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North Platte Snowpack Reconstructions Using Dendrochronology

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To the Graduate Council:

I am submitting herewith a thesis written by Amanda Kate Bowen entitled "North Platte Snowpack Reconstructions Using Dendrochronology." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Environmental Engineering.

Glenn Tootle, Major Professor

We have read this thesis and recommend its acceptance:

John Schwartz, Joanne Logan

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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North Platte Snowpack Reconstructions Using Dendrochronology

A Thesis Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Amanda Kate Bowen
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ABSTRACT

April 1st Snow Water Equivalent (SWE) reconstructions were generated using tree-ring chronologies for the Upper North Platte River Basin (UNPRB), located in north-central Colorado and south-eastern Wyoming. To regionalize April 1st snowpack data from 11 SNOw TELemetry stations (SNOTEL stations), Varimax Rotated Principal Components Analysis (PCA) was used. For the 11 station regionalization, the reconstruction explained 42% of the variance in the instrumental record and extended the record to 1378 (632 years). Retained tree-ring chronologies included those that were stable and positively correlated at 99% confidence levels or higher with the regional snowpack data for a 60–year overlapping period of record from 1940 to 1999. Stepwise Linear Regression was performed for the overlapping (calibration) period to develop regression models for the reconstructions. Eleven stations were individually reconstructed of which three stations (Dry Lake, Old Battle, and Lake Irene) explained variances greater than 40%. A contour plot of the R^2 values for all 11 stations revealed that the more statistically skillful reconstructions were for stations spatially adjacent to the tree-ring chronologies used in the regression models. When the two individual stations with the lowest explained variance were removed from the 11 station snowpack regionalization, the new nine station regionalization reconstruction explained 45% of the variance over the same 632 year period.

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1.0 INTRODUCTION

Water in the western United States has been a source of conflict within the past century, exposing the value of understanding its variability. The North Platte River provides water for agriculture, energy production and urban development in northern Colorado, southeastern Wyoming, and eastern Nevada (Shinker, et al., 2010). U.S. Supreme Court lawsuits over the North Platte River and its main tributaries began in 1911 when Wyoming filed a lawsuit against Colorado regarding water distribution of the Laramie River (Wyoming v. Colorado, 1922; ammended in 1957). The U.S. Supreme Court ruled that Colorado could divert water (15,500 acre-feet per year) primarily for agriculture lands, followed by industrial and energy production. Colorado also allocates the diverted water for municipal and domestic use and recreation (Shinker, et al., 2010).

During the Great Depression in the 1930s, severe drought led Nebraska to file a lawsuit against Wyoming regarding North Platte River water diversions. In 1945, the U.S. Supreme Court reached a decision for this lawsuit and set limitations on the North Platte River in Wyoming (Nebraska v. Wyoming, 1945). Recently, in 2001, Nebraska filed a lawsuit against Wyoming and Colorado leading to the Modified North Platte Decree of 2001 (Shinker, et al., 2010). The Modified North Platte Decree of 2001 resulted in the creation of the North Platte Decree Committee, whom monitor the North Platte River and its main tributaries and ensure implementation of the water right decisions as determined by the U.S. Supreme Court, Exhibits 4 through 15 (Nebraska v. Wyoming and Colorado, 2001).

The primary source of water supply in the Western United States is mountain snowpack runoff, providing 50 to 80 percent of yearly stream flow (Natural Resources Conservation

Service, 2000). Runoff from melting snowpack occurs during the spring and early summer. April 1st snowpack data is commonly considered the maximum seasonal snowpack and is the best indicator of summer runoff from the snowmelt (Cayan, 1996; Woodhouse, 2003; Kuhn, 2005; Timilsena and Piechota, 2008). Variability in North Platte snowpack drives variability in stream flow and water availability for Colorado, Wyoming, and Nebraska. Investigating historical snowpack patterns beyond instrumental records is necessary in the Upper North Platte River Basin.

To address current issues with water rights conflicts in Wyoming, the Wyoming Water Development Commission has initiated a Wyoming Weather Modification Pilot Program (NCAR, 2011). The weather modification program implemented winter cloud seeding to increase snowpack and runoff within Wyoming's Green River Basin, Wind-Bighorn River Basin, and Platte River Basins (NCAR, 2011). Cloud seeding is performed from ground-based and airborne efforts from November 15th to April 15th by dispersing a solution of silver iodide (AgI) (NCAR, 2011). Presently, all of the water in the UNPRB has been completely allocated. Future water demand is the driving force in the Wyoming Weather Modification Pilot Program (NCAR, 2011).

1.1 Existing Studies

Reconstructions based on dendrochronology are a popular means of determining historical streamflow, temperature and precipitation variability (Barnett, et al., 2010; Watson, et al., 2009; Woodhouse, et al. 2006). Snowpack reconstructions using tree-ring chronologies as predictors are becoming more popular (Woodhouse, 2003; Timilsena & Piechota, 2008), but, fewer studies have been completed.

Timilsena and Piechota (2008) regionalized and reconstructed Snow Water Equivalent (SWE) for the Upper Colorado River basin. The study regionalized 39 SNOTEL stations into three distinct regions in the Upper Colorado River basin (Eastern Region, Western Region and Southern Region). The variance explained by the reconstructions was 61%, 44%, and 58%, respectively, and the reconstructions were for 480 year period (Timilsena and Piechota, 2008). Moving averages (3-year, 5-year, and 10-year) were then used to determine droughts in the three basins. It was determined that all three basins had similar periods of droughts, but with different extremes (Timilsena & Piechota, 2008).

Woodhouse (2003) focused on the Gunnison River basin region in western Colorado. The variance explained by the reconstruction was 63% and the reconstruction was for a 431 year period. The study determined that variability in the twentieth century represented the long-term record for the region's general characteristics (mean, standard deviation). The twentieth century, however, lacked extreme events that occurred in the first half of the reconstruction (Woodhouse, 2003).

1.2 Research Goals

To provide a clearer understanding of snowpack variability in the Upper North Platte River Basin (UNPRB), tree–ring chronologies were used to reconstruct historical April 1st SWE. Both individual station and regional April 1st SWE in the UNPRB was reconstructed in order to show how the location of tree–ring chronologies relates to the R^2 values of the reconstructions.

A contribution of this research was the comparison of the regional reconstruction with the eleven individual station reconstructions. Many of the methods used in previous dendrochronology reconstructions were applied in this research. An additional contribution of this research was to provide historical (paleo) snowpack datasets such that water resource

planners and the North Platte Decree Committee have a better understanding of the long term variability of snowpack in the UNPRB. The Wyoming Weather Modification Pilot Program can also use this study to evaluate long term snowpack variability in the UNPRB over the past six centuries.

1.3 Study Area

The North Platte River originates in northern-central Colorado between the Sierra Madre Mountain Range and the Medicine Bow Mountain Range. The North Platte River flows north into south-eastern Wyoming turning east and flowing into Nebraska. The North Platte River is a tributary of the Platte River, which is a major drainage avenue for eastern Wyoming and western Nebraska (Shinker, et al., 2010). The North Platte River is approximately 680 mi (1,094 km) long and the UNPRB is approximately 30,900 sq mi (80,031 sq km) (USGS, 2010). Within and adjacent to the study area, there are 34 SNOTEL stations and 40 tree-ring chronologies (Figure 1).

