walter (JJ) Reading Date: 5/4/16 Site ID: Hordscrabble Collection Date: June 2 Collection Date: June 2015 Tree ID: 7.7 Slab ID: 14

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File Name:

of radii measured:

Series ID:

1990-ana A '911' burdal 1/2 90 1989 - Thermost way read 1988- word to t 1988 - wood from this year, byt no vings wis, ble -rotted inside of this

Ring reader: Alex Walther (JS) Site ID: Hardscrabble Tree ID: 7.7

Reading Date: 5/4/16Collection Date: June 2013 Slab ID: ₽2/₽

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

1991 + - root wood 1990 - outerwost nong read, and l'91, burial i/a '90 1989 - rellarge, in nermost nong read 1988 - Wood from layer visible, but no rings to mathe layer identified (

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Ring reader: Alex Walker (JS) Site ID: Hordscrabble Tree ID: 77

Reading Date: 5/4/16 Collection Date: Jure 2015 Slab ID: 15

Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

1990-outermost ring read, and 1'91, bund 1/a'90, 1989 - vel large, innermost ving read 1988 - wood visible, but no rings are seen past 1989, tree is nothed past this point.

Ring reader: Alex Walker (JS) Site ID: Handscrabble Tree ID: 77

Reading Date: 5/5/16Collection Date: Jure 2015 Slab ID: 16 - 40 p

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

1990 - outermost why read likely 1989 - rel large, midy rxyl band, and & '90 burial i/a 39 1988 -priches out on Iradius 1987 -rel lange 1986 - O w/pith

Ring reader: Alex Waller (JS) Site ID: Handscrabble Tree ID: 7.7

Reading Date: 5/5/16 Collection Date: Jure 2015 Slab ID: F/G

File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

1990-1990-1989-rel lorge, ana 1 '90, bunal i/a '89 1988 - rel small, vins surp? poss 1987 - rel large anal '88, tituly burrial i/a '87? 1986 - Ow/pith

(

Ring reader: Alex Walter (JS) Site ID: Handscrabble Tree ID: 7.7

Reading Date: 5/5/16Collection Date: $T_{une} \ 2015$ Slab ID: $17 - t_{ep}$

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Ring Counts/Notes:

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File Name:

of radii measured:

Series ID:

Ring reader: Alex Walter (JS) Site ID: Hondscrabble Tree ID: 7.7

Reading Date: 5/5/16 Collection Date: June 2015 Slab ID: 18 - Top

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File Name:

of radii measured:

Series ID:

Wood anatomy change notes:

1988 - outer most ving need, in distinct/root by and thes point 1987 - rel lorge 1986-@w/pith

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Ring reader: Alex Wather (JS) Site ID: Hourdscrabble Tree ID: 7.7

Reading Date: 3/5/16 Collection Date: June 2015 Slab ID: 18-Bottom

Ring Counts/Notes:

File Name:

of radii measured:

Series ID:

14

Wood anatomy change notes:

1988 - outermost ving read - had to identify ana & + 1987 - vel large (1986 -1985-0 w/ pits Final slab four thee Establishment in 1985 in this slab #7,7.18

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Ring Reader: Adam Fishez Site ID: Hond screabble

Tree ID: 20-2

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: To ssibly dead when collected with thee to not have new shools when collected, extensive cotting in stem 4

2009: Outernast ning

1986 ret log, and yor xyl band 1985 ret log 1984 ret small 1983 ret small, mod yor xyl band 1982 ret log 1981 ret bange

1979 : nod yr xyl band

1975 pith flecting

1957 - Ow/pith

1982: nod yr xyl band 1981 Rel Targe 1980: Mid jean xyl band 1978: Pith flecting

1990' distinct color charge fiel 1989: mid year xyl bard inge

1987-Ral. SMall 1986 Mid yean xyl band

1983: Rel lorge

1976: midyr xyl band

1966: Pel small, damage apperent to tree in this year 1964-1969 rel small 1963 rel large 1962 rel large 1961 rel large 1960: O /pitt

Reading Date: August 24, 2016

Collection Date: JUNG 2015

Slab ID: GROUND Suchase

Revened AEW 10/24/16

Per 10/26/16 AFW

Ring Reader: AAAAA F

Site ID: HOMScripidda

Tree ID: 20-2

Reading Date: August 24,2016 Collection Date: JUNE,2015 Slab ID: 20-2-1

Outer trute starting to not

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 2008: Octel Most Nix

1987: color, v. distinct in this year

1986: vel large 1985: vel large 1984: vel small 1983: vel small, rudyr xyl band 1982: rel large 1981: vel large

1979 ; midyr xyl band 1977 : midyr xyl band 1975; fith flecking

1959: rel large 1958: rel large 1957: O W/pith

1966 198 Kel small 1965 - faint Mand 192 1964 6 1986 mid year xyl bard 1485 1984 del mall, mid year xyl 1982 1982 1981 West SI mid year xyl Jone 1980 1429 mid year 1978 kyl band 1976 Rel sniph 1975 1974 1973 1422 1970 10,40 K69 red large 1468 1967 Rel Large

269

RW 10/26/16 AEW

Ring Reader: Adum Fisher Site ID: Hand Screabble Tree ID: 20-2

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Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 2008: OUVERNOST King 1907: V. distinct color change 1986: vel large 1986: vel large 1983: rel small 1983: rel small 1983: vel small 1982: vel large 1977; wel large 1977; wel large 1977: vel large 1957: vel large 1957: vel large visible Reading Date: August 31, 2016 Collection Date: JWe, 2015 Slab ID: 20-2-2

1989 midyean XYI band 1928 renet notsmall, midyung XVI bard 1986 1985 1984 Relsmall 1983 mill year X/1 land 1982 1981 10:80 10,49 1978 1972 SMALL + HAMC 10,76 19.7% ×/14 19.73 ¥172 1934 Kito Rel large 1969 1968 Gaint Locuel 1967 Pith

Per 10/26/16 AEW

Ring Reader: ARAM FROMZ

Site ID: Honogradidale

Tree ID: 20-2

Reading Date: August 31,2016 Collection Date: June 2015

Slab ID: 20-2-3

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 20,96: Atribut King

1986 vel longe 1985 vel longe 1984 vel small 1983 relsmall mulyr myl bund 1982 vel lange 1981' rel lange, sorta-same size approx as 1983 year 1979: mudyr xyl band 1977: mud yr xyl band 1975: pith flecheing 1961-1970: v. small

1959: rel large rotted but 1958: rel: large Visible 1957: Ow/pith

(

1989 1988 Mid year Xyl bird MET Malarge 1986 mid year xyl band, val small 1985 198.4 198:3 va small 19812 mid year xy band 1918:1 19820 1979 1978 tight SMAN 1977 1976 1975 1974 1973 1972 ma 1/70 1969 1968 Pot 196 +

1966 pim t

Ring Reader: Alex Walker Site ID: Hardscrabble Tree ID: 20-2

Reading Date: 10/26/16 Collection Date: Cut June 2015 removed March 2016 Slab ID: 4 Slab ID: 4

.

Ring Counts/Notes:

File Name:

of radii measured Outer trunk is roffed + hard to read

Series ID:

Wood anatomy change notes:

2003: outer most ring read

1986: rel large 1985: rel large 1983: rel small, Irg Xyl 1983: rel small mid yr Xyl band, faint -> largeish on Iradius 1982: rel large 1981: rel large

1979: watyr xyl band 1977: famt nudyr xyl band 1975: pith Fledeurg

1961-1970: compressed rings V. small

1959: innermost ring w/o rot 1958: rel large Z rotted but 1957: Ow/pith S visible

Ring Reader: Alex Walker Site ID: Handscraffele Tree ID: 20-2

Reading Date: 10/26/16 Collection Date: Cut Jine 2015, Nevroved March 2015 Slab ID: 5

1993-slight and A - poss burial i/a

Damage to tree in 1969, ± zyears

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2003: outer most rmg read 1987-lange xyl-poss burial 1/a 867 1986 rel lange 1985 rel lange 1984 rel small, nostby xyl 1983 rel small 1982 rel lange 1981 rel lange

1979 - mod yr xyl band 1977 - mod yr xyl band 1975 - pith Fledring

1973-wdyr xyl band

1959: vel large 1958: vel large 1957: Ou/pith, part rotted

273

Ring Reader: Alex Walker Site ID: Handscradde Tree ID: 20-2

Reading Date: 10/26/16 Collection Date: CA June 2015, Slab ID: venoved March 2016 Slab ID: A/K

Outen bank + stern rolled w/ Industriant eggles + borders

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2003 Outermost ring read

1986 rel large 1985 vel large 1984 rel small , mostly xyl 1983 vel small, and yor xyl band, and 1 '83, poss bunkel i/a '82 1982 rel large 1981 vel large

1979 wd yr xyl band

1977 mid yr xyl band

1975 pith fledring

1973 mid yr xyl band 1971-damage to tree begins in this year, could be 1968-1971 hand to read 1959 vel large

1958 rel lorge

1957 Owpith

Ring Reader: Alex Walker site ID: Hardscrabble

Tree ID: 20-2

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1994 - Outermost ring read 1986 - vel longe 1985-rel large 1984 -relsmall, nostly xyl 1983 -relsmall, fant wdyr xyl band, ana 183, likely borral i/a '82 1982 rel large 1981 - rel large 1979 - nody xyl bad 1977 - Wdyr xyl band 1975 - pith fleching 1973 - wd yr xyl bond 1959-rel large 1958 - rel large 1957- Dwpith

Reading Date: 10/27/16

Slab ID: 6

Collection Date Cut June 2016, removed March 2016

Ring Reader: Abex Walker Site ID: Handswabble Tree ID: 20-2

Reading Date: 10/27/16

Collection Date: (1) + June 15, removed Mar 16 Slab ID: K/M

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1994-Outernost ving read 1986 - vel large 1985 - vel large 1989 - mismall, marthy myl, 1983 - vel small, and 484, 1, hely bowal 1/a -83 1982 - vel large 1981 - vel large 1979 mid yr xyl band 1977 - mid yr xyl band 1975 - pith Flecking 1979 - mid yr xyl band 1959 - vel large 1958 - vel large 1958 - vel large 1957 O w/pith

Ring Reader: Abex Walker Site ID: Hards crabble Tree ID: 20-2

Reading Date: 1 9/27/16 Collection Date: Cut 6/2015, removed 3/2016 Slab ID: 7

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1994 Outer nost wing read 1986 rel large 1985 rel large 1985 rel small, nosty xyl 1983 relsmall mid yr xyl band 1982 rel large 1981 rel large 1979- wid yr xyl band 1977- mid yr xyl band 1973- no pith flecking seen-it gove 1973- mid yr xyl band 1957- rel large 1957- O w/ pith

Ring Reader: Alex Walker Site ID: Hordscrabble Tree ID: 20-2

Reading Date: 10/27/16 Collection Date: Cut 6/2015, removed 3/2016 Slab ID: \mathscr{B}

the 1983 growth year

The anatomical

Ring Counts/Notes:

File Name:

of radii measured

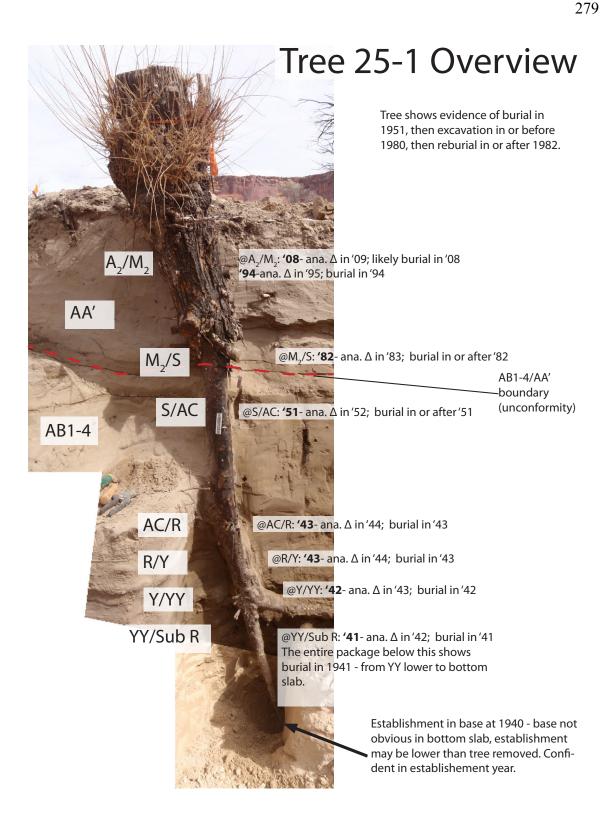
Series ID:

Wood anatomy change notes:

No pith flecking 1984 - Oter most ving read in 1975 1983-relsmall, midyr xyl bound 1982 - vel large - ana 183, burral i/a 182 1981 - vel large 1979- mud yr xyl band 1977 - nody xyl band 1973 - wel yo xyl band

1959 - vel large 1958 - bel large 1957- 0 w/ pith

278



Tree 25 615 T T overwen 1 2 3 D A2/M2 T 7 Ч - core is detached 5 - core detacted - Surrounding Parts are in 3 Pieces 6 7 - Core dedicated -surrounding Wased in 4 proces 8 - In 3 pieces Topots -In 2 pices 9 1 10 S/AL 11 12 13 14 15 16 AL/R . 17 Bot. of R Ш Į 18 Y upper

280

Ring Reader: Alex Walker site ID: Hordscrabble Tree ID: 25-1

Reading Date: 9/15/16 Collection Date: June 2015 Slab ID: 65-Top

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2015: outer most ring read

2012: Small

2008ivellarse 2007; vellarge

1986: rel large 1985: rel large 1984: rel small 1983: rel small, nolyn xyl band 1982: rel large 1969: rel small

1957: rel small 1956: rel small 1955: rel small

1953: vel large

1945: rel large comp to surrounding 1943; innermost ning vend 1942 wood visible inside of 1943 no pith seen reven AW 7/14/16 JS 9/15/16

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Ring Reader: Brudley Collette

site ID: Hard Surabble

Tree ID: 25-1

Reading Date: June 30, 2016

Collection Date: zut June 2015 excavated march 2016 Slab ID: GS - Btu

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2012 : Small

11 19.

2009 Rel. Small 2009 Rel hose ; ring supp offer 108; poss burial 3008 i/x 108

Mar Charles 1000 1997: Mid yer xyl buil 2 1996: Mid yer xyl buil 1998: Mid yer xyl buil 12

18.

1991 en large

. 2009

201

1988 Pul Snull 1988, Pul Jase 14 04, 101 1090 14 04, 101 1090 14 04, 1030 14 00 small 14 04 00 small 14 05 0 small 14 0

1979 : mid yo xyl band 1978 Red large 1977. wdyr nyl band

1969 Rel. Small

1965 Rel. koge 1964: Relismall 1962 : hel large

1959 Red. Small 1958 Red. Knge 1959 Red small 1956 Red small 1955 Ect (small

1953 Red. large some sont of physical transition here 1954. Red Small Xyl wider ad fore change - yoss burlet 1951 Red Small here NUT.

1948 Ret. Kuge. 1944 Rot smill 1943 Danesmest Fing read.

1942:

Ring Reader: Bradley Collette

Site ID: Hasdscrabble

Tree ID: 15-1

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2016: atternost ring read

2009: Relsmall 2008: Pellange, ring superafter 08, poss burneli/a '08

1991: Pel. Kigt 1990: Pel. lange

{

1986: Rol. K198 1985: vel large 1983: vel smull 1983: vel smull 1982: vel large 1981: vel large

1978: Hellarge 1977: mid yr xylband

1989: rel small

Reading Date: June 30, 2016

Collection Date: 2.015

Slab ID: 1

1962: Rel lorge 1958: Rol base 1958: Rol base 1957: Rol. Smill 1956: Rol. Smill 1955: Rol. Bage 1951: Rel. Smill 1951: Rel. Smill 1950: 1944: Rel Smill 1950: 1945: Visite Inside, but moster Vo Hed

Review Allulio

Ring Reader: Boad ley Collette

Site ID: HardScrabble

Tree ID: 25-1

Ring Counts/Notes:

File Name:

of radii measured

Viange notes: 2009! Outlesmost fing read indifusion indi 1964! Act -2008! Rol. Small Analdion Messachimen indi

1997: Rol. Small

1991: Rel large 1990: Rel large

1986: rel large

1984! Rel. Small 1983: Mid year Xy band, vel small 1982! Rel. Large

1978: vel lange 1477: Red Small, und yo sylbod 1972: Cal. Luige 1969 ! Pol. Small

Reading Date: June 30, 2016

2015 Collection Date: Slab ID: 2

1959: fel small 1959; Pel Lage 1957! fed. Small 1956: Rel Small 1955 Let. Spiel

1964: Ad Small 1963' fet Smatt 1962: Red laise 1961: Pel Small

1952: Red. Small -> Athr A 153, poss bornd 162

1951: Red Sproll

1951: en large 1945: vel large 1944: lel. Small; Innermost ring read. Possibly analler ring can be pread

Further in but not makes it hard to tell.

1943 visible inside

Review allo (110

Ring Reader: Alex Walker Site ID: Hard scrabble Tree ID: 25-1

Reading Date: 7/15/16 Collection Date: Jure 2015

Slab ID: 3

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

Zaozinaka

My supp in 09; Ilkely build i/1 '08 2008 1994: ana & 95, poss bornat 1/a '94

1991: rel lorge

1989: rel small

1986: Hellarge 1985: vel large 1984: rel small 1983: midyoxyl band 1982: rel large

1977: mid yv xyl band

1970!) ana l'Erom 69-70 xy/ 1969! go from layger to smaller, poss excavation?

1959 ring surp, these dates are 1958 informed some what 1952 1952: and A + ving surp 53 likely bowal 1/52 1951: relsmall

1949 ivel large

1945; vel large

1944; invermost ring read

| fer terre # | 4W 8/2/16 Allul 16 der: Bradley | Collette |
|-------------|--|----------|
| Site ID: | Hardscrabble | |

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Reading Date: July 1, 2016 2015 Collection Date:

Slab ID: 4

Ring Counts/Notes:

Tree ID: 25-1

File Name:

of radii measured

Series ID:

Azlur, Here is a large Similar to band of xyl after Wood anatomy change notes: to distinguish bands. Core: 1953' Duttermost sing read 1901 itel small ina & +ring swp52 1951 itel small ina & +ring burnal 1/251 195t: Rot. Smith 1949! fel. Laly ? ~ 1944 : Tunetrost Fing read $\ell^{e^{i\phi}}$ I don't see JS Outside' 1993 1979. poss & 2003; Outernost way 1942. 1991: ana 192, likely burial 1/a 91 1479: 2002: Rug sorp '03 1991' 1977. 1976: 1949; 1475 1974: widyr xyl 1673 insdyr xyl 1414: 1947: tout nidyr xyl bad? 1946: Pel large 1472. 附上 19th Pel. Small

1910; Inner most wing read, and A inside of this to larger Xyl, poss burial & excavation have

1982: Rel. Targe, ana 4'83, 1981: Rul. Large poss Sundal'82 1991: Rul large 1940: Ret. large

1913: nod yo xyl band

153 Where it B torghtimpossible

ourside

Ring Reader: Julian Scott Site ID: Hardscrabble Tree ID: 25-1

Reading Date: July 1, 2016

Collection Date:

Slab ID: A2/M2

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1

108: outermost ring read ; Ringsupp in 'oq; likely burial i/a '08 184: rel small 183: rel small w/ mid yer band islight and offer '83, possburial i/a '83 155-'69: compressed & rotten 152 ; ring supp & anad offer '52; likely burial i/a '52 This sequence of rings may indicate: burial i/a '52 by a sediment padage Mat was subsequently eroded in the late '60's or early '70s, in 151 rel small 193 intermost Ward

Review JS 9/10/16 Ring Reader: Brudley Collette Reading Date: July 1, 2016 Site ID: Hardscrabble **Collection Date:** Tree ID: 25-Slab ID: Az /M2 **Ring Counts/Notes:** File Name: Large Area of XI between 154 band and next readable # of radil measured band, tough/inpossible to distinguish bands within this Series ID: Wood anatomy change notes: 1454: Dutternes ring read core! -outside 1952: and A, 195000 53, 1951 / Rel. Small burind ile apen 52 unreaded 1949: ful. Lave Core 1944: Rel. Smill, Innernest ring read 1995: Outermost ving read 1979: Ditside! 1994 115 5000 95, por land 1/2-9419 78 1991 : relsmall 1977' widy xy/bad 1976: mid gr xy/bad 1989; vel small 19 88: Adismall 1975 rid you tof 1987: 1974 1986: vel large 1986: Nel large 1473 . 1993; velsmal wdyr ore laxis 1993; led Laisge 1983; an in 1972: Ael lorge 1971: Pel loze 1970 ; Innermost ving react 1961 ; Nul. 2056 19.50 '. Fring Sur p 83, poss burial Ya 182

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288

Ring Reader: Julian Scott site ID: HANDSCALDE

| Reading Date: | 4115 |
|------------------|------|
| Collection Date: | |

4

Slab ID:

116

Tree ID: 25-

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Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

189 Rel small 183 Rel small w/ mid yr band 182 ana Nich 183 or 184, poss bwral i/a 182 or 183 170 - 182 Rel large ; (release from bwral); anatomy: appears stem i/a 170

La barren de la composition

153. to "21; hel small; My supp. + ma & beginning in '53; burral ila '52

151: Rel small

144 mer most rong

Ring Reader: 35site ID: Hardscrasble Tree ID: 25-1

Reading Date: q(l5)(lG)

5

Slab ID:

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

'84 and b in '84; burnel i/a '83
'83 ring supp in '83: burnel i/a '82 (likely '83)
'75 to '82 rel large; release from burnel occured 1/a '75)
'53 to '74 pel small; ring supp + Aria b & giring supp
Inkely due to burnel i/a '52
'44 inner most ring read

peners Allollo

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Ring Reader: Bridley Colletie

Site ID: Hand Secold le

Tree ID: 2らー

Reading Date: July 1, 2016

Collection Date: 2015

Slab ID: 5

Ring Counts/Notes:

File Name:

of radii measured

Wood anatomy change notes: Slab is in 3 pieces. Lore is deliaded from Surrounding wood, Unable to read out could from where the core first. Similar to previous slobs (41 Az/ML).

Love:

1963 Outhermost ring read 1951, hel. Small tra. D 52, buryal 1/651 1951: Rot. Small 1945: fet Large

19994. Innerview right road, no pith seen

utside: mostin 2003; ade 11/2 102 +993; 1992: 92, poss burn/191 1591 ana Z J 1940: 1989! 468 tot. South 1981: 1900 in relemally outermost ring read 19 83: Ald Smill, wid yr xyl band, 1982 vel large, and 11, my surp '83, likely burred 1481 i rel loge 1940' rel longe, and I ad ston wood growth sumlier my) 195' poss excavation 1/6 '79 1979. P seens more like i/a '74, as evidenced by ringsupp release... and but clear to me 1978: 1977. 1974: innermost wing read, converts to lorger xyl inside

Review 35. allo116 Ring Reader: Bradley Collette

Site ID: Hald Scrubble

Tree ID: 26-1

Reading Date: July 1, 2016 Collection Date: 2015

Slab ID: 0

9

1984; Outternust My read

1982! Ad. Lange, and At ring surg 83, burin life 1481: Red. Lage

Letriside :

1983! Rel. Small,

1/679

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Stab 13 in 4 pieces including the detailed Lare. Tough/impessible to read bands On the precession surroughing the core because of the lade of distinction between bands.

love? 1653; Outgermost ring read 1951: And small, and M'SZ, burialila SI 145t. tet oreil 1948: Rol. Small 1945: fel. Large 1960; Ennerrost rig read, kyl grow borgs an Iside of this - White excaver thou

1943; Tomermet (ing read, but bardy

. How my trouble cross darting the cores

From 5 to 4

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Poster allel 17

Ring Reader: Bradley Collutt Site ID: Hard Scrabble

Reading Date: July 1, 2016

Collection Date: 2015

Slab ID: 7.

Ring Counts/Notes:

Tree ID; 25-1

File Name:

of radii measured

Wood anatomy change notes:

Slab is in 5 pices. Unable to read rings on the parts of the pices immediately next to the

Cose.

Lose 1953: autornust ning read 1952' Rel, Small 1951', Rol Small, and 1 52, buried ite '51

1948; Rel. Small

1945: Rel. Lalge on laxis

1943: Innermost ring read 19472 visible inside of this, but mostly roffed

- Over Can't read shaded parts

Octside

1983 Outleman May read 1982 vel large, and burial 1/9 82 1981: rel lage 1980: rel large, invermost ring read, Xyl much larger insido here, excavition 1/6 79

Review \$ 9/10/17

Ring Reader: Bradley Collecte

Site ID: Hardscrubbe

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Tree ID: 25-1

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

Slab 3 in 3 piccos. Core is actually attached, but rings are unable to be read in an area Dupside of 1952 rong.

Core: 1952: Outermost riving read 1957: Lel. Small; Ana. D in 162 possible burned 151 1930: Del Small 1949: Rol Small

1945! Rel large

1942: Inna prost ing read, no pith

Seen

1941: wood visable

Collection Date: 2015

Reading Date: July 1, 2016

294

Outside: 1983: autermost ving read 1982: vel large, and & ring surp '83, burket i/a '82 1981: inner most ving, surp inside, excavation i/6 80

Cove: Conternation of the second states of the seco

How to be more celtain dating these riggs with fewling indicators.

perrer allolit

Ring Reader: Bradby Collette

Site ID: Hardscrabble

Tree ID: 25-1

Reading Date: JUly 1, 2016 Collection Date: 2015 Slab ID: Top of S

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

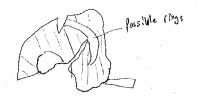
Wood anatomy change notes:

Slab 13 in 2 gives. The second pice is a not that book aff with little value. Jost outside the core it's impossible to distinguish rigs.

1953: OUHernost Fing read 1952: Pel. Small 1951; Ana. △ '52, possible burial '51 1950: 1949: 1948: 1948: 1946: 1945: 1948: 1948: 1945:

1942. Inner most ning read, fel. Lurge

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Possible: 1983: Outward ring read 1982: Ed. Lage 1981: Inner ring read, vel larse 4 No libely, But extremely faint - not usible on multiple readii by I do thank this is an excavition and then burical that we are descripting here Devreba Js gliulis

Ring Reader: Bradley Collette

Site ID: Hardscrabble

Tree ID: 25-1

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Reading Date: JUly 1,2016 Collection Date: 2015 Slab ID: 9

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1952: Outtermost ingread y. 1950: 1950: 1949: Rel. Smith 1948: Rel. Smith 1948: Rel. Smith 1949: Rol. Smith 1947: Rol. Smith 1942: rel large

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1942: rel large 1941: O w/ pith ۰,

Ring Reader: Bradley Collette

Site ID: HardScrabble

Tree ID: 25-1

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

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1952 : OUHermest ring read 1967: Anc. 5 52, 12644 butter of 1950: Pel. laige 1949. Pel. Small 1947: Pel. Small 1942. Pel. Laige 1941: O. V/ pith Reading Date: July 1, 2014 Collection Date: 2015 Slab ID: 10

1952; Ottermost ving read 1951: A ana '92, burial i/a 51 1950; vel large 1949: rel small

1947: rel small 1943: rel lorge 1942: rel large 1941: Ow/pith

Ring Reader: Bridley Collette Site ID: Hadserable

Tree ID: 25−\

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1952: Outhermost ring read 1951: Ann. A '52-Addy born '51 1950: 1949: Pel Small 1948: Pol Small 1948: Pol Small 1946: Pol Small 1946: Pol Small 1946: Pol Small 1942: Pol Small 1942: Pol Small 1942: Pol Small Reading Date: JUH 1,2016 Collection Date: 2015

Slab ID: SAL

Deview 35 9/14/14

Ring Reader: Brudley Collette

Site ID: Hardscrabble

Tree ID: 25-\

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Reading Date: July 5,2016 Collection Date: 2015

Slab ID:

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 1952: Outhernost ring read 1951: Ana. D 52, likely burned 'ST 1950: vol lange on thus radius 1949: Rel. Small 1949: Rel. Small 1947: Rod Small 1945: Pel Kage, ann D 76, ring sump "47-49, poss burial i/a '45 1944: Rel. Small 1945: Rel. Small 1945: Rel. Small 1945: Rel. Small 1947: Rel. Small 1947: Rel. Small 1948: Rel. Small 1948 Ring Reader: Boudley Colletie

Site ID: Hardscishble

Tree ID: 26-1

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Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 1952: Outlernost Ging Med 1951: And a '52, Hildy burbal '51. 1950: 1949: Lel small 1948: Lel small 1948: Lel small 1940: Norze surp '47; likely burbal i/a '46 1946: Norze surp '47; likely burbal i/a '46 1945: Rol large 1949: 1943: 1942: Rel. Lage, Faint wadyr xyl band 1941: O Wl firk 300

Reading Date: July 5,2016

Collection Date:

Slab ID: 12

2015

Ring Reader: Bradley Collette Site ID: Hardsenable

Tree ID: 25-1

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Reading Date: July 5, 2014 Collection Date: 2015 Slab ID: 13

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1947: Outlesmost Fing Fred ila 1947: Putlesmost Fing Fred ila 1946: Pet. Spall. And D'47, titlety build "46 1945: Pet. Table 1944: 1943: 1942: vel large, fount wdyr xyl band 1941: O W/pith Site ID: Hand Scalble

Tree ID: 151

Reading Date: JVM 5, 2016 Collection Date: 2015

Slab ID: 1여

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 1945: Dutteine St May read 1945: Dutteine St May read 1949 M. Bel. Small Ana. D 45, 1000 Me boilal 144

1943: Red large, mid year xyl band 1942: OW/ Pith

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1945: Outermost ving rend 1944: Relsmall, and 4 + ving surp '45, burdli/a'44 1943: Xyl size inc in '43, poss burnlik 1/4 1942: rel lange, fount mudyn xyl band -poss add nong 1941: O m/pith Site ID: Hurdscrabble

Tree ID: 25-1

Reading Date: July 5, 2016 Collection Date: 2015

Slab ID: 15

Ring Counts/Notes:

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1945: Dottement ing ted 1944: Rel. Spalli, Ann. D'45, fossible burial '44 1944: Rel. Spalli, Ann. D'45, fossible burial '44 1943: 1942: Rel. Juge, faint mid yn xyl band, ann A '43, poss burral i/a '42 1941: O w/ pith

Ring Reader: Bradley Collette

Site ID: Hardscrabble

Tree ID: 25-1

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Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 1943: When not right read 1942: Arra. 0.113, possible burial '42 1941: Let. Large. 1941: O W/ Fight Reading Date: July 5, 2016

Collection Date: 2015

Slab ID: 16

1944: Outer most ving read 1943: rel small 1942: 1941: rel large, midyr xylbad 1940: Ow/pith Ring Reader: Bradley Collette site ID: Handscrabble

Tree ID: 25-1

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

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1943 - Outlermost fing read 1942 ' Ann. D'43; lossible burlat '42 1941 : Ref Large; Mid year xyl bund? 1940: O w pith

Reading Date: July 5, 2014 2015 Collection Date: ACR Slab ID:

1944: Outer most ning read 1943: ana 1 44, litely bursal ifa'43 rel large 19424 1941: O / pith

1943 : outermost "42" ring supp & and in "43 likely switch ila "42 '41:001 (mp & mid yr brid Q w/ pith & mid yr bal "(0

Ring Reader: Bradley Collette Site ID: Hardscrubble

Tree ID: 25-1

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

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1943; outhermost ring read 1943; Rel. Small Ana. 12 43, possible builtal 42 1941; Rel. Small Ana. 12 43, possible builtal 42 1941; Rel. taise; Mid year xyl band? 1440; O W/ pith

Reading Date: July 5, 2016 Collection Date: 2015 Slab ID: Bot. of R

> 1945: outermost ving read 1942: Relsmall, and 1943 burial i/a '42 1941: rel large 1940: O w/ pith

Ring Reader: Bradley Collegge Site ID: Haidscrable

Tree ID: 25-1

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Reading Date: JUly 5, 2016 Collection Date: 2015 Slab ID: Y Upper

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

194431 Ocatermost Fing read 1942: Rel. Smill, Ana O 43, possible burnel 42 1941: Rel. 1910e 1949: Owl pith

Ring Reader: Bredley Collette

Site ID: Hardsumbble

Tree ID: 26-1

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1943. OUHermost King read 1942: Rel. Lagre; Ann. A '43; possible buricil '42. 1941: Del. Small 1940: Rel. Lagre 1943; O W/ pith

1943; Outernost ving read, but only on laxis 1942: rel large, ann 142, Surral 1/a 141 1940' vel large 1939: rel small, O ypith

Reading Date: July 6, 2016 Collection Date: 2016

Slab ID: YY up

Ring Reader: Bradley Collette Site ID: Huidscrabble

Reading Date: July 6, 2016

Slab ID: 20

2015

Collection Date:

Tree ID: 25-

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Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1942: Outrermost thing read 1941: Rel. Specific; Ama. 5 '42, possible buriest '41 1940: Rel Large 1939: O W/ pith

1991: Outermost ving read 1940: rel lange, ring surp '41, burial i/a '40 1939: Ow/pith

| Ring Rea | der: Biadley | GNette | Reading Date: | 8- |
|----------|--------------|--------|----------------|----|
| Site ID: | Hendscialle | | Collection Dat | e: |
| Tree ID: | 25-1 | | Slab ID: | 22 |

Ring Counts/Notes:

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1940 antermost ring read, and 140, burnial i/a '39

1939: OW/ pith

3-2016

Ring Reader: Bradley Whethe Site ID: Hardson bble Tree ID: 25-1

Reading Date: \$-3-2016, Collection Date: 2015 Slab ID: 23

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 1947 Duffermost ring vect

1940: Ana A '41, burial in '40

1938: Ow/ pith

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Ring Reader: Bradley Collette Site ID: Hardscrabble Tree ID: 25-1

Reading Date: 8-3-2014 Collection Date: 2015 Slab ID: 24

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

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Wood anatomy change notes:

1940: Outermost May and , and A outside of 40 - (41), burial i/a 140

1939: O w/ pinh, Ama D - 41, possible bacial - 410

Ring Reader: Bradley Collette

Site ID: Hardscrabble

Tree ID: 25-1

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

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1940: Outlemast File red ; Ans & artside '90, buril in '40 beaut midder eyl band 1939: O WI pith

Reading Date: 8/3/2016

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25 is one fled due to labeling ervor - no 25 exists

2015

Collection Date:

Slab ID:

Ring Reader: Bradley Collette Site ID: Hurdscrabble Tree ID: 25-1

Reading Date: 8/3/2012 Collection Date: 2015 Slab ID: 27

Ring Counts/Notes:

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1941. Outherman fing read 1940: Ring supp. in '41, burial in '40 1939: Owl pith

| Ring Rea | der: Brudley | 6 lette |
|----------|----------------|---------|
| Site ID: | Hard se rabble | • |

Reading Date: 8131 2016

Collection Date: 2015 Slab ID: 28

Ring Counts/Notes:

Tree ID: 25-1

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1940: authormost ring read, Ann & outside of '40, bursal in '40

1939: 0 w/ pith

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Ring Reader: Brudley Collette Site ID: Handscribble

Reading Date: 8/3/2016

| Collectior | n Date; | 2015 |
|------------|---------|------|
| Slab ID: | 29 | |

Ring Counts/Notes:

Tree ID: 25-)

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1940; Outlermost Fing read; Not much change in 40, bushal in 40

1939: 0 w/ pith

| Ring Rea | der: Brackley Collette | |
|----------|------------------------|--|
| Site ID: | Hardscrabble | |
| Tree ID: | 25-1 | |

Reading Date: 8/3/2016 Collection Date: 2015 Slab ID: 30

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1940: Outermost Ming read, Ling sopp. outside of 'to, buriel in '40

1939: O W/ Pith

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| Ring Re | ader: Bridley | Collette |
|---------|---------------|----------|
| | Hand Scrubble | |

Reading Date: 813/2016

Collection Date: 2015

Slab ID: 31

Tree ID: 3

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1940: authormost ring read ! Ann. A outside of 40, burial 40

1939: O w/pith

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| Ring Rea | der: Blue | lley | Collette |
|----------|-----------|------|----------|
| Site ID: | Hardsend | oble | |

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Reading Date: 8/3/2016

Collection Date: 2015

Slab ID: 32

Ring Counts/Notes:

Tree ID: 25 -1.

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1940! Outhermost ting read; appears to be little chance in '40, likely burial in '40

1939: Ow/ pirth

| Ring Rea | ider: Bradley | Collette |
|----------|---------------|----------|
| Site ID: | Haudscrabble | |
| Tree ID: | 25-1 | |

 Reading Date:
 8 /3 /2016

 Collection Date:
 2015

 Slab ID:
 33

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1940: OUTHERMOST Fing read, 19the change in '41, likely winn in '40

1939: 1 w/ pirk

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Germinated at on be low this stab 1939 t/- 2 yrs oning to unknown locatron of transtron to pitts in stem

Ring Reader: Alex Walter site ID: Hardscrabble Tree ID: 25-2

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2016-outer nost ring read. Is hard to read outer wings due to partial conversions to root wood + rotting on outside

Reading Date: 10/24/16

Above 65-Z

Slab ID:

Collection Date: Cof June 2015, exca varied March 2016

This slab + GS-1 both include

2009 - velsmall 2008 - rel lage 2007 - rel lage

1986 - rel large 1985 - rel large, mul yr xyl band 1984 - rel small 1983 - rel small, mul yr xyl band 1982 - rel large 1981 - rel large

1975-pith flecking 1945-wdyr xyl band 1941- @ W/pith

Ring Reader: Alex Walter site ID: Hardscrabble Tree ID: 25-2

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2016-outer nost ring read. Is hard to read outer wings due to partial conversions to root wood + rotting on outside

Reading Date: 10/24/16

Above 65-Z

Slab ID:

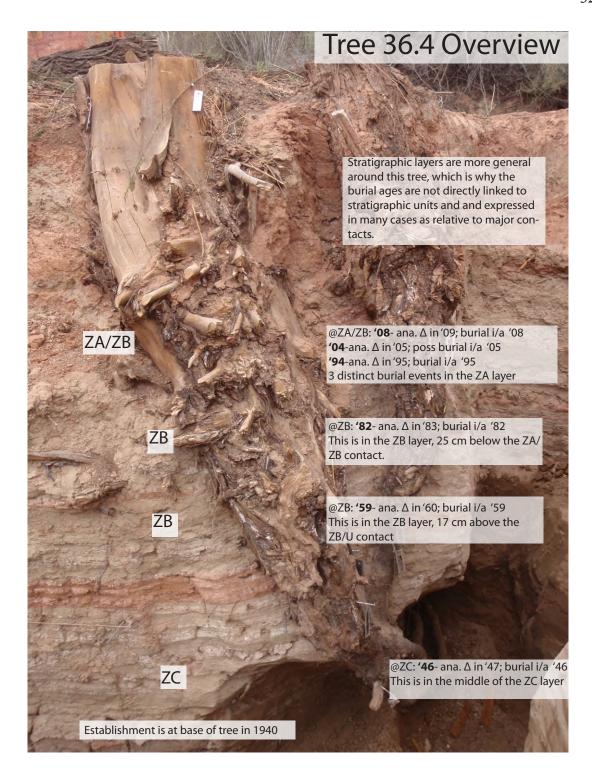
Collection Date: Cof June 2015, exca varied March 2016

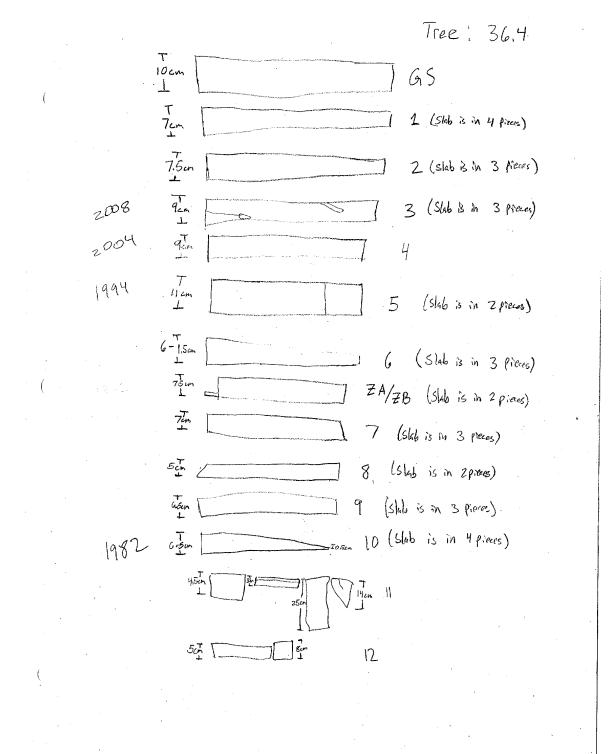
This slab + GS-1 both include

2009 - velsmall 2008 - rel lage 2007 - rel lage

1986 - rel large 1985 - rel large, mul yr xyl band 1984 - rel small 1983 - rel small, mul yr xyl band 1982 - rel large 1981 - rel large

1975-pith flecking 1945-wdyr xyl band 1941- @ w/pith





Ring Reader:

Site ID:

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Tree ID: 36. 4

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

Reading Date:

Collection Date:

Slab ID:

& This applies to the following notes &

Compared to fee 25-1 and the hydrology, 25-1 and the hydrology, these plabs may be 45 years older these plabs may be 45 years older man originally thought - so a year man originally thought - so a year Man originally years from actually would be - 3 years from actually recordend on notes 1982 Ex: reads 1986, but is actually 1983. When comped to 25-1 -A= 10/23/16

Reading Date: $lO/2.3/l_b$ Ring Reader: Alex Walker Site ID: Hardscrallde Collection Date: March 2016, cut June 2015 Slab ID: 65 Tree ID: 36.4 Note: this is updated dating sequence with cross-dating to tree 25-1 based on 83/84 Ring Counts/Notes: File Name: flood years, see cover note in this sequence # of radii measured as well for overall the notes Series ID: -AEW 10/23/16 Wood anatomy change notes: * Extensor rotted * 2011: Outermost ning read 1986 : fel lange 1985 : Kel lage 1984: Pelson, nudyr xylbud 1983: Kelsmell 1982: Rel large 1981: Pellarge.

1975: Pith flecking, cracking on two radius

1954: Center Mpith

Ring Reader: Bradley Collette Reading Date: 8 /4/2016 Site ID: Hard scalbble Collection Date: 2015 Tree ID: 36.4 Slab ID: GS - Outer Nings appeared votteet and so outer nings may be older that 2015 as read - AW 10/23/16 **Ring Counts/Notes:** File Name: # of radii measured Series ID: Wood anatomy change notes: - uncinnest Fing tend 1989! 2014: 2013: 2013: 2013: Corr: Relsmall B Mar: Relsmall, Midyland 1958: Passitly there, holde's damaget and had 2013: Corr: Relsmall B Mar: Adv. Small, Mrs 24/1 1958: Passitly there, holde's damaget and had 2013: Relsmall B Mar: Adv. Small instructured with wide 2013: Relsmall B Mar: Adv. Small instructured with wide 2013: Relsmall B Mar: Adv. Small instructured with and the other O w/pith visible poss (2010: Rels Large, and 1/2 poss burled 1989: rel large 2019: Rels Large 2019: Relsmall 1983: viel inse 2009: Relsmall 2009: Relsmall 1980: 2009: Relsmall 20 2007: fel. Lage 2006: 2005: WHH. 1979: solitting on Iradius, compressed wood as well 1977: Fel. Small 2004 2003 1976. Rel Lunge 2002. 2001 1975: Rel. Small 2000; fal. Large 1974'. 1999. 1473: 1998 1973: fel. Small 1997: 1971: 1996: 1995 1970 Let large 1994' 196.91 1943', 1968: 1968: Pd. Smill 1992 1991 tel Small 1967: Act Shall 1967: Act Shall 1968: Act Ins 1968: Rel Ins 1969: Fel large 1990 1962 1961. 1961: faint wild yr xyl band

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Ring Reader: Bradley collette

Site ID: Handson bbbe

Reading Date: 8/4/2016

Collection Date:

Slab ID: 生

2015

Tree ID: 36.4

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Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

2012: Ountermost Fing read 12 poss burial Ring Supp. 2011 2010; Rel. Lupe (2009! 2008 Mid year Xyl Lund? 2007: rel large 7006! 2005: 2004; 2003: 2002; Rel. Small 2001 2000: Rel. Large ; mild year xy ! band pagg; rel lizz 1998; relting 1997: fol Small 1996. reling 1495: rel Iry 1994) 1943: 1992: 1991: fol Small (1990;

11 1980: Pel. Smill; Mid year Xyl band? 11 1986: Pel. Smill; Mid year Xyl band? 1485: Pel. large 1987: vel large 1984: vel large 1982: 1982: 1979: aphilting on this wing - wood lookes life pith 1977: Add. Smill 1972: Add. Smill 1972: Add. Smill 1973: pail. Smill 1973: 1973: 1973: Rol L 1972: fel. Small 1971; 1970: rel barge 1969; Rel 1030 19671, Achi Small 1966 Rd. Small 1965: vel large 1964: W small 1963: 1962: 1961. 1960: μq.

1958; Pel luge, Innermost fing read

1989;

1988! fol, Small , mile

1957: some partial pith ussible, likely O ypith

Ring Reader: Bradley Glette

Site ID: Hurd Scrabble

Tree ID: 34,4

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 2012: Outer most ving read 2011: Am (1+ ving surp 1/2, burnd i/a 1/ 2008: nel small 2005. 2004 2003 2002; fel, Small 2001; 2000; mid y'r xyl band 1999; 1998: 1997; 1946; rel 1 mg 1945: rel 1 rg 1994: rel 1rg 1993: rel 1rg 1992: 1991; Fol. Small 1990; 1989; 1488: Ret Small, walyr xyl band 1987: Ret Small, mid yn xyl band 1981: Ret Small, mid yn xyl band 1986: ret Irg 1986: ret Irg 1989: ret Irg 1983'. 1962: 1981 tol lange 1980 Rel Irg

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Collection Date: 2015 Slab ID: 2

Reading Date: 8/4/2016

1974 1978 splitting on radius - pith wood 1977: Rel Some 1976 : Rel Lenge 1975: Red Small 1974: Nel Small 1973 . 1972: Rel Small 1971 1970: Rel large 1969; 1968: fet lange 1967. Rol Smith 1966: for Small 1965: 201 larse 1964 Red Small 1963; Rel small 1962: Rel small 1961; 1960; 1959; 1958: Rul large 1957: O w/psth, port vetted

foureved AEW 8/9/16

Ring Reader: BRudley Collette Site ID: Haidscrabble

Tree ID: 36.4

Reading Date: 8/4/2016 Collection Date: 2015 Slab ID: 3

-outer layers appear to be rotting

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

2012: outer most ring rend 2011: our O/ring surp 12, burring 1/a 1/1

Wood anatomy change notes:

1974: 1978: splitting on vadius - anotomy change 1977: fel. Small 2008 2007, ana A'08, poss burial 1/2.07 2005: and 1.06, poss burial 1/a '05 1976: Jed lage 1975! Ad. Spall 2003; 1974: 2002: Rel. Small 1973: 2001 1972; Ret. Small 2000: Mid yar Xyl bud 1971: 1999; 1970: 1998: 1969; 1997: 1968; rel large 1996: 1967; Reli Small 1995: rel large 1946; Red Small Kgu: rel large 1945: Reh lange 1993; (464', Jel. Small 1992: 1991 kel. Small 1963; 1410' 1962; 1989: 1941: 1981: fel. Small, mill yr xyl band 1987: fel. Small, mill yr xyl band 1980: fel. Small wid yr xyl band 1980: fel. Small wid yr xyl band 14601, 19591 1958; Rel. Large; i 19 85: 1957: O, portial pith visible 14 841 1983. 1982: 1981: 19:80;

Ring Reader: Bradley Collette

Reading Date: 8/4/2014 Collection Date: 2015

Site ID: Heidscrabble

Slab ID: 4

Tree ID: 36.4

Ring Counts/Notes: - can see out to 12 on 1 axis, so it may be that 2012 is the outer most ring, but had to File Name: see as a whole

of radii measured

2008; outermost ring read Series ID: 2007: ana A/ving surp '08, poss burial i/a '07

Wood anatomy change notes: 2005 and 106, poss burral 1/2 105

2000: (Wdyr xyl banl 1999; 1998: 1997' 1996 1945; rel lange 1994; rel lange 1993; Icl large 1992; 1991; Rei small, faint mid yr xyl band 1990; 1989. 1988. Rel Smill, med yor kyl bard 1987; fel Smill, much yor xyl band 1986, Rol. Smith 1985: rel large 1983: 1982: 1981: 1980;

1979; - 478: spitting @ ring, anawanty change 1477; fel Small 1976; fel. large, mid yor and burch 1975: Jel. Smill 1974' 1473: 1972; Rel. Small 1971: 1470% 1969: rel small 1468: 1967; fel. Small 1966; Rel. Small 1965; rel large 1964; Rollsmill 1963; bel small 1962: rel =mall 1961! 1900: 1958: rel hoge 1957; O y/pith visible portial

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2015

Site ID: Hardscrabble

Tree ID: 36.4

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Ring Counts/Notes:

2005: outer most ving read 2004: ana 4 '05, poss burial i/a '04

Slab ID:

Collection Date:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1998: Outhermost my read 1497. Ann & 48, Wrial 47, Rel. Smil 1996: 1995: 1494 1993: Rel. large 1992. 1991 : Rel. Small 1990' 1989! + 1987: Rel Small, and you myl band 1986: Rel Small, 1985: rel large ann A 86, poss bural i/a 85/957 O w/ pith 1984: rel larao 1984; vel lange 1483 1982. 1981; rel large 1980 ! 1978: Donge on ring in the year 1977: Fel. Small 1976: Fel. Large 1975 : Red Small 1974 1973. 1972; Rel. Small 19714 1970

1969; 1968: 1967; fel. Sme.11 1966 ; Rel. Sem.11 1965: 190 H ; Rd. Small 1463: 1962; 1961' 1960; faint wedge say I band 1951: 1958

Ring Reader: Bradley Collette 8/9/2016 Reading Date: Site ID: Hand Scalle 2015 Collection Date: h Tree ID: 36.4 Slab ID: Dunaage 1955 Ring Counts/Notes: File Name: # of radii measured Series ID: Wood anatomy change notes: $\left\{ \right. \right\}$ 1951; Rel. Small 1950; Rol. swall 19\$9: ... 1477 Quiterment sing read 1946: Invertionst My read 1976: an A 76, pous burklike 75 47 visible insibe, no pite seen 1975 19 74! 1473' 1472: Rel. Smill, continues to surpress further doing stery 1911 1970' 1969; Rel. Smill 1468: Pel. 10me 1467: Act Small 1966: Aul Smill MGS: Rel, lerge 1411: Rel. Small 1963 1462 ana A 63, poss burint 1/a 62 1461 140: 19591 1966: wdyr xyl bud, and A36, Ishody burral 9/n 55 1968: mod yw xyl band 458 14531

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1952: Rol. Small

Ring Reader: Braelley Collette Reading Date: 8/5/2016 Site ID: Hardscrabble Collection Date: 2015 Tree ID: 36.4 Slab ID: 6 - source beckeing and splitting on 1978 ring-det dange in that year Ring Counts/Notes: File Name: # of radii measured Series ID: this Wood anatomy change notes: to figu I would mese 1999' Outermost ring read 1969; arti dividuate 1418: finny supp. 199 , possible brief in '98 wes counted v. 1968: we 147 1967; Rel. Small 1996. Mdi; Del Small 1945 re 1994; 1965: 1943 that large 1964; Rel. Small 1992-1988: Area of large xil, Individual Muss cuit be destinguisted 1985: And large ' Ana D'86 possible burial : you '85 MG3: relsmall MGL: Rel. Small 1984 1461: 1983; Map; 19821 1959: 1981; vel large 1957: Ow/ pith 1910: 1979: 1978 splitting + pith fleck no longer seen on this radius 1477, Pel. Smg 11 1974; Rel. large 1975; fel. Small 1974: 19731 1972; Rd. Small 1971. 1470: rel large

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Ring Reader: Brudley Collette

Reading Date: 8/4/2011 Collection Date: 2015

Site ID: Hard Scabble

Tree ID: 56.4

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Slab ID: ZA/ZB Top

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

| There's a partien of rongs from H | e '903 that I and thering trouble daring. |
|-----------------------------------|---|
| Possibly i 1944, outlemant my ro | e in any more of the |
| NUCH A TOTAL TO THE TO | act |
| 1997 | the burral 198 |
| 19196 | |
| 1995-198/0 10000 41 | |
| 1986: Quant of White | a muy indicate a bartal in 185 tatend la and |
| 1985 rellarge, and AFrit | h muy indicate a borial in 185 tothered by excavation 195 ? |
| 1984: rel lamas | 7 16 85 1969 |
| 1483: | 1148. Fel longp |
| 1982 Rel. Small | 146 7: Let. Small |
| 1481: rel lange | 1966: Nel Small 1965: rel large |
| 1980. | 19641. Rel. Smg 11 |
| 1979: | 1963; |
| 1976 | 1962: relsmall |
| MM: Rol. Sun 11 | 1967. |
| 1971: fel. lasge | 14W: Faint mid yr xyl band |
| 1975! Rel Sung 4 | 1459: y' xyl band |
| (474) | 1958: |
| 1973! | |
| 1972; Del. Smill | 1957: O w/pith |
| 1971 : | |
| 1970; | |
| 11 14 1 | |

fervened ABW 8/15/16

Ring Reader: Brudley Whethe site ID: Hordscrabble Tree ID: 36. 4

Collection Date: June 2015 Slab ID: ZA/ZB Bottom

Reading Date: 8/10/16

& Switches Stem at ZA/ZB

Botton of slah

Slab between top and

Ring Counts/Notes:

File Name:

Series ID:

of radii measured

x64rr Wood anatomy change notes:

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1992: Outlermast ring read 1991: Rel small 1988, 1987 : Rel Small 1986: Rel small 1985: Rel lige, 21isht min A 86, poss burkl i/a 85/956; 1984; Ach lage 1483, 1482: Rel. Smill 1981: Rel lange 1980. 1979; 1978: 1977: Rel, Smill, mid xyl band 1976: followe, mid yr xyl band 1975'. 16744 1973 . 1472 . Rel. Small [4]1 1970", Rel Large 14694 1469: Ret lange 1967: Pel. Small 1960; Pel. Small 1965: Rol. Lange 1444: Rol. Small 1463. 1462: 1961 1960: Mid year XYI. and

1959; Rel large 1958: Pel lorge 19571 1455: 1954! M53; 1952; Relismall 1451: Rel, Smill +6 - 5 = 1955 1450; Ach simil 1449; Innernost ling Nuel

YAdds Byears here-is this for real? -25/ab switch here

Collection Date: 2016

Slab ID: 7

Tree ID: 36.4

Site ID: Had Endble

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

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1996, autheniust My want 1994; 1443: 1992: 1941: 1940: Rel. Small 1484 448 1987: Mae, likely the outermost ring 1986: Mill year XYI bund? 1986: Rel. Luge, and A 86, Idely burial 1/2 85 1984'. Rel. 1492 1983: 14. Santh 1482: 1481: Rel large, mid 1980 1979. 1978: 1977: Pol. Small 1476; felilage, mid yo xyl band 1975 Housent 1974; 1973i vel large 1972', Ret, Small 1971: Rellinge 1970: Rel large

1469; 1469; Rel. laise 1467; Hel. Son word you xyl beerd 1466; Pel. Son 1 1465; Pel. Jarre 1464; Pel. Son 11 1463; 1462; Splitting on radius at ring 1460; Mud year syl. bond 1469; 1469; 1459; 1458; 1457;

1969 : Dunemost ing read

1956;

195S!

bacenter rings spotted "above stab not seen here, no, pith seen

Ring Reader: Boadley Glette

Reading Date: 8/8/2010

Site ID: Hunderable

Collection Date: 2015 Slab ID: 8

1958; 1957; 1955:

1952: Roh Spratt

1951 . Innernost

19541 1953, Innen most

ving read

Tree ID: 36,4

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Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1987: 00 Herrost ring read 1955: 04 Have, and 4 ring sup 86, burial 1/2 85 1951. 1954: 44 Kee 1983: Rel. Small 1982: Acl. Small 1981: Pel large 1980: 1979! 1978: 1477; Rel. Small 1476: Rel. large 1975: 1974 No lower N. Smill, 1973. Poseware Missister 1472' Rel, Small 1971 1970 1969% 1968: Rel have 1967; Idi Small 1966; Rel. Small 1965: Rel. Janes. 1964: Rel. Small 1963: 1962: splitting on ring 1961: 1960: Mid year band?

Ring Reader: Bradley Collette Reading Date: 8/8/2014 Site ID: Hardsombble **Collection Date:** 2015 Tree ID: 30.4 9 Slab ID:

1

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Ring Counts/Notes: to tree Downege Storting File Name: 45 SS # of radii measured Those \mathfrak{D} Series ID: ve. أتني . 10m 10 Wood anatomy change notes: (od 1885; Outhernos ving read, and 486, burial i/c 85 1959; Pel large 1983: 1953: 1957; Pel large 1982: 1957; 1981: 181. Suna 11 1956; fel. Small 1953; Ad, Swall 1980 1979: 1954 1953', 1978: 1952; Rel. Sum 11 1977. Outer most ving read 1951: Nel, Smull 1976:1 1950: Innermost ng read 1975 ana A + ving wy 76, poso burialila 75 1974! 1973; 1972; Relismall 1471: Ana 1 72 ,053 burdal 1/2 71 1970. 1909; 1968: fel, luge 1967: Rol: Small 1966: Rel: Small 1965: Ach large 1964: Rel. Spr. 11 1963 1962: 1961: Midyor xyl ban 1960:

A for dear is burnd weak on Il

Ring Reader: Bradley Collette

Site ID: Hard scrabble

Tree ID: 36.4

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 1978: Outlearnest iny raid 1977; Pel. Smintl 1 1959: Bel longe 1958: Bel longe 1957: 1965: Pel smull 1955: Pel smull, ann 2'56, poss beimal i/a '55 1954: Mil your vyl. bard 1962. 1976; Rel. laye, wely & ryl band 1925: and 76, 1055 burlal :/6 75 19m 1473; 1972 ! Och. Small 1453 1452; Rel, Small 1971: 1951; pel. Small 1970; 1950; del small 1949 1969! Id sing 1948: Innermost Myread 1968: fel. Laipe "47 visible inside 1967; Rd. Small 1966: Relsmall 1965: Rellange 1964; Pelsmall (963', 1903, 1902: Ann 463, poss burial i/a 62, mid yr xy band have, but not seen fauther 10.... 1901: 1960.

Reading Date: 8/8/ 2016 Collection Date: 7015

Slab ID: 10

Dumage to tree on Vaclus beginny in 55

340

Ring Reader: Bradley Collette

Reading Date: 8 /10/2016

BC! Not confident on translation from 11-212

-Unsure it ving dates were interpretted correctly

Collection Date: 2015

Tree ID: 36.4

Site ID: Hurdscrabble

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slab ID: 12 thenaly hard to Figure out how free parts of, 12 match up w/cach

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

From frevious slab by I trute this interpretation

Wood anatomy change notes: 1963: astermost ving read is correct 1962: and K + Ving surp '83, Whely burial 1/2 62 -AEW 1961; 8/21/16 1960. 1959: 1958: 1957; 1956; Rel. Sug 11 1956; wed yr and band, and 256, likely burral 1/2 55, damage to trunk starting In 55 1953; 1952', Rd. SugA 195 1. Pol. South (450°.61.5~4 1949: 1948 Junetwoor ring veral

47 visible inside, no pith seen

Ring Reader: Bradley Collette Site ID: Hadscabble

Reading Date: 8/10/2010

Slab ID: B -top

Ring Counts/Notes:

Tree ID: 36.4

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1959; OUHermost rhy read 1958; 1957; 1956; Pel. South 1955; 1959; 1952; Let. South 1952; Let. South 1957; 1950; 1950; 1950; 1940; 1940; 1940; Innermost ring read

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1963: Outermost ring read 1962: 1961: 1960: 1959: ana A in 60 + wing surp poss burial 1/459 1958', Rellonge 1957: 1956: relsmall 1955; mid yr xyl band 1954: mid yo xyl band 1953 1752 rel small 1951: 1950: R/ lage 1949: Rel large 1948: Inner most ring read 1947 -? Maybe Wisible

47 At least 47-maybe 46 visible

Ring Reader: ALex Walker Site ID: Hardscrabble Tree ID: 36. 4

Reading Date: 8/25/66 Collection Date: 2015-June Slab ID: 13-base

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1960 : Dutermosting red, an 4 80, likely burnal 1/9 159 1959 : Rellinge 1957: vel small 1955: and you xyl band, 1103 surp & Ann 18 56, poss burnhall 35 1955: and you xyl band seen 1953: 1957: no and you xyl band seen 1953: 1952: 1952: 1952: 1950: 1949: 1949: 1948: innermost ving vedel

1947 visible inside, possibly 1946 as well

Ring Reader: Budley Collette Site ID: Had scrabbe Reading Date: \$/10/2016Collection Date: 2015Slab ID: 14 - 700

Ring Counts/Notes:

Tree ID: 34,4

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File Name:

of radii measured Series ID: This is hand to track across plabs here need to send base of 13

Wood anatomy change notes:

(456: Outermost ving read 1955: 41 lange 1955: 41 lange 1954: 41 lange 1954: 41 lange 1953: 41 lange 1953: 41 lange 1950: 41 small 1950: 41 small 1948: 1948: 1948: 41 1948: 4

Ring Reader: Abex Walter site ID: Handscrabble Tree ID: 36.4

Reading Date: 8/25/16 Collection Date: June 2015 Slab ID: 14 - Gase

Ring Counts/Notes:

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1952: atermost ving read ana & 15%, poss burral i/a 51 1951 1930 1749: vel large 1948 : 1947: 1946: innermost why mad 1945? possible ring in not possibly 44 in here below

Ring Reader: Brudley Collette

Site ID: Hardscrubble

Tree ID: 36,4

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Reading Date: 8/10/12014 Collection Date: 2015 Slab ID: 15

BC: Not confident in transition 14-715

-Ungreater ring dates were inservented correctly Sed base of 14

Those are allittle shaley as only on I radius

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1952: Outhermost my read, and & SZ, likely burral i/a SI 1951 Relismall 1948 1947

1946: Tunenvost May read

1945 WSille Miside but to wing seen

Ring Reader: Bradley Collette

Site ID: Hard Scalle

Reading Date: 8/10/2016 Collection Date: 2015 Slab ID: Tay of 4/2 B

Ring Counts/Notes:

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Tree ID: 26.4

File Name:

of radii measured

Series ID: Wood anatomy change notes: country switched asis, not confident with date -BC

19452: Outhermost ring read practices out end vandius - and A 53/52, pooss burted i/a 52/51 1957: Relsmalt 1949: Rel large 1948: Rel large, innernost ring read

1947 visible inside no pitty

Reading Date: & - 11 - 2016 Collection Date: 2015

Slab ID: 16

Ring Counts/Notes:

Tree ID: 36.4

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1950: Rel small 1952 - and 1950: Rel small longe 1949: Pel longe 1949: Ald your syl band a 1949: Mid your syl band a 1947: Usible in side, no pith

my read 1953 -orten most read also, and A'SZ, poss burial i/a SZ ana A'53, poss burial i/a SZ iel small, outer most ning read also, ana A'SZ, poss burial i/a SI 52,

Ring Reader: Bradley Collette

Site ID: Hadsorybble

Tree ID: 36.4

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Reading Date: 8-11-2016 Collection Date: 2015 Slab ID: Bottom of U/ZC

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1951: When ost ling read, ring surp + and 51, litely burial 1/2 50 1450 : fel. SixII 1949: vel lange 1448: Mid Denr XYI band. 1946: O v/ pits

Ring Reader: Bradley Cllette

Reading Date: & -11-2014

Collection Date: 2015

Slab ID: / 7

Site ID: Hundscrubble

Tree ID: 36.4

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Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 1951: OUHERMOST May read, and ISI, burial 1/250 1950: Red Small 1949: rel large 1948: Mid year XI burd, Nel. Small 1947: Red large

1946; Or pitts

Ring Reader: Bradley Collette

Collection Date: 2015Slab ID: 18

Tree ID: 36.4

Site ID: Hardsundle

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Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes: 1951: OUHEIMOST Wing Neid, and A SI, burstal 1/a 50 1950: Helisman 1949: rel large 1948: Mid year xyl band; rel. sman 1947: rel large Saunt yr xyl band 1946: Owy otth

351

Ring Reader: Brudley Collecte Site ID: Handscrubble

Tree ID: 36.4

Reading Date: 8-11-2016 Collection Date: 2015

Slab ID: 19

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1453: OUTHERMOST May read 1952: Reli Spall 1951: Reli Spall 1950: Reli Small 1949; 1948: My Vew band 947: Immermost Ting read; Fotted out in the center

> Oma A 48, poss burrial Va '47, Jamage apparent to tree stanting in 48

(

Damage seen beginning in SI, Damage outdance for flooding in Nore 1950

1951: Outermost ving read, om 2's, browd 1/2 50 1950; Rel small 1949: Rel targe small 1948: Rel small, ind yr xyl bound and 2'41, pos house 1947: Rel large, also ross bould have 1946: Rel large on Iradous 1945: Rel large on Iradous 1945: Rel large, innermost Wing read 1944 visible inside but no pith Seen Ring Reader: Boadlay Gillette Site ID: Hadsalble Tree ID: 34,4 Reading Date: 8-11-206 Collection Date: 2015 Slab ID: 20

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1952: OUTHERMOST (Dry vend) 1951: Pel. Smill 1950: Rol. Smill 1949: 1948: Myt yeur XYI burd? 1947: O W/ Pith

1950: Outer most my read, and So when brind it 49 1949: Relsmall 1948: Rel small 1947; Relonge, and 148, likely burral ila 47 1948: Rel large on I radius 1945: fel large, but should on other vadius 1944: O w/ pith

Ring Reader: Alex Walter site iD: Hardscrabble Tree ID: 36.4

Reading Date: 8/26/16 / Collection Date: June 2015 Slab ID: ZI

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1950: outermest ving read 1949: Rel = mall 1948: Rel = mall 1947: Rel Imge, an el 48, likely burial i/a 47 1946: Rel Imge, compresses on other radius, fourt midlyr xy/ band 1945: fourt wid yr xy/ band 1945: fourt wid yr xy/ band 1943: O W/ pith

Ring Reader: Abex Walker Site ID: Hordscrabble

Reading Date: 8/26/16 Collection Date: June 2015

-Thus is where two trucks combine, still unclear if tress trucks are 1 or 2 trees. Also, at this point, tree takes a 40-50° anyte offshope into wall of side trench, below this tree dives at a

lower roles than above, where it is vertical

Slab ID: 22

through the sediments.

Ring Counts/Notes:

Tree ID: 36.4

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1948: Outermost ring read 1947: Rel large, and A /ring surp 48, burial i/a 47 1946: Rel medium 1945: mid yor xyl band 1944: Pel small 1943: Ow/ pith

Ring Reader: Alex Walker Site ID: Hardscrabble Tree ID: 36.4

Reading Date: 8/26/16 Collection Date: June 2015 Slab ID: 23 -A

Ring Counts/Notes:

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File Name:

of radii measured

Series ID:

Rings Compress on certain radius

Wood anatomy change notes:

1948: Otternost ving read 1947: rel large, and 148, burtal i/a 147 1946: rel large 1945: mod yr xyl band 1944: rel small 1943: Ow/pitts

Ring Reader: Alex Walker Site ID: Hardscrabble Tree ID: 36.4

Reading Date: 8/26/16 Collection Date: June 2015 Slab ID: 23-8

Ring Counts/Notes:

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1948: arternost ving read 1947: 1946: ana & '47, poss bursal ita '46, wedger xyl barnl 1945: no wedger xyl burd seen 1944: rel small 1943: O w/ pitty

Ring Reader: Alex Willien Site ID: Hordscrabble Tree ID: 36,4

Ring Counts/Notes:

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

this mid y v band looks a lot this mid y v addred ving; but ite an time evidence the The count find evidence by T count find evidence by the count find evidence by personal evidence by personal evidence the power of the power of 100 king of the size of center 100 king he size of the diversion punding slubs 1948: Outermost ving read 1947 1946: strong usdyn wyl bard, ana A' 47, litely burial i/a 16 1945: Damage seen in Hus layer 1944: rel small -> save as above + below in width 1943: 0 -/ pity

Reading Date: 8/26/16

Slab ID: 24

Collection Date: June 2015

Ring Reader: Alex Worker Site ID: Hardscribble Tree ID: 36.4

Reading Date: 0/30/16 Collection Date: June 2015 Slab ID: 25

Ring Counts/Notes:

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1947: Ortemost Wing read 1946: vel guall, no workyor xyl board seers, and 147, likely burned i/a "46

1945: 1944: rel small 1943: Ow/pith

Ring Reader: Alex Walker Site ID: Hand scrabble Tree ID: 36,4

Reading Date: 8/30/16

Collection Date: Jone 2015

Slab ID: 26

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1946: aternost ving read 1945: and '46, poss Surial ila '45 1944: rel small 1943: Ow/ pith

Ring Reader: Alex Walker Site ID: Hordscrabble Tree ID: 36.4

Reading Date: 8/30/16 Collection Date: June 2015 Slab ID: 27

Ring Counts/Notes:

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File Name:

of radii measured

Series ID;

Wood anatomy change notes:

1944: rel small 1943: Ow/pith

· Ring Reader: Alex Walker Site ID: Hordscrabble Tree ID: 36.4

Reading Date: 8/30/16 Collection Date: June 2015 Slab ID: 28

Ring Counts/Notes:

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1946: Outermost ring read 1945: relsmall, and 146, burdal i/a '45 -fourt ning 1944: velsmall 1943: 10 w/pith

Ring Reader: Alex Walken Site ID: Hordscrabble Tree ID: 36.4

Reading Date: 8/30/16 Collection Date: Jure 2015 Slab ID: 29

Ring Counts/Notes:

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File Name:

of radii measured

Series ID:

Wood anatomy change notes:

1946: aternost ving vevel 1943: and 46, burial 1/a '45 - Kaint ring 1944: rel small 1943: O w/ pith

Ring Reader: Alex Walker Site ID: Hardscrabble Tree ID: 36.4

Reading Date: 8/30/16 Collection Date: June 2015

Slab ID: 30

Ring Counts/Notes:

File Name:

of radii measured

Series ID:

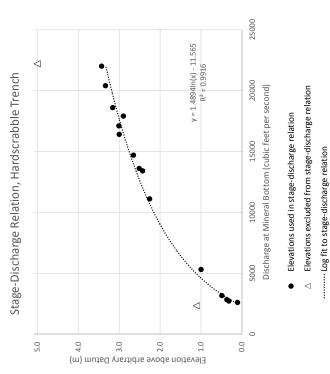
Wood anatomy change notes:

1946: Outermost ving read 1945: if two is a ning, it is really favorit, and 4 '46, burrial i/a '45 1944: rel small 1943: Ow/pith

establishment in 1943 in this slab 10/23/16: W/ 4 yr Older adj, establishment in 1939 -AEW

APPENDIX C. DATA USED TO COMPUTE STAGE-DISCHARGE RELATION AT HARDSCRABBLE BOTTOM

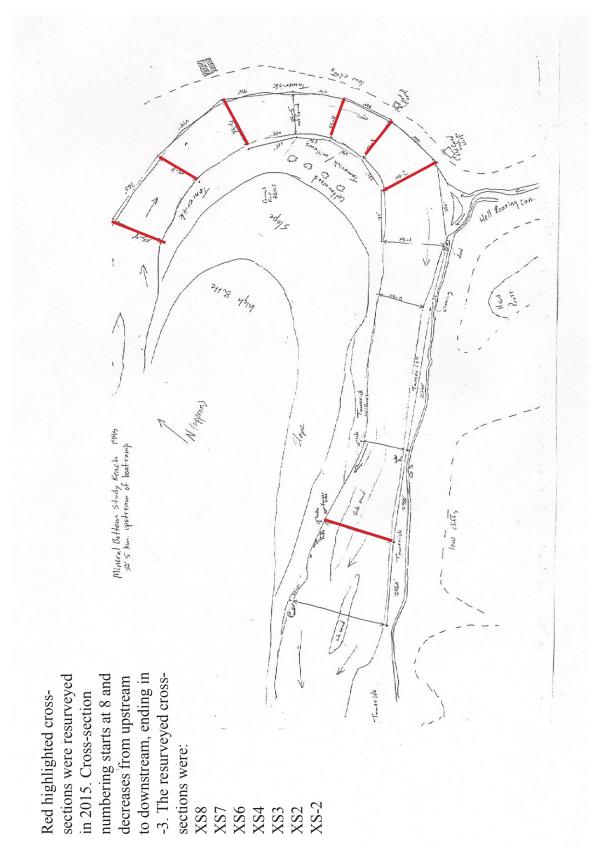
| | Elevation Above | Discharge at Mineral | Gage Height at Mineral | |
|-----------|---|---|---|--|
| Date | Arbitrary Datum (m) | Bottom (ft ³ /s) | Bottom (ft) | Notes |
| 9/20/2015 | 1.111 | 2340 | 6.71 | Not used in relation |
| 6/15/2016 | 5.009 | 22200 | 17.56 | Not used in relation |
| 8/8/2015 | 0.105 | 2600 | 6.84 | |
| 8/10/2015 | 0.317 | 2710 | 7.00 | |
| 3/14/2016 | 0.489 | 3160 | 7.46 | |
| 4/8/2016 | 0.369 | 2830 | 7.09 | |
| 5/12/2016 | 2.514 | 13600 | 14.28 | |
| 5/19/2016 | 2.654 | 14700 | 14.76 | |
| 5/26/2016 | 3.004 | 16400 | 15.44 | |
| 6/3/2016 | 2.259 | 11100 | 13.07 | |
| 6/6/2016 | 3.009 | 17100 | 15.71 | |
| 6/7/2016 | 3.164 | 18600 | 16.29 | |
| 6/9/2016 | 3.339 | 20400 | 16.92 | |
| 6/13/2016 | 3.434 | 22000 | 17.48 | |
| 6/22/2016 | 2.899 | 17900 | 15.75 | |
| 6/30/2016 | 2.429 | 13400 | 13.96 | |
| 7/12/2016 | 0.999 | 5310 | 9.45 | |
| | Water surface elevati | ions were collected imme | Water surface elevations were collected immediately off shore of the trench at a range of | anch at a range of |
| | discharges. Elevation: | s were all adjusted to the | discharges. Elevations were all adjusted to the same arbitrary datum and plotted against | d plotted against |
| | discharges from Mine data to produce a sta | eral Bottom (USGS 09328 Ige-discharge relation. Tv | discharges from Mineral Bottom (USGS 093.28920). I then fit a logarithmic trendline to the data to produce a stage-discharge relation. Two values were excluded from the relation. | ic trendline to the rom the relation. |
| | For both of the exclu | ded values, the elevation | For both of the excluded values, the elevations recorded were substantially higher than | ally higher than |
| | | | | |

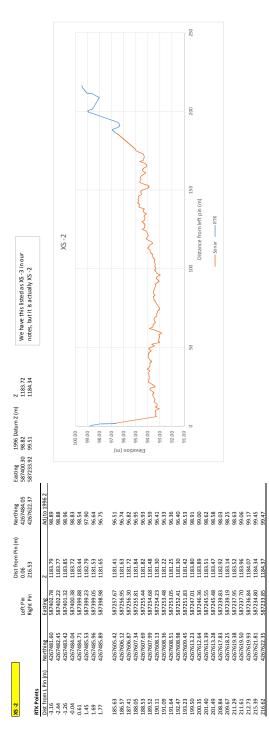


APPENDIX D. CROSS-SECTION SURVEY DATA FROM HELL ROARING CANYON, MAY 2015

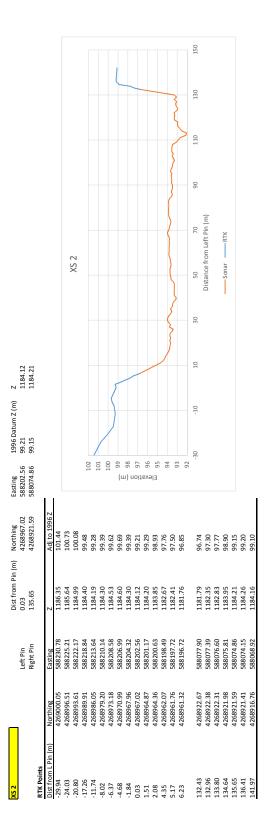
Cross-sections were marked at Hell Roaring Canyon by fence posts on both the left and right banks by previous surveys in 1995 and 1996. Some of the posts were eroded away between 1996 and 2015. Of the 12 cross-sections marked on a 1995 sketch of the study reach, 11 were resurveyed and 1 (XS5) wasn't found. In 2015, we were able to find the left and right benchmarks for 7 cross-sections, and we resurveyed inside of the channel using an Odom CV-100 echo sounder with a 200 kHz transducer. On the banks, the surveys were done by a Trimble RTK-GPS. Positioning was by RTK GNSS survey with a local base station using the coordinate system UTM Zone 12N, North American Datum of 1983 (EPSG 26912).

All collected RTK points were used to build cross-sections. Multiple sonar tracks were collected at each cross-section, resulting in thousands of points. I sub-sampled the raw sonar data to a density of 1 point per meter along an ideal cross-section line between benchmarks. For each cross-section, the ideal cross-section distance is the desired location for each sonar reading and the actual distance is the location on the cross-section of the sub-sampled reading. The 2015 Z values were then adjusted relative to the 1996 elevation of the left pin so the 2015 elevations could be compared to the surveys from the mids-1990s.

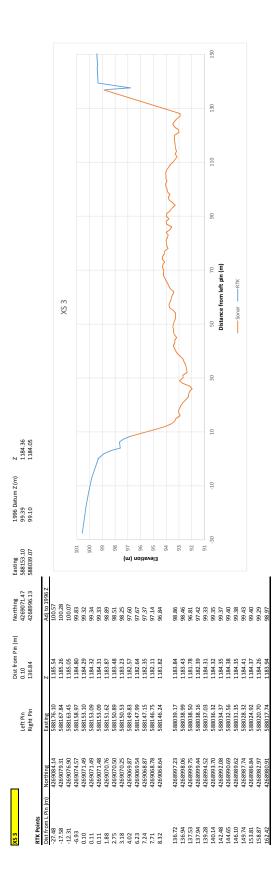




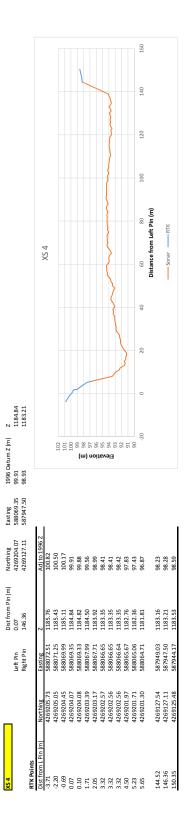
| Sonar Data at 1m points | points | | | | | | | | | | | | | | | | |
|----------------------------|--|----------------|------------------------|----------|------------------|----------------|--|--------------|------------|--|------------------|----------------------------|--|-------------|------------------------|----------|------------------|
| Ideal Dist from L P (m) | in Actual Dist from L Northir Din (m) | IL Northing | Easting | z | Adj to 1996 7 | | Ideal Dist from L Pin Actual Dist from Northing (m) | | Easting | N | Adj to 1996 7 | ldeal Dist from Pin (m) | Ideal Dist from L Actual Dist from Northing Pin (m) I Pin (m) | m Northing | Easting | N | Adj to 1996 7 |
| 177 | 77.1 | 00 3047264 | 00 000200 | 1101 66 | 06.75 | 00 63 | 00 00 | | 0 010200 | 1170 AE | 03 55 | 121.00 | 120.00 | 0 1022201 | 10 202202 | | 20 00 |
| 1.// 6.06 | 1.// 6.06 | 4267490.38 | 587395.62 | 20.1011 | 90.75 93.28 | 64.00 | 63.98 | 4267527.28 | 40'0cc/0c | 1178.48 | 93.59 | 122.00 | 121.99 | 4267565.51 | 587304.42 | 1178.92 | 4.03 |
| 2,00 | 66.9 | 4267490.88 | 587394.89 | 1178.27 | 93.38 | 65.00 | 64.99 | | 587349.26 | 1178.37 | 93.48 | 123.00 | 123.00 | 4267566.38 | 587303.63 | 1178.97 | 4.08 |
| 8.00 | 7.99 | 4267491.10 | 587394.10 | 1178.20 | 93.31 | 66.00 | 66.00 | 4267528.24 | 587348.47 | 1178.27 | 93.38 | 124.00 | 123.99 | 4267567.29 | 587302.85 | 1179.04 | 4.15 |
| 9.00 | 9.00 | 4267491.85 | 587393.31 | 1178.30 | 93.41 | 67.00 | 66.99 | 4267529.16 | 587347.69 | 1178.35 | 93.46 | 125.00 | 124.99 | 4267566.90 | 587302.06 | | 94.48 |
| 10.00 | 9.99 | 4267492.32 | 587392.53 | 1178.25 | 93.36 | 68.00 | 67.98 | 4267529.32 | 587346.91 | 1178.39 | 93.50 | 126.00 | 125.99 | 4267568.66 | 587301.28 | | 94.27 |
| 11.00 | 10.99 | 4267494.51 | 587391.74 | 1177.95 | 93.06 | 00.69 | 00.69 | 4267529.72 | 587346.11 | 1178.32 | 93.43 | 127.00 | 126.98 | 4267568.83 | 587300.50 | | 94.26 |
| 12.00 | 12.00 | 4267493.88 | 587390.95 | 1178.27 | 93.38 | 70.00 | 66.69 | 4267531.20 | 587345.33 | 1178.13 | 93.24 | 128.00 | 127.99 | 4267568.95 | 587299.70 | | 94.24 |
| 13.00 | 12.99 | 4267494.70 | 587390.17 | 1178.11 | 93.22 | 71.00 | 70.98 | 4267531.02 | 587344.55 | 1178.17 | 93.28 | 129.00 | 129.00 | 4267569.69 | 587298.91 | 1179.23 | 94.34 04.40 |
| 14.00 | 13.99 | 425/494.35 | 58/389.38 | 51.8/11 | 93.24 03.4F | 00.27 | 00.27 | 420/532.03 | C/:243.545 | 11/8/11 | 72.22 | 130.00 | 66.67T | 10.0/2/024 | 58/298.13 | | 94.48 |
| 15.00 | 14.99 | 12.0247024 | 58/388.0U | 11/8.34 | 75.45 | /3.00 | 66.7/ | 4/0252/024 | 16.242.58 | 60.8/11 | 93.2U | 131.00 | 66.0E1 | 68.1/6/024 | 58/29/.34 | | 97.4 |
| 19.00 | 15.99 | 426/496.04 | 18/38/36 | 11/8.30 | 93.47 | 74.00 | 74.02 | 426/533.44 | 81.242.18 | 10 10 10 10 10 10 10 10 10 10 10 10 10 1 | 20.55 | 132.00 | 132.00 | 18.1/2/024 | CC.062/8C | | 94.24 |
| 00.71 | 10.98 | 14/02/02/02/02 | 58/38/.U3 | 92.8/11 | 93.40 | 00.5/ | 74.97 Tr 00 | 426/555/024 | 19/19/2000 | CE.//II | 93.00 | 133.00 | 132.98 | 04/2/2/2/47 | 8/.252/82 | | 14.31 |
| 10.00 | 18.00 | 42b/49b.93 | 58/380.23 E0730E AE | 1170 44 | 06.59 73 50 | /6.00 | 86.67 | 15.452/024 | 20,042,042 | 11/8/11 | 21.55 | 134.00 | 135.99 | C0.5/C/075 | 58/294.98 58/204.98 | 1170.01 | 24.24 C1 h0 |
| 19.00 | 10.00 | 00.1641024 | 22 A 900 100 | 11/0.44 | 00.62 | 00.07 | 00 11 | 46'46C/074 | 70,955,05 | 50'0/TT | 10.02 | 135.00 | 125.00 | 20,6767024 | 6T-967/00 | | 24.12 |
| 00.02 | 66.6T | 07.024/074 | 70/384.00 | 10:0/11 | 73.02 03 E0 | 00.05 | 00 02 | 420/0250/074 | 10,955/55 | 07.0711 | 15.51 | 137.00 | 66'CET | 00.4/6/074 | 19:567/25 | | 94.30 |
| 00.12 | 90.12 | 02.004.004 | 10.000/00 | 1170 51 | 02.62 | 00.00 | 00.07 | 14:05:1024 | 97 722703 | 07.0/11 | 07 20 | 128 00 | 00 001 | 10.4757540 | 20,252/00 | | 04.40 04.20 |
| 00 66 | 00 66 | A267E01 01 | 10 000203 | 102 0211 | 10 00 | 00.00 | 00.10 | | L9 966203 | 00.0711 | 03 00 | 120.00 | 00.001 | 0T:C/C/075 | CO.107/0C | | CZ- V0 |
| 24.00 | 06.22 | 4267501.20 | 587381.52 | 1178.69 | 13.80 | 82.00 | 81.99 | 4267538 32 | 10,000,000 | 1178.46 | 93.57 | 140.00 | 139.99 | 4267576.74 | 587290.26 | 1179.61 | 477 |
| 25.00 | 24.99 | 4267487.35 | 587380.73 | 1178.28 | 93.39 | 83.00 | 82.99 | 4267539.69 | 587335.10 | 1178.30 | 93.41 | 141.00 | 141.00 | 4267577.65 | 587289 47 | | 94.70 |
| 26.00 | 25.99 | 4267491.17 | 587379.94 | 1178.44 | 93.55 | 84.00 | 83.99 | 4267540.27 | 587334.32 | 1178.40 | 93.51 | 142.00 | 141.99 | 4267578.62 | 587288.69 | | 94.85 |
| 27.00 | 26.99 | 4267502.90 | 587379.16 | 1178.63 | 93.74 | 85.00 | 84.98 | 4267539.87 | 587333.54 | 1178.46 | 93.57 | 143.00 | 142.99 | 4267578.65 | 587287.90 | | 94.76 |
| 28.00 | 27.96 | 4267503.78 | 587378.39 | 1178.87 | 93.98 | 86.00 | 85.98 | 4267541.27 | 587332.75 | 1178.38 | 93.49 | 144.00 | 144.00 | 4267579.69 | 587287.11 | | 94.82 |
| 29.00 | 28.99 | 4267504.64 | 587377.58 | 1178.82 | 93.93 | 87.00 | 87.00 | 4267541.89 | 587331.95 | 1178.37 | 93.48 | 145.00 | 144.96 | 4267579.79 | 587286.35 | | 94.75 |
| 30.00 | 29.99 | 4267505.22 | 587376.80 | 1178.79 | 93.90 | 88.00 | 87.96 | 4267542.64 | 587331.19 | 1178.31 | 93.42 | 146.00 | 145.98 | 4267580.74 | 587285.55 | | 4.79 |
| 31.00 | 30.99 | 4267505.76 | 587376.01 | 1178.77 | 93.88 | 89.00 | 88.99 | 4267543.38 | 587330.38 | 1178.24 | 93.35 | 147.00 | 146.99 | 4267581.47 | 587284.76 | 1179.44 | 94.55 |
| 32.00 | 31.98 | 4267506.11 | 587375.23 | 1178.79 | 93.90 | 90.00 | 89.97 | 4267543.26 | 587329.61 | 1178.28 | 93.39 | 148.00 | 147.99 | 4267581.71 | 587283.97 | | 4.55 |
| 33.00 | 33.00 | 4267507.09 | 587374.43 | 1178.81 | 93.92 | 91.00 | 66.06 | 4267544.84 | 587328.81 | 1178.14 | 93.25 | 149.00 | 148.99 | 4267582.92 | 587283.18 | | 4.60 |
| 34.00 | 33.99 | 4267507.69 | 587373.65 | 1178.83 | 93.94 | 92.00 | 91.98 | 4267544.52 | 587328.03 | 1177.96 | 93.07 | 150.00 | 150.00 | 4267583.29 | 587282.39 | | 94.47 |
| 35.00 | 34.98 | 4267507.49 | 587372.87 | 1178.73 | 93.84 | 93.00 | 93.00 | 4267544.90 | 587327.23 | 1178.08 | 93.19 | 151.00 | 150.98 | 4267584.00 | 587281.62 | | 4.03 |
| 36.00 | 35.97 | 426/508.40 | 58/3/2.09 | 11/8.95 | 94.06 | 94.00 27 20 | 93.99 | 426/545.57 | 58/326.45 | 11/8.20 | 93.31 | 152.00 | 151.97 | 426/584.59 | 58/280.84 | 11/8/./8 | 3.89 |
| 37.00 | 90.05 | 91,906/924 | 58/3/1.29 | 11/8.81 | 26.56 | 00.69 | 94.99 | 426/54/.18 | 00.025/80 | 11/8.14 | 23.25 | 153.00 | 153.00 | 420/585.18 | 28/280.03 | | 94.00 |
| 39.00 | 06.76 | 4267510.83 | 10,0/0/00 | 1178 70 | 93.81 | 97.00 | 96.99 | 4267547 51 | 00.426/00 | C0.1/11 | 94.26 | 155.00 | 154 98 | 4267586 74 | C2.61210C | | 94.44 |
| 40.00 | 39.98 | 4267512.16 | 587368.94 | 1178.73 | 93.84 | 00.86 | 66.76 | 4267548.34 | 587323.30 | 1178.22 | 93.33 | 156.00 | 156.00 | 4267587.46 | 587277.67 | | 94.64 |
| 41.00 | 40.97 | 4267512.83 | 587368.16 | 1178.57 | 93,68 | 00'66 | 00'66 | 4267550.52 | 587322.51 | 1178.34 | 93.45 | 157.00 | 156,99 | 4267588.73 | 587276.89 | | 94.56 |
| 42.00 | 41.99 | 4267513.42 | 587367.36 | 1178.72 | 93.83 | 100.00 | 66'66 | 4267551.32 | 587321.73 | 1178.23 | 93.34 | 158.00 | 157.99 | 4267588.81 | 587276.10 | 1179.51 | 94.62 |
| 43.00 | 42.98 | 4267513.95 | 587366.58 | 1178.80 | 93.91 | 101.00 | 100.99 | 4267552.09 | 587320.94 | 1178.30 | 93.41 | 159.00 | 159.00 | 4267589.16 | 587275.31 | | 94.55 |
| 44.00 | 43.99 | 4267512.48 | 587365.78 | 1178.89 | 94.00 | 102.00 | 102.00 | 4267553.04 | 587320.15 | 1178.29 | 93.40 | 160.00 | 159.98 | 4267590.13 | 587274.54 | | 94.33 |
| 45.00 | 45.00 | 426/513.11 | 58/364.99 | 11/8.82 | 93.93 | 103.00 | 102.99 | 426/552.09 | 58/319.37 | 87.8/11 | 93.39 | 161.00 | 161.00 | 426/590.30 | 58/2/3./5 | 00.6/11 | 94.17 |
| 47.00 | 00.04 | 4267516 A6 | 587363 42 | 1178 74 | 03.85 | 105.00 | 105.00 | 4267554.05 | 010101010 | 1178 37 | 14.00 | 163 00 | 162.00 | 4207502 28 | 71 272737 | | 04.40 |
| 48.00 | 48.00 | 4267517 31 | 587362 63 | 1178.61 | 93.77 | 106.00 | 105.99 | 4267553 99 | 587317.01 | 1178 32 | 03 43 | 164.00 | 163.99 | 4767591 88 | 587271 38 | | 54 33 |
| 49,00 | 48.99 | 4267517.59 | 587361.85 | 1178.83 | 93.94 | 107.00 | 106.99 | 4267555.58 | 587316.22 | 1178.46 | 93.57 | 165.00 | 165.00 | 4267593.70 | 587270.59 | 1178.97 | 94.08 |
| 50.00 | 49.97 | 4267518.74 | 587361.08 | 1178.66 | 93.77 | 108.00 | 107.99 | 4267555.56 | 587315,44 | 1178.55 | 93.66 | 166.00 | 165.99 | 4267594.04 | 587269.81 | | 94.10 |
| 51.00 | 51.00 | 4267519.41 | 587360.27 | 1178.35 | 93.46 | 109.00 | 108.98 | 4267555.83 | 587314.66 | 1178.49 | 93.60 | 167.00 | 166.98 | 4267594.12 | 587269.03 | 1179.16 | 94.27 |
| 52.00 | 51.99 | 4267517.95 | 587359.49 | 1178.57 | 93.68 | 110.00 | 109.98 | 4267558.10 | 587313.87 | 1178.65 | 93.76 | 168.00 | 168.00 | 4267594.87 | 587268.23 | | 94.67 |
| 53.00 | 52.99 | 4267520.61 | 587358.70 | 1177.91 | 93.02 | 111.00 | 110.99 | 4267557.93 | 587313.08 | 1178.71 | 93.82 | 169.00 | 168.98 | 4267595.74 | 587267.46 | 1179.27 | 94.38 |
| 54.00 | 54.00 | 4267521.11 | 587357.91 | 1178.03 | 93.14 | 112.00 | 111.98 | 4267559.40 | 587312.30 | 1178.72 | 93.83 | 170.00 | 169.99 | 4267596.07 | 587266.66 | | 94.35 |
| 55.00 | 54.99 | 4267521.56 | 587357.13 | 1178.00 | 93.11 | 113.00 | 112.98 | 4267559.63 | 587311.51 | 1178.92 | 94.03 | 171.00 | 170.99 | 4267596.70 | 587265.88 | | 94.29 |
| 56.00 | 55.98 | 426/521.63 | 58/356.35 | 11//.93 | 93.04 | 114.00 | 113.99 | 426/560.42 | 58/310./2 | 11/8.81 | 93.92 | 1/2.00 | 1/1.98 | 426/596.62 | 58/265.10 | | 94.33 |
| 57.00 | 56.99 | 426/522.37 | 58/355.56 | 26.//11 | 93.03 | 115.00 | 114.98 | 426/560.80 | 58/309.94 | 2/70 FO | 93.86 | 173.00 | 1/2.99 | 426/59/.96 | 58/264.30 | 67.6711 | 94.40 |
| 00.00 | 06.7C | 4267573 79 | 587353 QR | 1177 75 | 93.10 | 117.00 | 117.00 | 426/301.33 | 58730835 | 00.0/11 | 10.62 | 175.00 | 174 99 | 4267597 16 | 10,202,000 | | 94.74 94 99 |
| 60.00 | 60.00 | 4267524.49 | 587353 19 | 1177 99 | 93.10 | 118.00 | 117 99 | 4267562 71 | 58730757 | 1178.83 | 76 26 | 176.00 | 175.83 | 4767599 59 | 587262.07 | | 103 |
| 61.00 | 60.99 | 4267525.32 | 587352.41 | 1178.34 | 93.45 | 119.00 | 118.98 | 4267563.51 | 587306.79 | 1179.02 | 94.13 | 185.63 | 185.63 | 4267605.42 | 587257.67 | 1181.41 | 96.51 |
| 62.00 | 61.99 | 4267525.74 | 587351.62 | 1178.76 | 93.87 | 120.00 | 120.00 | 4267564.28 | 587305.99 | 1178.94 | 94.05 | | | | | | |