Historically, the climate of the UNPRB has been semiarid, meaning annual evapotranspiration is greater than annual precipitation, which therefore limits water supplies throughout the watershed (Shinker, et al., 2010). Surface water throughout the region is mainly supplied from winter snowpack from the higher elevations of the Medicine Bow Mountains and the Sierra Madre Mountains in the southwestern region of the basin. Increased springtime temperature has advanced the timing of spring snowmelt and peak river discharge throughout the western United States (Shinker, et al., 2010; Cayan, et al., 2001). Earlier spring runoff threatens to result in less water availability in the summer and a long term trend of less water availability for the western United States (Shinker, et al., 2010).

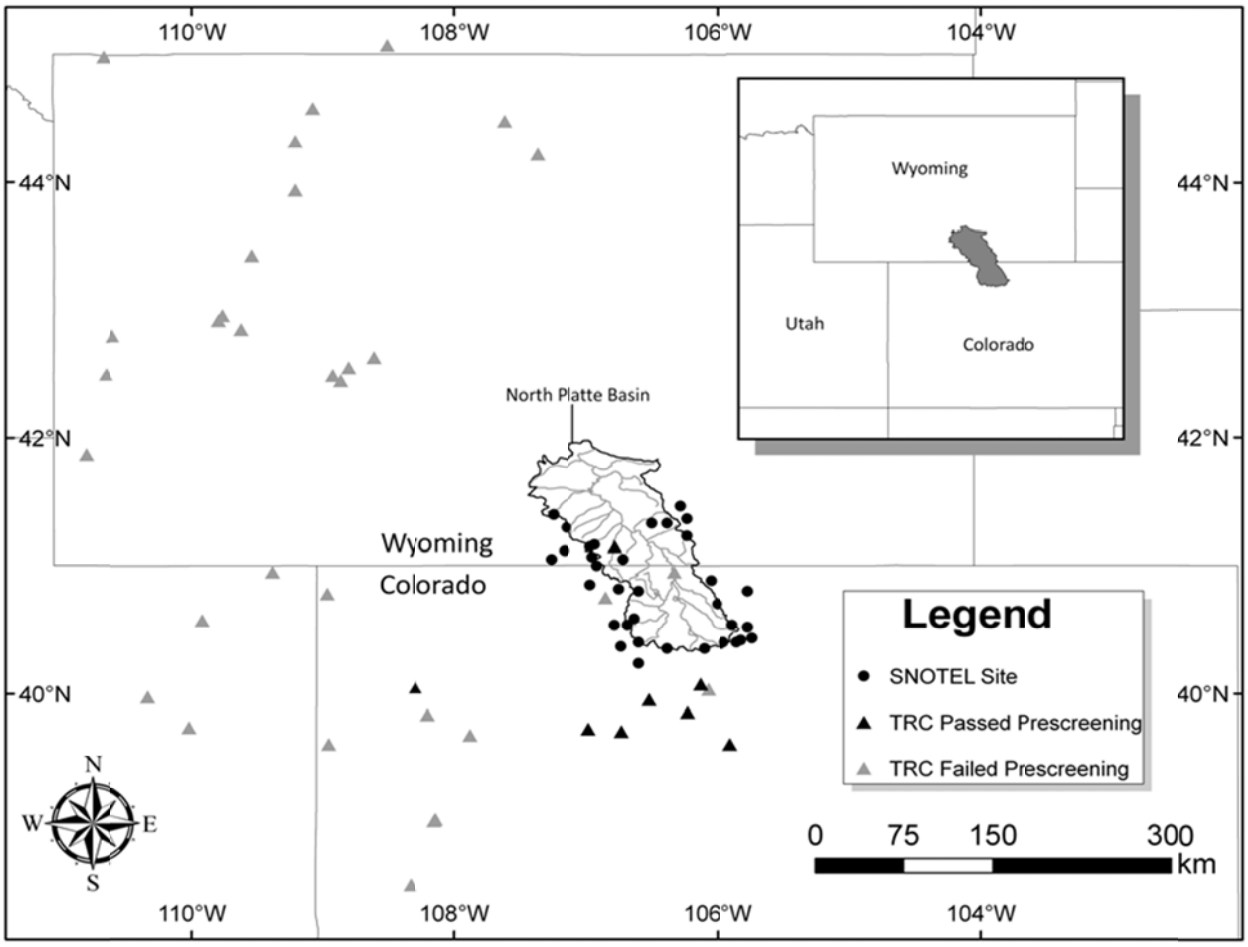

Figure 1. Map of SNOTEL stations and tree-ring chronologies in and adjacent to the Upper North Platte River Basin

2.0 DATA

To create snowpack reconstructions using dendrochronology, two datasets were required. April 1st Snow Water Equivalent (SWE) and dendrochronological data (annual tree-ring widths expressed as residual chronologies) were gathered from established online databases. It was assumed all data collected was developed and maintained according to reputable methods.

2.1 SNOTEL Stations

Snow Water Equivalent (SWE) data for SNOw TELemetry (SNOTEL) stations were collected from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) website (http://www.wcc.nrcs.usda.gov/snow/). The site regulates and maintains SWE, precipitation, temperature, snow depth, and soil moisture data for thirteen states in the western United States. Daily, monthly, and annual data was available. The SWE data consists of snowcourse data (measured by hand) and SNOTEL data (remotely sensed) with the longest period of record in the UNPRB dating back to 1936. Due to the increased interest in climate change in the western United States, several stations have been recently added throughout the basin but their periods of record are too short to be utilized in the current research.

There were 34 stations found to be in or within 20 miles (35 km) of the UNPRB. Eleven SNOTEL stations in the region have complete records of April 1st SWE from 1940 - present (Appendix 1). For this study, April 1st SWE data, given in inches and converted to centimeters, was used. A single missing value in one record, Deadman Hill in 1969, was estimated from a neighboring site per methods described in Woodhouse (2003). The elevations of these stations vary from 8400 ft (2560 m) to 10700 ft (3261 m) (Table 1).

2.2 Tree – Ring Chronologies

There were 40 dendrochronological datasets considered for this study (Figure 1, Appendix 2). The data was obtained from the International Tree Ring Data Bank (ITRDB), recent paleohydrological studies in western Wyoming (Gray, et al., 2004a; Gray, et al., 2004b; Gray, el al., 2007; Barnett, et. al., 2010; Watson, et al., 2009) (Table 2). Due to the possibility of low-order autocorrelation caused by changes in growth factors, residual chronologies were used (Fritts, 1976). Four species, found to be moisture sensitive, were taken into consideration in this study: Douglas Fir (*Pseudotsuga menzesii*), Piñon Pine (*Pinus edulis*), Limber Pine (*Pinus flexilis*), and Ponderosa Pine (*Pinus ponderosa*) (Fritts, 1976).

Table 1. Summary of SNOTEL stations in and around the Upper North Platte River Basin used in study.