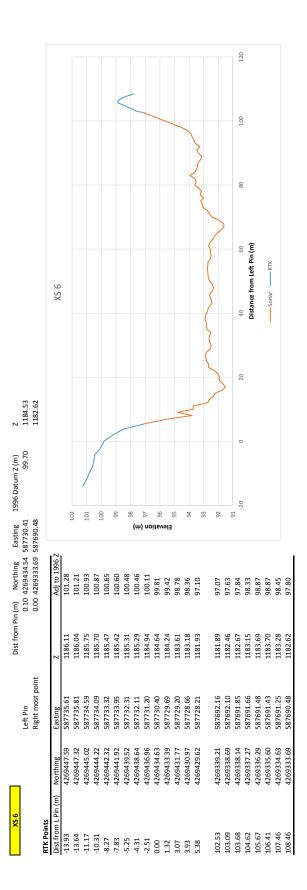
| 1.31(.32)(.36)(| ldeal Dist from L Pin (m) | Actual Dist from L Northing Pin (m) | L Northing | Easting | Z | Adj to 1996 Z | 6 Z Ideal Dist from L Pin (m) | Pin Actual Dist ITOTI E INOTUTING Pin (m) | 1 | Easung | 7 | 1996 Z |
|--|------------------------------|--|--------------------------|------------------------|-----------|----------------|----------------------------------|--|--------------------------|-------------------------|-------------------|----------------|
| 103 6666.43 5870.24 179.43 6666.45 6870.24 679.14 579.14 | 6.23 | 6.23 | 4268961.32 | 588196.72 | 1181.76 | 96.85 | 71.00 | 70.98 | 4268943.75 | 588135.76 | 1178.71 | 93.80 |
| 10.0 6664.1 681.1.3 611.1.3 610.4.1.3 610.4.1.3 610.4.1.3 611.1.4.1 610.4.1.3 611.1.4.1< | 11.00 | 10.99 | 4268964.38 | 588192.24 | 1179.62 | 94.71 | 72.00 | 71.96 | 4268943.68 | 588134.83 | 1178.66 | 93.75 |
| 130 6664.5 6810.13 11.01 6664.7 6800.13 6810.13 6101.13 6104.14 6101.13 61011.13 6101.13 6101. | 12.00 | 12.00 | 4268964.21 | 588191.29 | 1179.34 | 94.43 | 73.00 | 72.98 | 4268942.83 | 588133.87 | 1178.57 | 93.66 |
| 339 6686.47 6810.47 6810.47 6801.47 68 | 3.00 | 13.00 | 4268964.26 | 588190.35 | 1179.17 | 94.26 | 74.00 | 73.98 | 4268942.45 | 588132.93 | 1178.56 | 93.65 |
| 10 66840.37 6887.3 1170 6684.17 6887.3 1170 6684.17 6887.3 1170 6784.17 6884.16 1170 6784.17 6884.15 6847.16 1170 | 4.00 | 13.99 | 4268964.24 | 588189.42 | 1179.08 | 94.17 | 75.00 | 74.97 | 4268942.20 | 588132.00 | 1178.66 | 93.75 |
| 159 6660.13 5888.50 1170.0 569 5660.15 5888.50 1170.0 5690.15 5690.15 5690.15 5690.15 5690.15 5690.15 5690.15 5690.15 5690.15 5690.15 5690.15 5600.15< | 5.00 | 14.97 | 4268963.77 | 588188.49 | 1178.92 | 94.01 | 76.00 | 75.99 | 4268941.92 | 588131.04 | 1178.76 | 93.85 |
| 10.0 66664.15 58815.6 1170.7 32.0 70.0 75.9 66664.17 58115.6 1170.7 32.0 66664.17 58115.6 1170.7 32.0 66664.17 58115.6 1170.7 32.0 66664.17 58115.6 1170.7 32.0 66664.17 58115.6 1170.7 32.0 66664.17 58115.6 1170.7 32.0 66664.17 58117.6 1170.7 32.0 66664.17 58117.6 1170.7 32.0 66664.17 58117.6 1170.7 32.0 66664.17 58117.6 1170.7 32.0 66664.17 58117.6 1170.7 32.0 66664.17 58117.6 1170.7 32.0 66664.17 58117.6 1170.7 32.0 66664.17 58117.7 1170.7 32.0 66664.7 58117.7 1170.7 32.0 66664.7 58117.7 1170.7 32.0 66664.7 58117.7 1170.7 32.0 32.0 32.0 32.0 32.0 32.0 32.0 32.0 32.0 32.0 32.0 | 6.00 | 15.99 | 4268962.37 | 588187.53 | 1178.80 | 93.89 | 77.00 | 76.99 | 4268941.65 | 588130.10 | 1178.78 | 93.87 |
| 100 426661/F 50416 17745 92.4 700 739 65660.11 50116 50111 50111 50111 | 7.00 | 16.99 | 4268962.63 | 588186.59 | 1178.70 | 93.79 | 78.00 | 78.00 | 4268941.14 | 588129.15 | 1178.78 | 93.87 |
| 199 46660.1 501.1 701 709 70660.0 501.1 701.1 101 66660.1 501.0 177 91.1 700 709.0 700.0 | 8.00 | 18.00 | 4268961.87 | 588185.64 | 1178.65 | 93.74 | 79.00 | 78.98 | 4268941.31 | 588128.22 | 1178.78 | 93.87 |
| 19.6 46660.12 5616.3 177.57 3.95 8.10 9.99 56690.15 5616.3 177.57 12.19 66660.75 5616.3 177.56 9.37 8.10 9.17 5619.3 5619.3 5617.3 177.57 12.19 66660.75 5610.3 177.56 9.37 8.10 9.17 5617.3 177.57 12.00 66660.75 5617.3 177.56 9.37 8.10 9.39 5609.3 5617.3 177.57 12.00 66660.75 5617.3 177.54 9.34 50.0 9.39 50.0 50.0 50.03 50.13 50.13 12.00 66660.75 5617.3 177.74 9.34 50.0 9.39 50.00 50.00 50.03 50.13 | 9.00 | 18.99 | 4268960.71 | 588184.71 | 1178.62 | 93.71 | 80.00 | 66.62 | 4268940.68 | 588127.27 | 1178.78 | 93.87 |
| 109 426661.13 5610.23 1173.65 9.97 8.00 8.00 6.6009.73 5610.7.3 1173.65 12.90 426660.13 5610.30 1173.65 9.37 8.00 6409.03 5610.30 1173.65 12.00 62660.01 5610.01 1173.65 9.37 8.00 9.00 9.00 9.00 1173.65 12.00 62660.01 5600.01 100.01 9.00 9.00 9.00 1173.65 12.00 62660.01 5600.01 9.00 9.00 9.00 9.00 1173.61 12.01 62660.01 5600.01 9.00 9.00 9.00 1173.61 1173.61 12.01 62660.01 5600.01 9.00 9.00 9.00 1173.61 1173.61 12.01 62660.01 5801.01 1173.61 9.01 9.00 1174.61 1174.61 12.01 62660.01 5801.01 1174.71 9.01 1174.71 1174.71 1174.71 12.01 | 0.00 | 19.98 | 4268961.52 | 588183.78 | 1178.57 | 93.66 | 81.00 | 80.99 | 4268940.15 | 588126.33 | 1178.76 | 93.85 |
| 1219 0.0660/0.5 58101 31.7 81.00 30.00 43690.5 5881.1.4 11.7 233 0.6660.5 58401 17.6 57.5 6.6690.31 581.0.0 178.4 250 0.6660.5 58400 17.7 589.0 0.6690.31 581.0.0 178.4 250 0.6660.5 58400 17.7 589.0 0.6690.10 581.0.0 178.4 250 0.6660.5 5840.0 17.7 589.0 0.6690.11 581.0.0 178.4 250 0.6660.5 580.0 50.0 59.0 0.6690.11 51.0 178.4 250 0.6660.5 580.0 50.0 50.0 50.0 50.0 50.0 50.0 51.0 < | 1.00 | 20.98 | 4268961.13 | 588182.83 | 1178.66 | 93.75 | 82.00 | 81.98 | 4268939.74 | 588125.40 | 1178.78 | 93.87 |
| 2120 6.0600-50 5810.00 17.56 9.37 8.00 8.00 8.93 3.531.51 17.57 250 6.0600-50 5810.00 17.64 9.33 6.0699.31 5811.36 17.34 250 6.0600-31 5817.10 17.74 9.34 6.00 559 6.0699.31 5811.36 17.34 250 0.0600-31 5817.16 17.74 9.30 0.00 9.30 0.0699.31 5811.36 17.34 250 0.0600-31 5817.16 17.74 9.30 0.00 9.30 0.0699.31 5811.30 17.34 351 0.0600-31 5817.10 17.74 9.30 0.00 0.00 0.00 17.34 351 0.0600-31 5817.0 17.34 0.00 0.00 0.00 17.34 351 0.0600-31 581.0 17.34 0.00 0.00 0.00 0.00 17.34 351 0.0600-31 0.0600 0.00 0.00 0.00 | 2.00 | 21.99 | 4268960.57 | 588181.88 | 1178.58 | 93.67 | 83.00 | 83.00 | 4268939.52 | 588124.44 | 1178.78 | 93.87 |
| 13.8 -0.6695/16 5818/10 11.76 333 55.00 69.9 -0.6695/17 5811.75 11.76 2500 -0.6695/27 5817.71 11.76 3 | 23.00 | 22.99 | 4268959.59 | 588180.94 | 1178.66 | 93.75 | 84.00 | 84.00 | 4268939.28 | 588123.50 | 1178.69 | 93.78 |
| 350 4268932 589730 175 3 | 4.00 | 23.98 | 4268959.60 | 588180.01 | 1178.64 | 93.73 | 85.00 | 84.98 | 4268939.03 | 588122.57 | 1178.47 | 93.56 |
| 550 4268957 580710 1173.2 941 570 8299 6299371 5117.60 1173.3 259 4268956 5807.33 1178.30 9400 9400 940 | 5.00 | 25.00 | 4268959.22 | 588179.05 | 1178.44 | 93.53 | 86.00 | 85.98 | 4268938.27 | 588121.63 | 1178.42 | 93.51 |
| 759 62663.7 5817.71 173.71 540 62693.75 5817.73 173.71 739 62663.67 5817.73 173.87 530.75 5817.35 173.81 739 62663.67 5817.74 173.71 510.6 6369.75 5117.56 173.81 739 62663.67 5817.14 173.71 510.6 6369.75 5117.56 173.81 730 62665.15 5817.14 177.31 93.0 93.0 93.95 93.95 173.81 731 62665.15 5817.14 177.31 93.0 93.0 93.0 93.95 173.81 731 62665.15 5817.16 177.31 93.1 94.0 93.0 170.10 173.41 731 62665.15 5817.17 177.31 93.0 170.00 177.41 177.41 732 62665.15 5817.17 177.31 93.0 170.00 177.41 177.41 732 62665.15 5817.10 177.11 9 | 5.00 | 26.00 | 4268959.37 | 588178.11 | 1178.32 | 93.41 | 87.00 | 86.99 | 4268938.11 | 588120.68 | 1178.51 | 93.60 |
| 379 46666161 5877.53 1178 930 66997.75 5817.53 1178 930 66997.75 5817.54 1178.73 930 66997.75 5817.54 1178.73 930 66997.55 5817.54 1178.73 930 66997.55 5817.54 1178.73 930 930 66997.55 5817.54 1178.73 931 930 66997.55 5817.56 1178.73 931 930 930 930 66997.55 5817.56 1178.73 931 930 9 | 2.00 | 26.97 | 4268958.76 | 588177.19 | 1178.71 | 93.80 | 88.00 | 87.99 | 4268938.13 | 588119.74 | 1178.43 | 93.52 |
| 329 4000 939 4000 939 40003 931156 1178.0 329 4000516 587.7.3 1178.1 93.0 90.0 93.9 406995.3 5811.56 1178.1 329 4000516 587.7.4 1178.7 93.6 90.0 93.9 406995.3 5811.16 1178.4 329 4000515 587.06 1178.7 93.6 90.0 93.9 406995.3 5811.10 1178.4 329 4000515 588.6 1178.1 93.0 90.0 93.9 406995.3 5811.10 1178.4 329 4000515 588.6 1178.1 93.0 90.0 93.9 40699.4 5811.10 1178.4 329 4000515 588.6 1178.1 93.0 90.0 93.9 40699.4 5811.2 1178.4 410 40695146 588.6 1178.1 93.0 90.0 93.9 40699.4 5811.2 1178.4 410 40695146 588.6 </td <td>3.00</td> <td>27.99</td> <td>4268958.64</td> <td>588176.23</td> <td>1178.60</td> <td>93.69</td> <td>89.00</td> <td>89.00</td> <td>4268937.75</td> <td>588118.79</td> <td>1178.38</td> <td>93.47</td> | 3.00 | 27.99 | 4268958.64 | 588176.23 | 1178.60 | 93.69 | 89.00 | 89.00 | 4268937.75 | 588118.79 | 1178.38 | 93.47 |
| 329 4.6669/16 5817.3.4 1173.31 9.00 9.10 4.0669/5.3 5811.3.4 1173.45 320 4.6696/5.4 5817.3.4 1173.45 9.30 9.30 4.26696.35 5811.3.4 1173.45 321 4.6696/5.4 5817.3.4 1173.45 9.30 9.30 2.699 2.8931.3.5 5811.1.6 1173.45 329 4.6696/5.4 5817.3.6 1173.43 9.30 9.30 2.6993.3.5 5811.1.6 1173.45 359 4.6696/5.4 5816.6 1177.3.1 9.31 9.00 9.99 2.6999.3.5 5811.1.8 1173.4.5 350 4.6695.5 5816.6 1177.31 9.31 0.00 0.00 9.39 2.6993.3.6 5811.1.8 1177.4.7 350 4.6695.5 5816.6 1177.2.1 9.31 0.00 0.00 0.00 2.6993.3.6 5811.1.8 1177.4.7 41.90 4.6695.1 1177.21 9.31 10.00 0.019 4.26993.5.7 5810.6.5 1177. | 00.6 | 28.99 | 4268958.07 | 588175.29 | 1178.80 | 93.89 | 90.00 | 89.99 | 4268937.00 | 588117.86 | 1178.40 | 93.49 |
| 10.0 4.6696/16 511/16 1173/15 512/16 510/16 510/16 511/1 | 000 | 29.99 | 4268958.16 | 588174.35 | 1178.91 | 94.00 | 91.00 | 90.94 | 4268936.92 | 588116.96 | 1178.49 | 93.58 |
| 1.10 4.06005.05 5301 0.309 4.06005.05 5301 0.117.05 3.127 4.06005.05 5807.16 1178.17 95.00 95.00 4.06005.73 5811.13 1177.43 3.129 4.26005.55 5807.66 1178.47 93.0 93.00 4.06093.54 5811.13 1177.43 3.129 4.26005.57 5806.68 1178.43 93.00 93.00 4.06093.54 5811.13 1177.43 3.129 4.26005.57 5801.68 1177.43 93.00 93.00 4.06093.54 5811.13 1177.43 3.129 4.26005.57 5801.63 1177.61 93.10 100.10 93.90 4.06093.54 5810.54 1177.41 4.200 4.26095.57 5801.63 1177.61 93.01 100.10 100.99 4.06093.54 5810.56 1177.41 4.200 4.26095.57 5810.56 1177.61 1177.61 1177.61 4.200 5810.56 1177.61 1177.61 1177.61 1177.61 117 | 00. | 30.96 | 4268957.69 | 5881/3.44 F00470.46 | 11/8.8/11 | 93.96 | 92.00 | 50.02 | 4268936.39 | 588115.98 | 11/8.46 | 93.55 |
| JJJ Constant | 00.3 | 32.00 | 28.0020025 | 0477/T222 | 11/8./3 | 73.82 | 93.00 | 16.26 | 4208930.38 | CU.CII88C | 6470 LT | 93.38 |
| 343 56896513 56806503 56806503 56806503 56806503 5680153 < | 00.00 | 32.97 | 42,029,020 05,0200 | 5881/1.54 500170.60 | 71/8/21 | 93.64 02 56 | 94.00 05 00 | 93.99 OE OO | 4/05935./4 | 588114.09 5011214 | 22.8/11 71.970 | 93.61 02 E2 |
| 559 66665.01 5816.67 1178.67 97.01 96695.75 5816.67 1178.13 1177.13 37.9 45695.51 5816.68 1178.13 93.47 90.00 97.97 45693.54 5811.65 1173.13 37.9 45695.51 5816.58 1178.13 93.40 91.00 99.97 45693.34 5610.51 1173.13 40.0 45695.51 5816.58 1173.13 93.40 91.00 99.97 45693.35 5610.51 1173.13 41.9 45695.51 5816.51 1173.21 93.40 100.00 99.37 45693.51 5610.51 1175.14 42.9 45695.215 5816.51 1173.21 93.40 100.00 103.97 45693.21 5810.52 1175.41 43.9 45695.215 5816.51 1173.21 93.40 100.00 103.97 45693.21 5810.52 1175.41 45.0 45695.215 5816.51 1173.21 93.40 1175.41 1175.41 1175.41 | 00 | 34 98 | 4268955 52 | 588169.65 | 1178.60 | 93.69 | 96.00 | 96.00 | 4768935 54 | 588112.20 | 1178.60 | 63.69 |
| 36.8 32.88 53.87 1178.31 9.37 9.00 9.97 55.83 55.83 1178.31 37.99 42.8855.45 5881.65.85 1178.31 9.340 9.00 9.99 42.8933.34 5881.05.35 1178.31 40.09 42.8855.46 5881.65.39 1178.31 9.340 10.100 9.99 42.8933.34 5881.05.30 1178.31 41.99 42.8953.54 5881.61.31 1178.31 9.340 10.300 10.299 42.8932.341 5881.05.3 1178.31 42.99 42.8953.56 5881.61.17 1178.21 9.340 10.000 10.99 42.8932.41 5881.05.3 1178.41 43.99 42.8953.56 5881.54 1178.21 9.340 10.000 10.99 42.8932.41 5881.05.3 1178.41 45.99 42.8959.56 5881.54 1178.21 9.340 10.000 10.99 42.8932.41 5881.05.3 1178.41 45.99 42.8959.56 1178.61 93.40 10.000 10.99 | 00 | 35.99 | 4268955.03 | 588168.70 | 1178.42 | 93.51 | 00.76 | 96.98 | 4268934.67 | 588111.28 | 1178.52 | 93.61 |
| 3799 4268953.45 58816.68 1178.11 9.30 9.00 9.69 456893.45 58810.53 1178.31 4000 4268953.64 5881.65.9 1178.01 9.17 10.00 9998 426893.74 5881.05.5 1178.31 4000 426893.54 5881.65.9 1178.21 93.30 10.00 10.97 426893.74 5881.05.1 1178.31 4139 426893.56 5881.61.70 1178.21 93.30 10.00 10.97 426893.241 5881.05.81 1778.1 426892.48 5881.61.70 1178.21 93.30 106.00 10.99 426893.241 5881.05.81 1778.1 4439 426895.16 5881.64.8 1178.21 93.30 106.00 10.99 426893.241 5881.05.8 1178.41 4589 426895.16 1178.21 93.30 106.00 106.99 426893.241 5881.05.81 1178.41 4589 426895.16 1178.21 93.30 110.00 106.99 426893.241 5881.05.81 | 00 | 36.98 | 4268955.76 | 588167.77 | 1178.38 | 93.47 | 98.00 | 76.76 | 4268934.49 | 588110.34 | 1178.42 | 93.51 |
| 389 266895.54 58814.53 1178.01 93.17 0100 10599 266893.38 588117.53 1178.11 41.99 266893.34 58816.35 1178.21 93.10 101.00 100.99 266893.27 58810.52 1178.11 41.99 266893.35 58816.31 1178.21 93.30 104.00 103.99 266893.21 58810.52 1178.11 42.99 266893.26 58816.31 1178.21 93.30 107.00 103.99 266893.21 58810.52 178.41 43.99 266895.26 58815.35 1178.21 93.30 107.00 103.99 266893.16 5881.05 177.81 47.89 266895.26 5881.53 1178.21 93.30 107.00 109.99 266893.16 5881.05 177.81 47.89 266890.66 1178.41 93.30 111.00 110.99 266893.03 5801.25 177.61 51.00 266890.61 1178.61 117.81 111.00 111.98 266893.03 178. | 00 | 37.99 | 4268955.45 | 588166.82 | 1178.31 | 93.40 | 00.66 | 96.99 | 4268934.19 | 588109.38 | 1178.38 | 93.47 |
| 4000 426893.54 58816.36 1178.01 9.3.10 10.00 426893.76 58816.35 1178.11 9.3.10 10.00 426893.76 58816.35 1178.31 9.3.10 10.00 10.3.97 426893.71 58816.35 1178.31 9.3.30 10.00 10.3.97 426893.71 58816.35 1178.31 9.3.30 10.00 10.3.97 426893.21 58810.35 1178.31 9.3.30 10.00 10.3.97 426893.13 58810.35 1178.31 9.3.30 10.00 10.3.97 426893.13 58810.35 1178.41 9.3.30 10.00 10.3.97 426893.13 58810.35 1178.41 9.3.30 10.00 10.0.99 426893.13 58810.35 1178.41 1778.41 459 426893.120 58815.53 1178.61 93.33 113.00 110.00 426893.93 58810.35 1177.43 450 426893.120 58815.53 11778.61 1177.63 426893.93 58810.35 1177.43 450 426893.120 58815.53 11778.61 | 00. | 38.99 | 4268955.04 | 588165.88 | 1178.08 | 93.17 | 100.00 | 86.98 | 4268933.88 | 588108.45 | 1178.31 | 93.40 |
| 4109 426893.510 58816.36 1178.21 9.3.31 10.2.00 10.107 426893.279 58810.65 1178.41 41.99 426893.55 58816.30 1178.21 93.30 103.00 102.99 426893.281 58810.65 1178.41 42.99 426893.55 58816.31 1178.21 93.30 105.00 103.97 426893.163 58810.35 1178.41 43.99 426895.165 58815.83 1178.21 93.30 107.00 105.99 426893.163 58810.35 178.41 47.98 426895.10 58815.43 1178.81 93.30 107.00 100.99 426893.03 58810.95 1178.41 47.98 426895.16 58815.63 1178.81 93.37 112.00 110.99 426893.03 58810.95 1177.63 47.98 426895.16 58815.63 1178.81 93.37 112.00 1176.93 426893.65 1177.63 51.09 426893.64 58815.65 1178.81 93.37 112.00 1176.93 <td>00.</td> <td>40.00</td> <td>4268953.94</td> <td>588164.93</td> <td>1178.01</td> <td>93.10</td> <td>101.00</td> <td>100.99</td> <td>4268933.68</td> <td>588107.50</td> <td>1178.18</td> <td>93.27</td> | 00. | 40.00 | 4268953.94 | 588164.93 | 1178.01 | 93.10 | 101.00 | 100.99 | 4268933.68 | 588107.50 | 1178.18 | 93.27 |
| 41.99 42.689 26863.15 1178.21 93.30 104.00 103.97 426892.241 58810.66 1178.41 43.99 2268953.18 5881.61.17 1178.21 93.30 106.00 103.97 266932.81 58810.50 1178.41 44.00 426895.120 58815.01 1177.21 93.30 107.00 105.99 266893.165 58810.05 1178.41 45.01 426895.120 58815.43 1177.21 93.30 107.00 106.99 266893.05 58810.05 1178.41 45.03 426895.10 58815.45 1178.54 93.40 100.00 101.99 426893.05 58800.90 1177.64 45.04 426899.15 58815.45 1178.64 93.73 111.00 110.90 426893.95 58800.50 1177.64 51.00 426899.15 58815.47 1178.65 93.73 1177.64 426897.93 58809.50 1177.64 52.00 426899.15 58815.47 1178.65 93.71 1117.00 4268997.93 | 00. | 40.99 | 4268953.50 | 588163.99 | 1178.22 | 93.31 | 102.00 | 101.97 | 4268932.79 | 588106.58 | 1178.31 | 93.40 |
| 4.299 4.26893.18 58816.1.1 11.76.21 9.3.3 104.00 10.3.9 4.26893.2.15 58810.3.7 1178.47 4.60 4.56895.3.18 5881.6.1.1 11.76.21 93.30 106.00 10.4.99 4.26893.1.65 5881.0.57 1178.47 4.60 4.56895.1.6 5881.5.53 1178.21 93.30 107.00 105.99 4.268931.1.8 5881.0.59 1178.45 4.60 4.56895.1.5 5881.5.53 1178.54 93.37 111.00 100.09 4.26893.93 5881.5.53 1178.65 93.71 111.00 110.99 4.26893.93 5881.5.53 1178.64 93.73 111.00 111.99 4.26893.93 5880.5.50 1177.63 51.00 4.56894.81 5881.5.77 1178.64 93.73 111.00 111.99 4.26893.763 5809.5.50 1177.63 52.09 4.56894.81 5881.5.77 1178.64 93.73 114.00 111.99 4.26893.763 5809.5.50 1177.63 52.09 4.56894.81 5881.577 | 00. | 41.99 | 4268953.78 | 20.53163.02 | 17.8/11 | 93.30 | 103.00 | 102.99 | 4268932.41 | 29.501885 | 11/8.41 | 93.50 |
| 44.9 42.895.2.5 58816.0.4 1178.21 93.30 106.00 105.90 45.8931.1.5 58810.0.5 1178.45 46.00 42.8952.25 58815.35 1178.31 93.40 107.00 105.99 45.8931.15 58810.05 1178.45 46.00 42.8895.15 58815.55 1178.55 93.40 110.00 106.99 45.8930.35 58800.50 1177.64 47.98 42.8895.13 58815.53 1178.65 93.72 111.00 110.90 45.8930.35 58805.05 1177.64 51.00 42.8899.15 58815.53 1178.65 93.73 111.00 111.98 45.8930.35 58809.37 1177.64 52.00 42.8899.10 58815.64 1178.64 93.73 111.00 111.98 45.8930.35 58809.33 1177.64 52.00 42.8899.10 1178.64 93.73 113.00 111.99 45.8937.31 1377.83 52.00 42.8894.10 1178.64 93.73 118.00 1177.64 1177.64 | 8 8 | 42.33 | 4206953 18 | 71 120100C | 1178 21 | 02.50 | 105.00 | 10.5.01 10.4 99 | 10.2550024 | 588103 73 | 10.0/11 | 93.40 93.56 |
| 46.00 4268952.56 588159.23 1178.21 93.40 107.00 106.90 4268931.63 58810.15 1178.35 47.89 426895.21 58815.43 1178.31 93.40 100.00 100.00 4268931.63 58810.50 1178.01 47.89 426895.12 58815.53 1178.55 93.46 110.00 100.00 426893.03 58819.03 1178.01 47.99 426899.01 58815.53 1178.65 93.73 1110.00 110.00 426893.03 58819.03 1177.64 52.00 426899.04 58815.75 1178.64 93.73 1113.00 111.99 426899.23 1177.64 52.00 426899.46 58815.77 1178.64 93.73 1176.95 1177.64 52.00 426899.48 58815.77 1178.64 93.73 1177.64 1177.64 53.97 426899.48 58816.71 1178.67 91.70 1177.63 1177.63 54.98 426899.48 1178.60 117.60 1176.93 | 00 | 44.98 | 4268952.89 | 588160.24 | 1178.21 | 93.30 | 106.00 | 105.99 | 4268931.69 | 588102.79 | 1178.47 | 93.56 |
| 46.88 4268951.12 588156.35 1178.34 93.63 108.00 108.00 266831.13 588100.50 1177.54 47.98 4268951.50 588156.45 1177.54 1177.54 426899.03 58809.03 58809.03 1177.54 48.97 426899.15 588156.45 1177.55 93.71 111.00 110.08 426899.03 58809.02 1177.54 51.00 426899.46 588155.35 1177.65 93.71 111.00 111.98 426899.275 1177.64 52.09 426899.41 58815.17 1178.65 93.72 1112.00 111.99 426897.25 1177.64 52.99 426894.94 58815.17 1178.64 93.73 1176.00 1176.96 1177.64 52.99 426894.830 $5881.45.26$ 1178.66 93.65 1177.64 1177.64 52.99 426894.830 $5881.45.26$ 1178.66 93.76 1177.64 57.99 426894.830 $5881.45.26$ 1178.66 93.76 1177.64 57.99 426894.50 1178.66 93.76 1177.64 57.99 426894.50 1177.66 1177.64 57.99 426894.50 1177.65 1177.64 57.99 426894.50 1177.64 1177.64 57.99 426894.50 1177.64 1177.64 57.99 426894.50 1177.64 1177.64 57.99 426894.51 1177.64 1177.64 57.99 | 8 | 46.00 | 4268952.56 | 588159.28 | 1178.21 | 93.30 | 107.00 | 106.99 | 4268931.63 | 588101.85 | 1178.45 | 93.54 |
| 17.88 426895169 588157.41 1178.54 93.64 1000 100899 266890.65 58809.57 1178.01 49.99 4268990.12 588154.57 1178.65 93.71 11000 110.09 266890.35 58809.00 1177.64 49.98 4268990.17 588154.57 1178.65 93.71 1117.00 110.99 456890.35 588095.02 1177.64 51.00 4268994.65 588154.57 1178.64 93.73 112.00 111.99 456892.34 $58809.5.0$ 1177.64 52.99 4268994.16 588154.75 1178.64 93.73 115.00 113.99 456892.34 $58809.5.0$ 1177.64 53.97 426894.91 58816.92 1178.64 93.73 115.00 113.99 456897.54 $58809.5.3$ 1177.64 53.99 426894.50 $5881.45.97$ 1178.64 93.76 116.00 113.99 456897.54 $58809.5.3$ 1177.64 57.00 426897.32 $5881.45.16$ 1178.65 93.76 118.00 11799 456897.52 58809.56 1177.82 57.00 426897.32 1177.64 93.76 1177.64 1177.64 1177.82 1177.82 57.00 426897.32 1177.86 1177.82 1177.82 1177.82 1177.82 57.00 426897.32 1177.86 1177.82 1177.82 1177.82 57.00 426897.32 $5881.45.10$ 1178.76 93.81 1177.82 | 00 | 46.98 | 4268952.12 | 588158.35 | 1178.31 | 93.40 | 108.00 | 108.00 | 4268931.18 | 588100.90 | 1178.36 | 93.45 |
| $48,9$ 4268951_{20} 588156.48 117855 93.74 110.00 4268930.35 588155.53 117765 $49,9$ 4268950.15 588155.53 117865 93.71 111.00 110.98 426899.33 117755 52.00 428899.46 588155.53 117864 93.73 111709 426899.73 58807.52 117765 52.00 428899.44 58815.26 117864 93.73 111709 426897.53 $58809.5.0$ 117745 53.99 428899.44 5881.5102 117864 93.73 111700 426897.53 $58809.5.3$ 117765 54.39 428894.510 117866 93.76 117760 426897.53 58090.55 117785 57.90 428894.510 117875 93.48 117700 426897.54 5809.55 117782 57.90 428894.51 117875 93.48 117700 426897.43 58090.55 117782 57.00 </td <td>00:</td> <td>47.98</td> <td>4268951.69</td> <td>588157.41</td> <td>1178.54</td> <td>93.63</td> <td>109.00</td> <td>108.99</td> <td>4268930.68</td> <td>588099.97</td> <td>1178.01</td> <td>93.10</td> | 00: | 47.98 | 4268951.69 | 588157.41 | 1178.54 | 93.63 | 109.00 | 108.99 | 4268930.68 | 588099.97 | 1178.01 | 93.10 |
| 49.38 42.6839.015 58815.53 117.64 111.03 12.6639.95 58809.16 1177.64 51.00 42.6899.017 58815.45 1178.63 93.73 111.00 111.03 42.6899.37 18809.15 1177.65 52.09 42.6899.44 58815.17 1178.64 93.73 113.00 113.99 426899.38 58809.12 1177.65 53.29 42.6894.94 58815.17 1178.64 93.73 114.00 113.99 426899.23 1177.63 53.99 42.6894.91 58815.02 1178.64 93.73 114.00 113.99 426899.23 1177.63 55.99 42.6894.830 5881.45.0 1178.64 93.73 1177.69 1177.63 57.99 42.6894.830 5881.47.04 1178.55 93.45 1177.60 1177.63 57.90 42.6894.74 5881.47.04 1178.57 93.8809.55 1177.83 57.99 42.6894.51 1178.65 93.28 1177.00 426897.43 58809.55 1177.83 | 00. | 48.97 | 4268951.20 | 588156.48 | 1178.55 | 93.64 | 110.00 | 110.00 | 4268930.30 | 588099.02 | 1177.79 | 92.88 |
| 5100 4268993017 5815457 117863 93.72 111.00 111.98 45689357 958097.75 1177.05 52.99 4268993617 58815.47 1178.64 93.73 114.00 111.98 4568935.75 58905.75 1177.63 52.99 4268993416 58815.76 1178.64 93.73 114.00 114.99 456897.79 58095.26 1177.63 55.99 426899430 5881.46.72 1178.64 93.76 116.00 116.00 456897.79 58090.33 1177.63 55.99 426894930 5881.46.72 1178.61 93.76 118.00 117.00 456897.79 58090.45 1177.85 57.90 426894781 5881.46.0 1178.65 93.76 118.00 118.99 456897.25 58090.45 1177.85 57.90 426894781 5881.45.16 1178.75 93.81 120.00 118.99 456897.25 58090.45 1177.85 59.00 426894781 5881.45.16 1178.77 93.81 | 00 | 49.98 | 4268950.63 | 588155.53 | 1178.62 | 93.71 | 111.00 | 110.98 | 4268930.35 | 588098.09 | 1177.64 | 92.73 |
| 5.200 42689491 58815.16 1178.64 93.73 113.00 113.29 456892.31 58809.5.0 1176.95 5.397 42689491 58815.17 1178.64 93.63 115.00 113.99 456892.83 588095.50 1177.43 5.397 42689491 58815.02 1178.64 93.63 115.00 116.00 456897.51 58809.33 1177.83 5549 42689491 5881.40.57 1178.64 93.63 116.00 116.00 456897.74 58809.53 1177.82 5509 42684730 5881.45.70 1178.65 93.70 118.00 117.99 456897.51 58809.65 1177.82 5700 42684731 5881.45.10 1178.75 93.85 112.00 112.99 456897.52 58809.65 1177.82 5700 42684731 5881.45.10 1178.75 93.81 122.00 120.99 456895.56 58809.65 1177.82 5700 4268945.57 5881.45.10 1178.77 93.81 <t< td=""><td>00</td><td>51.00</td><td>4268950.17</td><td>588154.57</td><td>1178.63</td><td>93.72</td><td>112.00</td><td>111.98</td><td>4268929.99</td><td>588097.15</td><td>1177.05</td><td>92.14</td></t<> | 00 | 51.00 | 4268950.17 | 588154.57 | 1178.63 | 93.72 | 112.00 | 111.98 | 4268929.99 | 588097.15 | 1177.05 | 92.14 |
| 53.97 426894.94 53815.07 117.63 114.00 114.99 426897.51 58809.42 117.63 53.99 426894.94 58815.17 1178.54 93.63 115.00 114.99 426897.51 58809.43 1177.63 55.99 426894.94 58815.17 1178.54 93.63 117.00 116.00 456897.74 58809.53 1177.63 57.90 426894.80 588140.87 1178.65 93.63 117.00 426897.74 58809.55 1177.83 57.90 426894.80 588147.90 1178.65 93.24 1170.00 1179.99 456897.74 58809.51 1177.82 57.90 426894.61 58814.70 1178.75 93.24 1120.00 112.99 456895.56 58808.61 1178.12 57.99 426894.56 5881.46.20 1178.72 93.81 122.00 123.99 456895.56 58808.61 1177.82 60.99 426894.66 5881.46.25 1178.72 93.81 122.00 123.99 456895.6 | 00 | 52.00 | 4268949.86 | 588153.63 | 11/8.64 | 93./3 | 00.511 | 112.99 | 4268929./1 | 588096.20 F0000F 2C | 26.9/11 | 92.04 |
| 55.99 4268949.19 5881.602 11.600 11.600 11.600 456897.59 58899.33 11.77.81 57.99 4268949.10 5881.602 11.78.60 93.69 117.00 456897.59 58899.33 1177.82 57.90 4268949.20 5881.40.27 1178.60 93.76 117.00 456897.74 58809.43 1177.82 57.90 4268947.81 5881.47.04 1178.15 93.78 1170.00 1179.99 456897.53 58809.53 1177.82 57.90 4268947.31 5881.45.10 1178.15 93.78 120.00 118.99 426895.58 58808.51 1178.12 59.90 4268947.31 5881.45.10 1178.75 93.81 122.00 120.99 456895.58 58808.57 1178.12 60.99 4268947.66 5881.47.21 1178.72 93.81 122.00 122.09 456895.54 58808.57 1178.12 61.99 4268947.66 5881.45.10 1178.72 93.81 122.00 122.690 456895.54 | 00.00 | 70 23 | 1 4,04004 4 L 4,000 | 60.2C108C | 1178 54 | 93./3 02.62 | 115.00 | 11/ 00 | 4208928.43 1762079 91 | 02.0200820 75 000823 | 1177.62 | 5C.25 CT CD |
| 55.99 4268943.0 5881.45.0 117.60 117.00 117.00 456897.91 58809.14 1177.85 57.00 4268947.80 5881.46.0 1178.60 93.76 117.00 117.90 456897.91 58809.14 1177.85 57.00 4268947.81 5881.46.0 1178.65 93.76 119.00 117.99 456897.77 58809.61 1177.85 57.90 4268947.31 5881.46.10 1178.75 93.81 119.00 119.99 456895.58 58808.61 1178.20 59.99 4268947.31 5881.46.10 1178.75 93.81 122.00 119.99 456895.56 58808.61 1178.20 61.99 426894.52 5881.45.10 1178.77 93.81 122.00 122.00 456895.56 58808.77 1178.23 61.99 426894.52 5881.45.13 1178.77 93.81 122.00 126.99 456895.56 58808.78 1177.95 61.90 426894.52 5881.43.21 1178.77 93.81 122.00 <td< td=""><td>0</td><td>54 98</td><td>4268949.19</td><td>58150.82</td><td>1178 54</td><td>93.63</td><td>116.00</td><td>116.00</td><td>4768977.69</td><td>58809337</td><td>1177 82</td><td>92.91</td></td<> | 0 | 54 98 | 4268949.19 | 58150.82 | 1178 54 | 93.63 | 116.00 | 116.00 | 4768977.69 | 58809337 | 1177 82 | 92.91 |
| 57,00 4268948.08 588.143,92 1178.61 93.70 118.00 117.99 4268977.49 588.01.49 1177.82 59,00 4268977.32 588147.69 1178.65 93.78 119.00 119.99 4268977.7 58809.65 1178.20 59,00 4268477.31 588147.64 1178.75 93.48 110.00 119.99 4268977.7 58809.65 1178.20 59,99 4268947.31 5881.45.16 1178.75 93.81 122.00 120.99 426897.72 18800.51 1178.20 60.99 4268945.65 5881.45.16 1178.76 93.81 122.00 123.300 426895.65 58806.57 1177.82 61.09 4268945.65 5881.42.21 1178.77 93.81 122.00 123.300 4268945.61 5881.43.23 1177.81 61.30 4268945.65 5881.43.23 1178.77 93.72 127.00 4268945.421 58808.56 1177.81 61.30 4268945.66 5881.43.23 1178.77 9 | 00 | 55.99 | 4268948.30 | 588149.87 | 1178.60 | 93.69 | 117.00 | 117.00 | 4268927.91 | 588092.43 | 1177.89 | 92.98 |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | 00. | 57.00 | 4268948.08 | 588148.92 | 1178.61 | 93.70 | 118.00 | 117.99 | 4268927.49 | 588091.49 | 1177.85 | 92.94 |
| 59.00 4268947.81 588.147.04 1178.75 93.84 120.00 119.99 426895.82 58808.61 1178.15 59.99 4268977.37 588.145.10 1178.75 93.85 121.00 122.009 4268975.82 588087.87 1178.15 60.99 4258977.47 5881.45.10 1178.72 93.81 123.00 122.009 426895.52 588087.87 1177.85 61.90 4268946.65 5881.43.27 1178.72 93.81 123.00 123.300 426895.56 588087.87 1177.85 64.00 4268946.66 5881.43.21 1178.72 93.81 122.00 122.300 426895.66 58806.49 1177.85 64.00 4268946.06 5881.43.21 1178.77 93.81 122.00 122.300 426892.499 58808.49 1177.86 64.98 426894.50 5881.43.21 1178.77 93.72 125.00 122.09 426893.421 58808.49 1177.86 65.99 426894.52 5881.40.45 1178.77 93.72 125.00 127.00 426894.421 58808.361 1177.86 65.99 426894.52 5881.40.45 1178.67 93.75 127.00 127.00 426893.422 58808.301 1177.95 65.99 426894.42 5881.40.45 1178.87 93.75 127.00 127.00 426893.422 58808.301 1177.95 65.99 426894.42 5881.362 1178.76 93.85 1178.70 127.00 426894.427 58808.202 1178.76 | 003 | 57.99 | 4268947.92 | 588147.99 | 1178.69 | 93.78 | 119.00 | 118.99 | 4268927.27 | 588090.55 | 1178.20 | 93.29 |
| 59.99 4268947.37 588.46.10 1178.15 93.85 121.00 120.99 426895.58 588.08.57 1178.15 60.99 4268946.52 588.143.15 1178.72 93.81 122.00 126895.56.58 588.06.77 1177.25 61.99 4268946.52 588.143.27 1178.72 93.81 122.00 126895.56.56 588.06.78 1177.95 64.00 4268946.50 588.143.27 1178.72 93.81 124.00 123.30 426895.56.5 58806.78 1177.95 64.00 4268945.65 58814.32 1178.77 93.71 125.00 125.99 456894.21 58808.50 1178.03 64.30 4268945.20 58814.14 1178.77 93.78 127.00 125.99 456892.421 58808.36 1178.03 65.99 4268945.20 58814.04 1178.77 93.78 127.00 125.99 456892.421 58808.36 1178.03 65.99 4268945.20 5881.40.45 1178.87 93.78 127.00 125.99 <td>00.</td> <td>59.00</td> <td>4268947.81</td> <td>588147.04</td> <td>1178.75</td> <td>93.84</td> <td>120.00</td> <td>119.99</td> <td>4268926.82</td> <td>588089.61</td> <td>1178.20</td> <td>93.29</td> | 00. | 59.00 | 4268947.81 | 588147.04 | 1178.75 | 93.84 | 120.00 | 119.99 | 4268926.82 | 588089.61 | 1178.20 | 93.29 |
| 60.99 4268945.14 588145.16 1178.72 93.81 122.00 426895.62 58806.73 1177.52 61.99 4268946.92 5881.43.21 1178.74 93.83 123.00 426895.62 58806.73 1177.55 61.90 4268946.66 5881.43.21 1178.72 93.83 123.00 123.00 426895.61 58806.54 1177.55 64.00 4268945.05 5881.43.21 1178.72 93.31 125.00 123.49 456895.40 58808.56 1177.80 64.00 4268945.05 5881.41.21 1178.77 93.78 127.00 123.49 456895.40 1178.03 64.30 4268945.04 5881.41.21 1178.77 93.78 127.00 127.499 456892.42.1 58808.36 1178.07 65.99 4268945.04 5881.90.5 1178.67 93.78 127.00 127.09 426892.42.1 58808.36 1178.77 65.99 426894.44 5881.95.2 1178.77 93.78 127.00 127.09 426892.42.1 | 000 | 59.99 | 4268947.37 | 588146.10 | 1178.76 | 93.85 | 121.00 | 120.99 | 4268926.58 | 588088.67 | 1178.15 | 93.24 |
| 61.99 426894.62 5881.47.22 1178.74 93.83 123.00 426895.60 5880.68 1177.56 63.00 426894.65 5881.43.27 1178.72 93.81 124.00 123.99 426892.40 58806.84 1177.56 64.00 426894.50 5881.43.27 1178.77 93.81 124.00 123.99 426892.49 58808.56 1177.56 64.00 426894.50 5881.40.45 1178.77 93.82 126.00 123.99 456892.421 58808.36 1177.56 65.99 426894.54 5881.40.45 1178.77 93.82 127.00 127.700 426892.421 58808.306 1177.95 65.99 426894.54 5881.30.52 1178.76 93.85 127.00 127.700 456892.421 58808.308 1178.72 65.99 426894.42 5881.30.52 1178.76 93.85 128.00 127.90 426892.451 58808.168 1177.798 67.97 426894.42 5881.38.53 1178.76 93.85 128.00 | 00 | 60.99 | 4268947.41 | 588145.16 | 1178.72 | 93.81 | 122.00 | 122.00 | 4268926.22 | 588087.72 | 1178.23 | 93.32 |
| 64.00 $42.68946.05$ $58814.3.21$ $11/8/.12$ $24.6894.50$ $58814.3.21$ $11/8/.12$ $24.6894.50$ 58814.23 $11/8/.12$ <t< td=""><td>2:00</td><td>61.99</td><td>4268946.92</td><td>588144.22</td><td>1178.74</td><td>93.83</td><td>123.00</td><td>123.00</td><td>4268925.60</td><td>588086.78</td><td>1177.95</td><td>93.04</td></t<> | 2:00 | 61.99 | 4268946.92 | 588144.22 | 1178.74 | 93.83 | 123.00 | 123.00 | 4268925.60 | 588086.78 | 1177.95 | 93.04 |
| 64.98 4268945.25 588141.41 1178.73 93.73 126.00 125.99 4568942.21 58808.36 1178.07 65.99 4268945.52 588140.45 1178.69 93.78 127.00 125.99 456894.21 58808.306 1178.07 66.98 4268945.64 588140.45 1178.66 93.78 127.00 127.00 456894.21 58808.306 1177.93 66.98 4268944.86 588139.52 1178.76 93.85 127.00 127.09 456894.45 58808.108 1177.92 67.97 426894.42 58813.95 1178.77 93.95 129.00 129.00 456894.45 58808.13 1177.97 68.99 426894.413 588137.63 1178.90 93.99 130.00 129.10 426892.455 58808.07 1178.22 68.99 426894.413 588137.63 1178.90 93.99 130.00 129.10 426892.455 58808.07 1178.22 68.99 426894.413 588137.63 1178.90 93.99 | 00.9 | 63.00 | 4268946.00 A768946.00 | 588143.27 | 1178 70 | 13.81 02 70 | 124.00 125.00 | 12.499 12.4 QQ | 04.6268924 09.6268367 | 588083.690835 | 1178.03 | CE.25 03 17 |
| 65.99 4268945.04 588140.45 1177.09 127.00 127.00 127.00 4268942.12 58803.01 1177.95 65.99 426894.42 5881.952 1178.87 93.45 128.00 127.09 426894.45 58803.01 1177.95 67.97 426894.42 5881.382 1178.87 93.95 129.00 129.00 426892.45.5 588081.13 1177.92 67.97 426894.41.3 5881.38.53 1178.87 93.95 129.00 1259.00 426892.45.5 58808.13 1177.92 68.99 426894.41.3 5881.37.63 1178.90 93.99 130.00 129.10 426892.45.6 58808.097 1178.22 68.99 426894.41.3 5881.37.63 1178.90 93.99 130.00 129.17 426892.45.6 588080.97 1178.22 | 00 | 64.98 | 4268945 52 | 588141 41 | 1178 73 | 93.87 | 126.00 | 125.99 | 4768924.21 | 90 28082 | 1178.07 | 93.16 |
| 66.98 4268944.86 588139.52 1178.76 93.85 128.00 127.99 4268924.47 588082.08 1178.27 67.97 4268944.42 588138.59 1178.87 93.96 129.00 129.00 4268924.52 588081.13 1177.97 68.99 4268944.43 588137.63 1178.90 93.99 130.00 129.17 4268924.52 588081.31 1177.97 68.99 4268944.33 588137.63 1178.90 93.99 130.00 129.17 4268924.55 588080.97 1178.22 | 00 | 65.99 | 4268945.04 | 588140.45 | 1178.69 | 93.78 | 127.00 | 127.00 | 4268924.21 | 588083.01 | 1177.98 | 93.07 |
| 67.97 4268944.42 588138.59 1178.87 93.96 129.00 129.00 4268924.52 588081.13 1177.97 65.99 4268944.33 588137.63 1178.90 93.99 130.00 129.17 426894.58 588680.97 1178.22 250 250 250 250 250 250 250 250 250 2 | .00 | 66.98 | 4268944.86 | 588139.52 | 1178.76 | 93.85 | 128.00 | 127.99 | 4268924.47 | 588082.08 | 1178.22 | 93.31 |
| 68.99 4268944.13 588137.63 1178.90 93.99 130.00 129.17 426824.58 58808.97 1178.22 | 3.00 | 67.97 | 4268944.42 | 588138.59 | 1178.87 | 93.96 | 129.00 | 129.00 | 4268924.52 | 588081.13 | 1177.97 | 93.06 |
| | 00. | 68.99 | 4268944.13 | 588137.63 | 1178.90 | 93.99 | 130.00 | 129.17 | 4268924.58 | 588080.97 | 1178.22 | 93.31 |
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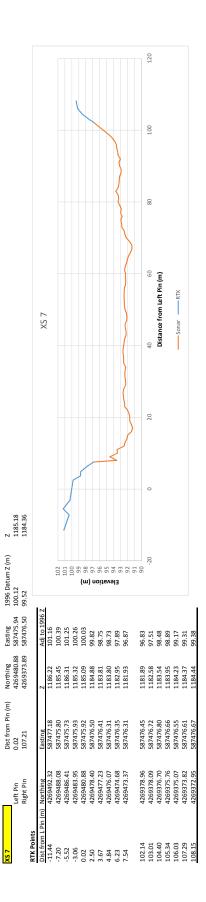
| Sonar Data at 1m p | Sonar Data at 1m points | | | | | | | | | | | | | | | | |
|------------------------------|---------------------------------|------------------------------|---|----------------------|----------------|------------------------------|--|------------------------------|---|--------------------|------------------|------------------------------|-------------------------------|------------|-----------|------------|------------------|
| Ideal Dist from L Pir (m) | n Actual Dist from L Pin (m) | Northing | Easting | Z | Adj to 1996 Z | Ideal Dist from L Pin (m) | Actual Dist from L Pin Northing (m) | Northing | Easting | z | Adj to 1996 7 | Ideal Dist from L Pin (m) | Actual Dist from L Pin (m) | Northing | Easting | Z AC | Adj to 1996 7 |
| 600 | 6.32 | CC 13083CV | P C 34 100 3 | 0 1011 | 06.04 | 60.00 | 68.07 | 10 000000 | C2 200002 | 1170.10 | 7 07 71 | (m) m | 00 201 | 10,000301 | 20017.04 | 4 117 00 0 | 00 |
| 11.00 | 10.99 | 4269067.03 | 588144.02 | 1179.77 | 94.80 | 70.00 | 69.99 | 42.69033.44 | 588.094.82 | 1179.17 | 94.20 | 136.72 | 136.72 | 4268997.23 | 588039.17 | | 98.86 98.86 |
| 12.00 | 12.00 | 4269066.38 | 588143.18 | 1179.06 | 60.66 | 71.00 | 71.00 | 4269032.40 | 588.093.98 | 1179.28 | 94.31 | 41007 | 4 / 0.07 | | 11.00000 | | 000 |
| 13.00 | 12.99 | 4269065.62 | 588142.35 | 1178.57 | 93.60 | 72.00 | 71.99 | 4269032.28 | 588093.15 | 1179.24 | 94.27 | | | | | | |
| 14.00 | 14.00 | 4269065.43 | 588141.51 | 1178.31 | 93.34 | 73.00 | 73.00 | 4269031.44 | 588092.31 | 1179.10 | 94.13 | | | | | | |
| 15.00 | 15.00 | 4269064.73 | 588140.68 | 1178.21 | 93.24 | 74.00 | 73.99 | 4269031.17 | 588091.48 | 1179.28 | 94.31 | | | | | | |
| 16.00 | 15.99 | 4269065.27 | 588139.85 | 1177.89 | 92.92 | 75.00 | 74.98 | 4269030.64 | 588090.66 | 1179.26 | 94.29 | | | | | | |
| 00.11 | 17.00 | 4,269,064.U/ | 10.951380 5 001 30 1 0 | 00 02 11 | 20.02 | /6.00 | /0/0/ | 4209029.63 | 18.980882 | 11 70 10 | 94.15 04.15 | | | | | | |
| 19.00 | 18.99 | 4269061.88 | 588137,35 | 1177.90 | 92.93 | 78.00 | 77.99 | 42 690 28.66 | 588088.15 | 1178.83 | 93.86 | | | | | | |
| 20.00 | 20.00 | 4269061.40 | 588136.51 | 1177.80 | 92.83 | 00.67 | 00.67 | 4269027.99 | 588087.31 | 1178.93 | 93.96 | | | | | | |
| 21.00 | 20.99 | 4269060.94 | 588135.68 | 1177.64 | 92.67 | 80.00 | 79.99 | 4269027.49 | 588086.48 | 1178.96 | 93.99 | | | | | | |
| 22.00 | 22.00 | 4269060.35 | 588134.84 | 1177.43 | 92.46 | 81.00 | 81.00 | 4269027.06 | 588085.64 | 1178.98 | 94.01 | | | | | | |
| 23.00 | 22.99 | 4269059.81 | 588134.01 | 1177.24 | 92.27 | 82.00 | 81.98 | 4269026.60 | 588084.82 | 1178.89 | 93.92 | | | | | | |
| 24.00 | 23.99 | 4269059.33 | 588133.18 | 1177.22 | 92.25 | 83.00 | 82.98 | 4269026.11 | 588083.99 | 1178.82 | 93.85 | | | | | | |
| 25.00 | 24.98 | 4269058.09 | 588132.35 | 1177.15 | 92.18 | 84.00 | 83.98 | 4269025.74 | 588083.15 | 1178.98 | 94.01 | | | | | | |
| 26.00 | 25.98 26.00 | 4 269058.61 | 588131.52 | 11/6.95 | 91.98 | 85.00 | 84.98 Br 00 | 4269025.12 | 588082.32 | 11/8.6/ | 93.70 on ro | | | | | | |
| 27.00 | 20.99 | 4 269056 77 | 588130.68 | CL.//11 | 92.18 92.71 | 85.00 | 86.09 86.00 | 42.690.24.59 42.690.23 91 | 585.080.64 | 22.8/11 1178 95 | 93.58 92 98 | | | | | | |
| 29.00 | 28.98 | 4269055.99 | 588129.02 | 1177.94 | 92.97 | 88.00 | 87.99 | 4269023.19 | 588079.81 | 1178.98 | 94.01 | | | | | | |
| 30.00 | 29.98 | 4269055.54 | 588128.18 | 1177.65 | 92.68 | 89.00 | 89.00 | 4269022.52 | 588078.97 | 1178.77 | 93.80 | | | | | | |
| 31.00 | 30.99 | 4269055.18 | 588127.34 | 1177.68 | 92.71 | 90.00 | 89.98 | 4269022.24 | 588078.15 | 1178.97 | 94.00 | | | | | | |
| 32.00 | 32.00 | 4269054.47 | 588126.50 | 1177.34 | 92.37 | 91.00 | 91.00 | 4269021.75 | 588077.30 | 1178.92 | 93.95 | | | | | | |
| 33.00 | 32.99 | 4269053.50 | 588125.67 | 1177.38 | 92.41 | 92.00 | 91.99 | 4269020.78 | 588076.47 | 1178.67 | 93.70 | | | | | | |
| 34.00 | 33.98 | 4269053.12 | 588124.85 | 1177.41 | 92.44 | 93.00 | 92.99 | 4269020.63 | 588075.64 | 1178.51 | 93.54 | | | | | | |
| 35.00 | 35.00 | 4269052.67 | 588124.00 | 1177.47 | 92.50 | 94.00 | 94.00 | 4269019.99 | 588074.80 | 1178.27 | 93.30 | | | | | | |
| 30.00 | 95.05 00.00 | 4269052.09 | 586123.1/ E 00133 E | 32.77.11 33.77.11 | 1976 | 95.00 | 94.99 | 4269019.13 | 16.5/0850 | 1176.49 | 25.52 | | | | | | |
| 38.00 | 38.00 | 4209051.13 | 500122.35 | 1177.87 | 92.09 00 00 | 90.00 | 95.07 06.07 | 10,0106024 | 5000/3.14 | C/ .0/ TT | 93.70 | | | | | | |
| 00.65 | 38.99 | 4269050.24 | 588120.67 | 1178.10 | 93.13 | 98.00 | 97.98 | 4269017.43 | 588071.48 | 1178.69 | 93.72 | | | | | | |
| 40.00 | 40.00 | 4269050.13 | 588119.83 | 1178.23 | 93.26 | 99.00 | 98.99 | 4269016.94 | 588070.64 | 1178.88 | 93.91 | | | | | | |
| 41.00 | 40.99 | 4269049.62 | 588119.00 | 1178.34 | 93.37 | 100.00 | 99.98 | 4269016.47 | 588069.81 | 1178.91 | 93.94 | | | | | | |
| 42.00 | 41.99 | 4269048.88 | 588118.17 | 1178.42 | 93.45 | 101.00 | 101.00 | 4269015.90 | 588068.96 | 1179.00 | 94.03 | | | | | | |
| 43.00 | 43.00 | 4269048.47 | 588117.33 | 1178.30 | 93.33 | 102.00 | 101.97 | 4269015.25 | 588068.15 | 1179.02 | 94.05 | | | | | | |
| 44.00 | 43.97 | 4269047.77 | 588116.52 | 1178.30 | 93.33 | 103.00 | 102.97 | 4269014.59 | 588067.32 | 1178.92 | 93.95 | | | | | | |
| 45.00 | 45.00 | 4269048.51 | 588115.66 | 1178.16 | 93.19 | 104.00 | 104.00 | 4269014.05 | 588066.46 | 1179.00 | 94.03 | | | | | | |
| 46.00 | 45.98 | 4269046.57 | 588114.84 | 1178.34 | 93.37 | 105.00 | 104.98 | 4269013.70 | 588065.64 | 11 78.99 | 94.02 | | | | | | |
| 48.00 | 47.98 | 4269046.64 | 588113.17 | 11 78 41 | 93.44 | 107.00 | 106.98 | 42.690.12.33 | 588063.97 | 1178.96 | 01.49 | | | | | | |
| 49.00 | 48.99 | 4269044.46 | 588112.33 | 1178.46 | 93.49 | 108.00 | 107.99 | 4269011.84 | 588063.13 | 1178.80 | 93.83 | | | | | | |
| 50.00 | 49.99 | 4269044.30 | 588111.50 | 1178.41 | 93.44 | 109.00 | 109.00 | 4269011.55 | 588062.29 | 1178.67 | 93.70 | | | | | | |
| 51.00 | 50.98 | 4269043.83 | 588110.67 | 1178.34 | 93.37 | 110.00 | 109.99 | 4269010.91 | 588061.46 | 11 78.44 | 93.47 | | | | | | |
| 00.25 | 16.TC | 4.209045.22 03.000301 | C 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | CZ.8/11 | 71,00 | 00 0111 | 111 07 | 12.01.06024 | 200000000000000000000000000000000000000 | 11 70 12 | 93.31 02.15 | | | | | | |
| 54.00 | 53.99 | 4269042.14 | 588108.16 | 1178.24 | 93.27 | 113.00 | 112.99 | 4269008.84 | 588058.96 | 1178.28 | 93.31 | | | | | | |
| 55.00 | 54.99 | 4269041.54 | 588107.33 | 1178.42 | 93.45 | 114.00 | 114.00 | 4269008.65 | 588058.12 | 1178.17 | 93.20 | | | | | | |
| 56.00 | 55.99 | 4269040.93 | 588106.49 | 1178.72 | 93.75 | 115.00 | 114.99 | 4269007.94 | 588057.29 | 1178.24 | 93.27 | | | | | | |
| 57.00 | 56.99 | 4269041.14 | 588105.66 | 1178.76 | 93.79 | 116.00 | 115.99 | 4269007.53 | 588056.46 | 1178.27 | 93.30 | | | | | | |
| 00.00 | 58.00 58.00 | CC. 620 602 4 | 200104-03 | 1178.60 | 93./ Z | 118 00 | 117.00 | 12:0006024 | 20.00000 | 1179 22 | 35.65 | | | | | | |
| 60.00 | 59.99 | 4269038.25 | 588103.16 | 1178.56 | 93.59 | 119.00 | 118.98 | 4269005.63 | 588053.97 | 1178.34 | 93,37 | | | | | | |
| 61.00 | 61.00 | 4269038.43 | 588102.32 | 1178.46 | 93.49 | 120.00 | 119.99 | 4269005.32 | 588053.12 | 1178.32 | 93.35 | | | | | | |
| 62.00 | 61.98 | 4269037.99 | 588101.50 | 1178.38 | 93.41 | 121.00 | 120.98 | 4269004.95 | 588052.30 | 1177.98 | 93.01 | | | | | | |
| 63.00 | 63.00 | 4269037.17 | 588100.65 | 1178.65 | 93.68 | 122.00 | 122.00 | 4269004.17 | 588051.45 | 1178.01 | 93.04 | | | | | | |
| 64.00 | 63.39 64.00 | 4 209 030.37 A 760 035 52 | 20.99.000 | 1178.96 | 93./9 02 20 | 124.00 | 122.99 | 4209003.92 | 20.000000 | 1178 AG | 02.62 | | | | | | |
| 66.00 | 65.98 | 4269035.57 | 588098.16 | 1178.98 | 94.01 | 125.00 | 125.00 | 4269002.26 | 588048.95 | 1178.35 | 93.38 | | | | | | |
| 67.00 | 66.98 | 4269034.48 | 588097.33 | 1179.08 | 94.11 | 126.00 | | 4269001.70 | 588048.12 | 1178.16 | 93.19 | | | | | | |
| 68.00 | 68.00 | 4269033.93 | 588096.48 | 1179.20 | 94.23 | 127.00 | 126.99 | 4269001.11 | 588047.29 | 1177.88 | 92.91 | | | | | | |