Code	Site Name	State	Site #	Longitude	Latitude	Elevation (ft)	Reporting Since
EKR	Elk River	CO	467	-106.97	40.85	8700	1936
COL	Columbine	CO	408	-106.60	40.40	9160	1936
DLK	Dry Lake	CO	457	-106.78	40.53	8400	1936
PHV	Phantom Valley	CO	688	-105.85	40.40	9030	1936
OBT	Old Battle	WY	673	-106.97	41.15	10000	1936
SBC	South Brush Creek	WY	772	-106.50	41.33	8440	1936
BKL	Brooklyn Lake	WY	367	-106.23	41.37	10240	1936
DMH	Deadman Hill	CO	438	-106.77	40.80	10220	1937
LKI	Lake Irene	CO	565	-105.82	40.42	10700	1938
WCP	Willow Creek Pass	CO	869	-106.10	40.35	9540	1938
ROA	Roach	CO	718	-106.05	40.88	9700	1940

Table 2. Tree-ring chronologies that passed pre-screening utilized in the April 1st SWE reconstructions

	Code	Site Name	Latitude	Longitude	Elevation	Species*
¤	*GMR*	*Green Mountain Reservoir*	*39.85*	*-106.23*	*2515*	*PSME*
¤	*PUM*	*Pump House*	*39.95*	*-106.52*	*2195*	*PIED*
¤	*TRG*	*Trail Gulch*	*39.72*	*-106.98*	*2210*	*PIED*
	DIL	Dillon	39.6	-105.9	2880	PSME
	HOT	Hot Sulphur Springs	40.07	-106.13	2500	PSME
	PIC	Piceance	40.05	-108.3	1900	PIED
	RED	Red Canyon	39.7	-106.73	2165	PIED
	ENC	Encampment	41.15	-106.78	2500	PSME

¤ Indicates the chronologies that were used in a reconstruction, as described in section 3.2
* PSME = Douglas fir; PIED = pinyon pine

3.0 METHODOLOGY

To develop accurate models, the methods consisted of four steps: regionalization of snowpack, prescreening, model creation, and model validation.

3.1 Principal Components Analysis for Regionalization

Regionalization of the 11 individual SNOTEL stations enabled a comparison of the individual stations to a regional SWE that was based on spatially and temporally varying climate parameters (Timilsena and Piechota, 2008). To define a snowpack region using the individual stations, Varimax Rotated Principal Components analysis (PCA) was used (Timilsena and Piechota, 2008; Woodhouse, 2003). PCA allowed for the reduction of the dataset without losing the integrity of the dataset (Timilsena and Piechota, 2008).

3.2 Prescreening Methods of Residual Tree-Ring Chronologies

Correlations between April 1st SWE and the 40 residual tree-ring chronologies for the overlapping period of 60 years (1940-1999) was utilized to determine which predictors would be used in the Stepwise Linear Regression model to develop reconstructions of April 1st SWE. The tree-ring chronologies were correlated to each individual station's April 1st SWE and to the regional dataset of April 1st SWE (positive correlation of greater than 99% significance) (Barnett, et al., 2010; Timilsena and Piechota, 2008). Stability analysis was used to confirm that significant changes have not occurred during the period of overlapping record due to natural causes, such as wildfires, insects, and lightning. DendroClim2002 was used to identify stability between the residual chronologies and the April 1st SWE datasets (Biondi and Waikul, 2004).

3.3 Stepwise Linear Regression

Stepwise linear regression is widely accepted in climate reconstructions and was chosen as the method for model development (Barnett, et al., 2010; Woodhouse, 2003; Watson, et al., 2009; Gray, et al., 2004a). Stepwise linear regression uses a forward selection, backward elimination approach with an alpha-to-enter of 0.05 and an alpha-to-remove of 0.10.

First, the stepwise regression model entered predictors (tree-ring residual chronologies) and selected, or retained, the predictors that were statistically significant as determined by a threshold alpha value (0.05). After the stepwise regression model selected the "forward selection" predictors, backward elimination was performed. A threshold alpha value (0.10) determined which predictors were not statistically significant and therefore were rejected. This forward and backward stepping through the predictors continued until the model had selected the predictors that were the most statistically significant.

3.4 Validation Statistics

Using the predictors (residual chronologies) retained during stepwise linear regression, statistical analysis was applied for each of the individual stations April 1st SWE and regional April 1st SWE for the calibration period. Twelve validation statistics were determined; Mallows' C_P, standard error of the regression (S), R^2, R^2 predicted, R^2 adjusted, predicted sum of squares (PRESS), the variance inflation factor (VIF), autocorrelation, Durbin – Watson, the reduction of error (RE) test, the root mean square error (RMSE) test, and the sign test.

3.4.1 Mallows' C_P

Mallows' C_p compares the precision and bias of the full model to the model which contains the best set of predictors. Mallows' C_p is a significant validation test because it allows determination of a balance between the numbers of predictors in the model with another model.

A model with too few predictors can bias its estimates, while one with too many predictors can be imprecise. Mallows' C_p helped determine the models were both precise and unbiased by estimating the true regression coefficients and predicting future responses. The C_p value must be close to the number of predictors plus the number of constant parameters. For example, if a stepwise regression model had one parameter and retained two predictors to explain the parameter, the best Mallows' C_p would be a value of three.

Models with a small C_p value indicate a model that was reasonably precise with small variance in estimating the true regression coefficients and predicting future responses. Models with larger C_p values have a more considerable lack-of-fit and bias. The Mallows' C_p statistic is related to the root mean square error (RMSE) test.

3.4.2 Standard Error of the Regression (S)

The standard error of the regression (S) is a measure of a models fit and accuracy. The S-Value represents the standard distance data values fall from the regression line, or the standard deviation of the residuals. Lower S-Values signified a more precise and accurate regression model and equation.

3.4.3 R^2

The R^2 value represents the proportion of variability in a data set that is accounted for in a statistical model. It is a measure of the percentage of response variation explained with the regression equation and predictor variables. R^2 is always between 0.0 and 1.0 (0 and 100%), with the higher the R^2 value, the better the model fits the data. The more variance that was accounted for by the regression model the closer the data points will fall to the fitted regression line. Theoretically, if all of the data points fall on the fitted regression line (fitted values equaling

observed values) the model would explain 100% of the variance. For this study an acceptable R^2 value was 0.40 or higher (Woodhouse, 2003; Timilsena and Piechota, 2008)

3.4.4 Adjusted R^2

Adjusted R^2 values take into consideration the number of predictors in the model. Increasing the number of predictors typically increases the R^2 for that model, but sometimes this is due to chance alone. A model with more terms may have a better fit simply because it has more terms, but this does not necessarily mean it is the best model. Adjusted R^2 eliminates the possibility of this falsely increased R^2 because the adjusted R^2 value will not increase if the additional predictors are not statistically significant. The adjusted R^2 value increases if the additional predictors improved the model more than just by chance.

3.4.5 Predicted R^2

Predicted R^2 values indicate how well a model predicted responses for additional observations. Predicted R^2 values are useful for comparing models because it is calculated using observations not included in the models estimation. It is used to prevent overfitting, referring to a model that appears to explain the relationship between the predictor and response variable but actually fails to provide valid prediction in new observations. If there is a significant difference between the R^2 and predicted R^2, this may indicate an overfitted model and suggest that the model will not predict new observations nearly as well as its existing data.

Predicted R^2 was calculated by analytically removing each observation from the data set and using the regression equation to estimate the observation then determining how well the model predicted the removed observation (drop one cross-validation). Predicted R^2 values

range from 0.0 to 1.0 (0 to 100%) and was calculated from the PRESS statistic. To get the best predictive ability of a model, a larger value of predicted R^2 was preferred.