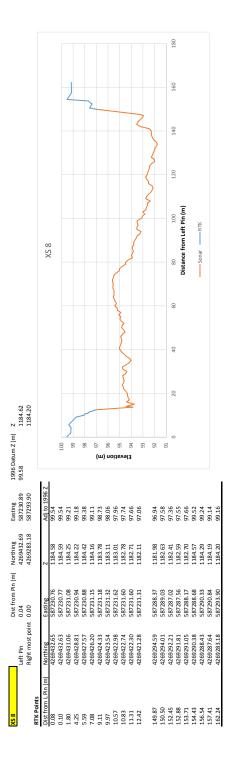
| Sonar Data at 1m points | its | | | | | | | | | | | J | | | | | |
|---|---------------------|---------------------------|--|----------------------|-----------------|---------------------|---|------------------------------|--------------------|---------------|----------------|---------------|-------------------|----------------|---------------|------------|----------------|
| Ideal Dist from L Pin (m) Actual Dist from L Northing | n) Actual Dist from | L Northing | Easting | z | Adj to 1996 | 5 Z Ideal Dist froi | Adj to 1996 Z I ldeal Dist from L Pin Actual Dist from L Northing | L Northing | Easting | z Ad | | ist from L | t from L Northing | g Easting | Z Br | A | Adj to 1996 Z |
| | Pin (m) | | | | | (m) | Pin (m) | | | | Z | | | | | | |
| 5.65 | 5.65 | 4269201.30 | 588064.71 | 1181.81 | 96.87 | 65.00 | 65.00 57 00 | 4269170.26 | 588015.27 | 1178.55 93.61 | .61 123.00 | 00 122.99 | 4269139.87 | 9.87 587966.96 | | 1178.45 9 | 93.51 02 74 |
| 00.6 | 0.00 | 4269200.55 | 588061.92 | 1178.10 | 93.46 | 67.00 | 86.60 86.66 | 4269169.62 | 588013.62 | | 93.94 124.00 | | 4269138.18 | | | | 3.87 |
| 10.00 | 9.99 | 4269200.54 | 588061.09 | 1177.87 | 92.93 | 68.00 | 66'29 | 4269168.80 | 588012.78 | | | | 4269137.70 | | | | 93.74 |
| 11.00 | 10.99 | 4269199.38 | 588060.26 | 1177.30 | 92.36 | 00'69 | 68.98 | 4269168.03 | 588011.95 | | | | 4269137.31 | | | | 3.83 |
| 12.00 | 12.00 | 4269199.58 | 588059.42 | 1177.15 | 92.21 | 70.00 | 66.69 | 4269167.84 | 588011.11 | | | | 4269137.01 | | | | 93.71 |
| 13.00 | 12.99 | 4269198.88 | 588058.59 | 1176.51 | 91.57 | 71.00 | 70.99 | 4269167.08 | 588010.28 | | | | 4269136.14 | | | | 93.79 |
| 14.00 15.00 | 13.99 15.00 | 4269198.43 | 588057.76 Feedere og | 1176.35 | 91.41 | 72.00 | 00.27 | 4269166.96 | 588009.44 | 1179.18 94. | 94.24 I30.00 | 00 00 1 29.99 | 4269135.78 | 587961.13 | | | 3.91 |
| 16.00 | 15,99 | 4269195.67 | 588056.09 | 1176.26 | 91.32 | 74.00 | 73.98 | 4269165.11 | 10.00000 588005 | | 94.17 132.00 | | 4269134.67 | | | 9 02 8711 | 3.76 |
| 17.00 | 16.99 | 4269196,10 | 588055.26 | 1176.26 | 91.32 | 75.00 | 75.00 | 4269164.85 | 588006.94 | | | | 4269133.56 | | | | 93.97 |
| 18.00 | 17.99 | 4269194.90 | 588054.43 | 1176.13 | 91.19 | 76.00 | 75.98 | 4269164.44 | 588006.12 | | | | 4269133.66 | | | | 3.74 |
| 19.00 | 18.97 | 4269194.18 | 588053.61 | 1176.19 | 91.25 | 77.00 | 76.99 | 4269163.89 | 588005.28 | 1179.10 94. | 94.16 135.00 | 00 135.00 | 4269132.99 | 2.99 587956.96 | | 1178.53 9 | 93.59 |
| 20.00 | 19.99 | 4269194.25 | 588052.76 | 1176.48 | 91.54 | 78.00 | 78.00 | 4269163.45 | 588004.44 | 1179.20 94. | | | 4269132.72 | 2.72 587956.14 | | | 3.75 |
| 21.00 | 20.98 | 4269193.61 | 588051.94 | 1176.70 | 91.76 | 00.67 | 78.98 | 4269162.89 | 588003.62 | | | | 4269131.44 | | | | 93.81 |
| 22.00 | 21.99 | 4269192.99 | 588051.10 | 1176.88 | 91.94 | 80.00 | 79.99 | 4269162.30 | 588002.78 | | | | 4269131.82 | | | | 93.98 |
| 23.00 | 22.99 | 4269193.24 | 588050.26 | 1177.07 | 92.13 | 81.00 | 80.99 | 4269161.68 | 588001.95 | | | | 4269131.74 | | | | 94.11 |
| 24.00 | 23.99 | 4269191.98 | 588049.43 | 1177.11 | 92.17 | 82.00 | 82.00 | 4269161.66 | 588001.11 | | 94.27 144.52 | 52 144.52 | 4269127.54 | _, | 587949.03 118 | 1183.16 9. | 98.23 |
| 25.00 | 25.00 | 4269192.33 | 588048.59 5 5 5 0 4 8 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 | 11.//11 | 71.76 0C C0 | 83.00 | 86.28 | 4269160./5 | 588000.29 | 1179.26 94. | 94.32 04.16 | | | | | | |
| 20.00 | 26.00 | 4203191.54 | 5 880/16 02 | 1177 25 | 92.25 0.0 21 | 04.00 85 00 | 00.33 BE 00 | 720016024 | C # 2002 5 2 | | 01.4C | | | | | | |
| 28.00 | 28.00 | 4269190.02 | 588046.09 | 1177.48 | 92.54 | 86.00 | 85.99 | 4269158.99 | 587997.78 | | 94.42 | | | | | | |
| 29.00 | 29.00 | 4269189.44 | 588045.26 | 1177.75 | 92.81 | 87.00 | 86.99 | 4269158.56 | 587996.95 | | 94.32 | | | | | | |
| 30.00 | 29.99 | 4269189.13 | 588044.43 | 1177.83 | 92.89 | 88.00 | 88.00 | 4269158.22 | 587996.11 | | 94.15 | | | | | | |
| 31.00 | 30.99 | 4269188.54 | 588043.60 | 1177.79 | 92.85 | 00.68 | 88.97 | 4269157.66 | 587995.30 | | 94.24 | | | | | | |
| 32.00 | 32.00 | 4269188.06 | 588042.76 | 1177.86 | 92.92 | 00.06 | 66.68 | 4269157.19 | 587994.45 | | 94.38 | | | | | | |
| 33.00 | 32.97 | 4269187.19 | 588041.95 | 1177.93 | 92.99 52.09 | 91.00 | 90.95 | 4269156.29 | 587993.65 | | 94.45 | | | | | | |
| 34.00 | 53.99 70 Mg | 4209180./4 | 588041.10 586040.39 | 10.8/11 | 93.07 | 00.26 | 00.26 | 4/2012014074 | 8/.766/8C | 1170.23 04. | 04.35 04.30 | | | | | | |
| 36.00 | 35.96 | 4269185.86 | 588039.46 | 1178.06 | 93.12 | 94.00 | 93.99 | 4269155.22 | 587991.12 | | 94.34 | | | | | | |
| 37.00 | 36.99 | 4269185.20 | 588038.60 | 1178.28 | 93.34 | 95.00 | 66.46 | 4269154.41 | 587990.29 | | 94.39 | | | | | | |
| 38.00 | 38.00 | 4269185.34 | 588037.76 | 1178.20 | 93.26 | 96.00 | 95.99 | 4269153.71 | 587989.45 | | 94.37 | | | | | | |
| 39.00 | 39.00 | 4269184.74 | 588036.93 | 1178.32 | 93.38 | 97.00 | 96.99 | 4269153.48 | 587988.62 | | 94.37 | | | | | | |
| 40.00 | 39.97 | 4269183.78 | 588036.12 | 1178.05 | 93.11 | 98.00 | 98.00 | 4269153.53 | 587987.78 | | 94.33 | | | | | | |
| 41.00 | 40.99 | 4269183.33 | 588035.27 | 11.8/11 | 93.1/ 02.22 | 00.66 | 00'66 | 4269152.52 | 26.986.95 | | 94.14 | | | | | | |
| 42.00 | 41.49 00.04 | 4269183.18 00 00 00 00 | 588034.44 | 11/8.2/ 11/70 E.7 | 93.33 02 E0 | 101.00 | 99.98 90.001 | 42091219424 9001210304 | 58/98b.13 | 11/9.14 94. | 94.20 | | | | | | |
| 44.00 | 43.99 | 42.691.81.79 | 588032.77 | 1178.65 | 93.71 | 102.00 | 102.00 | 4269150.36 | 587984.45 | | 94.01 | | | | | | |
| 45.00 | 45.00 | 4269181.18 | 588031.93 | 1178.55 | 93.61 | 103.00 | 102.99 | 4269150.06 | 587983.62 | | 94.15 | | | | | | |
| 46.00 | 45.99 | 4269180.80 | 588031.10 | 1178.37 | 93.43 | 104.00 | 103.99 | 4269149.63 | 587982.79 | | 94.18 | | | | | | |
| 47.00 | 46.99 | 4269179.74 | 588030.27 | 1178.31 | 93.37 | 105.00 | 105.00 | 4269149.30 | 587981.95 | | 94.01 | | | | | | |
| 48.00 | 48.00 | 4269179.43 4769179.03 | 588029.43 | 11 78 03 | 93.24 93.09 | 105.00 | 99.501 106.99 | 4,2691,48,44 4,7691,47,84 | 58/981.12 | 1178 92 94. | 94.U3 93 99 | | | | | | |
| 50.00 | 49.98 | 4269178,45 | 588027.78 | 1178,39 | 93.45 | 108.00 | 108.00 | 4269147.42 | 587979.45 | | 93,93 | | | | | | |
| 51.00 | 50.99 | 4269177.78 | 588026.94 | 1178.37 | 93.43 | 109.00 | 109.00 | 4269146.94 | 587978.62 | | 93.94 | | | | | | |
| 52.00 | 52.00 | 4269177.57 | 588026.10 | 1178.63 | 93.69 | 110.00 | 109.99 | 4269146.30 | 587977.79 | _ | 93.76 | | | | | | |
| 53.00 | 52.99 | 4269177.11 | 588025.27 | 1178.66 | 93.72 | 111.00 | 110.98 | 4269146.29 | 587976.97 | | 93.75 | | | | | | |
| 54.00 | 53.99 EF 00 | 42.64/19624 | 588024.44 | 26.8/ II 0C 02 11 | 93.98 | 112.00 | 00.211 | 4269145.07 | 21.0/6/85 | 11/8./8 93. | 93.84 | | | | | | |
| 56.00 | 00.cc | 4269175.34 | 588022.77 | 1179.17 | 94.23 | 114.00 | 113.99 | 4269144.06 | 587974.46 | | 93.92 | | | | | | |
| 57.00 | 56.98 | 4269174.65 | 588021.95 | 1179.29 | 94.35 | 115.00 | 114.99 | 4269143.74 | 587973.63 | 1178.90 93. | 93.96 | | | | | | |
| 58.00 | 58.00 | 4269174.63 | 588021.10 | 1179.26 | 94.32 | 116.00 | 115.99 | 4269143.25 | 587972.79 | _ | 93.96 | | | | | | |
| 59.00 | 59.00 | 4269173.65 | 588020.27 | 1179.34 | 94.40 | 117.00 | 116.99 | 4269142.77 | 587971.96 | | 93.88 | | | | | | |
| 60.00 | 59.99 | 4269173.11 | 588019.44 | 11.79.17 | 94.23 02.06 | 118.00 | 117.98 | 4269141.82 | 587971.14 | 1178.84 93. | 93.90 | | | | | | |
| 62.00 | 62.00 | 4269172.29 | 588017.77 | 1178.91 | 93.97 | 120.00 | 119.98 | 4269140.98 | 587969.47 | | 93.59 | | | | | | |
| 63.00 | 62.99 | 4269171.87 | 588016.94 | 1178.97 | 94.03 | 121.00 | 120.98 | 4269140.74 | 587968.64 | | 93.64 | | | | | | |
| 64.00 | 63.99 | 4269171.05 | 588016.11 | 1178.87 | 93.93 | 122.00 | 122.00 | 4269139.97 | 587967.79 | 1178.63 93. | .69 | | | | | | |
| | | | | | | | | | | | | | | | | | |



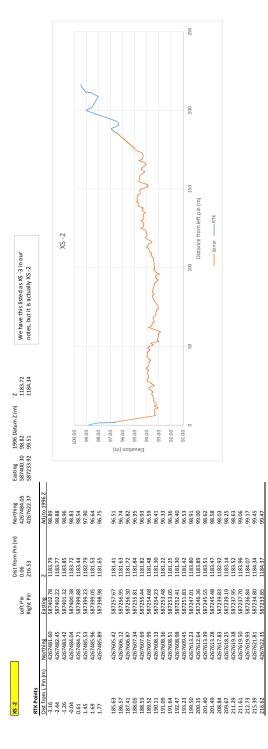
| 5.38 5.38 5.38 7.01 7.01 7.00 7.01 9.00 9.00 9.10.00 10.00 11.00 10.00 11.00 10.99 12.00 11.99 13.00 11.99 14.00 11.99 14.00 11.99 14.00 12.99 14.00 14.90 15.00 14.90 16.00 16.00 18.00 17.99 19.00 20.00 20.00 21.00 23.00 22.99 23.00 23.90 25.00 25.00 25.00 26.96 27.00 26.96 | | | | 7 0CCT | (m) fro | rom L Pin (m) | | | | 1996 Z |
|--|------------|-----------|---------|--------|-----------|---------------|------------|-----------|---------|--------|
| | 4403443.04 | 587728.21 | 1181.93 | 97.10 | 56.00 55 | 55.99 | 4269425.02 | 587476.51 | 1177.53 | 92.71 |
| | 4269428.10 | 587727.45 | 1180.19 | 95.37 | - , | 56.99 | 4269424.02 | 587476.31 | 1177.36 | 92.54 |
| | 4269472.92 | 587478.35 | 1178.62 | 93.80 | -, | 58.00 | 4269423.01 | 587476.69 | 1177.33 | 92.51 |
| | 4269471.92 | 587475.85 | 1179.60 | 94.78 | -, | 58.99 | 4269422.02 | 587476.68 | 1177.37 | 92.55 |
| | 4269470.92 | 587477.71 | 1178.53 | 93.71 | -, | 59.99 | 4269421.02 | 587476.84 | 1177.36 | 92.54 |
| | 4269469.93 | 587477.12 | 1178.56 | 93.74 | | 60.99 | 4269420.02 | 587476.81 | 1177.50 | 92.68 |
| | 4269468.93 | 587476.21 | 1177.55 | 92.73 | 62.00 62 | 62.00 | 4269419.02 | 587476.33 | 1177.40 | 92.58 |
| | 4269467.93 | 587475.66 | 1177.44 | 92.62 | | 62.99 | 4269418.03 | 587476.73 | 1177.22 | 92.40 |
| | 4269466.93 | 587476.41 | 1177.16 | 92.34 | | 63.99 | 4269417.03 | 587476.57 | 1177.10 | 92.28 |
| | 4269465.94 | 587476.24 | 1177.06 | 92.24 | 65.00 64 | 64.99 | 4269416.03 | 587476.55 | 1176.91 | 92.09 |
| | 4269464.93 | 587476.31 | 1176.51 | 91.69 | 66.00 65 | 65.98 | 4269415.04 | 587476.54 | 1176.63 | 91.81 |
| | 4269463.94 | 587476.17 | 1176.35 | 91.53 | | 67.00 | 4269414.03 | 587476.24 | 1176.44 | 91.62 |
| | 4269462.94 | 587475.86 | 1176.52 | 91.70 | 68.00 67 | 67.98 | 4269413.05 | 587476.40 | 1176.46 | 91.64 |
| | 4269461.96 | 587476.38 | 1176.75 | 91.93 | | 68.99 | 4269412.04 | 587476.38 | 1176.78 | 91.96 |
| | 4269460.94 | 587476.21 | 1176.75 | 91.93 | | 66.69 | 4269411.04 | 587476.65 | 1177.27 | 92.45 |
| | 4269459.94 | 587476.17 | 1176.85 | 92.03 | 71.00 70 | 70.98 | 4269410.05 | 587476.64 | 1177.44 | 92.62 |
| | 4269458.95 | 587476.04 | 1177.07 | 92.25 | 72.00 71 | 71.99 | 4269409.05 | 587476.32 | 1177.56 | 92.74 |
| | 4269457.95 | 587476.46 | 1177.48 | 92.66 | 73.00 72 | 72.98 | 4269408.06 | 587476.99 | 1177.88 | 93.06 |
| | 4269456.95 | 587476.22 | 1177.49 | 92.67 | | 73.98 | 4269407.06 | 587476.74 | 1177.92 | 93.10 |
| | 4269455.95 | 587476.57 | 1177.61 | 92.79 | | 74.99 | 4269406.05 | 587476.59 | 1178.03 | 93.21 |
| | 4269454.95 | 587476.33 | 1177.68 | 92.86 | 75.00 75 | 75.99 | 4269405.05 | 587476.59 | 1177.84 | 93.02 |
| | 4269453.99 | 587475.96 | 1177.71 | 92.89 | | 76.98 | 4269404.06 | 587476.84 | 1178.08 | 93.26 |
| | 4269452.96 | 587476.17 | 1177.60 | 92.78 | | 78.00 | 4269403.05 | 587476.85 | 1177.97 | 93.15 |
| | 4269451.97 | 587476.16 | 1177.35 | 92.53 | | 79.00 | 4269402.05 | 587476.67 | 1178.17 | 93.35 |
| | 4269450.97 | 587476.42 | 1177.33 | 92.51 | | 79.94 | 4269401.11 | 587477.17 | 1178.43 | 93.61 |
| | 4269449.98 | 587476.96 | 1177.42 | 92.60 | | 80.99 | 4269400.06 | 587476.64 | 1178.35 | 93.53 |
| | 4269448.98 | 587476.62 | 1177.46 | 92.64 | | 81.97 | 4269399.08 | 587476.81 | 1178.41 | 93.59 |
| | 4269447.97 | 587476.09 | 1177.42 | 92.60 | | 82.98 | 4269398.08 | 587476.66 | 1178.76 | 93.94 |
| | 4269446.98 | 587476.66 | 1177.33 | 92.51 | | 84.00 | 4269397.06 | 587476.80 | 1178.41 | 93.59 |
| | 4269445.98 | 587476.38 | 1177.61 | 92.79 | | 84.99 | 4269396.07 | 587476.82 | 1178.31 | 93.49 |
| | 4269444.97 | 587476.33 | 1177.64 | 92.82 | | 85.96 | 4269395.10 | 587476.87 | 1178.26 | 93.44 |
| | 4269444.00 | 587476.00 | 1177.64 | 92.82 | | 86.98 | 4269394.08 | 587477.52 | 1178.22 | 93.40 |
| | 4269443.00 | 587476.68 | 1177.72 | 92.90 | | 88.00 | 4269393.07 | 587476.92 | 1178.03 | 93.21 |
| | 4269441.98 | 587475.96 | 1177.71 | 92.89 | | 89.00 | 4269392.07 | 587476.77 | 1177.97 | 93.15 |
| | 4269440.98 | 587476.69 | 1177.63 | 92.81 | | 00.06 | 4269391.07 | 587476.76 | 1178.21 | 93.39 |
| | 4269439.98 | 587476.27 | 1177.55 | 92.73 | | 66.06 | 4269390.08 | 587476.55 | 1178.30 | 93.48 |
| - | 4269438.98 | 587476.33 | 1177.46 | 92.64 | | 91.99 | 4269389.08 | 587476.46 | 1178.10 | 93.28 |
| | 4269437.99 | 587476.66 | 1177.26 | 92.44 | | 93.00 | 4269388.08 | 587476.35 | 1178.41 | 93.59 |
| - | 4269437.00 | 587476.64 | 1177.29 | 92.47 | | 94.00 | 4269387.08 | 587476.65 | 1178.49 | 93.67 |
| | 4269436.00 | 587476.29 | 1177.40 | 92.58 | | 95.00 | 4269386.08 | 587476.98 | 1178.62 | 93.80 |
| | 4269435.01 | 587476.21 | 1177.41 | 92.59 | | 95.99 | 4269385.09 | 587477.46 | 1178.68 | 93.86 |
| - | 4269434.01 | 587476.19 | 1177.20 | 92.38 | | 96.99 | 4269384.09 | 587477.69 | 1178.94 | 94.12 |
| | 4269433.00 | 587476.65 | 1177.16 | 92.34 | | 97.99 | 4269383.09 | 587476.89 | 1179.35 | 94.53 |
| | 4269432.01 | 587476.52 | 1177.23 | 92.41 | | 98.83 | 4269382.26 | 587475.90 | 1179.82 | 95.00 |
| | 4269431.01 | 587476.55 | 1177.43 | 92.61 | 102.53 10 | 102.53 | 4269339.21 | 587692.16 | 1181.89 | 97.07 |
| | 4269430.00 | 587476.51 | 1177.51 | 92.69 | | | | | | |
| | 4269429.00 | 587476.42 | 1177.53 | 92.71 | | | | | | |
| | 4269428.02 | 587476.48 | 1177.55 | 92.73 | | | | | | |
| 54.00 53.99 | 4269427.01 | 58/4/6.56 | 85.//11 | 97.76 | | | | | | |