3.4.6 Predicted Sum of Squares (PRESS)

The predicted sum of squares (PRESS) value is used to assess the model's predictive capability. The model with the best predictive skill had the smallest PRESS value. The PRESS value is used to help prevent overfitting the model by including calculations using observations not included in the models estimation. The PRESS value is the sum of the squares of the predicted error, and is similar to the error sum of squares (SSE). PRESS was determined by excluding the i^{th} observation from the data sat, estimating the regression equation from the remaining n-1 observations. The fitted regression function was used to obtain the predicted value for the i^{th} observation

3.4.7 Variance Inflation Factor (VIF)

The variance inflation factor (VIF) was used to detect the extent to which correlation within prediction (multicollinearity) occurs in a model. Multicollinearity increases the variance of the regression coefficients and is problematic to a model by making it unstable and difficult to precisely interpret. Moderate multicollinearity is generally not problematic, but severe multicollinearity is a significant issue. VIF is a measure of how much the variance of the estimated regression coefficients are inflated compared to non-linearly related predictor variables.

If the VIF equaled 1, there was no multicollinearity but if the VIF was greater than 1, predictors were moderately correlated. However, if the VIF becomes 5 to 10, the regression coefficients are poorly estimated and the model is not considered a reasonable model. VIF

values greater than 10 indicate extreme multicollinearity and are excessively influencing the regression results. Possible solutions to severe multicollinearity would be to remove the highly correlated predictors from the model because they supply redundant information. Removing them does not drastically reduce the R^2 in most cases.

3.4.8 Durbin – Watson Statistic

The Durbin-Watson Statistic was also calculated to ensure there was no low-order autocorrelation in the residuals that were chosen in the stepwise linear regression. The Durbin – Watson statistic tests for autocorrelation in non-missing observations by determining whether or not the correlation between two adjacent error terms is zero, assuming the errors were generated by a first – order autoregressive process. The error terms are then correlated and examined with upper and lower bounds using an autocorrelation significance of 5% or less. If the Durbin – Watson value is greater than the upper bound, no correlation exists; however, if it is lower a positive correlation exists. For this study, because there were 60 terms that were being correlated, the Durbin – Watson bound was 1.5 for 95% significance (autocorrelation was 5% significant or less). Any Durbin – Watson value greater than 1.5 showed no autocorrelation, less than 1.5 meant there was a significant autocorrelation in the model, and if it equaled 1.5 the test was inconclusive.

3.4.9 Reduction of Error (RE)

The reduction of error (RE) statistic is used to evaluate the estimation potential of the regression model. It is similar to R^2 because it measures the strength of the calibration. It compares the mean square error of the calibration data to the mean square error of the time equivalent value of the instrumental data. If the reconstruction has significant predictive value it would do a more precise job than just the sample average over the calibration period, and would

be positive and greater than zero. The sum of the distance the calibration fits from the instrumental data squared divided by the sum of the distance the calibration fits from the instrumental average squared is the RE statistic value.

3.4.10 Root Mean Square Error Test (RMSE)

The root mean square error (RMSE) test is used to calculate estimation precision in the regression model. It measures the difference between values predicted by a model and those actually observed. It is expressed in the same units as the instrumental data. For this research, RMSE explained how many cm, plus or minus, off the model was on average for the calibration of April 1st SWE.

3.4.11 Sign Test

The sign test is used to test the hypothesis that there is no difference in the medians between the instrumental data and the reconstructed data. It is a non-parametric test and makes very few assumptions about the nature of the distribution of the test. To test the data with a sign test the mean of the instrumental data was calculated. The difference between the mean and instrumental data and also the reconstructed data was determined. If the sign of the difference was the same then the model predicted a “hit”, meaning the model predicted the correct magnitude from the average that actually occurred in the instrumental record. A “miss” meant the model did not correctly predict the correct magnitude from the average. Passing a sign test was dependent on the number of parameters in the model. For this study there are 60 years of data and to pass the sign test with 99% significance only 19 or less misses were allowed, for 95% significance only 21 or less misses were allowed.

4.0 RESULTS

The three most statistically skillful individual SNOTEL stations (Dry Lake, Old Battle, and Lake Irene) and the regionalized April 1st SWE were evaluated.

4.1 Principal Components Analysis Results

All 11 SNOTEL stations were retained in the first component of the Principal Components Analysis, denoted by an eigenvalue of 8.32 (Appendix 3). This first component was the only component with an eigenvalue greater than 1.0, so no other components were retained (Woodhouse, 2003). The first principal component accounted for 76% of the explained variance for the 11 SNOTEL stations. To create the regional April 1st SWE dataset, the yearly values for the 11 stations were averaged (Woodhouse, 2003; Timilsena and Piechota, 2008) to form one dataset.

4.2 Prescreening of Residual Tree-Ring Chronologies Results

Of the 40 tree-ring residual chronologies, ten residual chronologies were positively correlated (significance greater than 99%) for each eleven individual snowpack stations and the regional snowpack dataset. DendroClim2002 determined that two of the tree-ring chronologies lost stability during some part of the overlapping history. This resulted in eight residual tree-ring chronologies used in stepwise linear regression to develop reconstruction models (Figure 1) (Table 2).

4.3 Statistical Validation Results

Three stations (Dry Lake, Old Battle and Lake Irene) resulted in R^2 values greater than 0.40. The predicted R^2 values were 10 to 14% lower than the R^2 value for the stations. The largest VIF value was 1.6, which was on the lower end of the scale in determining

multicollinearity. Therefore, some autocorrelation was present but it was insignificant (Table 3) (Appendix 4).

The Mallows' C_p test is beneficial for comparing two models that predict the same response (i.e. SWE). The closer the C_p value was to the number of predictors plus one, the more precise and less bias the model was. Dry Lake and Lake Irene resulted in the best Mallows' C_p values (Table 4) (Appendix 4).

Significant autocorrelation at 95%, displayed by the Durbin-Watson statistic, was not observed in the Dry Lake, Old Battle, or Lake Irene reconstruction models (Table 5). Also, the RE values for all three stations were positive and greater than zero displaying that all of the models were considered statically significant in their potential to estimate new values (Table 5). The RMSE showed within how many centimeters (±) the models predicted from the average April 1st SWE (Table 5). For example, the Dry Lake RMSE was 10.12 cm, which meant that the model accurately predicted April 1st SWE within ±10.12 cm of the instrumental value. Dry Lake, Old Battle, and Lake Irene each passed the sign test with 99% significance.

Table 3. Regression Analysis Statistical Results

SNOTEL Station	S	R^2	Adj R^2	Pred R^2	PRESS	VIF
Dry Lake (DLK)	*10.4*	*0.48*	*0.46*	*0.43*	*6710.5*	*1.6*
Old Battle (OBT)	*14.8*	*0.42*	*0.40*	*0.36*	*13836.6*	*1.4*
Lake Irene (LKI)	*12.4*	*0.41*	*0.39*	*0.35*	*9662.3*	*1.6*
Columbine (COL)	12.1	0.36	0.33	0.30	9000.4	1.0
Deadman Hill (DMH)	6.8	0.33	0.32	0.29	2845.8	1.0
Willow Creek Pass (WCP)	6.0	0.33	0.31	0.25	2311.8	1.4
Phantom Valley (PHV)	5.4	0.30	0.27	0.23	1823.0	1.6
Roach (ROA)	7.7	0.29	0.28	0.24	3686.7	1.0
Elk River (EKR)	10.0	0.28	0.27	0.23	6165.3	1.0
Brooklyn Lake (BKL)	15.1	0.19	0.18	0.15	13974.5	1.0
South Brush Creek (SBC)	6.4	0.17	0.16	0.12	2546.0	1.0