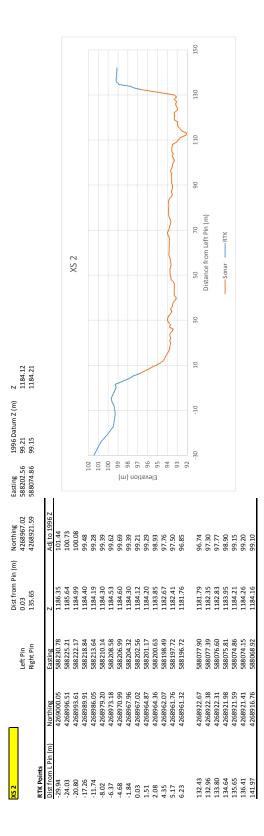
| Ideal Dist from L Actu Pin (m) | Actual Dist from L Northing Pin (m) | L Northing | Easting | Z | Adj to 1996 Z | Ideal Dist from L Din (m) | Actual Dist from L Northing Din (m) | Northing | Easting | Z | Adj to 1996 Z |
|-----------------------------------|--|--------------------|-----------|--------------------|----------------|------------------------------|--|------------|-----------|---------|---------------|
| 7.54 | 7.54 | 4269473.37 | 587476.31 | 1181.93 | 96.87 | 70.00 | 66.69 | 4269411.04 | 587476.65 | 1177.27 | 92.21 |
| 8.00 | 7.99 | 4269472.92 | 587478.35 | 1178.62 | 93.56 | 71.00 | 70.98 | 4269410.05 | 587476.64 | 1177.44 | 92.38 |
| 00.6 | 00.6 | 4269471.92 | 587475.85 | 1179.60 | 94.54 | 72.00 | 71.99 | 4269409.05 | 587476.32 | 1177.56 | 92.50 |
| 10.00 | 10.00 | 4269470.92 | 587477.71 | 1178.53 | 93.47 | 73.00 | 72.98 | 4269408.06 | 587476.99 | 1177.88 | 92.82 |
| 11.00 | 10.99 | 4269469.93 | 587477.12 | 1178.56 | 93.50 | 74.00 | 73.98 | 4269407.06 | 587476.74 | 1177.92 | 92.86 |
| 12.00 | 11.99 | 4269468.93 | 587476.21 | 1177.55 | 92.49 | 75.00 | 74.99 | 4269406.05 | 587476.59 | 1178.03 | 92.97 |
| 13.00 | 12.99 | 4269467.93 | 587475.66 | 1177.44 | 92.38 | 76.00 | 75.99 | 4269405.05 | 587476.59 | 1177.84 | 92.78 |
| 14.00 | 14.00 | 4269466.93 | 587476.41 | 1177.16 | 92.10 | 77.00 | 76.98 | 4269404.06 | 587476.84 | 1178.08 | 93.02 |
| 15.00 | 14.99 | 4269465.94 | 587476.24 | 1177.06 | 92.00 | 78.00 | 78.00 | 4269403.05 | 587476.85 | 1177.97 | 92.91 |
| 16.00 | 16.00 | 4269464.93 | 587476.31 | 1176.51 | 91.45 | 00.97 | 79.00 | 4269402.05 | 587476.67 | 1178.17 | 93.11 |
| 17.00 | 16.99 | 4269463.94 | 587476.17 | 1176.35 | 91.29 | 80.00 | 79.94 | 4269401.11 | 587477.17 | 1178.43 | 93.37 |
| 18.00 | 17.99 | 4269462.94 | 587475.86 | 1176.52 | 91.46 | 81.00 | 80.99 | 4269400.06 | 587476.64 | 1178.35 | 93.29 |
| 19.00 | 18.98 | 4269461.96 | 587476.38 | 1176.75 | 91.69 | 82.00 | 81.97 | 4269399.08 | 587476.81 | 1178.41 | 93.35 |
| 20.00 | 20.00 | 4269460.94 | 587476.21 | 1176.75 | 91.69 | 83.00 | 82.98 | 4269398.08 | 587476.66 | 1178.76 | 93.70 |
| 21.00 | 21.00 | 4269459.94 | 587476.17 | 1176.85 | 91.79 | 84.00 | 84.00 | 4269397.06 | 587476.80 | 1178.41 | 93.35 |
| 22.00 | 21.99 | 4269458.95 | 587476.04 | 1177.07 | 92.01 | 85.00 | 84.99 | 4269396.07 | 587476.82 | 1178.31 | 93.25 |
| 23.00 | 22.99 | 4269457.95 | 587476.46 | 1177.48 | 92.42 | 86.00 | 85.96 | 4269395.10 | 587476.87 | 1178.26 | 93.20 |
| 24.00 | 23.99 | 4269456.95 | 587476.22 | 1177.49 | 92.43 | 87.00 | 86.98 | 4269394.08 | 587477.52 | 1178.22 | 93.16 |
| 25.00 | 25.00 | 4269455.95 | 587476.57 | 1177.61 | 92.55 | 88.00 | 88.00 | 4269393.07 | 587476.92 | 1178.03 | 92.97 |
| 26.00 | 26.00 | 4269454.95 | 587476.33 | 1177.68 | 92.62 | 89.00 | 89.00 | 4269392.07 | 587476.77 | 1177.97 | 92.91 |
| 27.00 | 26.96 | 4269453.99 | 587475.96 | 1177.71 | 92.65 | 90.00 | 90.00 | 4269391.07 | 587476.76 | 1178.21 | 93.15 |
| 28.00 | 27.99 | 4269452.96 | 587476.17 | 1177.60 | 92.54 | 91.00 | 90.99 | 4269390.08 | 587476.55 | 1178.30 | 93.24 |
| 29.00 | 28.98 | 4269451.97 | 587476.16 | 1177.35 | 92.29 | 92.00 | 91.99 | 4269389.08 | 587476.46 | 1178.10 | 93.04 |
| 30.00 | 29.99 | 4269450.97 | 587476.42 | 1177.33 | 92.27 | 93.00 | 93.00 | 4269388.08 | 587476.35 | 1178.41 | 93.35 |
| 31.00 | 30.98 | 4269449.98 | 587476.96 | 1177.42 | 92.36 | 94.00 | 94.00 | 4269387.08 | 587476.65 | 1178.49 | 93.43 |
| 32.00 | 31.98 | 4269448.98 | 587476.62 | 1177.46 | 92.40 | 95.00 | 95.00 | 4269386.08 | 587476.98 | 1178.62 | 93.56 |
| 33.00 | 32.99 | 4269447.97 | 587476.09 | 1177.42 | 92.36 | 96.00 | 95.99 | 4269385.09 | 587477.46 | 1178.68 | 93.62 |
| 34.00 | 33.98 | 4269446.98 | 587476.66 | 1177.33 | 92.27 | 97.00 | 96.99 | 4269384.09 | 587477.69 | 1178.94 | 93.88 |
| 35.00 | 34.99 | 4269445.98 | 587476.38 | 1177.61 | 92.55 | 98.00 | 97.99 | 4269383.09 | 587476.89 | 1179.35 | 94.29 |
| 36.00 | 36.00 | 4269444.97 | 587476.33 | 1177.64 | 92.58 | 00.66 | 98.83 | 4269382.26 | 587475.90 | 1179.82 | 94.76 |
| 37.00 | 36.97 | 4269444.00 | 587476.00 | 1177.64 | 92.58 | | 102.14 | 4269378.96 | 587476.45 | 1181.89 | 96.83 |
| 38.00 | 37.97 | 4269443.00 | 587476.68 | 1177.72 | 92.66 | | | | | | |
| 39.00 | 38.99 | 4269441.98 | 587475.96 | 1177.71 | 92.65 | | | | | | |
| 40.00 | 40.00 | 4269440.98 | 58/4/6.69 | 11//.63 | 92.57 | | | | | | |
| 41.00 | 41.00 | 4269439.98 | 58/4/6.2/ | 22.//II | 92.49 | | | | | | |
| 42.00 | 42.00 | 4269438.98 | 58/4/b.33 | 11//.46 | 92.40 | | | | | | |
| 43.00 | 90 CV | 420343/ UC FCF03CF | 00.0/4/80 | 0C 2211 | 07.26 | | | | | | |
| 44.00 | 00.04 | 00.1646024 | 40.01410C | 67.1/TT | 67.76 VC CO | | | | | | |
| 46.00 | 45.98 | 4269435.01 | 587476.21 | 1177.41 | 92.35 | | | | | | |
| 47.00 | 46.98 | 4269434.01 | 587476.19 | 1177.20 | 92.14 | | | | | | |
| 48.00 | 47.99 | 4269433.00 | 587476.65 | 1177.16 | 92.10 | | | | | | |
| 49.00 | 48.98 | 4269432.01 | 587476.52 | 1177.23 | 92.17 | | | | | | |
| 50.00 | 49.98 | 4269431.01 | 587476.55 | 1177.43 | 92.37 | | | | | | |
| 51.00 | 51.00 | 4269430.00 | 587476.51 | 1177.51 | 92.45 | | | | | | |
| 52.00 | 52.00 | 4269429.00 | 587476.42 | 1177.53 | 92.47 | | | | | | |
| 53.00 | 52.98 | 4269428.02 | 587476.48 | 1177.55 | 92.49 | | | | | | |
| 54.00 | 53.99 | 4269427.01 | 587476.56 | 1177.58 | 92.52 | | | | | | |
| 55.00 | 54.96 | 4269426.04 | 587476.37 | 1177.54 | 92.48 | | | | | | |
| 56.00 | 55.99 | 4269425.02 | 587476.51 | 1177.53 | 92.47 | | | | | | |
| 57.00 | 56.99 | 4269424.02 | 587476.31 | 1177.36 | 92.30 | | | | | | |
| 58.00 | 58.0U | TU.5242324 | 90.0/4/8C | TC 7711 | 12.26 | | | | | | |
| 00.95 | 20.99 | 4203422.UZ | 00.0/4/00 | 10.1/11 35 7711 | 16.26 | | | | | | |
| 61.00 | 60.99 | 4269420.02 | 587476.81 | 1177.50 | 92.44 | | | | | | |
| | | | | | | | | | | | |



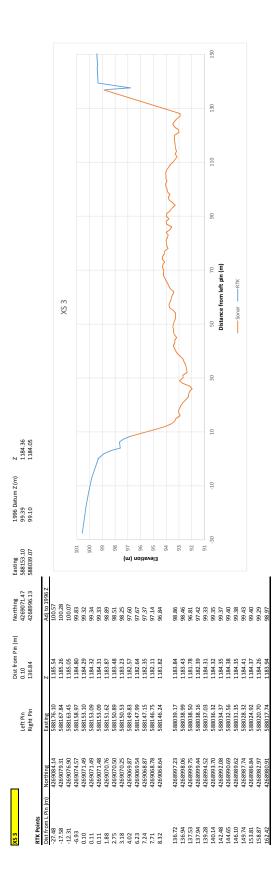
| Colorentia Coloren | Ideal Dist from L Pin Ac | n Actual Dist fr | Actual Dist from L Northing | Easting | Z | Adj to 1996 Z | Ideal Dist from L | Actual Dist from L Northing | n L Northing | Easting | Z Adj to | Ideal Dist from L Actual Dist from Northing | Actual Dist fr | om Northing | Easting | Z Adj t | Adj to 1996 Z |
|---|--------------------------|------------------|-----------------------------|------------------------|----------|----------------|-------------------|-----------------------------|-------------------------|------------------------|---------------|---|------------------|-------------------------|-----------|-----------------|---------------|
| 10. 0.000.1 0.000.1 0.000 0.000.1 0.000.0 0.00 | | Pin (m) | 00 1010301 | AC ACCEDI | 10.00 | 1010 | Pin (m) | Pin (m) | 100000 | 00 110101 | | Pin (m) | L Pin (m) | 100000 | CO POLICI | | |
| 000 0000000 0000000 0000000< | 44 | 75.5L | 67 0CV03CV | 16.152/8C | 11.2011 | 9///6 | 72.00 | 73 00 | 4209500.38 4420365 | 55.002/80 | | 140.07 | 147.49 140.07 | 4209290./8 01.000000 | 70'T07/0C | 11 / 8.24 93.20 | 2 5 |
| 0.0 0.00010 0.7315.6 1179.4 0.7315.6 0.7 | 88 | 14.00 | 4269419.82 | 587236.02 | 1179.49 | 94.45 | 74.00 | 74.00 | 4203503.44 | 58775613 | | 143.07 | 143.07 | 60.4636034 | 10.002100 | | 1 |
| 16.0 6.90(1/36 672/36 173/3 6.400 6.200(1/3 672/36 173/3 17.97 6.960(1/3 672/37 173/3 6.200(1/3 672/36 173/3 17.97 6.960(1/3 672/37 173/3 6.400 6.900(1/3 672/37 173/3 17.97 6.960(1/3 672/37 173/3 6.400 6.900(1/3 672/37 173/3 17.97 6.960(1/3 672/31 173/3 9.400 872/46 173/3 17.97 6.960(1/3 672/31 173/3 9.400 8600 6600 672/46 173/3 17.97 690(1/3 672/31 173/3 9.400 8600 8600 872/41 173/3 17.96 670(1/3 673/3 173/3 9.400 873/41 173/41 17.96 670(1/3 670/4 670/4 670/41 173/41 17.96 670(1/3 670/4 670/4 670/41 173/41 17.97 670/4 <td< td=""><td>0</td><td>14.99</td><td>4269418.91</td><td>587235.58</td><td>1178.78</td><td>93.74</td><td>75.00</td><td>74.99</td><td>4269363.60</td><td>587256.54</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<> | 0 | 14.99 | 4269418.91 | 587235.58 | 1178.78 | 93.74 | 75.00 | 74.99 | 4269363.60 | 587256.54 | | | | | | | |
| 159 65941.10 572.16 17.10 7.66 45061.17 577.16 <td>00</td> <td>16.00</td> <td>4269417.98</td> <td>587236.39</td> <td>1179.44</td> <td>94.40</td> <td>76.00</td> <td>75.98</td> <td>4269362.69</td> <td>587256.79</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> | 00 | 16.00 | 4269417.98 | 587236.39 | 1179.44 | 94.40 | 76.00 | 75.98 | 4269362.69 | 587256.79 | | | | | | | |
| 17.97 6.0641.51 5.772.73 1.173.1 6.427 7.60 7.60 6.269.63 5.772.43 1.173.53 17.97 6.0641.51 5.772.43 1.173.13 6.775 6.756.95 5.772.45 1.775.45 17.97 6.0641.51 5.772.43 1.173.13 6.775 6.756.95 5.772.45 1.775.45 17.96 6.7641.51 5.772.45 1.775.45 6.756.95 5.772.45 1.775.45 17.96 6.7661.75 5.772.45 1.775.45 6.775.45 5.772.45 1.775.45 17.96 6.7661.75 5.772.45 1.775.45 6.775.45 5.772.45 1.775.45 17.96 6.7661.75 5.772.45 1.775.45 6.776.45 1.775.45 17.96 6.7761.75 1.775.45 6.776 6.776.45 1.775.45 17.96 6.776.45 1.775.45 6.776.45 1.775.45 6.776.45 1.775.45 17.96 6.776.45 1.775.45 6.776.45 6.776.45 7.776.45 7.776.45 < | 00 | 16.99 | 4269417.06 | 587236.86 | 1179.20 | 94.16 | 77.00 | 76.98 | 4269361.77 | 587256.99 | | | | | | | |
| 997 60040423 9772/16 11036 64000 550 64000 550 675001 575201 110361 120 60040135 57737/6 11031 6000 5730 677303 11031 120 60040135 57737/6 11031 6700 577301 11031 120 60040135 577301 11701 6700 577301 11701 120 6004013 577301 11701 6700 577301 11701 120 6004013 577301 11701 6700 6700 577301 11701 120 6004013 577301 11701 6700 6700 577301 11701 120 6004013 577401 11702 6700 6700 577301 11701 1200 577401 11702 6700 6700 6700 57741 11701 1200 577401 11701 6700 6700 6700 577401 11701 | 00 | 17.97 | 4269416.16 | 587237.38 | 1179.31 | 94.27 | 78.00 | 78.00 | 4269360.83 | 587257.25 | | | | | | | |
| 130 0.0001.13 9732.80 1173.31 9772.80 9772.80 1773.80 130 0.0001.13 9773.80 1173.11 9773.80 1773.80 1773.80 130 0.0001.13 9773.80 1173.11 9773.80 1773.80 130 0.0001.13 9773.80 1173.11 9773.80 1773.80 130 0.0001.13 9773.10 1773.70 9770.80 9770.80 1773.80 130 0.0001.13 9770.13 1773.70 9770.70 9770.90 1773.90 130 0.0001.13 9770.13 1773.70 9770.70 9770.70 9770.70 1773.70 130 0.0001.13 9770.13 1773.70 9770.70 9770.70 9770.70 1773.70 130 0.0001.13 9770.13 1773.70 9770.70 9770.70 1773.70 130 0.0001.13 9770.13 1770.70 9770.70 9770.70 1776.70 130 0.0001.13 9770.70 9770.70 9770. | 00 | 18.97 | 4269415.24 | 587237.67 | 1179.36 | 94.32 | 79.00 | 78.98 | 4269359.93 | 587258.14 | | | | | | | |
| 11.00 6.0001.14 9.07.36 11.07.31 9.07.36 11.07.31 2.3.0 6.0001.15 9.77.36 11.07.31 9.07.36 11.07.31 2.3.0 6.0001.15 9.77.36 11.07.31 9.07.30 11.07.31 2.3.0 6.0001.05 9.77.31 11.07.31 9.07.30 9.07.003 17.07.31 2.3.0 6.0001.05 9.77.31 11.07.31 9.07.01 9.07.003 9.77.013 11.07.31 2.3.0 6.0001.05 9.77.11 11.77.3 9.000 9.000 9.07.013 9.77.013 11.77.01 2.3.0 4.0001.01 9.77.10 9.7.3 9.7.3 9.7.013 9.7.013 11.77.01 2.3.0 4.0001.01 9.77.10 9.7.01 9.7.01 9.7.013 9.7.013 11.77.01 2.3.0 4.0001.01 9.77.10 9.7.01 9.7.01 9.7.013 11.77.01 2.3.0 4.0001.01 9.77.10 9.7.01 9.7.01 9.7.010 11.7.010 2.3.0 4.7. | 00 | 19.97 | 4269414.32 | 587237.78 | 1179.39 | 94.35 | 80.00 | 79.97 | 4269359.01 | 587258.50 | | | | | | | |
| 1.2.6 0.0001.1 5.7.2.6 0.0001.1 5.7.2.6 0.0001.1 5.7.2.6 0.0001.1 5.7.2.6 0.0001.1 5.7.2.6 0.0001.1 5.7.2.6 0.0001.1 5.7.2.6 0.0001.1 5.7.2.6 0.0001.1 5.7.2.6 0.0001.1 5.7.2.6 0.0001.1 5.7.2.6 0.0001.1 5.7.2.6 0.0001.1 5.7.2.6 0.0001.1 0.00001.1 0.00001.1< | 00 | 21.00 | 4269413.37 | 587238.00 | 1179.51 | 94.47 | 81.00 | 80.97 | 4269358.09 | 587258.46 | | | | | | | |
| 3.2.9 0.0001.01 9.0203.0 0.0000.01 9.0203.0 | 2 2 | 86.12 | 4269412.46 | 58/238.34 re7336.63 | 1/.6/11 | 94.67 | 82.00 | 81.98 | 4269357.1b | 99.827/85 | | | | | | | |
| 0.07 0.6000/1 0.7000/1 <th< td=""><td></td><td>26:77 20 CC</td><td>45.11.42024</td><td>CV 057793</td><td>11.70.01</td><td>94.70</td><td>83.00 84.00</td><td>16.78</td><td>67.0655024</td><td>20,902/80</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<> | | 26:77 20 CC | 45.11.42024 | CV 057793 | 11.70.01 | 94.70 | 83.00 84.00 | 16.78 | 67.0655024 | 20,902/80 | | | | | | | |
| 0000 056006 05700 05600 057006 077006 077006 077006 077006 077006 077006 077006 077006 077006 | | 10 VC | 50.0145024 | CH-CC2 /OC | 10.5/11 | 04.64 | 04.00 95 00 | 04.00 | 05.05.00364 | 06.602/00 50 030703 | | | | | | | |
| 0600 050000 05000 05000 <th< td=""><td></td><td>26.00</td><td>1/20409.1</td><td>16.667/00</td><td>00'6/TT</td><td>94.04</td><td>00.00</td><td>04.99 06.00</td><td>96.46026044</td><td>CC.U02/0C</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<> | | 26.00 | 1/20409.1 | 16.667/00 | 00'6/TT | 94.04 | 00.00 | 04.99 06.00 | 96.46026044 | CC.U02/0C | | | | | | | |
| 75% 66606.10 6770.16 6770 670 6770 6770.10 6770.10 75% 65606.00 6770.11 1179.71 647 6770.10 8770.10 <td< td=""><td></td><td>26.00</td><td>A 260A07 85</td><td>587340 51</td><td>1179.73</td><td>01.60</td><td>87.00</td><td>86.06</td><td>A 260252 57</td><td>587760 96</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<> | | 26.00 | A 260A07 85 | 587340 51 | 1179.73 | 01.60 | 87.00 | 86.06 | A 260252 57 | 587760 96 | | | | | | | |
| 150 050000 05700 1177 0470 0570000 057000 0570000 057000 0570000 0570000 0570000 0570000 0570000 </td <td></td> <td>27 08</td> <td>20100000</td> <td>10.012100</td> <td>1179.78</td> <td>00-FC</td> <td>88 00</td> <td>20.00</td> <td>A 769351 6A</td> <td>587760 96</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> | | 27 08 | 20100000 | 10.012100 | 1179.78 | 00-FC | 88 00 | 20.00 | A 769351 6A | 587760 96 | | | | | | | |
| 936 63694(5) 63711 1173 637 010 6369 63764(5) 63711 1173 120 63640(12) 57713 1173 0 | | 28.99 | 4269406.00 | 587240.78 | 1179.54 | 94.50 | 89.00 | 88.99 | 4269350.70 | 587261.49 | | | | | | | |
| 000 00000 0000 0000 <th< td=""><td></td><td>29 98</td><td>4269405.09</td><td>587241 11</td><td>1179.42</td><td>94.38</td><td>00.00</td><td>80 00</td><td>4769349 78</td><td>587767 13</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<> | | 29 98 | 4269405.09 | 587241 11 | 1179.42 | 94.38 | 00.00 | 80 00 | 4769349 78 | 587767 13 | | | | | | | |
| 200 0.56401.3 6772.50 1179.51 0.61 9.566 9.56 9.566 9.575 9.575.51 1178.51 35.9 0.56900.31 6770.25 1179.51 0.41 9.36 0.4664.01 9775.61 1178.51 35.9 0.56900.41 5773.43 1179.71 9.44 | | 66 UE | 4269404.16 | 587241.55 | 1179.77 | 94.73 | 91.00 | 90.95 | 4269348.89 | 587262.82 | | | | | | | |
| 2299 405640.12 5773.25 14.48 94.00 33.8 42593.61.0 3775.63 1178.50 34.7 425940.01 5773.43 1179.51 94.00 95.95 42593.61.0 3775.61 1178.50 35.5 425939.51 5773.43 1179.51 94.00 97.00 94.97 42693.43.5 1178.51 35.9 456939.71 577.34.8 1179.51 97.00 95.99 42693.43.5 1178.53 39.9 456939.71 577.34.8 1199.71 94.93 90.00 95.96 42693.43.5 1178.53 39.9 45693.61 1179.57 94.93 100.00 99.96 42693.43.5 1178.53 41.0 45693.61 1179.57 94.87 100.00 109.95 42693.43.5 1177.54 41.0 45693.61 1179.56 1179.61 1177.54 1177.54 41.0 45693.61 1179.56 1177.61 1177.54 1177.54 41.0 45693.61 1179.56 1177. | 0 | 32.00 | 4269403.23 | 587242.20 | 1179.80 | 94.76 | 92.00 | 91.95 | 4269347.97 | 587263.05 | | | | | | | |
| 337 45660(1.0) 5773.26 117.02 6410 539 425661(2.0) 5773.16 117.02 347 42690(1.0) 5773.12 117.01 94.00 95.99 429934.23 5775.13 1178.63 3539 426995(1.9) 577.34.31 1179.19 94.45 97.00 95.99 429934.23 577.64.51 1178.63 3539 426995.73 577.34.11 1179.19 94.01 95.00 95.99 429934.23 577.64.51 1178.63 3639 456995.63 577.34.11 1179.63 94.01 95.00 95.99 429934.13 577.64.51 1178.63 4100 45699.51 577.44.1 1179.51 94.87 100.00 100.99 429934.13 577.64.51 1178.64 4100 45699.51 577.44 1179.50 94.87 100.00 100.99 4299.34.11 1177.64 4100 45699.51 577.44 1179.50 1177.69 4299.34.11 1177.64 4100 45699.51 | | 32.99 | 4269402.32 | 587242.50 | 1179.52 | 94.48 | 93.00 | 92.98 | 4269347.02 | 587263.29 | | | | | | | |
| 01 025000.05 5773.05 1170.05 95.00 95.97 02699.05 5775.16 1176.15 55.95 4209396.75 5773.45 1177.15 94.15 94.05 95.00 95.95 45093.42.15 5775.45 1176.55 57.95 4209396.75 5773.41.8 1179.15 94.45 90.00 95.95 45093.42.15 5775.45 1176.55 37.95 420939.95 5773.41.8 1179.05 94.05 100.00 95.95 45093.92.15 5776.55 1178.55 47.90 420939.91 5773.42.8 1179.95 94.91 100.00 109.95 456.93.91.55 5775.65 1177.55 47.90 420939.01 5773.52 1177.85 94.81 120.00 119.99 456.93.175 1177.65 47.90 420939.03 5773.62 1177.95 94.91 120.00 120.99 456.93.175 1177.76 47.90 420939.65 5773.46 1177.60 122.90 122.90 127.99 127.76 | | 33.97 | 4269401.41 | 587242.89 | 1179.22 | 94.18 | 94.00 | 93.98 | 4269346.10 | 587263.61 | | | | | | | |
| 55 4726396.5 5777.43 1177.15 5777.43 1177.65 5777.43 1177.65 77.99 4726397.71 5777.43.5 1177.64 94.65 97.90 95.99.43 8775.57 1178.56 77.99 4726397.71 577.44.3 1177.69 94.65 97.99 4569.94.15 8775.55 1178.56 97.99 4269.99.01 577.44.3 1177.95 94.91 100.00 95.95 4756.56 1178.51 97.99 4269.99.01 577.45.6 1177.95 94.81 100.00 102.90 456.93 1177.65 44.90 4269.91.15 577.45.6 1177.95 94.81 117.00 119.99 456.93 1177.61 44.90 4269.91.25 577.47.6 1177.85 1177.61 1177.61 45.90 4269.91.25 577.47.6 1177.61 1177.61 1177.61 46.90 4269.91.25 577.47.6 1177.61 1177.61 1177.61 47.91 4269.91.25 577.47.6 1177. | 0 | 34.97 | 4269400.49 | 587243.26 | 1179.06 | 94.02 | 95.00 | 94.97 | 4269345.19 | 587264.83 | | | | | | | |
| 358 436398;1 577.36 1173.45 94.45 94.05 97.90 4259342.43 877.36.57 1173.65 39.7 4569396;7 587.244.81 1179.86 94.45 99.00 98.95 4269344.05 877.64.59 1178.65 39.7 4569396;73 587.24.43 1179.05 94.93 100.00 98.95 4269344.05 877.65 1177.81 41.97 4569392,13 587.26.3 1179.95 94.91 100.00 98.95 4269334.05 577.65.63 1177.81 43.00 4569392,13 587.26.3 1179.95 94.91 102.00 103.98 459.93 1176.10 43.00 4569392,13 587.26.3 1179.95 94.91 122.00 129.96 459.93 1177.63 44.98 456990,13 587.26.45 1179.95 94.75 1170.05 459.93 1177.63 45.99 45.99 1179.05 1179.16 1177.05 1177.63 1177.63 45.99 45.96 1179.85 | 0 | 35.95 | 4269399.59 | 587243.48 | 1179.19 | 94.15 | 96.00 | 95.98 | 4269344.26 | 587264.28 | | | | | | | |
| 379 4763 443 980 975 425343 117813 387 47639371 5872448 11700 9469 42694453 5872657 117813 387 475693568 5872448 110010 9487 10010 99.66 42694153 5872657 117813 41.97 456993105 5872458 117901 10010 1003 459333.11 5872653 117763 41.07 456993105 5872463 117939 9481 117010 1003 456933.11 5877653 117763 41.00 4069313 5872463 117939 9435 112100 11039 45693173 5877243 117763 45.99 45693643 5872463 11793 9445 112100 11293 426931743 5877343 117763 45.99 45693643 5872463 11793 9445 11200 11293 426931743 5877454 117763 45.99 45693643 5872424 117763 | 0 | 36.98 | 4269398.64 | 587243.64 | 1179.49 | 94.45 | 97.00 | 97.00 | 4269343.32 | 587264.57 | | | | | | | |
| 399 406396.5 5872.4.18 117.88 4.04 9.00 9.65 4.269340.55 5872.6.51 117.81 39.9 4.06939.45 5872.4.31 117.99 3.943 100.00 9.65 4.269340.55 5772.63 117.81 41.97 4.66939.43 5872.45.3 117.997 3.493 100.00 100.95 4.269337.13 5772.65 117.81 43.00 4.56939.01 5872.46 117.93 9.431 120.00 100.95 4.269337.31 5777.63 1177.63 44.00 4.56939.03 5877.46 117.93 9.441 120.00 100.95 4.269317.53 5777.73 1177.63 45.99 4.66939.03 5877.46 117.93 9.445 122.00 122.99 4.269317.53 5777.73 1177.03 45.99 4.66938.13 5877.46 1177.63 9.475 122.00 122.91 4.269317.53 5777.43 1177.03 57.94 4.69387.13 5877.43 1177.00 122.91 127.910 | 0 | 37.99 | 4269397.71 | 587243.87 | 1179.67 | 94.63 | 98.00 | 97.99 | 4269342.40 | 587265.37 | | | | | | | |
| 397 405035.68 5872.48 118.003 9.4.99 10000 9.9.66 4259336.55 117.813 197 456934.05 5872.43 117.901 1000 100.96 4269334.55 5872.65 117.813 107 456934.10 5872.45.3 117.991 9.4.87 110.00 100.97 4269332.15 5872.65.3 1177.63 45.99 456993.13 5872.66.3 1179.83 9.4.87 117.00 100.97 4269332.15 5877.26.3 1177.63 45.99 456993.13 5872.46.3 1179.83 9.4.87 120.00 120.97 426932.14 5877.25.3 1177.63 45.99 456998.13 5872.46.3 1179.65 9.4.5 122.00 123.98 45997.23.3 1177.63 47.90 456998.13 5872.46.3 1179.65 9.4.5 125.00 125.96 4269312.63 5877.74.3 1177.73 47.90 456998.13 5872.46 1179.07 125.00 125.00 127.91 1177.73 | | 38.99 | 4269396.79 | 587244.18 | 1179.88 | 94.84 | 00.66 | 98.95 | 4269341.52 | 587264.95 | | | | | | | |
| 40.98 40.66934,05 5872,45 118,005 50.20 101,00 102,09 426933,45 5872,45.38 1178,05 41,07 456939,405 5872,45.30 1179,93 9,487 101,00 102,07 426933,71 58775,45 1178,65 41,07 456939,15 58724,63 1179,93 9,487 112,100 110,93 426933,71 58777,73 1177,63 41,07 456939,136 58724,63 1179,93 9,445 122,100 120,93 426933,73 58775,73 1177,63 45,98 456938,43 58724,63 1179,85 9,454 122,00 122,93 426931,54 58777,43 1177,63 46,98 456938,43 58724,63 1179,87 9,449 122,00 122,93 426931,54 5877,43 1177,63 47,99 456938,43 58724,63 1179,63 9,454 122,00 122,09 426931,54 5877,44 1177,03 51,97 456938,43 5877,463 1179,00 123,00 123,00 </td <td>0</td> <td>39.97</td> <td>4269395.88</td> <td>587244.84</td> <td>1180.03</td> <td>94.99</td> <td>100.00</td> <td>99.96</td> <td>4269340.59</td> <td>587265.67</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> | 0 | 39.97 | 4269395.88 | 587244.84 | 1180.03 | 94.99 | 100.00 | 99.96 | 4269340.59 | 587265.67 | | | | | | | |
| (1.9) (3.693)(0) (377.53) (177.8) (3.9) (3.693)(2) (377.53) (177.8) (3.9) (3.693)(2) (377.54) (177.8) (3.9) (3.693)(2) (377.54) (177.63) (3.0 | 0 | 40.98 | 4269394.95 | 587245.19 | 1180.06 | 95.02 | 101.00 | 100.98 | 4269339.65 | 587265.83 | | | | | | | |
| 41.00 456931.01 5872.56 117.801 9.4.87 103.00 103.97 426931.21 5872.75.63 117.805 43.8 456939.17 5872.46.8 117.93 9.4.87 121.00 129.97 426931.21 5877.748 1177.63 45.98 456939.13 5872.46.8 1179.83 9.4.3 121.00 129.97 426931.21 5877.748 1177.63 45.98 4569396.47 5872.41 1179.83 9.4.3 122.00 129.93 426931.21 5877.73 1177.64 57.99 4569395.73 5872.46 1179.83 9.4.3 125.00 129.93 426931.51 5877.745 1177.64 50.90 456936.53 5872.486 1179.83 9.4.3 125.00 125.99 426931.51 5877.745 1177.74 51.97 426931.51 5877.48 1177.01 127.70 127.74 1177.01 52.98 456938.73 1179.61 9.4.3 128.00 128.91.01 5877.745 1177.13 | 0 | 41.97 | 4269394.04 | 587245.33 | 1179.97 | 94.93 | 102.00 | 102.00 | 4269338.71 | 587265.98 | | | | | | | |
| 44.00 450391.11 597.26.68 117.93 54.01 112.00 112.93 450391.23 587.27.64 117.763 6.5 405039.63 587.26.68 117.953 9.45 122.00 122.99 426311.35 587.77.33 1177.63 6.5 405039.63 587.26.68 117.95 9.45 122.00 122.99 426311.45 587.77.33 1177.63 6.5 405039.84 587.24.68 1179.83 9.45 122.00 122.99 426911.45 587.73.33 1177.03 5.1.9 456938.61 587.24.68 1179.83 9.47 122.00 122.99 426911.45 587.74.31 1177.03 5.1.9 456938.21 587.24.91 1179.91 9.47 122.00 122.90 426911.35 5877.43 1177.03 5.1.9 456938.21 5877.49 1177.01 1177.01 1177.01 1177.01 1177.01 1177.01 1177.01 1177.01 1177.01 1177.01 1177.01 1177.01 1177.01 1177.01 | 0 0 | 43.00 | 4269393.09 | 587245.69 | 1179.91 | 94.87 | 103.00 | 102.97 | 4269337.81 | 587266.53 | | | | | | | |
| 47.36 47.363 57.47.46 117/10.37 47.363 117/10.37 117/10.37 47.363 117/10.37 47.363 117/10.37 47.363 117/10.37 47.363 117/10.37 47.363 117/10.37 47.363 117/10.37 47.363 117/10.37 47.363 117/10.37 47.363 117/10.37 47.363 <td></td> <td>00.44</td> <td>11.2656024</td> <td>7 01240.24</td> <td>C0.6/11</td> <td>94.0T</td> <td>00.021</td> <td>06'6TT</td> <td>4709522.14</td> <td>77.7/7/0C</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> | | 00.44 | 11.2656024 | 7 01240.24 | C0.6/11 | 94.0T | 00.021 | 06'6TT | 4709522.14 | 77.7/7/0C | | | | | | | |
| 6.56 6.773.31 1177.03 5197 2466395.3 5872465 1179.67 9.46 120.00 125.00 25.06 456915.69 5877.45 1177.02 5198 2466392.01 5872435 1179.01 125.00 125.00 125.00 125.00 125.00 127.01 1177.02 5198 246538.01 58724.05 1177.02 127.00 123.01 127.01 1177.02 5198 246538.01 58724.05 1177.02 25911.06 25911.06 < | | 44.98 AF 00 | 47.1959397.A | 02/240.30 | 1170.05 | C8.42 | 00 221 | 12/02/1 | 4209351.22 05 055057 | 847.2/2/8C | | | | | | | |
| 0.0 0.0 <th0.0< th=""> <th0.0< th=""> <th0.0< th=""></th0.0<></th0.0<></th0.0<> | | 46.08 | A 760280 A 7 | 587247 12 | 1170.80 | 20.76 | 1 23 00 | 122 00 | 1260210 26 | 587773 73 | | | | | | | |
| (6.8) (3.638)'58 (3773)'51 (3773)'53 (| | 47.99 | 4269388.49 | 587247.69 | 1179.58 | 94.54 | 124.00 | 123.98 | 4269318.45 | 587273.73 | | | | | | | |
| 000 12600 1273866 17987 9433 112600 12691565 8772433 117701 5197 426938423 8772465 117967 9436 117967 9436 117967 9436 117967 94781153 9577465 117712 5197 426938423 8772465 117967 9446 112900 12297 426931435 8777465 117772 5508 426938123 8772465 117900 429911139 8777465 117772 5598 426938113 8772405 117700 117900 117900 117700 5598 42693113 8772451 117900 113970 117900 117700 5598 42693754 117900 113970 117900 117703 5598 42693754 119012 95201 11300 11397 117763 5798 42693754 119024 95201 113000 117690 | 0 | 48.98 | 4269387.58 | 587247.90 | 1179.69 | 94.65 | 125.00 | 125.00 | 4269317.51 | 587273.39 | | | | | | | |
| 0.98 2.6938.5.3 5.872.483 117.083 4.79 127.00 125.97 4.50391.56 5.877.461 117.17 2.1.97 4.56393.61 5.872.483 117.967 9.453 128.00 129.97 4.56311.53 5877.451 1177.32 2.3.66 4.56393.21 5.872.463 1170.03 9.493 133.00 122.97 4.56311.23 5877.451 1177.14 55.08 4.56393.21 5877.403 118.011 9.507 133.00 122.97 4.56311.23 5877.545 1177.14 55.09 4.56393.213 5877.167 119.01 131.00 123.07 123.97 4.56311.33 5877.543 1177.13 55.07 4.56393.213 5877.261 119.013 9.507 133.00 133.96 4.56911.38 5877.543 1176.69 55.96 4.56397.36 5977.15 1180.24 9.521 134.00 133.96 4.56911.38 5877.543 1176.89 56.97 4.56397.36 5977.11 113.00 133.90 < | 0 | 50.00 | 4269386.64 | 587248.66 | 1179.87 | 94.83 | 126.00 | 126.00 | 4269316.59 | 587274.33 | | | | | | | |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | 0 | 50.98 | 4269385.73 | 587248.85 | 1179.83 | 94.79 | 127.00 | 126.97 | 4269315.69 | 587274.41 | | | | | | | |
| 2.36 4.06383391 5772-46 1177-20 9-4.86 12500 12397 4269113.83 5577.45 1177.12 5.30 4.063832.91 5772-46 1177.91 9-4.92 130.00 123.97 426911.33 5777.45 1177.16 5.30 4.06383.213 5772.45 1177.06 123.00 133.97 426911.08 5777.54 1177.06 5.59 4.063930.21 5772.07 1179.94 9.490 133.00 132.97 426911.08 5777.64 1176.69 5.59 4.06397.26 577.15 110.90 133.00 133.97 426911.06 5775.63 1176.69 5.59 4.06397.26 577.15 110.90 133.00 133.97 426910.38 5777.64 1176.79 5.96 4.06397.52 577.15 110.80 133.00 133.97 426910.38 5777.64 1176.79 5.97 4.06397.54 577.11 110.80 134.00 134.95 426910.55 5777.64 1177.31 5.97 </td <td>0</td> <td>51.97</td> <td>4269384.82</td> <td>587248.92</td> <td>1179.67</td> <td>94.63</td> <td>128.00</td> <td>127.99</td> <td>4269314.75</td> <td>587274.65</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> | 0 | 51.97 | 4269384.82 | 587248.92 | 1179.67 | 94.63 | 128.00 | 127.99 | 4269314.75 | 587274.65 | | | | | | | |
| 5.38 4.6593(2) 5872(3) 1180(0) 124(0) 124(0) 124(0) 123(| 0 | 52.96 | 4269383.91 | 587249.18 | 1179.90 | 94.86 | 129.00 | 128.99 | 4269313.83 | 587274.97 | | | | | | | |
| 5.00 4.66392.03 5872.45.75 117/10 4.51 113.07 4.5631.10 5775.58 1177.05 5.97 4.06398.01 5872.40.75 1179.04 4.5611.05 5275.63 1177.05 5.97 4.06398.01 5877.50.7 1179.04 4.5611.05 5277.63 1176.89 5.98 4.066398.01 5877.51 119.07 4.5611.05 5277.63 1176.89 5.99 4.066398.01 5877.51 1180.24 95.20 133.00 133.39 4.26930.13 5877.56 1176.89 5.99 4.06637.66 5877.17 1180.24 95.20 133.00 133.97 4.26930.23 5877.57 1177.13 6.98 4.0637.56 5772.17 1180.24 95.34 135.00 133.97 4.26930.55 5877.54 1177.13 6.99 4.6637.56 577.51 1180.12 95.34 138.00 137.07 1177.13 6.99 4.6637.54 577.54 1177.13 577.54 1177.13 1177.13 | 0 | 53.98 | 4269382.97 | 587249.36 | 1180.03 | 94.99 | 130.00 | 129.97 | 4269312.93 | 587275.45 | | | | | | | |
| 5.98 $4.60397.12$ $5.97.110$ $11.8.01$ $11.4.00$ $11.4.00$ $11.4.01$ $11.8.10$ $11.8.10$ 5.97 $4.66397.12$ 5877.12 119.012 $9.5.01$ 113.00 $113.3.07$ $426931.01.6$ 5877.52 1176.79 5.96 $4.56937.62$ 58725.11 1180.24 95.20 133.00 133.98 $4.26930.23$ 58777.54 1176.79 9.96 $4.56937.62$ 1180.12 95.20 133.00 133.98 $4.26930.53$ 58777.54 1177.31 0.98 $4.56937.62$ 1180.12 95.20 133.00 137.97 $4.26990.53$ 58777.54 1177.32 0.98 $4.56937.62$ 1180.12 95.42 1137.00 1177.32 58777.54 1177.32 0.99 $4.56937.63$ 58772.49 1180.64 95.45 1177.32 58777.84 1177.32 0.99 $4.56997.52$ 1180.64 95.75 1177.32 587778.41 1177.32 | 0 | 55.00 | 4269382.03 | 587249.75 | 11 79.96 | 94.92 | 131.00 | 131.00 | 4269311.98 | 587275.58 | | | | | | | |
| 393 4.00394.1.1 3.9.2.0.1.1 1.1.9.3.4 4.5.9.3.1 1.5.0.0.1 57.9.8 4.06397.3.8 5872.1.1 11.0.2.4 9.5.0 135.00 133.3.6 4.56397.3.1 5777.6.4 11.7.0.3 59.9 4.06397.3.8 5872.1.15 1180.2.4 9.5.20 135.00 133.3.6 4.55390.3.1 5677.5.6 1176.89 59.9 4.05637.6.8 5872.1.15 1180.2.4 9.5.20 135.00 133.9.6 4.55390.3.3 58777.5.6 1177.1.2 60.9 4.05637.6.5 5877.2.1 1180.4.2 9.5.2 135.00 137.90 4.26907.3.5 58777.5.6 1177.7.2 61.99 4.05637.5 5877.2.1 1180.42 9.5.4 140.00 138.9.7 4.56907.35 58777.6 1177.7.2 61.99 4.05637.5 5877.2.1 1180.42 9.5.4 140.00 138.9.7 4.56907.35 58777.6 1177.3.2 61.99 4.05637.7 1180.62 9.5.4 140.00 138.9.7 4.1777.3 1177.3.2 | | 55.50 FC 01 | 4C002024 | 02.02750 CF 0.7750 | 11.00.11 | 10.66 | 132.00 | 121.07 | 4209311.US | 58/2/0.03 | | | | | | | |
| 5.6 4.66977.46 1.00.1 5.24.1 1.40.0 1.34.5 4.66977.45 1.00.1 5.9.6 4.66977.45 5972.1.1 1.00.4 9.24 1.34.95 4.65907.35 59777.74 1.177.13 6.9.6 4.66977.52 5972.51 118.01 134.95 4.65907.55 55777.54 1.177.13 6.9.9 4.66977.52 58772.19 118.01 137.00 137.00 137.00 137.00 6.9 4.66977.55 58772.19 118.042 9.545 137.00 137.00 137.00 6.9 4.66977.46 58772.24 118.040 9.545 140.00 138.97 4.26900.55 58777.61 1177.23 6.9 4.66977.46 58772.41 118.06 9.545 140.00 139.97 4.26900.55 5877.76 1177.23 6.99 4.66977.46 58772.41 118.057 9.545 140.00 139.97 4.26900.55 5877.76 1177.23 6.99 4.66977.16 58772.41 118.067 9 | | 90.57 | 17.0006074 | 20/220.72 | 11.79.94 | 94.90 0F.34 | 134.00 | 16.261 | 0T.UI 66024 | 012/02 012/02 | | | | | | | |
| 59.6 46697/5 58724.13 1.0004 57.24 1.500 1.55.9 465997.85 58777.61 1177.03 69.8 466937.52 58725.19 1180.45 54.2 156.00 135.99 455907.55 58777.61 1177.23 61.99 456937.65 58725.19 1180.42 55.38 137.00 127.00 425907.55 58777.61 1177.23 61.99 456937.46 58725.12 1180.40 95.46 137.00 137.97 425907.55 58777.61 1177.32 62.97 426937.46 58772.21 1180.40 95.46 140.00 137.97 4259306.55 58777.84 1177.31 63.99 456937.46 58772.41 1180.60 95.46 140.00 139.97 426930.51 58777.84 1177.32 65.99 456937.10 58772.47 1180.62 95.48 140.00 143.99 426930.15 58777.77 1178.23 65.91 456937.10 58775.47 1180.62 95.48 144.00 <t< td=""><td></td><td>06.70</td><td>07.6/06074 00 02.02074</td><td>CT.1C7/0C</td><td>CZ.0011</td><td>17.02</td><td>134.00</td><td>124.05</td><td>67.6066074</td><td>07.0/2/00</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<> | | 06.70 | 07.6/06074 00 02.02074 | CT.1C7/0C | CZ.0011 | 17.02 | 134.00 | 124.05 | 67.6066074 | 07.0/2/00 | | | | | | | |
| 0.00 4.060375.0 0.002.11.0 1.0001 1.3000 1.37.00 1.37.00 1.37.00 1.37.01 0.19 4.060375.3 58772.47 1180.12 9.3.8 137.00 117.0.2 4.06055.5 58777.61 1177.12 0.19 4.060375.46 58772.21 1180.42 9.3.8 1380.00 137.00 1177.32 4.05095.55 58777.61 1177.12 0.39 4.060377.46 58772.21 1180.42 9.5.45 140.00 139.97 4.05006.55 58777.61 1177.32 0.39 4.060377.46 58772.21 1180.60 9.5.46 140.00 139.97 4.05007.15 5877.87.11 1177.32 0.49 4.060377.46 5877.22.1 1180.60 9.5.46 140.00 139.97 4.05007.15 5877.87.11 1177.32 0.59 4.06977.10 5877.67 1180.53 95.48 140.00 143.99 4.05090.15 5877.977 1178.23 0.59 4.06977.10 5877.84 1180.62 95.48 <t< td=""><td></td><td>20.00</td><td>0C.0/CC024</td><td>10.102/00</td><td>11 00 45</td><td>93.40 0E 43</td><td>00.001</td><td>105.00</td><td>40.0000024</td><td>46.01710C</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<> | | 20.00 | 0C.0/CC024 | 10.102/00 | 11 00 45 | 93.40 0E 43 | 00.001 | 105.00 | 40.0000024 | 46.01710C | | | | | | | |
| (i) 4.26937.59 58772.249 118.0.42 95.38 138.00 137.97 4.269305.55 587778.34 1177.31 6.3.97 4.26937.45 587725.24 118.0.42 95.45 139.00 139.97 4.269304.55 587778.34 1177.31 6.3.97 4.26937.46 58772.24 118.0.40 95.45 149.00 139.97 4.269304.55 58778.31 1177.31 6.3.99 4.26937.24 118.0.52 95.46 14.0.0 139.97 4.269307.17 587728.70 1177.31 6.99 4.269377.00 587723.47 1180.52 95.48 14.0.0 140.99 4.269304.31 587737.70 1177.34 6.97 4.269377.00 587724.71 1180.52 95.48 14.0.00 140.39 4.269304.35 587736.6 1177.34 6.97 4.269377.00 587724.41 1180.52 95.48 14.4.00 143.00 4269304.35 587796.6 1178.23 6.807 4.269377.00 587724.41 1180.62 95.48 144 | | 60.98 | 4269376.52 | 587251.97 | 1180.32 | 95.28 | 137.00 | 137.00 | 4269306.45 | 587277.67 | | | | | | | |
| Q37 Q4633746 S8725.21 118.049 95.45 139.00 138.97 426391.61 83725.81 1177.31 G3.99 4263937.71 58772.24 118.06 95.56 140.00 139.97 426390.77 58772.94 1177.32 G3.99 426397.72 58772.54 118.06 95.56 140.00 139.97 426390.77 587778.70 1177.32 G5.99 4263971.00 58775.37 118.05.2 95.48 14.100 14.09 426390.155 58773.77 1178.23 G6.97 4263971.00 58775.34 1180.62 95.48 14.400 14.300 426390.135 58773.93 1178.23 G6.07 4263971.05 58772.34 1180.62 95.58 14.400 14.400 426390.00 58773.94 1178.43 G8.00 4263971.05 58775.44 1180.62 95.58 144.00 14.400 4269300.00 587779.66 1178.43 G8.01 4269397.105 58775.44 1180.62 95.58 144.00 <td></td> <td>61.99</td> <td>4269375.59</td> <td>587252.49</td> <td>1180.42</td> <td>95.38</td> <td>138.00</td> <td>137.97</td> <td>4269305.55</td> <td>587278.34</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> | | 61.99 | 4269375.59 | 587252.49 | 1180.42 | 95.38 | 138.00 | 137.97 | 4269305.55 | 587278.34 | | | | | | | |
| 63.99 4269373.43 58725.43 1180.60 95.56 140.00 139.7 426903.71 58725.73 1177.33 65.99 426937.30 58725.24 1180.65 95.46 140.00 139.7 426930.71 587278.70 1177.83 65.99 426937.100 58772.32 1180.53 95.48 14.00 141.99 426930.18 58773.77 1178.23 65.90 426937.100 58772.34 1180.53 95.48 14.200 141.99 426930.012 58773.97 1178.23 65.07 456937.100 58772.41 1180.52 95.48 14.400 144.30 426930.003 58773.94 1178.42 65.08 456939.103 58772.44 1180.52 95.58 144.00 144.30 426930.003 58773.94 1178.42 65.08 456936.13 58775.44 1180.62 95.58 144.00 145.90 426930.903 58773.94 1178.42 65.08 456936.13 58775.46 1180.62 95.58 144.00 <td>0</td> <td>62.97</td> <td>4269374.68</td> <td>587252.21</td> <td>1180.49</td> <td>95.45</td> <td>139.00</td> <td>138.98</td> <td>4269304.62</td> <td>587278.81</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> | 0 | 62.97 | 4269374.68 | 587252.21 | 1180.49 | 95.45 | 139.00 | 138.98 | 4269304.62 | 587278.81 | | | | | | | |
| (4) 4.06372.82 5.8725.35 1180.52 9.54.88 141.00 140.99 4.263902.77 3572.77 117.48 (5.9) 4.263971.00 5872.35.4 1180.52 95.49 142.00 141.99 4.263901.85 58773.77 117.43 (5.9) 4.263971.00 5872.35.4 118.05.2 95.49 142.00 144.00 4.63900.18 58773.75 117.82.3 (5.9) 4.263971.00 5872.54.4 118.06.2 95.58 144.00 144.00 4.269300.00 587739.66 1178.48 (6.0) 4.263937.05 58772.44 118.06.2 95.58 144.00 144.00 4.269300.00 587739.66 1178.43 (8.3) 4.269396.14 58725.46 118.06.2 95.58 144.00 144.09 4.269390.03 587739.66 1178.43 (9.97) 4.269396.13 58775.46 118.06.2 95.55 146.00 145.99 4.26939.03 587739.66 1178.43 (9.97) 4.56938.13 58775.46 1180.62 | 00 | 63.99 | 4269373.74 | 587252.43 | 1180.60 | 95.56 | 140.00 | 139.97 | 4269303.71 | 587279.14 | | | | | | | |
| 65.9 4.269371.00 58723.47 1180.53 95.49 14.200 14.109 4.269301.35 587279.37 1178.23 66.57 4.269371.00 587254.78 1180.62 95.48 14.400 14.4.00 4.269300.00 587279.37 1178.28 68.00 4.269370.05 587254.18 1180.62 95.58 14.4.00 14.4.00 4.269300.00 587279.66 1178.48 68.38 4.2693970.05 587254.18 1180.62 95.58 14.4.00 14.4.99 4.269302.00 587279.66 1178.42 69.39 4.26936.13 587254.69 1180.52 95.58 14.6.00 14.5.98 4.26939.81 75729.56 1178.12 69.97 4.26936.23 587254.69 1180.59 95.55 14.6.00 14.5.98 4.26939.81 75729.56 1178.12 | 0 | 64.99 | 4269372.82 | 587253.50 | 1180.52 | 95.48 | 141.00 | 140.99 | 4269302.77 | 587278.70 | | | | | | | |
| 6.57 4.269371.00 587253.47 1180.52 95.48 14.3.00 14.300 4.269300.32 53279.33 1178.58 6.00 4.269370.05 587254.31 1180.62 95.58 144.00 144.00 4.26930.00 587279.66 1178.48 66.38 4.269396.14 587254.69 1180.62 95.58 145.00 145.99 4.269399.08 587279.36 1178.12 69.97 4.269398.23 587254.69 1180.62 95.58 145.00 145.98 4.269399.08 587279.36 1178.12 | 0 | 65.99 | 4269371.90 | 587253.72 | 1180.53 | 95.49 | 142.00 | 141.99 | 4269301.85 | 587279.77 | | | | | | | |
| 6.00 4.2695/0.10 587/24.18 1180.02 95.38 144.00 144.90 4.26929.00 92.72/95 1178.32 65.98 4.26929.01 58725.98 1178.32 65.99 426929.03 58725.46 1178.32 65.99 145.00 145.09 145.09 426929.03 58725.98 1178.32 65.99 95.55 146.00 145.98 426929.81.78 58728.75 1178.17 | 0 | 66.97 | 4269371.00 | 587253.47 | 1180.52 | 95.48 | 143.00 | 143.00 | 4269300.92 | 587279.33 | | | | | | | |
| 69.97 4.269568.23 58724.69 1180.59 95.55 146.00 145.98 4.56298.17 82280.75 1178.12 | | 00.00 | 20:0/ 26034 | 587 754 33 | 1180.62 | 95.50 | 145.00 | 144.00 | 4269500.00 | 00.612100 | | | | | | | |
| | | 76.97 | 4269368.23 | 587254.69 | 1180.59 | 95.55 | 146.00 | 145.98 | 4269298.17 | 587280.75 | | | | | | | |
| 70.98 4269367.30 587255.24 1180.65 95.61 147.00 146.98 4269297.25 587281.13 1177.99 | 0 | 86.07 | 4269367.30 | 587255.24 | 1180.65 | 95.61 | 147.00 | 146.98 | 4269297.25 | 587281.13 | 1177.99 92.95 | | | | | | |
| | | | | | | | | | | | | | | | | | |



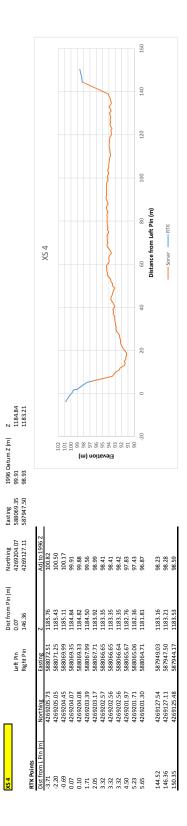
| Sonar Data at 1m points | points | | | | | | | | | | | | | | | | |
|----------------------------|--|----------------|------------------------|----------|------------------|--------|--|--------------|------------|--|------------------|----------------------------|--|-------------|------------------------|----------|------------------|
| Ideal Dist from L P (m) | in Actual Dist from L Northir Din (m) | IL Northing | Easting | Z | Adj to 1996 7 | | Ideal Dist from L Pin Actual Dist from Northing (m) | | Easting | N | Adj to 1996 7 | ldeal Dist from Pin (m) | Ideal Dist from L Actual Dist from Northing Pin (m) I Pin (m) | m Northing | Easting | N | Adj to 1996 7 |
| 177 | 77.1 | 00 307776 | 00 000200 | 1101 66 | 06.75 | 00 00 | 00 00 | | 0 010200 | 1170 AE | 03 55 | 121.00 | 120.00 | 0 1022201 | 10 202202 | | 20 00 |
| 1.// 6.06 | 1.// 6.06 | 4267490.38 | 587395.62 | 20.1011 | 90.75 93.28 | 64.00 | 63.98 | 4267527.28 | 40'0cc/0c | 1178.48 | 93.59 | 122.00 | 121.99 | 4267565.51 | 587304.42 | 1178.92 | 4.03 |
| 2,00 | 66.9 | 4267490.88 | 587394.89 | 1178.27 | 93.38 | 65.00 | 64.99 | | 587349.26 | 1178.37 | 93.48 | 123.00 | 123.00 | 4267566.38 | 587303.63 | 1178.97 | 4.08 |
| 8.00 | 7.99 | 4267491.10 | 587394.10 | 1178.20 | 93.31 | 66.00 | 66.00 | 4267528.24 | 587348.47 | 1178.27 | 93.38 | 124.00 | 123.99 | 4267567.29 | 587302.85 | 1179.04 | 4.15 |
| 9.00 | 9.00 | 4267491.85 | 587393.31 | 1178.30 | 93.41 | 67.00 | 66.99 | 4267529.16 | 587347.69 | 1178.35 | 93.46 | 125.00 | 124.99 | 4267566.90 | 587302.06 | | 94.48 |
| 10.00 | 9.99 | 4267492.32 | 587392.53 | 1178.25 | 93.36 | 68.00 | 67.98 | 4267529.32 | 587346.91 | 1178.39 | 93.50 | 126.00 | 125.99 | 4267568.66 | 587301.28 | | 94.27 |
| 11.00 | 10.99 | 4267494.51 | 587391.74 | 1177.95 | 93.06 | 00.69 | 00.69 | 4267529.72 | 587346.11 | 1178.32 | 93.43 | 127.00 | 126.98 | 4267568.83 | 587300.50 | | 94.26 |
| 12.00 | 12.00 | 4267493.88 | 587390.95 | 1178.27 | 93.38 | 70.00 | 66.69 | 4267531.20 | 587345.33 | 1178.13 | 93.24 | 128.00 | 127.99 | 4267568.95 | 587299.70 | | 94.24 |
| 13.00 | 12.99 | 4267494.70 | 587390.17 | 1178.11 | 93.22 | 71.00 | 70.98 | 4267531.02 | 587344.55 | 1178.17 | 93.28 | 129.00 | 129.00 | 4267569.69 | 587298.91 | 1179.23 | 94.34 04.40 |
| 14.00 | 13.99 | 425/494.35 | 58/389.38 | 51.8/11 | 93.24 03.4F | 00.27 | 00.27 | 420/532.03 | C/:243.545 | 11/8/11 | 72.22 | 130.00 | 66.67T | 10.0/2/024 | 58/298.13 | | 94.48 |
| 15.00 | 14.99 | 12.0247024 | 58/388.0U | 11/8.34 | 75.45 | /3.00 | 66.7/ | 4/0252/024 | 16.242.50 | 60.8/11 | 93.2U | 131.00 | 66.0E1 | 68.1/6/024 | 58/29/.34 | | 97.4 |
| 19.00 | 15.99 | 426/496.04 | 18/38/36 | 11/8.30 | 93.47 | 74.00 | 74.02 | 426/533.44 | 81.242.18 | 10 10 10 10 10 10 10 10 10 10 10 10 10 1 | 20.55 | 132.00 | 132.00 | 18.1/2/024 | CC.062/8C | | 94.24 |
| 00.71 | 10.98 | 14/02/02/02/02 | 58/38/.U3 | 92.8/11 | 93.40 | 00.27 | 74.97 Tr 00 | 426/555/024 | 19/19/2000 | CC.//II | 93.00 | 133.00 | 132.98 | 04/2/2/2/47 | 8/.252/82 | | 14.31 |
| 10.00 | 18.00 | 42b/49b.93 | 58/380.23 E0730E AE | 1170 44 | 06.59 73 50 | /0.00 | 86.67 | 15.452/024 | 20,042,042 | 11/8/11 | 21.55 | 134.00 | 135.99 | C0.5/C/075 | 58/294.98 58/204.98 | 1170.01 | 24.24 C1 h0 |
| 19.00 | 10.00 | 00.1641024 | 22 A 900 100 | 11/0.44 | 00.02 | 00.07 | 00 11 | 46'46C/074 | 70,955,05 | 50'0/TT | 10.02 | 135.00 | 125.00 | 20,6767024 | 6T-967/00 | | 24.12 |
| 00.02 | 66'6T | 07.024/074 | 70/384.00 | 10:0/11 | 73.02 03 E0 | /8.00 | 00 02 | 420/0250/074 | 10,000,000 | 07.0/11 | 15.51 | 137.00 | 66'CET | 00.4/6/074 | 19:567/25 | | 94.30 |
| 00.12 | 90.12 | 02.004.004 | 10.000/00 | 1170 51 | 02.62 | 00.67 | 00.07 | 14:05:1024 | 97 722703 | 07.0/11 | 07 20 | 128 00 | 00 001 | 10.4757540 | 20,252/00 | | 04.40 04.20 |
| 00 66 | 00 66 | A267E01 01 | 10 000203 | 102 0211 | 10 00 | 00.00 | 00.10 | VC 0C3L3CV | L9 966203 | 00.0711 | 03 00 | 120.00 | 00.001 | 0T:C/C/075 | CO.107/0C | | CZ- V0 |
| 24.00 | 06.22 | 4267501.20 | 587381.52 | 1178.69 | 13.80 | 82.00 | 81.99 | 4267538 32 | 10,000,000 | 1178.46 | 93.57 | 140.00 | 139.99 | 4267576.74 | 587290.26 | 1179.61 | 477 |
| 25.00 | 24.99 | 4267487.35 | 587380.73 | 1178.28 | 93.39 | 83.00 | 82.99 | 4267539.69 | 587335.10 | 1178.30 | 93.41 | 141.00 | 141.00 | 4267577.65 | 587289 47 | | 94.70 |
| 26.00 | 25.99 | 4267491.17 | 587379.94 | 1178.44 | 93.55 | 84.00 | 83.99 | 4267540.27 | 587334.32 | 1178.40 | 93.51 | 142.00 | 141.99 | 4267578.62 | 587288.69 | | 94.85 |
| 27.00 | 26.99 | 4267502.90 | 587379.16 | 1178.63 | 93.74 | 85.00 | 84.98 | 4267539.87 | 587333.54 | 1178.46 | 93.57 | 143.00 | 142.99 | 4267578.65 | 587287.90 | | 94.76 |
| 28.00 | 27.96 | 4267503.78 | 587378.39 | 1178.87 | 93.98 | 86.00 | 85.98 | 4267541.27 | 587332.75 | 1178.38 | 93.49 | 144.00 | 144.00 | 4267579.69 | 587287.11 | | 94.82 |
| 29.00 | 28.99 | 4267504.64 | 587377.58 | 1178.82 | 93.93 | 87.00 | 87.00 | 4267541.89 | 587331.95 | 1178.37 | 93.48 | 145.00 | 144.96 | 4267579.79 | 587286.35 | | 94.75 |
| 30.00 | 29.99 | 4267505.22 | 587376.80 | 1178.79 | 93.90 | 88.00 | 87.96 | 4267542.64 | 587331.19 | 1178.31 | 93.42 | 146.00 | 145.98 | 4267580.74 | 587285.55 | | 4.79 |
| 31.00 | 30.99 | 4267505.76 | 587376.01 | 1178.77 | 93.88 | 89.00 | 88.99 | 4267543.38 | 587330.38 | 1178.24 | 93.35 | 147.00 | 146.99 | 4267581.47 | 587284.76 | 1179.44 | 94.55 |
| 32.00 | 31.98 | 4267506.11 | 587375.23 | 1178.79 | 93.90 | 90.00 | 89.97 | 4267543.26 | 587329.61 | 1178.28 | 93.39 | 148.00 | 147.99 | 4267581.71 | 587283.97 | | 4.55 |
| 33.00 | 33.00 | 4267507.09 | 587374.43 | 1178.81 | 93.92 | 91.00 | 66.06 | 4267544.84 | 587328.81 | 1178.14 | 93.25 | 149.00 | 148.99 | 4267582.92 | 587283.18 | | 4.60 |
| 34.00 | 33.99 | 4267507.69 | 587373.65 | 1178.83 | 93.94 | 92.00 | 91.98 | 4267544.52 | 587328.03 | 1177.96 | 93.07 | 150.00 | 150.00 | 4267583.29 | 587282.39 | | 94.47 |
| 35.00 | 34.98 | 4267507.49 | 587372.87 | 1178.73 | 93.84 | 93.00 | 93.00 | 4267544.90 | 587327.23 | 1178.08 | 93.19 | 151.00 | 150.98 | 4267584.00 | 587281.62 | | 4.03 |
| 36.00 | 35.97 | 426/508.40 | 58/3/2.09 | 11/8.95 | 94.06 | 94.00 | 93.99 | 426/545.57 | 58/326.45 | 11/8.20 | 93.31 | 152.00 | 151.97 | 426/584.59 | 58/280.84 | 11/8/./8 | 3.89 |
| 37.00 | 90.05 | 91,906/924 | 58/3/1.29 | 11/8.81 | 26.56 | 00.25 | 94.99 | 426/54/.18 | 00.025/80 | 11/8.14 | 23.25 | 153.00 | 153.00 | 420/585.18 | 28/280.03 | | 94.00 |
| 39.00 | 06.76 | 4267510.83 | 10,0/0/00 | 1178 70 | 93.81 | 97.00 | 96.99 | 426754751 | 00.426/00 | C0.1/11 | 94.26 | 155.00 | 154 98 | 4267586 74 | C2.61210C | | 94.44 |
| 40.00 | 39.98 | 4267512.16 | 587368.94 | 1178.73 | 93.84 | 98.00 | 66.76 | 4267548.34 | 587323.30 | 1178.22 | 93.33 | 156.00 | 156.00 | 4267587.46 | 587277.67 | | 94.64 |
| 41.00 | 40.97 | 4267512.83 | 587368.16 | 1178.57 | 93,68 | 00'66 | 00'66 | 4267550.52 | 587322.51 | 1178.34 | 93.45 | 157.00 | 156,99 | 4267588.73 | 587276.89 | | 94.56 |
| 42.00 | 41.99 | 4267513.42 | 587367.36 | 1178.72 | 93.83 | 100.00 | 66'66 | 4267551.32 | 587321.73 | 1178.23 | 93.34 | 158.00 | 157.99 | 4267588.81 | 587276.10 | 1179.51 | 94.62 |
| 43.00 | 42.98 | 4267513.95 | 587366.58 | 1178.80 | 93.91 | 101.00 | 100.99 | 4267552.09 | 587320.94 | 1178.30 | 93.41 | 159.00 | 159.00 | 4267589.16 | 587275.31 | | 94.55 |
| 44.00 | 43.99 | 4267512.48 | 587365.78 | 1178.89 | 94.00 | 102.00 | 102.00 | 4267553.04 | 587320.15 | 1178.29 | 93.40 | 160.00 | 159.98 | 4267590.13 | 587274.54 | | 94.33 |
| 45.00 | 45.00 | 426/513.11 | 58/364.99 | 11/8.82 | 93.93 | 103.00 | 102.99 | 426/552.09 | 58/319.37 | 87.8/11 | 93.39 | 161.00 | 161.00 | 426/590.30 | 58/2/3./5 | 00.6/11 | 94.17 |
| 47.00 | 00.04 | 4267516 A6 | 587363 42 | 1178 74 | 03.85 | 105.00 | 105.00 | 4267554.05 | 010101010 | 1178 37 | 14.00 | 163 00 | 162.00 | 4207502 28 | 71 272737 | | 04.40 |
| 48.00 | 48.00 | 4267517 31 | 587362 63 | 1178.61 | 93.77 | 106.00 | 105.99 | 4267553 99 | 587317.01 | 1178 32 | 03 43 | 164.00 | 163.99 | 4767591 88 | 587271 38 | | 54 33 |
| 49,00 | 48.99 | 4267517.59 | 587361.85 | 1178.83 | 93.94 | 107.00 | 106.99 | 4267555.58 | 587316.22 | 1178.46 | 93.57 | 165.00 | 165.00 | 4267593.70 | 587270.59 | 1178.97 | 94.08 |
| 50.00 | 49.97 | 4267518.74 | 587361.08 | 1178.66 | 93.77 | 108.00 | 107.99 | 4267555.56 | 587315,44 | 1178.55 | 93.66 | 166.00 | 165.99 | 4267594.04 | 587269.81 | | 94.10 |
| 51.00 | 51.00 | 4267519.41 | 587360.27 | 1178.35 | 93.46 | 109.00 | 108.98 | 4267555.83 | 587314.66 | 1178.49 | 93.60 | 167.00 | 166.98 | 4267594.12 | 587269.03 | 1179.16 | 94.27 |
| 52.00 | 51.99 | 4267517.95 | 587359.49 | 1178.57 | 93.68 | 110.00 | 109.98 | 4267558.10 | 587313.87 | 1178.65 | 93.76 | 168.00 | 168.00 | 4267594.87 | 587268.23 | | 94.67 |
| 53.00 | 52.99 | 4267520.61 | 587358.70 | 1177.91 | 93.02 | 111.00 | 110.99 | 4267557.93 | 587313.08 | 1178.71 | 93.82 | 169.00 | 168.98 | 4267595.74 | 587267.46 | 1179.27 | 94.38 |
| 54.00 | 54.00 | 4267521.11 | 587357.91 | 1178.03 | 93.14 | 112.00 | 111.98 | 4267559.40 | 587312.30 | 1178.72 | 93.83 | 170.00 | 169.99 | 4267596.07 | 587266.66 | | 94.35 |
| 55.00 | 54.99 | 4267521.56 | 587357.13 | 1178.00 | 93.11 | 113.00 | 112.98 | 4267559.63 | 587311.51 | 1178.92 | 94.03 | 171.00 | 170.99 | 4267596.70 | 587265.88 | | 94.29 |
| 56.00 | 55.98 | 426/521.63 | 58/356.35 | 11//.93 | 93.04 | 114.00 | 113.99 | 426/560.42 | 58/310./2 | 11/8.81 | 93.92 | 1/2.00 | 1/1.98 | 426/596.62 | 58/265.10 | | 94.33 |
| 57.00 | 56.99 | 426/522.37 | 58/355.56 | 26.//11 | 93.03 | 115.00 | 114.98 | 426/560.80 | 58/309.94 | 2/70 FO | 93.86 | 173.00 | 1/2.99 | 426/59/.96 | 58/264.30 | 67.6711 | 94.40 |
| 00.00 | 06.7C | 4267573 79 | 587353 QR | 1177 75 | 93.10 | 117.00 | 117.00 | 426/301.33 | 58730835 | 00.0/11 | 10.62 | 175.00 | 174 99 | 4267597 16 | 10,202,000 | | 94.74 94 99 |
| 60.00 | 60.00 | 4267524.49 | 587353 19 | 1177 99 | 93.10 | 118.00 | 117 99 | 4267562 71 | 58730757 | 1178.83 | 76 26 | 176.00 | 175.83 | 4767599 59 | 587262.07 | | 103 |
| 61.00 | 60.99 | 4267525.32 | 587352.41 | 1178.34 | 93.45 | 119.00 | 118.98 | 4267563.51 | 587306.79 | 1179.02 | 94.13 | 185.63 | 185.63 | 4267605.42 | 587257.67 | 1181.41 | 96.51 |
| 62.00 | 61.99 | 4267525.74 | 587351.62 | 1178.76 | 93.87 | 120.00 | 120.00 | 4267564.28 | 587305.99 | 1178.94 | 94.05 | | | | | | |