Table 4. Retained Tree-Ring Chronologies (TRC) and Mallows' C_p

SNOTEL Station	# Predictors	TRC retained	Mallows' C_p
Dry Lake (DLK)	*2*	*GMR, PUM*	*1.9*
Old Battle (OBT)	*2*	*GMR, TRG*	*6.4*
Lake Irene (LKI)	*2*	*GMR, PUM*	*4.2*
Columbine (COL)	2	GMR, PUM	3.0
Deadman Hill (DMH)	1	GMR	5.2
Willow Creek Pass (WCP)	2	TRG, GMR	1.6
Phantom Valley (PHV)	2	GMR, PUM	0.2
Roach (ROA)	1	GMR	8.7
Elk River (EKR)	1	PUM	0.4
Brooklyn Lake (BKL)	1	GMR	7.2
South Brush Creek (SBC)	1	GMR	-0.5

Table 5. Statistical Validation Results

SNOTEL Station	Durbin - Watson	RE	RMSE (cm)	% Avg.	Sign Test (# Misses)	TRC retained
Dry Lake (DLK)	*2.1*	*0.48*	*10.1*	*20.2*	*14*	*GMR, PUM*
Old Battle (OBT)	*1.9*	*0.42*	*14.4*	*20.2*	*17*	*GMR, TRG*
Lake Irene (LKI)	*2.1*	*0.41*	*12.1*	*22.4*	*12*	*GMR, PUM*
Columbine (COL)	2.3	0.26	12.6	24.9	22	GMR, PUM
Deadman Hill (DMH)	2.2	0.33	6.7	23.9	13	GMR
Willow Creek Pass (WCP)	2.0	0.33	5.9	22.4	16	TRG, GMR
Phantom Valley (PHV)	2.0	0.30	5.3	25.2	18	GMR, PUM
Roach (ROA)	2.6	0.29	7.6	24.4	18	GMR
Elk River (EKR)	2.0	0.28	9.8	24.3	21	PUM
Brooklyn Lake (BKL)	1.8	0.19	14.8	26.9	18	GMR
South Brush Creek (SBC)	2.3	0.17	6.3	27.5	21	GMR

4.3.1 Dry Lake

The Green Mountain Reservoir (GMR) and Pump House (PUM) tree-ring chronologies were retained and the reconstruction model resulted in an R^2 value of 0.48. The predicted R^2 had a value of 0.43 and PRESS statistic was the lowest for the three stations. The RMSE magnitude was approximately 20% of the mean. Based on the R^2, R^2 predicted, PRESS statistic, and RMSE value, the Dry Lake April 1st SWE reconstruction model was considered a highly skilled model.

4.3.2 Old Battle

The Green Mountain Reservoir (GMR) and Trail Gulch (TRG) tree-ring chronologies were retained and the reconstruction model resulted in an $R^2 = 0.42$ and a R^2 predicted = 0.35. The PRESS statistic was the highest of the three stations, which was expected because Old Battle had larger magnitudes of April 1st SWE, which was most likely attributed to the station's higher elevation. The RMSE was approximately 20% of the mean which compared favorably to the Dry Lake model. Based on these results, the Old Battle April 1st SWE reconstruction model was considered a moderately to highly skilled model.

4.3.3 Lake Irene

The Green Mountain Reservoir (GMR) and Pump House (PUM) tree-ring chronologies were retained and the reconstruction model resulted in an $R^2 = 0.41$. The predicted R^2 value was 0.35 and the RMSE was approximately 22% of the mean. Based on the R^2, PRESS statistic, and RMSE value, the Lake Irene April 1st SWE reconstruction model was considered a moderately to highly skilled model.

4.3.4 Regional April 1st SWE

Principal Components Analysis (Varimax Rotated) was used to develop a regional April 1st SWE data set. The first principal component accounted for 76% of the explained variance for the 11 SNOTEL stations. To create the regional April 1st SWE dataset, the yearly values for the 11 stations were averaged (Woodhouse, 2003; Timilsena and Piechota, 2008) to form one dataset. However, based on the results of the individual stations (Table 3), it was noted that two of the stations, South Brush Creek (SBC) and Brooklyn Lake (BLK) performed very poorly, with R^2 values less than 0.20. Therefore, two regional snowpack datasets were developed. The first regional reconstruction utilized all eleven stations while the second regional snowpack dataset utilized nine stations, removing SBC and BLK.

Stepwise linear regression and statistical validation was performed on both snowpack regionalizations. The eleven station April 1st SWE reconstruction model resulted in an R^2 of 0.42 while the nine station April 1st SWE reconstruction model resulted in a R^2 of 0.45. The remaining validation statistics (adjusted R^2, predicted R^2, the S value, PRESS statistic, and VIF) were similar (Table 6). The Mallows' C_p for the nine station Regional April 1st SWE reconstruction model (Table 7) was slightly better when compared to the eleven station model and the RSME was smaller for the nine station Regional April 1st SWE reconstruction model (Table 8). The remaining statistics (Durbin-Watson, RE, and Sign Test) displayed that the nine station Regional April 1st SWE reconstruction model passed with 95% significance. Therefore, it was determined that the nine station Regional April 1st SWE reconstruction model was more accurate and contains a better predictive capability for the UNPRB than the eleven station Regional April 1st SWE reconstruction model.

Table 6. Regional April 1st SWE Statistical Analysis

SNOTEL Station	S	R^2	Adj R^2	Pred R^2	PRESS	VIF
SWE 11	8.1	0.42	0.40	0.36	4090.8	1.6
SWE 9 (w/o SBC, BKL)	7.9	0.45	0.43	0.40	3937.9	1.6

Table 7. Regional April 1st SWE Mallows' C_p

SNOTEL Station	# Predictors	TRC retained	Mallows' C_p
SWE 11	2	GMR, PUM	4.5
SWE 9 (w/o SBC, BKL)	2	GMR, PUM	3.7

Table 8. Regional April 1st SWE Statistical Validation

SNOTEL Station	Durbin - Watson	RE	RMSE (cm)	% Avg.	Sign Test (# Misses)	TRC retained
SWE 11	2.2	0.42	7.9	21.5	17	GMR, PUM
SWE 9 (w/o SBC, BKL)	2.2	0.45	7.8	20.7	12	GMR, PUM

4.4 Regression Equations, Model Calibrations, and Reconstructions

This section presents the regression equations (Appendix 5), calibration models (Appendix 6 and Appendix 7), and reconstruction models (Appendix 8 and Appendix 9) for Dry Lake, Old Battle, Lake Irene and the nine station Regional April 1st SWE dataset. End year filters (5-year, 10-year, and 20-year) were developed for each of the stations and the regionalization.

4.4.1 Regression Equations and Model Calibrations

Regression equations were determined using the retained tree-ring chronologies from Stepwise Linear Regression (Table 9). Upon determining the regression equations, the models were compared by graphing the reconstructed fits and the observed SWE for comparison (Figure 2). A visual assessment determined models under predicted snowpack during the 1950's. The 1970's had several years with under predictions, but the oscillation was matched by the models. In the 1990's, Old Battle, Lake Irene and the nine station Regional April 1st SWE calibrations have periods where the model over predicts the instrumental record. During the 1960's and 1980's, all models were moderately precise in their predictions of April 1st SWE.