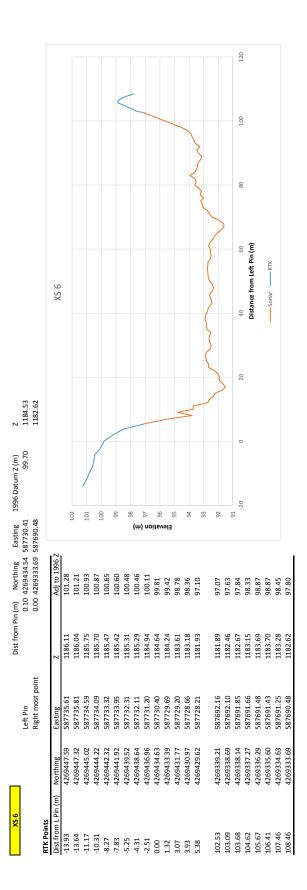
| ldeal Dist from L Pin (m) | Actual Dist from L Northing Pin (m) | L Northing | Easting | Z | AdJ to 1996 Z | Z Ideal Dist from L Pin (m) | Pin Actual Dist from L Northing Pin (m) | n L Northing | Easting | Z | AdJ to 1996 Z |
|------------------------------|--|---|--------------------------|---------|----------------|---|--|---|-----------------------|----------|------------------|
| 6.23 | 6.23 | 4268961.32 | 588196.72 | 1181.76 | 96.85 | 71.00 | 70.98 | 4268943.75 | 588135.76 | 1178.71 | 93.80 |
| 11.00 | 10.99 | 4268964.38 | 588192.24 | 1179.62 | 94.71 | 72.00 | 71.96 | 4268943.68 | 588134.83 | 1178.66 | 93.75 |
| 12.00 | 12.00 | 4268964.21 | 588191.29 | 1179.34 | 94.43 | 73.00 | 72.98 | 4268942.83 | 588133.87 | 1178.57 | 93.66 |
| 13.00 | 13.00 | 4268964.26 | 588190.35 | 1179.17 | 94.26 | 74.00 | 73.98 | 4268942.45 | 588132.93 | 1178.56 | 93.65 |
| 14.00 | 13.99 | 4268964.24 | 588189.42 | 1179.08 | 94.17 | 75.00 | 74.97 | 4268942.20 | 588132.00 | 1178.66 | 93.75 |
| 15.00 | 14.97 | 4268963.77 | 588188.49 | 1178.92 | 94.01 | 76.00 | 75.99 | 4268941.92 | 588131.04 | 1178.76 | 93.85 |
| 16.00 | 15.99 | 4268962.37 | 588187.53 | 1178.80 | 93.89 | 77.00 | 76.99 | 4268941.65 | 588130.10 | 1178.78 | 93.87 |
| 17.00 | 16.99 | 4268962.63 | 588186.59 | 1178.70 | 93.79 | 78.00 | 78.00 | 4268941.14 | 588129.15 | 1178.78 | 93.87 |
| 18.00 | 18.00 | 4268961.87 | 588185.64 | 1178.65 | 93.74 | 79.00 | 78.98 | 4268941.31 | 588128.22 | 1178.78 | 93.87 |
| 19.00 | 18.99 | 4268960.71 | 588184.71 | 1178.62 | 93.71 | 80.00 | 66.67 | 4268940.68 | 588127.27 | 1178.78 | 93.87 |
| 20.00 | 19.98 | 4268961.52 | 588183.78 | 1178.57 | 93.66 | 81.00 | 80.99 | 4268940.15 | 588126.33 | 1178.76 | 93.85 |
| 21.00 | 20.98 | 4268961.13 | 588182.83 | 1178.66 | 93.75 | 82.00 | 81.98 | 4268939.74 | 588125.40 | 1178.78 | 93.87 |
| 22.00 | 21.99 | 4268960.57 | 588181.88 | 1178.58 | 93.67 | 83.00 | 83.00 | 4268939.52 | 588124.44 | 1178.78 | 93.87 |
| 23.00 | 22.99 | 4268959.59 | 588180.94 | 1178.66 | 93.75 | 84.00 | 84.00 | 4268939.28 | 588123.50 | 1178.69 | 93.78 |
| 24.00 | 23.98 | 4268959.60 | 588180.01 | 1178.64 | 93.73 | 85.00 | 84.98 | 4268939.03 | 588122.57 | 1178.47 | 93.56 |
| 25.00 | 25.00 | 4268959.22 | 588179.05 | 1178.44 | 93.53 | 86.00 | 85.98 | 4268938.27 | 588121.63 | 1178.42 | 93.51 |
| 26.00 | 26.00 | 4768959 37 | 588178 11 | 1178 37 | 93.41 | 87.00 | 86 99 | 4768938 11 | 588120.68 | 1178 51 | 03.60 |
| 00 2 00 | 26.97 | 4268958 76 | 588177 19 | 1178 71 | 93.80 | 88.00 | 87 99 | 4768938 13 | 588119 74 | 1178 43 | 93.52 |
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| 00.6 | 28.99 | 4268958.07 | 588175.29 | 1178.80 | 68.56 | 00.09 | 66.68 | 4268937.00 | 588117.86 | 1178.40 | 93.49 |
| 30.00 | 29 99 | 4268958 16 | 588174 35 | 1178 91 | 94.00 | 91.00 | 00 07 | 4768936 92 | 588116 96 | 1178 49 | 93 58 |
| 31.00 | 30.96 | 4768957 69 | 588173 44 | 1178 87 | 93.96 | 00.00 | 91 98 | 4768936 39 | 588115 98 | 1178 46 | 93.55 |
| 2.00 | 32.00 | 4268956.82 | 588172.46 | 1178.73 | 93.82 | 93.00 | 79.97 | 4268936.38 | 588115.05 | 1178.49 | 93.58 |
| 33.00 | 3.7 9.7 | 1768056 86 | 588171 54 | 1178 55 | 03.64 | 00 00 | 03 00 | A768935 7A | 588114 00 | 1178 5 2 | 93.61 |
| 34.00 | 79.97 | 4268956 33 | 588170.60 | 1178.47 | 93.56 | 95.00 | 95.00 | 4768935 78 | 588113 14 | 1178 44 | 10.00 |
| 35.00 | 34 98 | 4268955 52 | 588169.65 | 1178.60 | 93.69 | 96.00 | 96.00 | 4768935 54 | 588112 20 | 1178.60 | 63.69 |
| 6.00 | 35.99 | 4768955.03 | 588168 70 | 1178.42 | 93.51 | 00.79 | 96 98 | 4768934.67 | 588111.28 | 1178.52 | 93.61 |
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| 38.00 | 37.99 | 4268955.45 | 588166.82 | 1178.31 | 93.40 | 00.99 | 98.99 | 4268934.19 | 588109.38 | 1178.38 | 93.47 |
| 39.00 | 38.99 | 4268955.04 | 588165.88 | 1178.08 | 93.17 | 100.00 | 86.98 | 4268933.88 | 588108.45 | 1178.31 | 93.40 |
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| 41.00 | 40.99 | 4268953.50 | 588163.99 | 1178.22 | 93.31 | 102 00 | 101.97 | 4268937.79 | 588106.58 | 1178.31 | 03.60 |
| 42.00 | 41.99 | 4268953.78 | 588163.05 | 1178.21 | 93.30 | 103.00 | 102.99 | 4268932.41 | 588105.62 | 1178.41 | 93.50 |
| 3.00 | 42.99 | 4268953.55 | 588162.11 | 1178.24 | 93.33 | 104.00 | 103.97 | 4268932.81 | 588104.69 | 1178.31 | 93.40 |
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| 46.00 | 46.00 | 4268952.56 | 588159.28 | 1178.21 | 93.30 | 107.00 | 106.99 | 4268931.63 | 588101.85 | 1178.45 | 93.54 |
| 47.00 | 46.98 | 4268952.12 | 588158.35 | 1178.31 | 93.40 | 108.00 | 108.00 | 4268931.18 | 588100.90 | 1178.36 | 93.45 |
| 18.00 | 47.98 | 4268951.69 | 588157.41 | 1178.54 | 93.63 | 109.00 | 108.99 | 4268930.68 | 588099.97 | 1178.01 | 93.10 |
| 49.00 | 48.97 | 4268951.20 | 588156.48 | 1178.55 | 93.64 | 110.00 | 110.00 | 4268930.30 | 588099.02 | 1177.79 | 92.88 |
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| 52.00 | 52.00 | 4268949.86 | 588153.63 | 1178.64 | 93.73 | 113.00 | 112.99 | 4268929.71 | 588096.20 | 1176.95 | 92.04 |
| 53.00 | 52.99 | 4268949.41 | 588152.69 | 1178.64 | 93.73 03.63 | 114.00 | 113.99 | 4268928.43 | 588095.26 | 1177.44 | 92.53 |
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| 50.00 | 59.99 | 4268947.37 | 588146.10 | 1178.76 | 93.85 | 121.00 | 120.99 | 4268926.58 | 588088.67 | 1178.15 | 93.24 |
| 61.00 | 60.99 | 4268947.41 | 588145.16 | 1178.72 | 93.81 | 122.00 | 122.00 | 4268926.22 | 588087.72 | 1178.23 | 93.32 |
| 62.00 | 61.99 | 4268946.92 | 588144.22 | 1178.74 | 93.83 | 123.00 | 123.00 | 4268925.60 | 588086.78 | 1177.95 | 93.04 |
| 63.00 | 63.00 | 4268946.66 | 588143.27 | 1178.72 | 93.81 | 124.00 | 123.99 | 4268925.40 | 588085.84 | 1177.86 | 92.95 |
| 64.00 | 64.00 | 4268946.09 | 588142.33 | 1178.70 | 93.79 | 125.00 | 124.99 | 4268924.99 | 588084.90 | 1178.03 | 93.12 |
| 65.00 | 64.98 | 4268945.52 | 588141.41 | 1178.73 | 93.82 | 126.00 | 125.99 | 4268924.21 | 588083.96 | 1178.07 | 93.16 |
| 00.00 | 65.99 | 4268945.04 | 588140.45 | 1178.69 | 93.78 | 127.00 | 127.00 | 4268924.21 | 588083.01 | 1177.98 | 93.07 |
| 67.00 | 66.98 | 4268944.86 | 588139.52 | 11/8./6 | 93.85 | 128.00 | 96.721 | 4268924.47 | 588082.08 | 77.8/11 | 93.31 |
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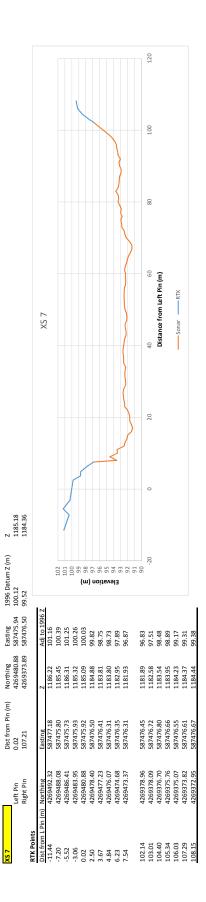
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| | 2260065.27 2260065.27 2260061.40 2260061.40 2260061.94 2260061.95 2260061.94 2260061.95 2260055.54 2260055.59 2260055.59 2260055.59 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.54 2260055.15 2260055.55 2260055 2260055.55 2260055.55 2260055.55 2260055.55 2260055.55 226 | 588139.85 588139.85 588138.15 58813.85 58813.55 58813.56 58813.56 58813.56 58813.56 58813.25 58813.25 58813.25 58812.26 58812.26 58812.26 58812.26 58812.26 58812.26 58812.26 58812.26 58812.26 58812.21 | 1177.89 1177.80 1178.00 1177.64 1177.64 1177.64 1177.64 1177.24 1177.64 1177.24 1177.65 1177.65 1177.65 1177.65 1177.65 1177.65 1177.65 1177.65 1177.65 1177.65 1177.65 1177.65 1177.65 1177.65 1177.65 1177.65 1177.56 1177.5 | 92.92 93.03 92.93 92.2.67 92.2.67 92.2.6 92.2.18 92.21 92.21 92.27 92.2.18 92.37 92.37 92.37 | 75.00 77.00 77.00 79.00 81.00 81.00 83.00 84.00 85.000 | | 226030.64 2269030.63 2269029.63 2269029.66 2269029.66 2269027.99 2269027.06 2269025.74 2269025.12 226905.12 2269025.12 20 | 588090.66 588089.81 588089.81 588088.35 588086.48 588086.48 588085.64 588083.54 588083.35 588083.32 588083.32 588083.32 588083.32 588083.32 588083.32 588080.64 | 1179.26 1179.13 1179.10 | 94.31 | | | | | | |
| | 2269063.07 2269063.07 2269061.48 2269061.44 2269060.35 2269060.35 2269060.35 2269050.55 2269053.56 2269053.57 2269053.12 2269053.12 2269053.12 2269053.12 2269053.12 2269053.13 22690553.13 2269053.13 | 5881.36.01 5881.36.15 5881.37.51 5881.37.51 5881.34.68 5881.34.01 5881.34.01 5881.32.15 5881.32.15 5881.32.15 5881.23.10 5881.23.10 5881.24.10 5881.24.10 5881.24.17 | 1177.99 1177.90 1177.90 1177.90 1177.90 1177.64 1177.64 1177.15 1177.15 1177.15 1177.15 1177.68 1177.68 1177.68 1177.68 1177.54 1177.5 | 9302 9303 9238 9246 9246 9246 9218 9218 9218 9271 9271 9271 9271 9277 9277 9277 9277 | 77.00 77.00 8.00 8.000 8.1.00 8.2.00 8.3.00 8.4.00 8.4.00 8.5.000 8.5.00 8.5.000 8.5.000 8.5.000 8.5.000 8.5.000 8.5.000 8.5.000 8.5.000 8.5.000 8.5.0000 8.5.0000 8.5.0000000000 | | 226002043 226002043 2260028.66 2260027.49 2260027.49 2260027.46 2260025.74 2260025.71 2260025.71 2260025.71 2260023.51 22600020000000000000000000000000000000 | 588089.81 588088.98 588088.15 588086.48 588085.44 588085.48 588083.99 588083.15 588083.15 588083.15 588083.32 588083.33 588083.33 588083.33 588083.35 588083.64 | 1179.13 | 94.29 | | | | | | |
| | 426005.28 426005.38 4269060.35 4269060.35 4269060.35 4269069.35 4269059.81 4269055.59 4269055.59 4269055.59 4269055.59 4269055.54 4269055.54 4269055.51 4269055.54 4269055.51 4269055.51 4269055.51 4269055.51 4269055.51 4269055.13 4269055.54 42690555.54 4269055.54 420055.54 420055.54 420055.54 420055.54 420055.555055.54 420055055.555005505550055005500550055000550 | 5881.361.18 5881.361.18 5881.36.51 5881.36.51 5881.34.61 5881.34.01 5881.34.18 5881.34.18 5881.34.18 5881.26.18 5881.26.18 5881.26.18 5881.26.18 5881.26.18 5881.26.17 5881.26.15 5881.26.17 5881.26.15 5881.26.1 | 117500 117750 117756 117766 117766 117766 117723 117723 117723 117723 117756 1177756 1177776 1177757 1177757 1177777 11777777 1177777 1177777777 | 93.03 92.83 92.65 92.66 92.27 92.26 92.18 92.28 92.18 92.21 92.21 92.21 92.21 92.21 92.27 92.21 92.27 | 77,00 78,00 88,000 83,000 83,000 84,000 86,000 88,000 88,000 88,000 89,000 89,000 | | 26602349 26602349 26602549 226602739 226602739 226602510 226602510 226602512 226602512 226602512 226602512 226602512 226602319 226602319 226602319 226602319 226602319 226602319 226602319 226602319 226602324 226602352 226602350 226602350 226602350 226602350 226602350 226602350 226602350 226602350 226602350 226602350 226602350 226602350 226602350 226602350 226502350 226502350 226502350 226502350 226502550 227502550 227502550 227502550 227502550 227502550 227502550 227502550 227502550 227502550 227502550 227502550 226502550 226502550 226502550 226502550 226502550 226502550 226502550 226502550 226502550 226502550 226502550 226502550 226502550 226502550 226502550 22650250 226502500 2255000 2255000 2275000 225000 225000 225000 225000 257000 255000 255000 255000 255000 255000 255000 255000 255000 255000 255000 255000 255000 255000 2550000 2550000 25500000000 | 588088.98 588088.15 588087.31 588085.64 588085.64 588083.59 588083.39 588083.15 588083.15 588083.15 588083.15 588083.14 588082.64 | 01 02 11 | 94.16 | | | | | | |
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| | 4 260/053 81 4 260/053 81 4 260/053 07 4 260/055 07 4 260/053 12 4 260/053 12 4 260/053 12 4 260/053 12 4 260/051 13 4 260 | 588134.01 588132.18 588132.35 588130.68 588130.68 588120.02 58812.20 58812.20 58812.56 58812.56 58812.21 588125 | 1177.24 1177.25 1177.15 1177.15 1177.16 1177.68 1177.68 1177.68 1177.33 1177.33 1177.33 1177.38 | 9.2.27 9.2.25 9.2.18 9.2.18 9.2.71 9.2.71 9.2.71 9.2.71 9.2.41 | 82.00 83.00 85.00 86.00 87.00 88.00 88.00 88.00 88.00 | | 2569026.60 4269025.74 4269025.74 4269025.12 4269023.91 4269023.91 4269023.19 4269022.52 4269022.52 | 588084.82 588083.99 588083.15 588082.32 588081.48 588081.48 588080.64 | 1178.98 | 94.01 | | | | | | |
| | 4260053 33 4260058 05 4260058 61 4260058 61 4260058 17 4260058 19 4260055 15 4260055 15 4260053 12 4260053 12 4260053 12 4260053 12 4260051 13 4260051 13 4260051 20 4260051 24 4260051 24 4260051 24 4260051 24 4260051 24 4260051 24 4260050 24 4260050000000000000000000000000000000000 | 5681.33.18 5681.33.15 5681.31.55 5681.31.55 5681.35.55 5681.26.34 5681.26.3 5681.26.50 5681.26.57 5681.26.57 5681.26.67 5681.26.17 5681.21.17 5681.21.17 5681.23.1555 5681.23.15 5681.23.1 | 1177.22 1177.15 1176.15 1177.15 1177.16 1177.65 1177.68 1177.68 1177.68 1177.38 1177.38 1177.38 | 92.25 92.18 92.18 92.71 92.71 92.68 92.67 92.67 | 83.00 84.00 85.00 87.00 88.00 89.00 | | 1269025.11 1269025.74 1269025.12 1269024.59 1269023.91 1269023.19 1269023.13 1269022.52 1269022.52 | 588083.99 588083.15 588082.32 588081.48 588081.64 | 1178.89 | 93.92 | | | | | | |
| | 2260058.03 4260058.03 4260058.07 4260055.54 4260055.54 4260055.54 4260055.54 4260055.54 4260055.54 4260055.54 4260055.54 4260055.64 4260055.64 4260055.64 4260055.15 400055.150 | 5881.32.35 5881.32.55 5881.30.68 5881.30.68 5881.25.02 5881.25.02 5881.25.67 5881.26.7 5881.24.85 5881.24.15 5 | 1177.15 1176.95 1177.68 1177.68 1177.65 1177.65 1177.34 1177.34 1177.34 1177.38 | 92.18 91.98 92.17 92.71 92.68 92.71 92.71 | 84.00 85.00 87.00 88.00 89.00 | | 42 690 25.74 42 690 25.12 42 690 24.59 42 690 23.91 42 690 23.19 42 690 23.19 42 690 22.52 42 600 22.25 42 600 22.25 | 588083.15 588082.32 588081.48 588080.64 | 1178.82 | 93.85 | | | | | | |
| | 2260058.61 4260058.72 4260055.95 4260055.95 4260055.95 4260055.18 4260055.18 4260055.15 4260053.15 4260053.15 4260053.15 4260053.13 4260055.13 | 5881.31.52 5881.30.68 5881.20.02 5881.20.02 5881.25.15 5881.25.55 5881.25.55 5881.25.67 5881.25.67 5881.24.00 5881.24.10 5881.24.10 5881.24.10 5881.24.15 5881.24.15 5881.24.15 | 117695 1177.65 1177.68 1177.65 1177.68 1177.38 1177.38 1177.38 1177.58 | 91.98 92.71 92.97 92.68 92.71 92.71 92.37 | 85.00 86.00 88.00 89.00 | | 42 690 25.12 42 690 24.59 42 690 23.91 42 690 23.19 42 690 22.52 42 690 22.52 | 588082.32 588081.48 588080.64 | 1178.98 | 94.01 | | | | | | |
| | 2260565,07 2260555,99 2260055,59 2260055,51 2260055,51 2260055,67 2260055,13 2260055,13 2260055,13 2260051,13 2260051,13 2260051,13 2260051,13 2260051,13 2260051,13 2260051,13 2260051,13 2260051,13 2260051,13 2260051,13 2260051,13 2260051,13 2260051,13 2260051,13 2260051,13 2260049,62 2260049,62 2260049,62 | 5881.30.68 5881.29.02 5881.29.02 5881.29.02 5881.25.13 5881.25.57 5881.25.57 5881.26.57 5881.24.57 5881.24.50 5881.24.50 5881.24.50 5881.24.50 5881.24.50 | 1177.15 1177.68 1177.65 1177.65 1177.68 1177.34 1177.41 1177.41 1177.58 | 92.18 92.71 92.68 92.71 92.37 92.41 | 86.00 87.00 88.00 89.00 | | 42 690 24.59 42 690 23.91 42 690 23.19 42 690 22.52 42 690 22.24 | 588081.48 588080.64 | 1178.67 | 93.70 | | | | | | |
| | 4260055.72 4260055.54 4260055.54 4260055.18 4260055.18 4260053.15 4260053.15 4260053.05 4260053.05 4260053.05 4260050.13 4260050.13 4260050.13 4260050.13 4260050.13 | 588125,84 588125,02 588127.34 588126.50 588126.50 588126.67 588124.85 588124.00 588123.17 588123.17 588123.17 588123.17 588123.150 588123.150 | 1177.68 1177.65 1177.65 1177.65 1177.34 1177.31 1177.41 1177.57 | 92.71 92.68 92.71 92.37 92.41 | 87.00 88.00 89.00 | | 4269023.91 4269023.19 4269022.52 4269022.24 | 588080.64 | 1178.55 | 93.58 | | | | | | |
| | 4260055.59 4260055.58 4260055.18 4260054.47 4260054.47 4260053.12 4260055.13 4260055.13 4260051.13 4260051.13 4260051.23 4260051.23 4260051.24 4260051.24 4260051.24 4260051.24 4260051.24 4260040.52 | 58812502 58812818 58812514 58812550 58812550 58812400 588123400 588123.17 588123.17 588122.150 588122.50 | 1177.94 1177.65 1177.68 1177.34 1177.38 1177.47 1177.47 1177.58 | 92.97 92.68 92.71 92.37 92.41 | 88.00 | • | 4269023.19 4269022.52 4269022.24 | | 1178.95 | 93.98 | | | | | | |
| | 4260055.54 4260055.18 4260054.47 4260054.47 4260053.15 4260053.15 4260053.16 4260053.05 4260053.13 4260050.13 4260050.13 4260050.13 4260050.13 4260048.65 | 588125.18 588125.34 588126.60 588126.60 588124.85 588124.00 588124.17 588121.7 588121.50 588121.50 | 1177.65 1177.68 1177.34 1177.38 1177.41 1177.58 | 92.68 92.71 92.37 92.41 | 89.00 | | 4269022.52 4269022.24 | 588079.81 | 1178.98 | 94.01 | | | | | | |
| | 4269055.13 4269055.13 4269053.15 4269053.12 4269053.15 4269053.15 4269053.15 4269051.16 4269050.13 4269050.13 4269050.13 4269050.13 4269049.65 4269049.65 | 588127.34 588126.50 588126.67 588124.67 588124.00 588123.17 588122.35 588122.35 588122.35 | 1177.68 1177.34 1177.38 1177.41 1177.47 1177.58 | 92.71 92.37 92.41 | | - | 4269022.24 | 588078.97 | 1178.77 | 93.80 | | | | | | |
| | 4.28054.47 4.28055.50 4.269053.12 4.269053.15 4.269051.16 4.269051.16 4.269051.13 4.269050.13 4.269050.13 4.269050.13 4.269049.62 | 588126.50 588125.67 588125.67 588124.85 588124.00 588123.17 588122.35 588121.50 | 1177.34 1177.38 1177.41 1177.47 1177.58 | 92.37 92.41 | 90.00 | | 32 100301 | 588078.15 | 1178.97 | 94.00 | | | | | | |
| | 4269053.50 4269053.12 4269052.67 4269052.09 4269051.65 4269051.16 4269051.13 4269050.24 4269049.62 4269048.88 | 588125,67 588124,00 588123,17 588123,17 588122,35 588122,35 588122,35 | 1177.38 1177.41 1177.47 1177.58 | 92.41 | 91.00 | | C/TZ02074 | 588077.30 | 1178.92 | 93.95 | | | | | | |
| | 4269053.12 4269052.67 4269052.09 4269051.66 4269051.13 4269050.24 4269050.23 4269050.13 4269050.13 4269050.13 4269049.62 4269048.88 | 588124.85 588124.00 588123.17 588122.35 588122.35 588121.50 | 1177.41 1177.47 1177.58 | | 92.00 | | 4269020.78 | 588076.47 | 1178.67 | 93.70 | | | | | | |
| | 4269052.67 4269052.09 4289051.16 4269051.13 4269050.24 4269050.13 4269048.88 | 588124,00 588123.17 588122.35 588121.50 588121.50 | 1177.47 1177.58 | 92.44 | 93.00 | | 4269020.63 | 588075.64 | 1178.51 | 93.54 | | | | | | |
| | 4269052.09 4269051.66 4269051.13 4269050.24 4269050.13 4269049.62 4269049.62 | 588123.17 588122.35 588121.50 | 1177.58 | 92.50 | 94.00 | | 4269019.99 | 588074.80 | 1178.27 | 93.30 | | | | | | |
| | 4269051.05 4269051.13 4269050.24 4269049.62 4269048.88 | 588121.50 | 11 11 10 | 92.61 | 95.00 | | 4269019.13 | 588073.97 | 11 78.49 | 93.52 | | | | | | |
| | 4 269 050 . 13 4 269 050 . 24 4 269 049 . 62 4 269 048 . 88 | 05.121885 | 00.//TT | 60.26 | 90.00 | 40.07 F0.00 | 102106074 | P200013.14 | C/ .0/ TT | 93.70 | | | | | | |
| | 4269050.13 4269050.13 4269049.62 4269048.88 | L 001 00 C 1 | / 9/ 10/ IT | 06.26 | 00.00 | | 56./T06024 | 588U/2.32 | 11/8.61 | 43.64 | | | | | | |
| | 4 269 049, 62 4 269 048, 88 | 7 0 0 1 1 0 0 1 | 01.8/11 | 93.13 01.16 | 98.00 | 97.98 | 4269016.04 4260016.04 | 588U/1.48 | 11 / 8. 69 11 70 00 | 93.72 01.01 | | | | | | |
| | 4209049.02 | CO.01 100C | 67.0/TT | 07.66 | 00.00 | | 4500106074 | 40.U/U000 | 11 / 0.00 | 10.00 | | | | | | |
| | 00.040.044 | 2 0 0 1 1 0 1 2 | 40.0711 | 70.00 | 101.00 | | 1260015 00 | 10, 200.000 | 11 70 00 | 50.00 | | | | | | |
| | 77 01000CV | 11.011000 | 1170.01 | CC CO | 102 00 | 10107 | 1260015 25 | 1000000 | 1179.00 | 0105 | | | | | | |
| | 4269047 77 | 58811652 | 1178 30 | 93.33 | 103.00 | | 426901459 | 588067 32 | 1178 92 | 93.95 | | | | | | |
| | 4269048.51 | 588115.66 | 1178.16 | 93,19 | 104.00 | | 4269014.05 | 588066.46 | 1179.00 | 94.03 | | | | | | |
| | 4269046.57 | 588114.84 | 1178.34 | 93.37 | 105.00 | | 4269013.70 | 588065.64 | 1178.99 | 94.02 | | | | | | |
| 47.00 46.97 | 4269046.16 | 588114.02 | 1178.40 | 93.43 | 106.00 | | 4269013.24 | 588064.80 | 1179.02 | 94.05 | | | | | | |
| | 4269046.64 | 588113.17 | 1178.41 | 93.44 | 107.00 | | 4269012.33 | 588063.97 | 1178.96 | 93.99 | | | | | | |
| | 4269044.46 | 588112.33 | 1178.46 | 93.49 | 108.00 | 7 | 4269011.84 | 588063.13 | 1178.80 | 93.83 | | | | | | |
| | 4269044.30 | 588111.50 | 1178.41 | 93.44 | 109.00 | 7 | 4269011.55 | 588062.29 | 1178.67 | 93.70 | | | | | | |
| | 4269043.83 | 588110.67 | 1178.34 | 93.37 | 110.00 | | 4269010.91 | 588061.46 | 1178.44 | 93.47 | | | | | | |
| 52.00 51.97 | 4269043.25 | 588109.85 | 1178.25 | 93.28 | 111.00 | 110.99 | 4269010.27 | 588060.63 | 11 78.28 | 93.31 | | | | | | |
| | 00.240.0024 | 5 881 08 16 | 1178 2A | 77.50 | 112.00 | | | 10.900000 | 11 78 28 | 12 20 | | | | | | |
| | 4269041.54 | 588107.33 | 1178.42 | 93.45 | 114.00 | | | 588058.12 | 1178.17 | 93.20 | | | | | | |
| | 4269040.93 | 588106.49 | 1178.72 | 93.75 | 115.00 | | 4269007.94 | 588057.29 | 1178.24 | 93.27 | | | | | | |
| | 4269041.14 | 588105.66 | 1178.76 | 93.79 | 116.00 | 7 | 4269007.53 | 588056.46 | 1178.27 | 93.30 | | | | | | |
| | 4269039.55 | 588104.83 | 1178.69 | 93.72 | 117.00 | | | 588055.62 | 1178.29 | 93.32 | | | | | | |
| | 4269039.62 | 588103.99 | 1178.60 | 93.63 | 118.00 | 7 | | 588054.79 | 1178.33 | 93.36 | | | | | | |
| | 4269038.25 | 588103.16 | 1178.56 | 93.59 | 119.00 | | | 588053.97 | 1178.34 | 93.37 | | | | | | |
| 61.00 61.00 | 4 269038.43 | 588102.32 | 11/8.46 | 93.49 | 120.00 | | 4269005.32 | 588053.12 record 20 | 11 /8.32 | 93.35 | | | | | | |
| | FF FC003C4 | DC:TOT995 | 1170.55 | 193.4L | 00.121 | 4 50.07T | 55,000204 71,000204 | 288052.30 | 11.70.01 | 10.55 | | | | | | |
| | 11. 150 502 4 75 350 632 4 | 5 88000 82 | 1178.76 | 93,79 | 123.00 | | 42 69003 92 | CH. LUOOD | 11 78 37 | 93.35 | | | | | | |
| | 4269035.58 | 588098.99 | 1178.86 | 93.89 | 124.00 | 7 | | 588049.79 | 1178.46 | 93.49 | | | | | | |
| | 4269035.57 | 588098.16 | 1178.98 | 94.01 | 125.00 | | | 588048.95 | 1178.35 | 93.38 | | | | | | |
| 67.00 66.98 | 4269034.48 | 588097.33 | 1179.08 | 94.11 | 126.00 | 125.99 4 | 4269001.70 | 588048.12 | 1178.16 | 93.19 | | | | | | |
| | 4269033.93 | 588096.48 | 1179.20 | 94.23 | 127.00 | | | 588047.29 | 1177.88 | 92.91 | | | | | | l |



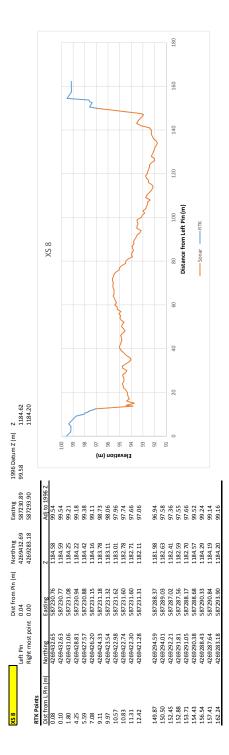
| Ideal Dist from L Pin (m) Actual Dist from L Northing | m) Actual Dist from | L Northing | Easting | z | Adj to 1996 | Z Ideal Dist fron | Adj to 1996 Z I ldeal Dist from L Pin Actual Dist from L Northing | . Northing | Easting | z Ad | | ist from L | from L Northing | Easting | z | Adj to 1996 Z | 2 966 Z |
|---|---------------------|--------------------------|------------------------|----------|----------------|-------------------|---|-------------------------|-------------------------|------------|----------------|--------------|-----------------|-------------|-----------|---------------|---------|
| | Pin (m) | | | | | (m) | Pin (m) | | | | Z | | | | | | |
| 5.65 | 5.65 | 4269201.30 | 588064.71 580063 75 | 1181.81 | 96.87 | 65.00 | 65.00 65.00 | 4269170.26 | 588015.27 | 1178.55 93 | 93.61 123.00 | 122.99 | 4269139.87 | 7 587966.96 | 5 1178.45 | 93.51 | |
| 00.6 | 0.0 | 4269200.55 | 588061.92 | 1178.10 | 93.16 | 67.00 | 66.co 86.68 | 4269169.62 | 588013.62 | | 93.94 124.00 | | 4269138.18 | | | | |
| 10.00 | 6.6 | 4269200.54 | 588061.09 | 1177.87 | 92.93 | 68.00 | 66.79 | 4269168.80 | 588012.78 | | | | 4269137.70 | | | 93.74 | |
| 11.00 | 10.99 | 4269199.38 | 588060.26 | 1177.30 | 92.36 | 00.69 | 68.98 | 4269168.03 | 588011.95 | | | | 4269137.31 | | | | |
| 12.00 | 12.00 | 4269199.58 | 588059.42 | 1177.15 | 92.21 | 70.00 | 66.69 | 4269167.84 | 588011.11 | | | | 4269137.01 | | | | |
| 13.00 | 12.99 | 4269198.88 | 588058.59 | 1176.51 | 91.57 | 71.00 | 70.99 | 4269167.08 | 588010.28 | | | | 4269136.14 | | | 93.79 | |
| 14.00 | 13.99 15.00 | 4269198.43 | 588057.76 | 11 /6.35 | 91.41 01 FC | 72.00 | 12.00 | 4269166.96 | 588009.44 F 86008 64 | 11703E 04 | 94.24 I30.00 | 00 00 129.99 | 4269135.78 | 587961.13 | | 93.91 | |
| 16.00 | 15.99 | 4269195.67 | 58056.09 | 1176.26 | 91.37 | 74.00 | 73 98 | 4269165.11 | 588005 79 | | 94.17 132.00 | | 4269134.67 | | 0 1178.70 | 93.76 | |
| 17.00 | 16,99 | 4269196.10 | 588055.26 | 1176.26 | 91.32 | 75.00 | 75.00 | 4269164.85 | 588006.94 | | | | 4269133.56 | | | 93.97 | |
| 18.00 | 17.99 | 4269194.90 | 588054.43 | 1176.13 | 91.19 | 76.00 | 75.98 | 4269164.44 | 588006.12 | | | | 4269133.66 | | | 93.74 | |
| 19.00 | 18.97 | 4269194.18 | 588053.61 | 1176.19 | 91.25 | 77.00 | 76.99 | 4269163.89 | 588005.28 | _ | | | 4269132.99 | | | 93.59 | |
| 20.00 | 19.99 | 4269194.25 | 588052.76 | 1176.48 | 91.54 | 78.00 | 78.00 | 4269163.45 | 588004.44 | 1179.20 94 | | | 4269132.72 | 2 587956.14 | | | |
| 21.00 | 20.98 | 4269193.61 | 588051.94 | 1176.70 | 91.76 | 79.00 | 78.98 | 4269162.89 | 588003.62 | | | | 4269131.44 | | | | |
| 22.00 | 21.99 | 4269192.99 | 588051.10 | 1176.88 | 91.94 | 80.00 | 79.99 | 4269162.30 | 588002.78 | | | | 4269131.82 | | | | |
| 23.00 | 22.99 | 4269193.24 | 588050.26 | 1177.07 | 92.13 | 81.00 | 80.99 | 4269161.68 | 588001.95 | | | | 4269131.74 | | | 94.11 | |
| 24.00 | 23.99 | 4269191.98 | 588049.43 | 1177.11 | 92.17 | 82.00 | 82.00 | 4269161.66 | 588001.11 | | 94.27 144.52 | 52 144.52 | 4269127.54 | 4 587949.03 | 3 1183.16 | 98.23 | |
| 25.00 | 25.00 | 4269192.33 | 588048.59 | 11.//11 | 71.26 | 83.00 | 86.28 | 4,269160.75 | 588000.29 | 11/9.26 94 | 94.32 04.16 | | | | | | |
| 20.00 | 25.33 76.00 | 4203101634 | 5 880/16 02 | 11 77 25 | 92.25 03 21 | 00.45 00.78 | 00.33 RE 00 | 126015054 | C4/266/00 | | 01.40 | | | | | | |
| 28.00 | 28.00 | 4269190.02 | 588046.09 | 1177.48 | 92.54 | 86.00 | 85.99 | 4269158.99 | 587997.78 | | 94.42 | | | | | | |
| 29.00 | 29.00 | 4269189.44 | 588045.26 | 1177.75 | 92.81 | 87.00 | 86.99 | 4269158.56 | 587996.95 | | 94.32 | | | | | | |
| 30.00 | 29.99 | 4269189.13 | 588044.43 | 1177.83 | 92.89 | 88.00 | 88.00 | 4269158.22 | 587996.11 | | 94.15 | | | | | | |
| 31.00 | 30.99 | 4269188.54 | 588043.60 | 1177.79 | 92.85 | 00.68 | 88.97 | 4269157.66 | 587995.30 | | 94.24 | | | | | | |
| 32.00 | 32.00 | 4269188.06 | 588042.76 | 1177.86 | 92.92 | 90:00 | 89.99 | 4269157.19 | 587994.45 | | 94.38 | | | | | | |
| 33.00 | 32.97 | 4269187.19 | 588041.95 | 1177.93 | 92.99 55.55 | 91.00 | 90.95 20.05 | 4269156.29 | 587993.65 | | 94.45 | | | | | | |
| 34.00 | 25.55 70 Ac | 4269186./4 | 588041.10 588040.38 | 11/8/11 | 93.07 | 00.26 | 00.26 | 4/2512024 | 8/.7992.78 | 1170 22 04 | 04.30 | | | | | | |
| 36.00 | 35.96 | 4269185.86 | 588039.46 | 1178.06 | 93.12 | 00.56 | 93,99 | 4269155.22 | 587991.12 | | 94.34 | | | | | | |
| 37.00 | 36.99 | 4269185.20 | 588038.60 | 1178.28 | 93.34 | 95.00 | 94.99 | 4269154.41 | 587990.29 | | 94.39 | | | | | | |
| 38.00 | 38.00 | 4269185.34 | 588037.76 | 1178.20 | 93.26 | 96.00 | 95.99 | 4269153.71 | 587989.45 | | 94.37 | | | | | | |
| 39.00 | 39.00 | 4269184.74 | 588036.93 | 1178.32 | 93.38 | 97.00 | 96.99 | 4269153.48 | 587988.62 | | 94.37 | | | | | | |
| 40.00 | 39.97 | 4269183.78 | 588036.12 | 1178.05 | 93.11 | 00.86 | 98.00 | 4269153.53 | 587987.78 | | 94.33 | | | | | | |
| 41.00 | 40.99 | 4269183.33 | 588035.2/ | 11/8/11 | 93.17 | 00.66 | 00.69 | 4269152.52 | 26,986,92 | | 94.14 | | | | | | |
| 42.00 | 41.99 | 4269183.18 4769187 20 | 588034.44 588033.60 | 11.78.57 | 93.33 02 FR | 101.00 | 99.98 90.001 | 42691515954 | 58/986.13 587985 30 | 117016 04 | 94.2U | | | | | | |
| 44.00 | 43.99 | 4269181.79 | 588032.77 | 1178.65 | 93.71 | 102.00 | 102.00 | 4269150.36 | 587984.45 | | 94.01 | | | | | | |
| 45.00 | 45.00 | 4269181.18 | 588031.93 | 1178.55 | 93.61 | 103.00 | 102.99 | 4269150.06 | 587983.62 | _ | 94.15 | | | | | | |
| 46.00 | 45.99 | 4269180.80 | 588031.10 | 1178.37 | 93.43 | 104.00 | 103.99 | 4269149.63 | 587982.79 | | 94.18 | | | | | | |
| 47.00 | 46.99 | 4269179.74 | 588030.27 | 1178.31 | 93.37 | 105.00 | 105.00 | 4269149.30 | 587981.95 | | 94.01 | | | | | | |
| 49.00 | 48.97 | 4269179.03 | 588029.43 588078.62 | 11 78.03 | 93.09 | 107.00 | 96.COL | 4269147.84 | 51.156/5C | 117893 94 | 94.U3 93.99 | | | | | | |
| 50.00 | 49.98 | 4269178.45 | 588027.78 | 1178.39 | 93.45 | 108.00 | 108.00 | 4269147.42 | 587979.45 | | 93.93 | | | | | | |
| 51.00 | 50.99 | 4269177.78 | 588026.94 | 1178.37 | 93.43 | 109.00 | 109.00 | 4269146.94 | 587978.62 | | 93.94 | | | | | | |
| 52.00 | 52.00 | 4269177.57 | 588026.10 | 1178.63 | 93.69 | 110.00 | 109.99 | 4269146.30 | 587977.79 | _ | 93.76 | | | | | | |
| 53.00 | 52.99 | 4269177.11 | 588025.27 | 1178.66 | 93.72 03.00 | 111.00 | 110.98 | 4269146.29 | 587976.97 | 1178.69 93 | 93.75 02.84 | | | | | | |
| 55.00 | 55.00 | 90 37 10975 | 588023.60 | 1170.92 | 92.50 | 113.00 | 112.00 | 42691445.07 | 587975 30 | | 40.05 | | | | | | |
| 56.00 | 55.99 | 4269175.34 | 588022.77 | 1179.17 | 94.23 | 114.00 | 113.99 | 4269144.06 | 587974.46 | | 93.92 | | | | | | |
| 57.00 | 56.98 | 4269174.65 | 588021.95 | 1179.29 | 94.35 | 115.00 | 114.99 | 4269143.74 | 587973.63 | 1178.90 93 | 93.96 | | | | | | |
| 58.00 | 58.00 | 4269174.63 | 588021.10 | 1179.26 | 94.32 | 116.00 | 115.99 | 4269143.25 | 587972.79 | _ | 93.96 | | | | | | |
| 59.00 | 59.00 | 4269173.65 | 588020.27 | 1179.34 | 94.40 | 117.00 | 116.99 | 4269142.77 | 587971.96 | | 93.88 | | | | | | |
| 61.00 | 99.90 00 09 | 4269173.45 4769177.45 | 588019.44 | 11.9.11 | 94.23 03 06 | 119.00 | 110.00 | 4269141.82 476014150 | 91.176/85 | 117877 03 | 93.90 | | | | | | |
| 62.00 | 62.00 | 4269172.29 | 588017.77 | 1178.91 | 93.97 | 120.00 | 119.98 | 4269140.98 | 587969.47 | | 93.59 | | | | | | |
| 63.00 | 62.99 | 4269171.87 | 588016.94 | 1178.97 | 94.03 | 121.00 | 120.98 | 4269140.74 | 587968.64 | | 93.64 | | | | | | |
| 64.00 | 63.99 | 4269171.05 | 588016.11 | 1178.87 | 93.93 | 122.00 | 122.00 | 4269139.97 | 587967.79 | 1178.63 93 | .69 | | | | | | |