Table 9. Regression Equations for Dry Lake, Old Battle, Lake Irene, and Nine Station Regional Reconstructions

SNOTEL STATION	Retained Predictors	Regression Equation
Dry Lake (DLK)	GMR, PUM	DLK = 20.373 + 17.413*GMR + 18.559*PUM
Old Battle (OBT)	GMR, TRG	OBT = 41.745 + 21.603*GMR + 18.719*TRG
Lake Irene (LKI)	GMR, PUM	LKI = 26.746 + 17.545*GMR + 20.051*PUM
Nine Station Regional	GMR, PUM	SWE 9 = 24.160 + 13.151*GMR + 12.807*PUM

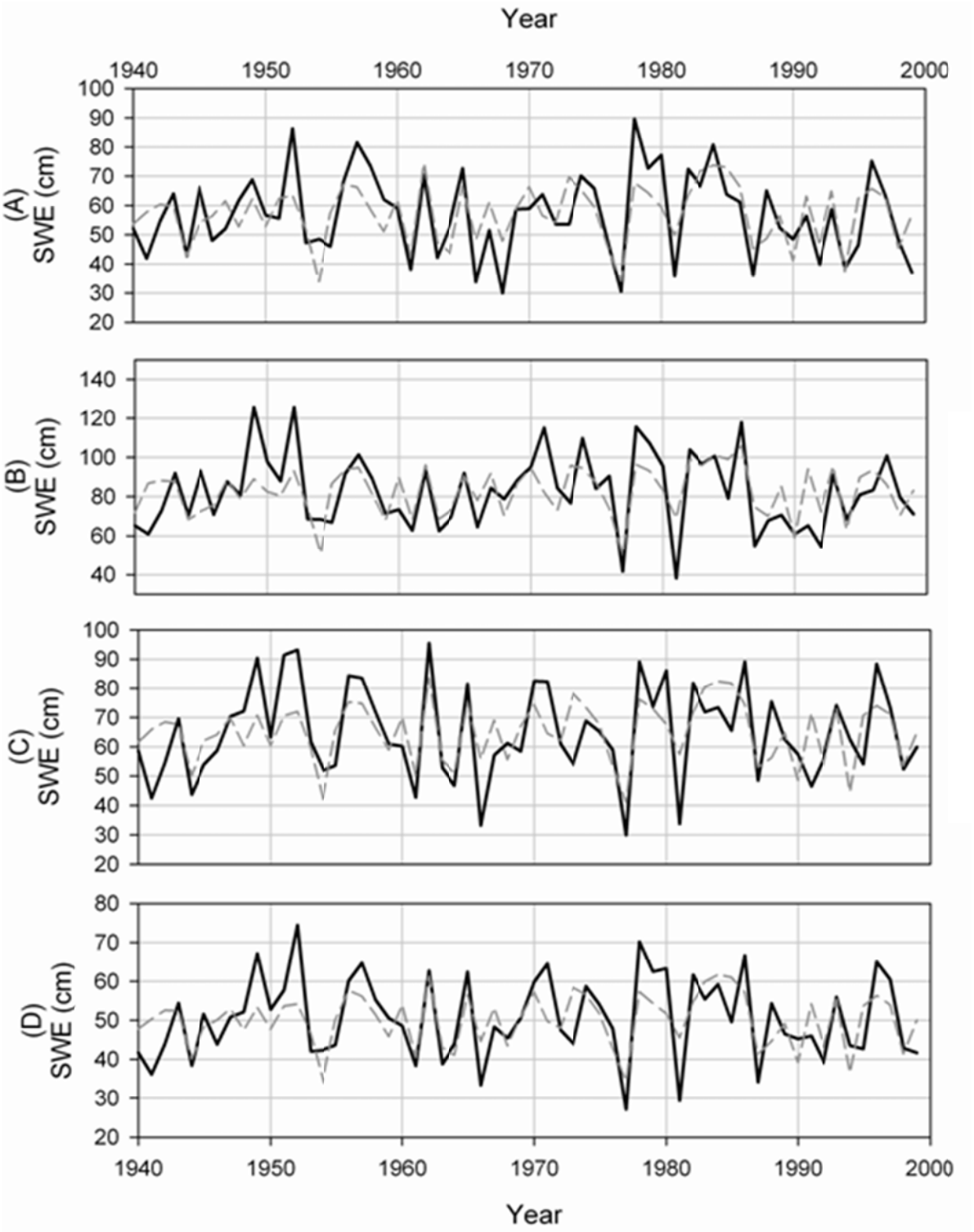

Figure 2. Calibration Results (A) Dry Lake, (B) Old Battle, (C) Lake Irene, (D) Nine Station Regional. The dark line is the instrumental data; the dashed gray line is the reconstruction model.

4.4.2 Model Reconstructions

For the reconstruction data, 5-year, 10-year, and 20-year end year filters were developed to observe the long term trends in the data for Dry Lake, Old Battle, Lake Irene, and the nine station Regional April 1st SWE (Figures 3, 4, 5, and 6). Dry Lake, Lake Irene and the nine station Regional April 1st SWE reconstruction models reconstructed April 1st SWE for a period of 623 years (1378-2000) while the Old Battle April 1st SWE reconstruction model reconstructed April 1st SWE for a period of 509 years (1402-2000).

Each model displayed very similar extreme periods of wetness and droughts. It appeared there were extreme droughts in the mid-1400s, the early-1500s and early- and late-1600s. It also appeared that over the last century, the stations in the UNPRB region have seen moderately wet years of SWE. To get a more precise understanding of the actual drought trends, an in-depth drought analysis would need to be preformed.

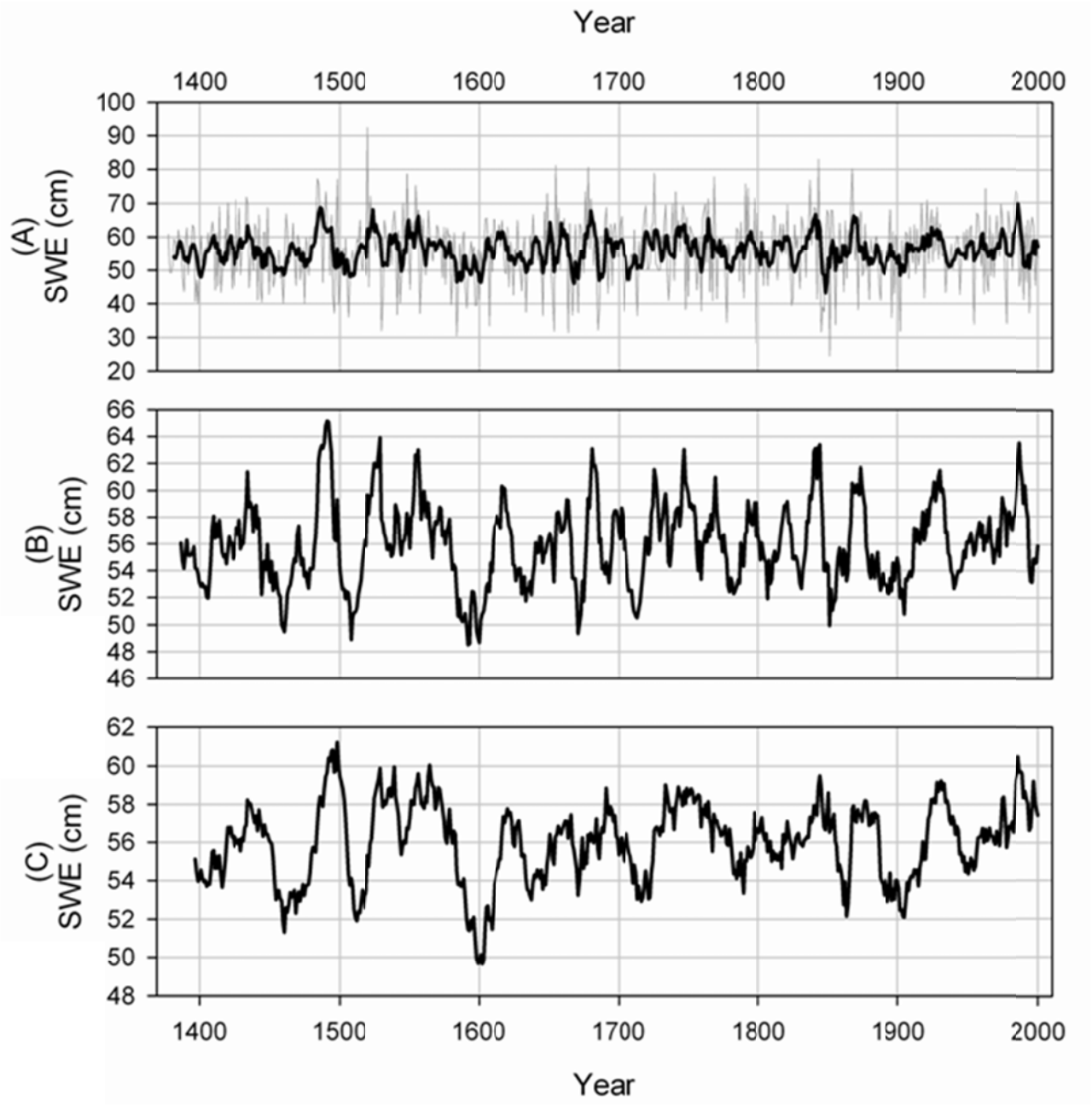

Figure 3. Dry Lake Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)

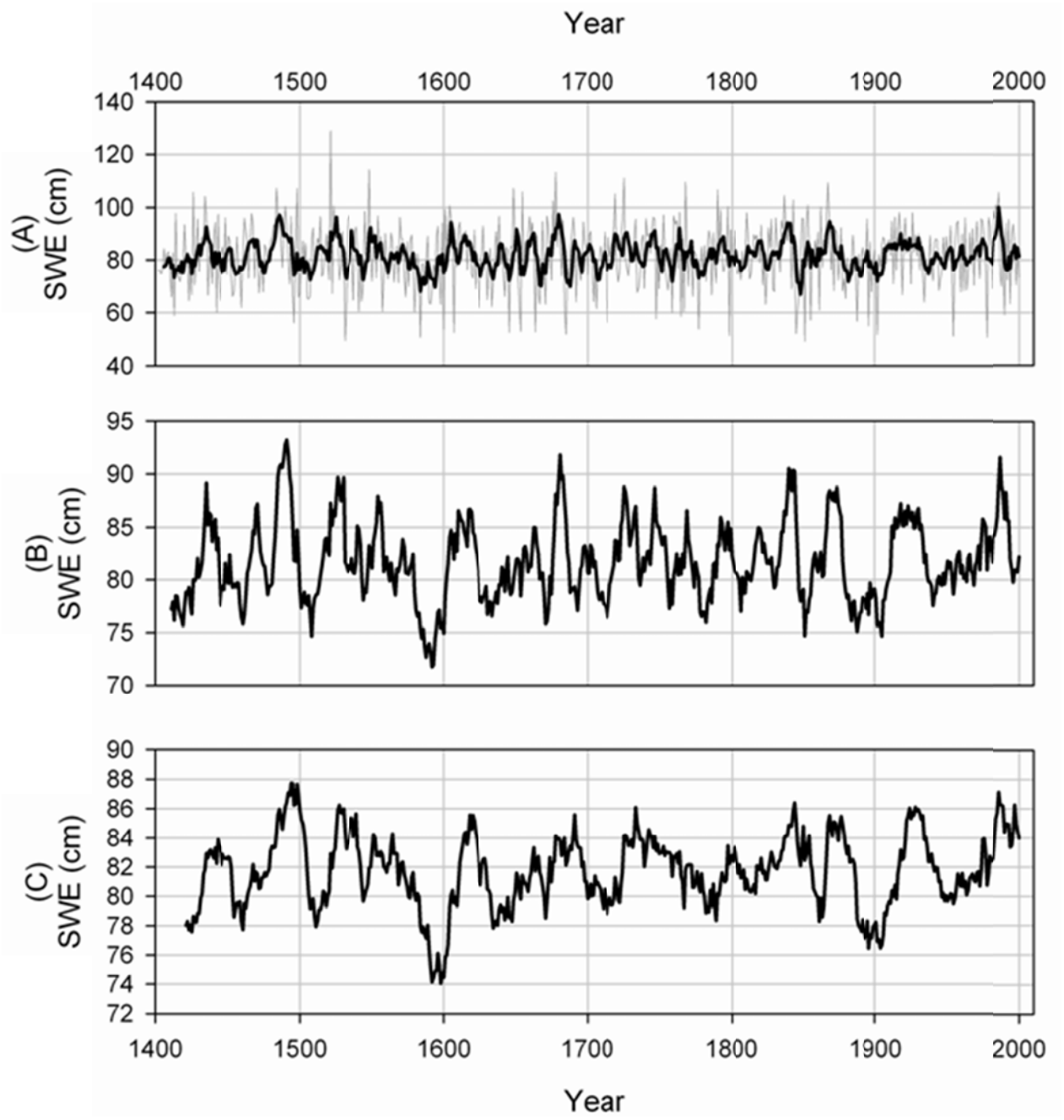

Figure 4. Old Battle Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)