| 42664261 5777821 1181/3 570 5690 5690 5690 5690 5690 5690 5690 5690 5690 5690 5690 5690 5690 5690 5690 5690 5690 5771 5773 5773 5773 5773 5773 5773 5773 5770 5690 5599 6590 | Ideal Dist from L Pin Actual Dist from Northing (m) | Actual Dist from I Pin (m) | Northing | Easting | Z | Adj to 1996 7 | Ideal Dist from L Pin Actual Dist (m) | in Actual Dist from I Pin (m) | Northing | Easting | Z | Adj to 1996 7 |
|--|--|-------------------------------|--------------------------|-----------|---------|------------------|---------------------------------------|----------------------------------|------------|-----------|---------|------------------|
| 0.1 65.90 55.90 55.90 4509.412 5747.51 117.75 0.0 4569.412 58.475 117.75 55.90 4569.412 5747.61 117.75 0.00 4569.412 58.477.51 117.75 57.90 56.90 56.90 4569.412 5747.61 117.75 111.90 4569.013 58.477.11 117.75 52.90 4569.412 57.90 4569.417 57.90 57.90 56.90 4569.417 57.75 111.90 4569.01 58.477.51 117.76 52.91 56.90 4569.417 57.75 57.90 56.90 4569.417 57.75 57.75 57.90 57.90 56.90 57.75 57.75 57.90 57.90 57.75 57.75 57.75 57.90 57.90 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57.75 57. | .38 | 5.38 | 4269429.62 | 587728.21 | 1181.93 | 97.10 | 56.00 | 55.99 | 4269425.02 | 587476.51 | 1177.53 | 92.71 |
| 910 0.0001/10 0.00 | .01 | 7.01 | 4269428.10 | 587727.45 | 1180.19 | 95.37 | 57.00 | 56.99 | 4269424.02 | 587476.31 | 1177.36 | 92.54 |
| 0.0 2.601/1.2 5777.3 117.3 6.00 5.99 2.690.20 577.4 117.5 10.9 2.690.403 577.71 117.3 6.00 5.99 2.690.403 577.71 11.9 2.690.403 577.71 117.3 6.00 5.99 2.690.403 577.71 11.0 2.690.403 577.74 117.6 6.00 6.99 2.690.403 577.71 11.0 2.690.403 577.74 117.6 6.00 6.99 2.690.403 597.75 11.0 2.690.403 577.74 117.6 9.10 6.99 2.690.403 597.75 117.70 11.0 2.690.403 577.74 117.6 9.10 6.90 6.90 6.90 117.70 597.75 117.71 11.0 2.690.403 577.74 117.70 2.70 7.90 2.904.10 177.72 11.0 2.690.403 577.74 117.70 2.70 2.904.10 577.71 177.72 2.690.403 | .00 | 7.99 | 4269472.92 | 587478.35 | 1178.62 | 93.80 | 58.00 | 58.00 | 4269423.01 | 587476.69 | 1177.33 | 92.51 |
| 0000 4500403 567777 1175 600 599 4500402 57775 1190 4500403 57777 1175 270 6100 2600402 57764 11774 1200 4500403 57777.1 11756 270 6100 2690403 5777.1 1400 4500403 5777.6 1177.6 270 6500 6599 4260410 5777.6 1500 4500403 5777.6 1177.6 270 650 4260410 5777.6 1177.0 1500 4500403 5777.6 1177.6 270 650 4290410 5777.6 1177.0 1500 4500403 5776.1 1175.7 270 | 00. | 9.00 | 4269471.92 | 587475.85 | 1179.60 | 94.78 | 59.00 | 58.99 | 4269422.02 | 587476.68 | 1177.37 | 92.55 |
| 109 4264403 5574751 11755 5 0.00 4264403 5874751 11770 1109 4264463 54745 11775 5 0.00 4264403 5874751 11771 1109 4264463 54745 11775 5 0.00 4264413 587753 11771 1100 4264463 57754 11775 5 0.00 4264413 587753 11771 1100 4264463 57754 11755 910 600 4564414 57753 11771 1100 4264463 57753 11755 910 600 4564414 57753 11771 1100 4264453 5717 11755 910 700 710 910 11771 1100 4264453 5717 11755 910 910 910 91753 11771 1100 4264414 5717 11755 910 910 910 91753 11771 1100 | 0.00 | 10.00 | 4269470.92 | 587477.71 | 1178.53 | 93.71 | 60.00 | 59.99 | 4269421.02 | 587476.84 | 1177.36 | 92.54 |
| 1199 42694(53) 5577,56 1177,45 2,73 6,00 6,39 42644(35) 5577,55 1177,15 1400 42694(54) 5775,64 1177,15 2,24 6,00 6,99 42644(35) 5777,55 1177,15 1500 42694(54) 5775,64 1177,15 2,24 6,00 7,99 42644(35) 5777,55 1177,15 1700 42694(54) 5777,54 1177,64 5700 6709 42644(35) 5777,51 1719 42644(55) 5717,54 1177,64 5710 7109 42644(35) 5777,51 1719 42645 5717,51 2,23 7100 7199 42644(35) 5777,51 1177,51 1719 42765 1177,41 2,24 7100 7394 42644(35) 5777,51 1177,51 1719 426455 577,51 1177,41 2,24 700 7394 42644(35) 5777,51 1177,51 1719 4264444 57764 1177,51 < | 1.00 | 10.99 | 4269469.93 | 587477.12 | 1178.56 | 93.74 | 61.00 | 60.99 | 4269420.02 | 587476.81 | 1177.50 | 92.68 |
| 1100 205646733 5874756 1177.14 2.0.6 6.00 6.3.90 2.6964103 587476.7 1177.0 1100 20566534 587476.1 1175.6 6.00 6.3.9 2.6964103 577476.3 1177.0 1100 20566534 587476.1 1175.3 9.1.9 6.00 6.3.9 2.6964103 577476.3 1176.0 1100 20566534 587476.1 1175.3 9.1.9 6.00 6.3.9 2.6941103 577476.3 1176.0 1100 20566134 587476.1 1175.3 9.1.9 6.00 6.3.9 2.6941103 577476.3 1177.0 1100 2056535 587476.1 1177.0 2.2.3 7.00 7.0.0 | 2.00 | 11.99 | 4269468.93 | 587476.21 | 1177.55 | 92.73 | 62.00 | 62.00 | 4269419.02 | 587476.33 | 1177.40 | 92.58 |
| 1100 25064653 5877654 117716 2.34 6.00 6.39 269641013 5777553 11705 11290 25064033 5877651 11755 913 6500 6539 26964103 5777553 11705 11290 25964034 5877651 11755 913 6700 639 26964103 5777543 11765 11290 25964034 5877651 11755 913 6700 6939 26964100 577754 11766 11290 25964034 5877651 11775 913 7000 7399 26964100 577756 11777 11290 2596403 5877651 11776 913 7000 7399 26964100 577766 11777 11290 2596403 5877651 11771 913 700 7399 26964001 577766 11777 11290 2596403 5877651 11771 913 700 7399 26964001 577766 11777 | 3.00 | 12.99 | 4269467.93 | 587475.66 | 1177.44 | 92.62 | 63.00 | 62.99 | 4269418.03 | 587476.73 | 1177.22 | 92.40 |
| 14.90 25646534 5877634 117756 9.24 6.00 6.39 246941501 5877653 11765 16.90 22696534 587761 11755 913 6600 6539 226941501 5877654 11765 17.90 22696534 5877651 11755 913 00 6539 226941301 587763 11765 17.90 22996034 5877651 117753 913 00 6539 226941101 587763 11763 17.01 22996035 5877651 117763 9275 700 739 22694100 587763 117763 17.01 2295455 587765 117713 9267 700 739 22694100 577763 117763 17.01 2295455 587765 117713 9276 71776 7239 22694100 577763 117763 17.01 2295455 587765 117713 9236 700 739 2694000 577763 11773 | 4.00 | 14.00 | 4269466.93 | 587476.41 | 1177.16 | 92.34 | 64.00 | 63.99 | 4269417.03 | 587476.57 | 1177.10 | 92.28 |
| (1) (2) <th(2)< th=""> <th(2)< th=""> <th(2)< th=""></th(2)<></th(2)<></th(2)<> | 5.00 | 14.99 | 4269465.94 | 587476.24 | 1177.06 | 92.24 | 65.00 | 64.99 | 4269416.03 | 587476.55 | 1176.91 | 92.09 |
| 17.99 25776-11 27.75 27.70 25644.30 57776.31 177.54 17.99 42564.164 577.75 9.19 600 67.90 42644.120 57776.31 177.54 21.00 42644.63 577.75 1.9 7.00 42644.120 57776.31 177.54 21.00 42644.53 57776.41 117.77 9.20 7.00 42644.120 57776.33 177.76 21.00 42644.53 577.76 117.71 9.26 7.00 7.99 42644.00 577.63 177.74 21.00 42644.53 577.76 117.71 9.26 7.00 7.99 42644.00 577.63 177.74 21.00 42644.54 577.75 117.71 9.26 7.00 7.99 42644.00 577.63 177.74 21.00 42644.74 577.74 1177.71 9.26 7.00 7.99 42644.00 577.63 177.74 21.01 42644.74 577.74 1177.71 9.26 7 | 6.00 | 16.00 | 4269464.93 | 587476.31 | 1176.51 | 91.69 | 66.00 | 65.98 | 4269415.04 | 587476.54 | 1176.63 | 91.81 |
| 139 25394634 577758 117 579 25394136 577753 117 579 25394136 577754 11777 2100 25394534 577751 117 210 25394136 577753 1177 577 2100 25394533 577757 117 210 739 425940305 577753 1177 2100 25394533 577754 1177 225 710 7199 425940305 577753 11773 2100 45394533 577754 1177 225 7100 7399 425940505 577753 11773 2100 42594454 577754 11773 226 700 7399 425940505 577753 11773 2100 42594454 577754 11773 226 700 7399 425940505 577753 11778 2103 42594454 577754 11773 226 700 7399 425940505 577753 11773 2103 | 7.00 | 16.99 | 4269463.94 | 587476.17 | 1176.35 | 91.53 | 67.00 | 67.00 | 4269414.03 | 587476.24 | 1176.44 | 91.62 |
| 10.8 4.26946.05 57.75.3 117.75 5.99 4.26941.06 58776.3 1177.5 21.00 4.26946.05 58746.51 1177.65 7.00 65.99 4.26941.06 58776.51 1177.55 21.00 4.26946.05 587476.1 1177.61 2.25 7.00 7.99 4.26940.05 58776.51 1177.55 21.00 4.26945.55 58747.51 1177.61 2.25 7.00 7.99 4.26940.05 58776.51 1177.51 25.00 4.26945.59 58747.51 1177.61 2.25 7.00 7.99 4.26940.05 58776.51 1177.81 25.00 4.26945.95 58747.51 1177.61 2.25 700 7.99 4.26940.05 58776.51 1177.81 25.99 4.26944.91 58747.51 1177.41 2.25 700 7.99 4.26940.05 58776.51 1177.81 25.99 4.26944.91 577.45 1177.41 2.26 810.0 7.99 4.26940.05 58776.51 1177.81 | 8.00 | 17.99 | 4269462.94 | 587475.86 | 1176.52 | 91.70 | 68.00 | 67.98 | 4269413.05 | 587476.40 | 1176.46 | 91.64 |
| 2100 42694694 57476.1 1176.7 219 700 7296 4269410.6 58776.5 1177.8 2100 42694595 5776.6 1177.8 22.6 7.00 79.9 426940.05 58776.5 1177.8 2139 42694595 5776.6 1177.8 2.26 7.00 7.99 426940.05 58776.5 1177.8 2139 42694595 5776.7 1177.8 2.7 7.00 7.99 426940.05 58776.5 1177.8 2160 42694595 5776.7 1177.8 2.7 7.00 7.99 426940.05 58776.5 1177.8 2160 42694595 577.6 1177.8 2.7 7.00 7.99 426940.05 58776.5 1177.8 2169 426944595 577.1 1177.8 2.7 2.7 2.7 2.7 2.7 2.7 2.7 2.7 2.7 2.7 2.7 2.7 2.7 2.7 2.7 2.7 2.7 2.7 2.7 | 9.00 | 18.98 | 4269461.96 | 587476.38 | 1176.75 | 91.93 | 69.00 | 68.99 | 4269412.04 | 587476.38 | 1176.78 | 91.96 |
| 21.00 4268459.4 59776.51 1177.40 21.00 70.86 426840.05 59776.56 1177.41 21.39 42684555 59776.56 1177.40 2.2.7 7.3.00 7.3.98 426946.05 59776.56 1177.41 21.39 42684555 58776.55 1177.46 2.2.7 7.3.00 7.3.98 426946.05 58776.56 1177.75 25.00 42684535 58776.51 1177.48 2.2.7 7.400 7.3.98 426940.05 58776.51 1177.61 25.00 42684630 58776.51 1177.41 2.2.8 7.00 7.3.99 426940.05 58776.51 1177.81 25.01 426944303 58776.51 1177.41 2.2.9 7.00 7.2.99 426940.05 58776.51 1177.81 25.01 426944303 58776.51 1177.42 2.2.6 82.00 58776.51 1177.81 25.01 426944407 58776.51 1177.42 2.2.6 82.00 58776.51 1177.81 25.01 <td>0.00</td> <td>20.00</td> <td>4269460.94</td> <td>587476.21</td> <td>1176.75</td> <td>91.93</td> <td>70.00</td> <td>66.69</td> <td>4269411.04</td> <td>587476.65</td> <td>1177.27</td> <td>92.45</td> | 0.00 | 20.00 | 4269460.94 | 587476.21 | 1176.75 | 91.93 | 70.00 | 66.69 | 4269411.04 | 587476.65 | 1177.27 | 92.45 |
| 21.99 4064535 58776.60 1177.01 22.5 7.200 7.199 40664756 58776.51 1177.61 23.90 40645755 58776.51 1177.40 22.67 7.300 7.393 426940.05 58776.51 1177.65 25.00 406447539 58776.51 1177.61 22.87 7.300 7.393 426940.05 58776.51 1177.81 26.00 42694539 58776.51 1177.71 22.81 7.000 75.99 426940.05 58776.51 1177.81 26.01 42694539 58776.52 1177.73 22.51 8000 7.800 25940.05 58776.51 1177.81 27.93 42694039 58776.52 1177.31 22.51 8000 726940.05 58776.61 1177.81 28.94 42694039 58776.61 1177.31 22.51 8000 726940.05 58776.61 1177.81 29.94 426940439 58776.61 1177.31 22.51 8000 426940.05 58776.61 1177.81 | 1.00 | 21.00 | 4269459.94 | 587476.17 | 1176.85 | 92.03 | 71.00 | 70.98 | 4269410.05 | 587476.64 | 1177.44 | 92.62 |
| 1299 426945795 53775.46 1177.48 2.26 7.300 7.298 426946.16 53775.95 1177.91 2500 426945395 53775.45 1177.41 2.27 7.400 7.39 426946.16 53775.59 1177.91 2500 426945395 53775.45 1177.61 2.27 7.400 7.59 426940.16 53776.59 1177.81 2509 42694039 53775.45 1177.71 2.27 700 75.99 426940.16 53776.51 1177.81 2799 42694039 53775.45 1177.13 2.26 81.00 73.00 426940.16 53776.51 1177.81 2799 42694497 53775.45 1177.43 2.26 81.00 73.00 426940.11 53776.51 1177.81 3198 42694497 53775.65 1177.43 2.26 81.00 426940.13 53776.51 1177.81 3198 42694497 53775.66 1177.43 2.26 81.00 2.26940.20 53776.51 1 | 2.00 | 21.99 | 4269458.95 | 587476.04 | 1177.07 | 92.25 | 72.00 | 71.99 | 4269409.05 | 587476.32 | 1177.56 | 92.74 |
| 3190 42694505 537457 1177.49 22.67 74.00 73.36 42694705 53745.74 1177.02 25.00 426945435 53745.75 1177.61 22.75 75.00 75.39 4269405.05 53775.74 1177.02 25.00 4269451.97 53775.64 1177.61 2.28 75.00 75.99 426940.05 53775.54 1177.01 27.99 4269451.97 53775.64 1177.61 2.28 7.00 75.99 426940.05 53775.54 1177.03 28.99 4269449.07 53775.65 1177.42 2.25.1 80.00 79.90 426940.05 53775.61 1177.43 31.98 4269449.07 53775.65 1177.42 2.26.6 82.00 1177.81 1177.81 31.98 426944.07 53775.66 1177.42 2.26.6 82.00 426940.01 53775.61 1177.91 31.98 426944.07 53775.66 1177.42 2.26.6 82.00 84.00 1177.81 177.81 | 3.00 | 22.99 | 4269457.95 | 587476.46 | 1177.48 | 92.66 | 73.00 | 72.98 | 4269408.06 | 587476.99 | 1177.88 | 93.06 |
| 5.00 2.504 2.704 2.504 2.706 2.705 2.7756 1.177.81 2.205 2.704 2.504 2.706 2.707 2.706 2.706 2.706 2.706 2.706 2.707 2.706 2.706 2.706 2.707 2.706 2.707 2.706 2.706 2.706 2.706 2.707 2.706 2.707 2.706 2.707 2.706 2.707 2.706 2.706 2.706 2.706 <th2.706< th=""> 2.706 2.706 <</th2.706<> | 4.00 | 23.99 | 4269456.95 | 587476.22 | 1177.49 | 92.67 | 74.00 | 73.98 | 4269407.06 | 587476.74 | 1177.92 | 93.10 |
| 56.00 42694539 587475.3 1177.61 22.83 75.00 75.99 426940.05 587475.61 1178.06 21.99 42694539 587475.61 1177.11 22.83 75.00 75.90 426940.05 587475.61 1177.06 21.99 426945197 587475.62 1177.31 22.53 79.00 75.90 426940.05 587475.61 1178.43 21.99 426944307 587475.62 1177.43 22.60 81.00 79.90 426940.05 587475.61 1178.43 21.98 426944307 587476.65 1177.41 22.60 81.00 79.00 426940.05 587475.61 1178.41 21.99 426944307 587475.63 1177.41 22.60 81.00 79.00 426940.016 587475.61 1178.41 21.91 426944407 587475.66 1177.41 22.60 81.00 81.99 426940.016 587475.61 1177.41 21.91 426944307 587475.61 1177.41 22.60 81.00 | 5.00 | 25.00 | 4269455.95 | 587476.57 | 1177.61 | 92.79 | 75.00 | 74.99 | 4269406.05 | 587476.59 | 1178.03 | 93.21 |
| 25.6 42694539 587476.4 1177.0 22.8 75.98 426940.06 587476.61 1177.97 23.9 4269453.97 587476.17 1177.33 22.33 79.00 75.90 426940.05 587476.61 1177.91 23.99 426944398 587476.61 1177.43 22.60 81.99 426940.015 58775.61 1178.43 23.99 426944398 587476.60 1177.41 22.60 81.99 426940.015 58775.61 1178.43 31.99 426944308 587476.60 1177.41 22.60 81.99 426940.015 58775.61 1178.41 31.99 426944407 587476.60 1177.41 22.60 88.90 4569939.06 587475.61 1178.41 31.99 426944400 587476.61 1177.71 22.60 88.90 456939.016 587476.61 1178.41 31.99 426944400 587476.61 1177.41 22.60 88.90 456939.016 587476.61 1178.41 31.00 426944400 </td <td>6.00</td> <td>26.00</td> <td>4269454.95</td> <td>587476.33</td> <td>1177.68</td> <td>92.86</td> <td>76.00</td> <td>75.99</td> <td>4269405.05</td> <td>587476.59</td> <td>1177.84</td> <td>93.02</td> | 6.00 | 26.00 | 4269454.95 | 587476.33 | 1177.68 | 92.86 | 76.00 | 75.99 | 4269405.05 | 587476.59 | 1177.84 | 93.02 |
| 27/99 426945126 587476.1 1177.60 27.80 78.00 4269403.05 587476.51 1177.17 2898 426945197 587476.16 1177.35 22.51 80.00 79.00 426940.05 587476.61 1178.17 29.99 426944098 587476.65 1177.43 22.60 82.00 79.00 426940.05 587476.61 1178.43 31.98 42694459 587476.65 1177.42 22.60 82.00 82.999.06 587476.61 1178.43 32.99 42694449 587476.65 1177.42 22.61 82.00 82.999.06 587476.61 1178.43 32.99 42694440 587476.63 1177.41 22.91 85.00 82.999.06 587476.61 1178.43 32.99 42694440 587476.63 1177.71 22.91 85.00 85.999.06 587476.71 1177.31 36.00 42694410 587476.63 1177.72 22.21 87.00 426939.010 587476.71 1177.31 36.01 | 7.00 | 26.96 | 4269453.99 | 587475.96 | 1177.71 | 92.89 | 77.00 | 76.98 | 4269404.06 | 587476.84 | 1178.08 | 93.26 |
| 28.96 45644517 58747.61 1177.35 2.5.3 7.9.00 7.9.00 7.9.01 6.76940.11 58747.61 1178.43 31.98 45644398 58745.64 1177.43 2.5.61 81.00 7.9.94 4.26940.11 58747.61 1178.43 31.98 45644398 58745.65 1177.42 2.5.6 81.00 80.99 4.26940.11 58747.61 1178.43 31.99 45644698 58745.66 1177.42 2.5.6 81.00 80.99 4.26940.05 58747.63 1178.43 31.99 456944300 58745.63 1177.42 2.5.6 81.00 80.99 4.26940.05 58747.63 1178.43 31.99 456944100 58745.63 1177.43 2.5.7 85.90 4.269940.05 58747.63 1178.43 31.90 456944100 58745.63 1177.71 2.9.29 85.00 84.99 4.56999.06 5776.53 1178.43 31.91 45694400 58745.64 1177.71 2.2.89 85.00 <t< td=""><td>8.00</td><td>27.99</td><td>4269452.96</td><td>587476.17</td><td>1177.60</td><td>92.78</td><td>78.00</td><td>78.00</td><td>4269403.05</td><td>587476.85</td><td>1177.97</td><td>93.15</td></t<> | 8.00 | 27.99 | 4269452.96 | 587476.17 | 1177.60 | 92.78 | 78.00 | 78.00 | 4269403.05 | 587476.85 | 1177.97 | 93.15 |
| 29.90 42694507 58745.42 1177.42 2.551 80.00 79.34 426940.06 58747.17 1178.43 31.98 426944398 58745.66 1177.42 2.56 83.00 81.97 426940.06 587476.61 1178.43 31.98 42694439 587476.65 1177.42 2.56 83.00 81.97 426940.06 587476.61 1178.43 31.99 42694439 587476.61 1177.42 2.56 83.00 81.97 426939.08 587476.61 1178.43 36.07 42694430 587476.31 1177.12 2.273 81.00 85.96 426939.07 587476.81 1178.43 36.07 42694430 587476.30 1177.12 2.282 87.00 85.96 426939.07 587476.81 1177.62 36.07 42694439 587476.41 1177.12 2.89 86.00 86.99 426939.07 587476.81 1177.91 36.07 4269439.08 587476.61 1177.12 2.89 26939.07 58 | 9.00 | 28.98 | 4269451.97 | 587476.16 | 1177.35 | 92.53 | 79.00 | 79.00 | 4269402.05 | 587476.67 | 1178.17 | 93.35 |
| 3038 12644938 587476.56 1177.42 2.5.60 81.00 81.97 426944308 587476.61 1178.41 3138 126944308 587476.60 1177.42 2.5.60 81.00 81.97 426934539 857475.60 1178.41 31398 126944508 587476.60 1177.42 2.5.60 84.00 426934506 587475.60 1178.41 31398 126944300 587476.30 1177.41 227.9 84.00 829396.07 587475.60 1178.41 35.97 426944300 587476.50 1177.71 227.9 87.00 85.96 4269339.07 587475.61 1178.43 36.97 426944300 587475.60 1177.71 22.99 87.00 86.98 4269332.07 587475.51 1177.27 37.97 426943700 587476.53 1177.71 92.89 90.00 90.00 4269332.07 587475.51 1177.97 40.00 426943700 587476.51 1177.72 92.89 90.00 90.00 4269332.07 </td <td>00.0</td> <td>29.99</td> <td>4269450.97</td> <td>587476.42</td> <td>1177.33</td> <td>92.51</td> <td>80.00</td> <td>79.94</td> <td>4269401.11</td> <td>587477.17</td> <td>1178.43</td> <td>93.61</td> | 00.0 | 29.99 | 4269450.97 | 587476.42 | 1177.33 | 92.51 | 80.00 | 79.94 | 4269401.11 | 587477.17 | 1178.43 | 93.61 |
| 31.98 12694489 587476.62 1177.46 2.564 82.00 81.97 426939.08 587476.81 1178.76 32.99 4269446.93 587476.66 1177.42 2.56 83.00 84.99 426939.08 587476.81 1178.47 33.99 4269446.93 587476.66 1177.42 2.27 85.00 84.99 426939.06 587476.82 1178.47 34.99 426944.97 587476.66 1177.41 2.27 86.00 85.06 426939.30 587476.82 1178.25 37.97 426944.190 587476.66 1177.71 2.28 86.00 86.00 4269393.07 587476.77 1177.97 37.99 426944.300 587476.56 1177.71 2.28 80.00 88.00 4269393.07 587476.57 1177.97 37.99 426943.908 587476.53 1177.61 2.246 92.00 90.09 4269339.08 587476.57 1177.97 $42.093587476.531177.462.24792.0090.9090.904269339.08587476.571177.3042.0943309587476.531177.462.24792.0091.9092.909587476.551178.4042.09436.00587476.531177.4092.0092.0092.00992.039.08587476.551178.4042.0933887476.301177.4092.2992.0092.0092.09992.093.0092.047.691177.69$ | 1.00 | 30.98 | 4269449.98 | 587476.96 | 1177.42 | 92.60 | 81.00 | 80.99 | 4269400.06 | 587476.64 | 1178.35 | 93.53 |
| 32.99 42694459 5374566 1177.42 25.60 83.00 82.38 4269396.05 587476.66 1178.41 33.99 42694459 587476.36 1177.42 22.51 84.00 826939.60 587476.81 1178.41 34.99 42694430 587476.36 1177.72 22.82 86.00 85.96 4269396.07 587476.81 1178.21 36.07 426944100 587476.30 1177.72 22.81 90.00 85.96 426939.07 587476.75 1178.21 38.99 42694309 587476.50 1177.12 22.81 90.00 4269392.07 587476.75 1178.21 41.00 426943398 587476.52 1177.52 22.81 90.00 4269392.07 587476.55 1178.61 41.00 426943398 587476.52 1177.42 22.81 90.00 4269392.07 587476.55 1178.61 42.0993808 587476.29 1177.42 22.44 | 2.00 | 31.98 | 4269448.98 | 587476.62 | 1177.46 | 92.64 | 82.00 | 81.97 | 4269399.08 | 587476.81 | 1178.41 | 93.59 |
| 33.38 42694538 53745.65 1177.33 $2.5.51$ 84.00 84.90 426935.05 58747.82 1178.31 36.07 426944407 58746.33 1177.61 2.27 8.00 85.36 4269395.05 58747.82 1178.31 36.07 426944407 587476.33 1177.61 2.22 8.00 85.36 4269395.10 587475.87 1178.25 37.97 426944038 587476.53 1177.27 2.290 88.00 85.96 426939.07 587475.75 1178.25 38.99 426944038 587476.53 1177.51 2.213 91.00 90.09 426939.07 587476.57 1177.27 41.00 426943700 587476.51 1177.57 92.10 92.9000 587476.55 1178.10 42.99 426943700 587476.51 1177.20 92.10 92.6900 92.6900 92.6900 92.6900 $92.6930.06$ 587476.55 1178.43 | 3.00 | 32.99 | 4269447.97 | 587476.09 | 1177.42 | 92.60 | 83.00 | 82.98 | 4269398.08 | 587476.66 | 1178.76 | 93.94 |
| 34.90 42694459 55745.33 117761 $2.7.9$ 85.00 84.90 426935.10 58745.82 1178.25 36.00 42694430 587476.33 1177.64 2.82 86.00 4269394.05 587476.87 1178.25 37.97 42694430 587476.53 1177.74 2.20 88.00 4269394.05 587476.75 1178.25 38.99 4269439.98 587476.53 1177.75 2.29 88.00 426939.05 587476.75 1178.25 38.99 4269439.98 587476.53 1177.52 2.23 90.00 90.00 426939.06 587476.55 1178.21 41.00 4269436.00 587476.53 1177.56 22.30 92.00 92.900 $92.690.95$ $92.769.95$ 1178.49 42.093 587476.54 1177.40 22.44 92.00 $92.690.95$ 587476.55 1178.49 42.093 587476.54 1177.40 22.38 92.00 $92.690.95$ <td>4.00</td> <td>33.98</td> <td>4269446.98</td> <td>587476.66</td> <td>1177.33</td> <td>92.51</td> <td>84.00</td> <td>84.00</td> <td>4269397.06</td> <td>587476.80</td> <td>1178.41</td> <td>93.59</td> | 4.00 | 33.98 | 4269446.98 | 587476.66 | 1177.33 | 92.51 | 84.00 | 84.00 | 4269397.06 | 587476.80 | 1178.41 | 93.59 |
| 36.00 426944407 587476.31 1177.64 2.82 86.00 85.96 4269395.10 587476.87 1178.25 37.97 42694440 587476.60 1177.72 2.820 87.00 85.96 4269393.07 587476.57 1178.25 37.97 4269443.00 587476.56 1177.71 2.90 88.00 426933.03 587476.57 1178.25 40.00 426943928 587476.53 1177.63 2.81 90.00 4269330.08 587476.57 1178.20 40.00 426943928 587476.53 1178.10 2.269 2.000 90.909 4269330.08 587476.57 1178.20 41.00 4269436.00 587476.53 1177.46 2.244 93.00 91.909 26939.38 587476.55 1178.40 42.993 587476.53 1177.46 2.244 93.00 92639.08 587476.55 1178.40 42.993 42694330.08 587476.29 1177.40 | 5.00 | 34.99 | 4269445.98 | 587476.38 | 1177.61 | 92.79 | 85.00 | 84.99 | 4269396.07 | 587476.82 | 1178.31 | 93.49 |
| 9.9 4.2694400 $85/46.60$ 1177.72 2.282 87.00 88.03 2.42934303 85745.63 1177.12 2.87 8.00 $4.269392.07$ 87476.75 1178.03 3.99 426944138 87475.64 1177.12 2.281 90.00 80.00 820392.07 87476.75 1178.03 41.00 426943938 857476.35 1177.64 2.81 90.00 4269392.07 887476.55 1178.03 41.00 426943398 857476.53 1177.69 92.10 90.00 4269392.07 887476.55 1178.30 41.00 426943308 857476.54 1177.30 92.47 93.00 92.699 92.699 $92.765.5$ 1178.40 42.99 4269436.01 1177.40 92.47 92.00 92.699 92.699 92.699 92.699 $92.693.868$ 87476.65 1178.40 $42.9336.03$ 87476.25 1177.40 92.59 92.699 $92.693.869$ | 5.00 | 36.00 | 4269444.97 | 587476.33 | 1177.64 | 92.82 | 86.00 25 20 | 85.96 | 4269395.10 | 587476.87 | 1178.26 | 93.44 |
| 37.97 4.5644130 $58.745.65$ 1177.72 22.90 88.00 4.2693207 58745.65 1177.97 38.99 4.2694138 58747656 1177.71 2.81 90.00 90.00 $4.26933.07$ 58745.67 1177.97 40.00 4.26944038 58747656 1177.61 2.81 90.00 90.00 $4.26939.07$ 58745.65 1178.31 41.00 4.26943928 587476.65 1177.65 9.217 91.00 90.99 $4.26939.08$ 58745.65 1178.31 42.09 4.26943790 587476.66 1177.46 2.247 92.00 91.99 $4.26939.08$ 587476.55 1178.41 43.98 426943700 587476.66 1177.26 92.47 92.00 94.00 $4.26938.08$ 587476.65 1178.41 43.98 426943.00 $587476.1177.17$ 1177.26 92.47 92.00 95.00 426938.08 587476.56 1178.41 4.99 426943.00 587476.52 1177.41 22.59 96.00 95.00 95.90 587476.96 1178.61 4.59 426943.00 587476.52 1177.41 22.59 95.00 95.90 426938.09 587476.59 1178.64 4.799 426943.00 587476.52 1177.41 22.54 92.00 95.90 426938.09 587476.59 1178.64 4.799 426943.00 587476.52 1177.42 22.41 99.00 97.99 426938.26 587476.59 <td>7.00</td> <td>36.97</td> <td>4269444.00</td> <td>587476.00</td> <td>1177.64</td> <td>92.82</td> <td>87.00</td> <td>86.98</td> <td>4269394.08</td> <td>587477.52</td> <td>1178.22</td> <td>93.40</td> | 7.00 | 36.97 | 4269444.00 | 587476.00 | 1177.64 | 92.82 | 87.00 | 86.98 | 4269394.08 | 587477.52 | 1178.22 | 93.40 |
| 35.39 42694038 $55/475.56$ 1177.17 2.28 89.00 89.00 426939.07 587476.76 1178.21 41.00 42694339.8 587476.57 1177.51 92.17 91.00 4269390.07 587476.57 1178.21 41.00 42694339.8 587476.57 1177.55 92.17 91.00 91.99 4269390.08 587476.55 1178.10 42.09 426943709 587476.54 1177.26 92.44 93.00 92.00 92.09 587476.55 1178.41 42.99 4269435.00 587476.54 1177.40 92.87 92.00 92.00 92.00 92.00 92.00 92.00 92.00 92.00 92.00 92.00 92.06 1178.40 1178.40 $42.9836.00$ 587476.52 1177.40 92.50 92.00 92.00 92.000 92.00 91.00 $92.038.746.56$ 1178.65 $42.9836.00$ 587476.52 1177.40 92.38 | 8.00 | 37.97 | 4269443.00 | 587476.68 | 1177.72 | 92.90 | 88.00 | 88.00 | 4269393.07 | 587476.92 | 11/8.03 | 93.21 |
| 4000 42694038 85745635 1177.53 $2.2.81$ 9000 92000 829390.87 8574555 1178.30 4100 42694339 857476.57 1177.54 22.64 92.00 90.99 4269390.87 87476.55 1178.30 42.09 426943790 857476.51 1177.46 22.44 93.00 91.99 4269380.8 587476.55 1178.40 42.98 426943700 857476.54 1177.40 22.44 93.00 91.00 426938.08 587476.55 1178.40 43.98 426943600 857476.51 1177.40 22.38 97.00 95.99 426938.08 587476.51 1178.42 45.98 42694300 587476.52 1177.40 92.30 95.99 426938.09 587476.91 1178.63 45.98 42694300 587476.52 1177.40 92.30 $92.699.00$ 95.99 $426938.293.25$ 587477.69 1178.63 45.99 | 9.00 | 38.99 | 4269441.98 | 58/4/5.96 | 17.7711 | 92.89 | 00.68 | 00.68 | 4269392.07 | 587476.77 | 11/7.97 | 93.15 |
| 41.00 42694303 56746.21 1177.46 51.00 91.90 42093036 587476.45 1178.10 42.09 426643836 587476.33 1177.46 92.44 93.00 91.99 42693830.8 587476.45 1178.10 42.99 426943700 587476.65 1177.46 92.44 93.00 93.00 4269380.8 587476.65 1178.40 43.98 426943600 587476.21 1177.40 92.59 95.00 94.00 4269386.08 587476.65 1178.49 45.98 426943501 587476.19 1177.40 92.59 95.00 95.99 4269386.08 587476.65 1178.46 45.98 426943.01 587476.25 1177.46 92.30 95.99 4269386.08 587476.69 1178.62 45.98 426943.01 587476.52 1177.46 92.30 92.99 4269386.08 587476.98 1178.62 48.98 426943.01 587475.52 | 0.00 | 40.00 | 4269440.98 | 58/4/6.69 | 11//.63 | 18.26 | 90.00 | 90.09 | 4269391.07 | 58/4/6./6 | 17.8/11 | 93.39 |
| 4.200 4.2694739 5.074653 1177.6 2.244 3.200 3.2300 3.2730 3.274635 3.274635 3.27663 3.27635 3.2746535 3.276655 3.27847535 1178.61 4.398 4.26943500 58747664 1177.26 $9.2.47$ 94.00 94.00 4269387.08 587476.65 1178.41 4.398 4.26943600 587476.29 1177.40 92.50 95.00 426938.08 587476.65 1178.64 4.598 42694301 587476.52 1177.42 92.34 90.00 95.99 426938.09 58747.66 1178.64 4.599 42694301 587476.52 1177.42 92.34 90.00 95.99 426938.09 587476.65 1178.64 4.99 42694300 587476.52 1177.12 92.34 99.00 95.99 426938.09 58747.66 1178.64 4.90 42694300 587476.52 1177.12 92.34 99.00 | 00.T | 41.00 | 4269439.98 4260439.08 | 12.014/9C | CC.//TT | 92.73 | 00.16 | 90.99 | 4269390.08 | CC.0/4/8C | 1170.10 | 95.48 |
| 43.98 426943100 587476.60 1177.29 2.47 94.00 94.00 94.00 587476.51 1188.49 43.98 4269436.00 587476.29 1177.40 92.58 95.00 94.00 4269387.08 587476.51 1178.62 44.98 4269436.00 587476.10 1177.40 92.58 95.00 95.00 4269387.08 587476.51 1178.62 45.98 4269430.01 587476.51 1177.41 92.59 96.00 95.09 4269387.08 587476.56 1178.63 45.98 426943.01 587476.52 1177.41 92.59 96.00 97.00 97.99 4269383.09 587475.65 1178.63 45.99 426943.01 58746.52 1177.43 92.61 102.53 4269383.09 587475.90 1179.82 49.98 426943.00 58746.52 1177.43 92.61 102.53 426938.03 587475.90 1179.82 51.00 426943.00 58746.52 1177.43 92.61 102.53 426938.03 <td>0.00</td> <td>42.00</td> <td>4203430.90 1760137 00</td> <td>587476.66</td> <td>1177 26</td> <td>92.04</td> <td>92.00</td> <td>03 00</td> <td>4203289.08</td> <td>587476 35</td> <td>1178.41</td> <td>02.00</td> | 0.00 | 42.00 | 4203430.90 1760137 00 | 587476.66 | 1177 26 | 92.04 | 92.00 | 03 00 | 4203289.08 | 587476 35 | 1178.41 | 02.00 |
| 44.98 42694500 537476.29 1177.40 9.2.8 95.00 95.00 4269386.08 587476.98 1178.62 45.98 4269435.01 587476.21 1177.41 92.59 96.00 95.99 4269386.08 587476.98 1178.62 45.98 4269435.01 587476.11 1177.41 92.59 96.00 95.99 4269386.09 587477.69 1178.65 45.98 426943.00 587476.55 1177.72 92.34 97.00 95.99 426938.09 587476.98 1179.35 45.99 426943.00 58746.55 1177.73 92.41 99.00 98.83 426938.09 587475.90 1197.35 49.98 426943.00 58746.55 1177.21 92.41 99.00 98.83 426938.26 587475.90 1197.35 49.08 426943.00 58746.55 1177.51 92.61 102.53 426933.021 587475.90 1179.35 51.00 426943.00 58746.55 1177.53 92.61 102.53 426933.021 </td <td>00 4</td> <td>43.98</td> <td>4269437.00</td> <td>587476.64</td> <td>1177.29</td> <td>92.47</td> <td>00.66</td> <td>94.00</td> <td>4269387.08</td> <td>587476.65</td> <td>1178.49</td> <td>93.67</td> | 00 4 | 43.98 | 4269437.00 | 587476.64 | 1177.29 | 92.47 | 00.66 | 94.00 | 4269387.08 | 587476.65 | 1178.49 | 93.67 |
| 45.98 4269435.01 58747.61 1177.41 92.59 96.00 95.99 4269385.09 587477.46 1178.68 46.98 426643300 58746.55 1177.20 92.38 97.00 96.99 4269385.09 587477.46 1178.68 47.99 426643300 58746.55 1177.20 92.34 99.00 96.99 4269383.09 587476.91 1179.35 48.98 42694300 58746.55 1177.20 92.41 99.00 98.83 4269333.09 58747.69 1179.35 49.98 426943.01 58746.52 1177.23 92.61 102.53 426933.021 58747.69 1197.35 51.00 426943.000 58746.52 1177.43 92.61 102.53 426933.21 58745.90 1197.82 51.00 426943.000 58746.52 1177.53 92.61 102.53 426933.92.1 58745.90 1197.82 52.00 426943.800 58746.42 1177.53 92.61 102.53 426933.92.1 58745.90 1197 | 5.00 | 44.98 | 4269436.00 | 587476.29 | 1177.40 | 92.58 | 95.00 | 95.00 | 4269386.08 | 587476.98 | 1178.62 | 93.80 |
| 46.98 4269434.01 587476.19 1177.20 92.38 97.00 96.99 4269384.09 587476.69 1178.94 47.99 426943.00 58747.65 1177.16 92.34 98.00 97.99 4269338.09 587475.69 1178.35 48.98 426943.01 58746.55 1177.14 92.41 99.00 98.83 4269332.15 58745.50 1179.82 49.98 426943.00 58746.55 1177.51 92.61 102.53 4269339.21 587692.16 1181.98 51.00 426943.00 58746.51 1177.51 92.61 102.53 4269339.21 587692.16 1181.92 52.00 426943.00 58746.42 1177.51 92.61 102.53 4269339.21 587692.16 1181.89 52.00 426942.00 58746.42 1177.53 92.61 102.53 4269339.21 587692.16 1181.89 52.30 426942.80 58746.42 1177.53 92.73 52.92 58746.56 1177.53 92.73 | 6.00 | 45.98 | 4269435.01 | 587476.21 | 1177.41 | 92.59 | 96.00 | 95.99 | 4269385.09 | 587477.46 | 1178.68 | 93.86 |
| 47.99 4269433.00 587476.65 1177.16 92.34 98.00 97.99 4269383.09 587476.89 1179.35 48.98 4269432.01 587476.52 1177.23 92.41 99.00 98.83 4269383.09 587476.89 1179.35 49.98 4269432.01 587475.52 1177.23 92.61 102.53 4269339.21 587692.16 1181.89 49.98 4269430.00 587476.51 1177.51 92.61 102.53 4269339.21 587692.16 1181.89 51.00 4269430.00 58776.52 1177.51 92.71 52.29 4269339.21 587692.16 1181.89 52.08 4269420.00 58776.42 1177.53 92.71 52.98 42694390.0 58776.42 1177.53 92.71 52.98 42694280.0 58776.42 1177.58 92.76 52.33 42694280.1 587476.56 1177.58 92.76 53.99 4269427.01 587476.56 1177.58 92.76 52.33 52.26 52.26 52 | 7.00 | 46.98 | 4269434.01 | 587476.19 | 1177.20 | 92.38 | 97.00 | 96.99 | 4269384.09 | 587477.69 | 1178.94 | 94.12 |
| 48.98 4269432.01 587476.52 1177.23 92.41 99.00 98.83 4269382.26 587475.90 1179.82 49.98 4269431.01 587476.55 1177.43 92.61 102.53 4269339.21 587692.16 1181.89 51.00 4269430.00 58776.51 1177.51 92.69 92.69 102.53 4269339.21 587692.16 181.89 51.00 4269420.00 58776.51 1177.51 92.69 92.71 52.08 4269429.00 58746.48 1177.55 92.71 52.08 4269428.02 58746.48 1177.56 92.73 53.99 4269427.01 58746.56 1177.58 92.76 53.99 4269427.01 58746.56 1177.58 92.76 | 8.00 | 47.99 | 4269433.00 | 587476.65 | 1177.16 | 92.34 | 98.00 | 97.99 | 4269383.09 | 587476.89 | 1179.35 | 94.53 |
| 49.98 426431.01 58745.55 1177.43 92.61 102.53 4269339.21 587692.16 1181.89 51.00 426943000 58746.51 1177.51 92.69 92.69 92.69 92.69 92.69 92.61 92.69 92.61 92.69 92.61 92.61 92.69 92.61 92.69 92.61 92.69 92.61 92.69 92.61 92.69 92.71 92.71 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.73 92.74 92.74 92.74 92.74 92.74 92.74 92.74 92.74 92.74 92.74 92.76 | 9.00 | 48.98 | 4269432.01 | 587476.52 | 1177.23 | 92.41 | 00.66 | 98.83 | 4269382.26 | 587475.90 | 1179.82 | 95.00 |
| 51.00 42643000 587476.51 1177.51 52.00 426943000 587476.42 1177.53 52.98 426942802 587476.48 1177.53 52.99 426942802 587476.46 1177.55 53.99 426942802 587476.56 1177.55 | 0.00 | 49.98 | 4269431.01 | 587476.55 | 1177.43 | 92.61 | 102.53 | 102.53 | 4269339.21 | 587692.16 | 1181.89 | 97.07 |
| 52.00 4269429.00 587476.42 1177.53 52.98 4269428.02 587476.48 1177.55 53.99 4269427.01 587476.56 1177.58 | 1.00 | 51.00 | 4269430.00 | 587476.51 | 1177.51 | 92.69 | | | | | | |
| 52.98 4269428.02 587476.48 1177.55 53.99 4269427.01 587476.56 1177.58 | 2.00 | 52.00 | 4269429.00 | 587476.42 | 1177.53 | 92.71 | | | | | | |
| 53.99 4269427.01 587476.56 1177.58 | 3.00 | 52.98 | 4269428.02 | 587476.48 | 1177.55 | 92.73 | | | | | | |
| | 4.00 | 53.99 | 4269427.01 | 587476.56 | 1177.58 | 92.76 | | | | | | |



| Sonar Data at 1m points Ideal Dist from L Actu Din (m) Dist | Actual Dist from L Northing | L Northing | Easting | Z | Adj to 1996 Z | Ideal Dist from L | Actual Dist from L Northing | . Northing | Easting | Z | Adj to 1996 Z |
|---|-----------------------------|--|------------------------|---------|----------------|-------------------|-----------------------------|--------------------------|-----------|----------|----------------|
| 7.54 | 7.54 | 4269473.37 | 587476.31 | 1181.93 | 96.87 | 70.00 | 66.69 | 4269411.04 | 587476.65 | 1177.27 | 92.21 |
| 8.00 | 7.99 | 4269472.92 | 587478.35 | 1178.62 | 93.56 | 71.00 | 70.98 | 4269410.05 | 587476.64 | 1177.44 | 92.38 |
| 00.6 | 00.6 | 4269471.92 | 587475.85 | 1179.60 | 94.54 | 72.00 | 71.99 | 4269409.05 | 587476.32 | 1177.56 | 92.50 |
| 10.00 | 10.00 | 4269470.92 | 587477.71 | 1178.53 | 93.47 | 73.00 | 72.98 | 4269408.06 | 587476.99 | 1177.88 | 92.82 |
| 00.11 | 66.0T | 4269469.93 | 21.14/22 | 95.8/11 | 93.50 | 74.00 | 71.98 | 4269407.05 | 58/4/6./4 | 26.//11 | 98.26 |
| 13.00 | 11.99 12 00 | 4269468.93 4769467 93 | 587475 66 | CC.//11 | 92.49 | 76.00 | 75 99 | 4269406.05 4269405 05 | 58747659 | 1172 84 | 16.26 |
| 14.00 | 14.00 | 4269466.93 | 587476.41 | 1177.16 | 92.10 | 77.00 | 76.98 | 4269404.06 | 587476.84 | 1178.08 | 93.02 |
| 15.00 | 14.99 | 4269465.94 | 587476.24 | 1177.06 | 92.00 | 78.00 | 78.00 | 4269403.05 | 587476.85 | 1177.97 | 92.91 |
| 16.00 | 16.00 | 4269464.93 | 587476.31 | 1176.51 | 91.45 | 79.00 | 79.00 | 4269402.05 | 587476.67 | 1178.17 | 93.11 |
| 17.00 | 16.99 | 4269463.94 | 587476.17 | 1176.35 | 91.29 | 80.00 | 79.94 | 4269401.11 | 587477.17 | 1178.43 | 93.37 |
| 18.00 | 17.99 | 4269462.94 | 587475.86 | 1176.52 | 91.46 | 81.00 | 80.99 | 4269400.06 | 587476.64 | 1178.35 | 93.29 |
| 19.00 | 18.98 | 4269461.96 | 587476.38 | 1176.75 | 91.69 | 82.00 | 81.97 | 4269399.08 | 587476.81 | 1178.41 | 93.35 |
| 20.00 | 20.00 | 4269460.94 | 587476.21 | 1176.75 | 91.69 | 83.00 | 82.98 | 4269398.08 | 587476.66 | 1178.76 | 93.70 |
| 21.00 | 21.00 | 4269459.94 | 587476.17 | 1176.85 | 91.79 | 84.00 | 84.00 | 4269397.06 | 587476.80 | 1178.41 | 93.35 |
| 22.00 | 21.99 | 4269458.95 | 587476.04 | 1177.07 | 92.01 | 85.00 | 84.99 | 4269396.07 | 587476.82 | 1178.31 | 93.25 |
| 23.00 | 22.99 | 4269457.95 | 587476.46 | 1177.48 | 92.42 | 86.00 | 85.96 | 4269395.10 | 587476.87 | 1178.26 | 93.20 |
| 24.00 | 23.99 | 4269456.95 | 587476.22 | 1177.49 | 92.43 | 87.00 | 86.98 | 4269394.08 | 587477.52 | 1178.22 | 93.16 |
| 25.00 | 25.00 | 4269455.95 | 587476.57 | 1177.61 | 92.55 | 88.00 | 88.00 80.00 | 4269393.07 | 587476.92 | 1178.03 | 92.97 |
| 20.00 | 20.00 | 00 00 00 00 00 00 00 00 00 00 00 00 00 | 20/4/00 | 00'//TT | 92.02 07.65 | 00.00 | 00.00 | 70,10,26,00,4 | 11.014100 | 16.1/TT | 92.91 03.15 |
| 00.12 | 00.02 | 00 C30024 | 71 377783 | 1177 60 | 02 54 | 00.00 | | | 50747655 | 1170.111 | VC 20 |
| 29.00 | 28.98 | 4269451.97 | 587476.16 | 1177.35 | PC 20 | 00.76 | 91.99 | 4269389.08 | 587476.46 | 1178.10 | 10.59 |
| 30.00 | 66.94 | 4269450.97 | 587476.42 | 1177.33 | 92.27 | 93.00 | 00.59 | 4269388.08 | 587476.35 | 1178.41 | 93.35 |
| 31.00 | 30.98 | 4269449.98 | 587476.96 | 1177.42 | 92.36 | 94.00 | 94.00 | 4269387.08 | 587476.65 | 1178.49 | 93.43 |
| 32.00 | 31.98 | 4269448.98 | 587476.62 | 1177.46 | 92.40 | 95.00 | 95.00 | 4269386.08 | 587476.98 | 1178.62 | 93.56 |
| 33.00 | 32.99 | 4269447.97 | 587476.09 | 1177.42 | 92.36 | 96.00 | 95.99 | 4269385.09 | 587477.46 | 1178.68 | 93.62 |
| 34.00 | 33.98 | 4269446.98 | 587476.66 | 1177.33 | 92.27 | 97.00 | 96.99 | 4269384.09 | 587477.69 | 1178.94 | 93.88 |
| 35.00 | 34.99 | 4269445.98 | 587476.38 | 1177.61 | 92.55 | 98.00 | 97.99 | 4269383.09 | 587476.89 | 1179.35 | 94.29 |
| 36.00 | 36.00 | 4269444.97 | 587476.33 | 1177.64 | 92.58 | 00.66 | 98.83 | 4269382.26 | 587475.90 | 1179.82 | 94.76 |
| 37.00 | 36.97 | 4269444.00 | 587476.00 | 1177.64 | 92.58 | | 102.14 | 4269378.96 | 587476.45 | 1181.89 | 96.83 |
| 38.00 | 37.97 | 4269443.00 | 587476.68 | 1177.72 | 92.66 | | | | | | |
| 00.65 | 38.99 | 4269441.98 | 58/4/5.96 | 1/.//11 | 92.65 | | | | | | |
| 40.00 | 40.00 | 4204440.98 | 20.0/4/8C | 11//.03 | 16.26 | | | | | | |
| 42.00 | 00.14 | 00.0040044 | 12.014100 | 9V 2211 | 02 40 | | | | | | |
| 43.00 | 42.99 | 4269437.99 | 587476.66 | 1177.26 | 92.20 | | | | | | |
| 44.00 | 43.98 | 4269437.00 | 587476.64 | 1177.29 | 92.23 | | | | | | |
| 45.00 | 44.98 | 4269436.00 | 587476.29 | 1177.40 | 92.34 | | | | | | |
| 46.00 | 45.98 | 4269435.01 | 587476.21 | 1177.41 | 92.35 | | | | | | |
| 47.00 | 46.98 | 4269434.01 | 587476.19 | 1177.20 | 92.14 | | | | | | |
| 48.00 | 47.99 | 4269433.00 | 587476.65 | 1177.16 | 92.10 | | | | | | |
| 49.00 | 40.30 | 1012646024 | 20/4/00 | CZ.//TT | 72.20 | | | | | | |
| 51.00 | 51.00 | 4269430.00 | 587476.51 | 1177.51 | 92.45 | | | | | | |
| 52.00 | 52.00 | 4269429.00 | 587476.42 | 1177.53 | 92.47 | | | | | | |
| 53.00 | 52.98 | 4269428.02 | 587476.48 | 1177.55 | 92.49 | | | | | | |
| 54.00 | 53.99 | 4269427.01 | 587476.56 | 1177.58 | 92.52 | | | | | | |
| 55.00 | 54.96 | 4269426.04 | 587476.37 | 1177.54 | 92.48 | | | | | | |
| 56.00 | 55.99 | 4269425.02 | 587476.51 | 1177.53 | 92.47 | | | | | | |
| 57.00 | 56.99 | 4269424.02 | 587476.31 | 1177.36 | 92.30 | | | | | | |
| 58.00 | 58.00 F8.00 | 4269423.01 | 99.974763 | TC 7711 | 12.26 | | | | | | |
| 00.95 | 00.00 | 4203422.02 | 00.014100 587476.84 | 10.111 | 12.2L | | | | | | |
| 61.00 | 66.09 | 4269420.02 | 587476.81 | 1177.50 | 92.44 | | | | | | |
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| Mr(m) Mr(m) <th< th=""><th>Pin (m) Pin (m) Pin (m) 1178 81 97.06 7.300 7.180 456.956.34 8725.79 1180.15 1179 43 9.445 7.300 7.30 456.915.43 8725.57 1180.15 1179 43 9.445 7.300 7.598 456.915.15 91180.25 1179 43 9.447 75.00 7.598 456.915.15 9725.57 1180.15 1179 43 9.447 75.00 75.97 4269.953.15 9725.57 1180.15 1179 71 9.477 78.00 75.97 456.993.01 9725.56 1179.12 1179 71 9.477 81.00 87.96 456.933.180.05 977.53 1199.12 1179 71 9.477 81.00 87.96 456.932.3 977.53 1179.13 1179 71 9.475 81.00 87.97 456.932.3 977.56 97.93 1179 75 9.46 85.00 81.99 95.954.4 97.955.93 1179.35 1179 72 9.46</th><th>1996 Z 1180/67 9595 Z 1180/67 55.43 1180/57 55.44 1180/58 55.44 1180/58 55.44 1179/53 94.49 1179/53 94.49 1179/53 94.49 1179/53 94.49 1179/53 94.49 1179/53 94.49 1179/53 94.49 1178/53 94.39 1178/53 94.39 1178/53 94.36 1178/54 93.56 1178/55 93.56 1178/54 93.56 1178/54 93.56 1178/55 93.56 1178/54 93.56 1178/54 93.56 1178/54 93.56 1178/54 93.56 1178/54 93.56 1178/54 93.56 117754 93.56 117754 93.56 117754 93.56 117754 93.56</th></th<> | Pin (m) Pin (m) Pin (m) 1178 81 97.06 7.300 7.180 456.956.34 8725.79 1180.15 1179 43 9.445 7.300 7.30 456.915.43 8725.57 1180.15 1179 43 9.445 7.300 7.598 456.915.15 91180.25 1179 43 9.447 75.00 7.598 456.915.15 9725.57 1180.15 1179 43 9.447 75.00 75.97 4269.953.15 9725.57 1180.15 1179 71 9.477 78.00 75.97 456.993.01 9725.56 1179.12 1179 71 9.477 81.00 87.96 456.933.180.05 977.53 1199.12 1179 71 9.477 81.00 87.96 456.932.3 977.53 1179.13 1179 71 9.475 81.00 87.97 456.932.3 977.56 97.93 1179 75 9.46 85.00 81.99 95.954.4 97.955.93 1179.35 1179 72 9.46 | 1996 Z 1180/67 9595 Z 1180/67 55.43 1180/57 55.44 1180/58 55.44 1180/58 55.44 1179/53 94.49 1179/53 94.49 1179/53 94.49 1179/53 94.49 1179/53 94.49 1179/53 94.49 1179/53 94.49 1178/53 94.39 1178/53 94.39 1178/53 94.36 1178/54 93.56 1178/55 93.56 1178/54 93.56 1178/54 93.56 1178/55 93.56 1178/54 93.56 1178/54 93.56 1178/54 93.56 1178/54 93.56 1178/54 93.56 1178/54 93.56 117754 93.56 117754 93.56 117754 93.56 117754 93.56 |
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I hereby give my permission to Alexander Walker to be listed as a coauthor in Chapter 2 of his thesis.

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