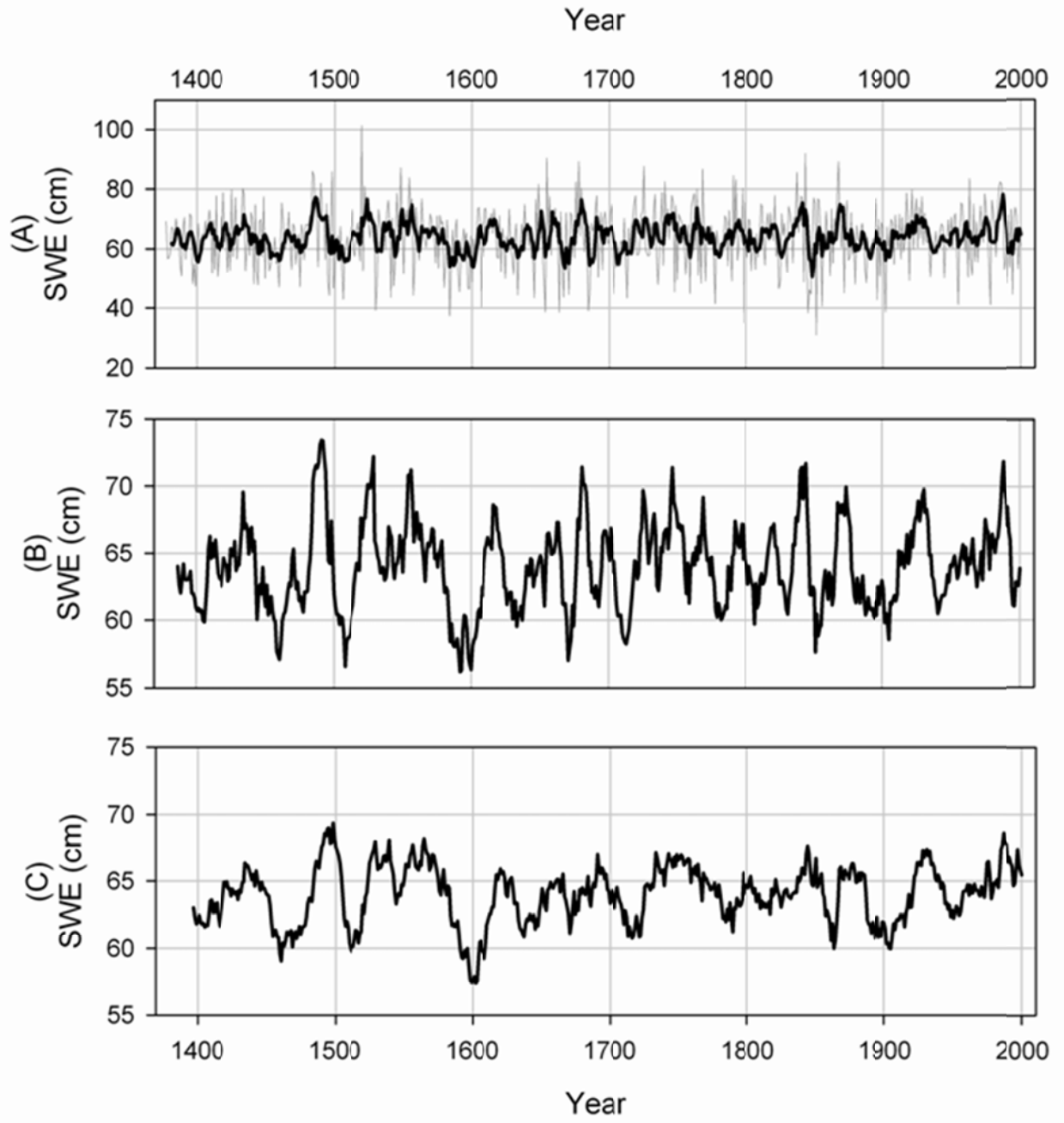

Figure 5. Lake Irene Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)

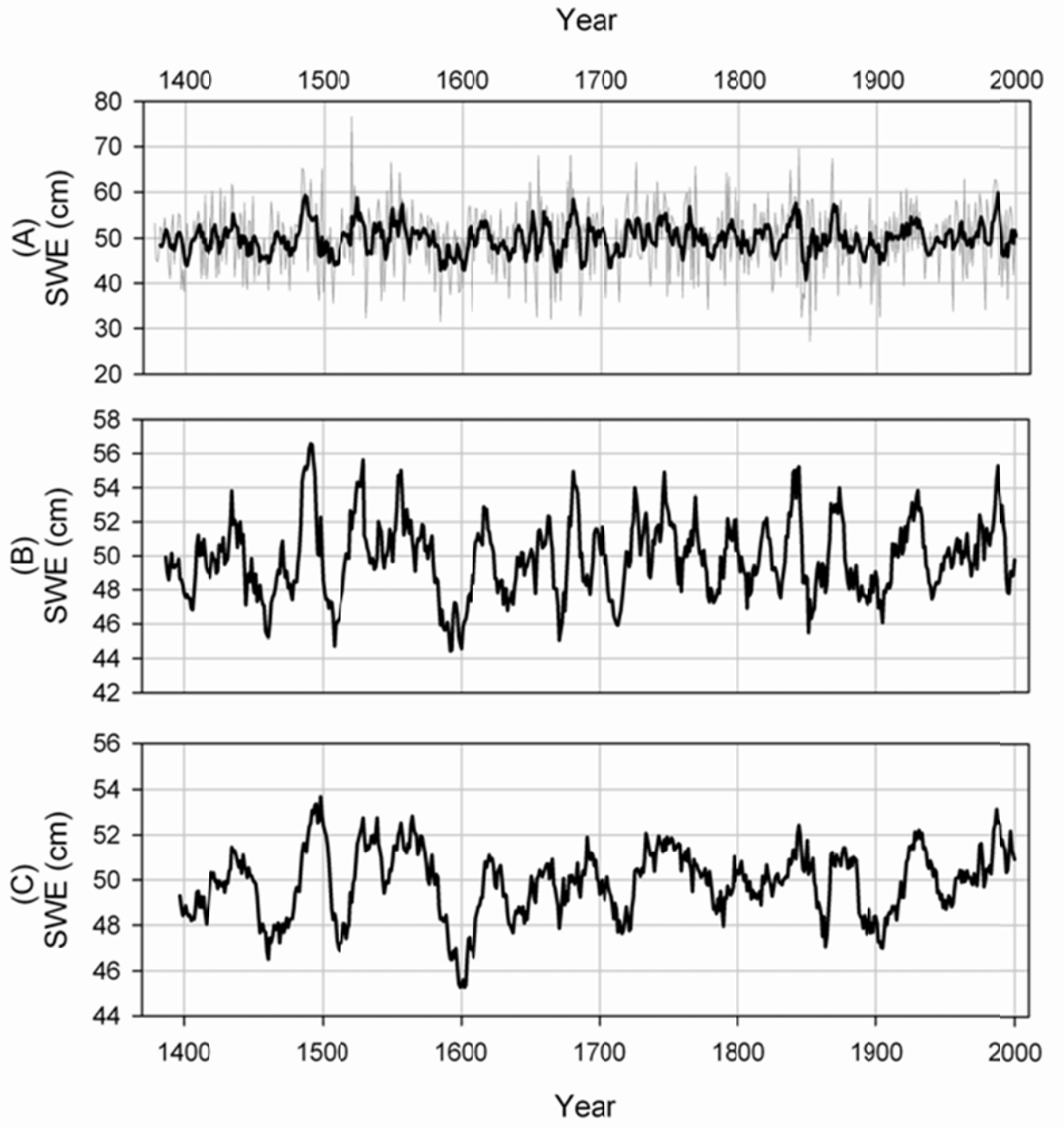

Figure 6. Nine station Regionalization Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)

4.5 Residual Tree-Ring Chronologies

One of the findings of this study was that the lack of tree-ring chronologies in and adjacent to the UNPRB may have attributed to the lower R^2 values for these reconstructions. Of the 40 tree-ring chronologies collected for this research, only eight passed the prescreening requirements (Figure 1). Only three residual tree-ring chronologies (Appendix 10) were retained in Stepwise Linear Regression (Figure 8). Reviewing a contour plot of the R^2 values, the stations spatially near the retained tree-ring chronologies displayed higher R^2 values (Figure 8).

Three of the eight tree-ring chronologies were retained in at least one snowpack reconstruction. The Green Mountain Reservoir tree-ring chronology was the most frequently retained chronology, followed by the Pump House tree-ring chronology. Trail Gulch was only retained in the reconstruction of Old Battle April 1st SWE. Pump House and Trail Gulch were both Piñyon Pine and Green Mountain Reservoir was a Douglas Fir. This was consistent with the types of trees used for dendrochronology reconstructions in the western United States (Woodhouse, 2003)

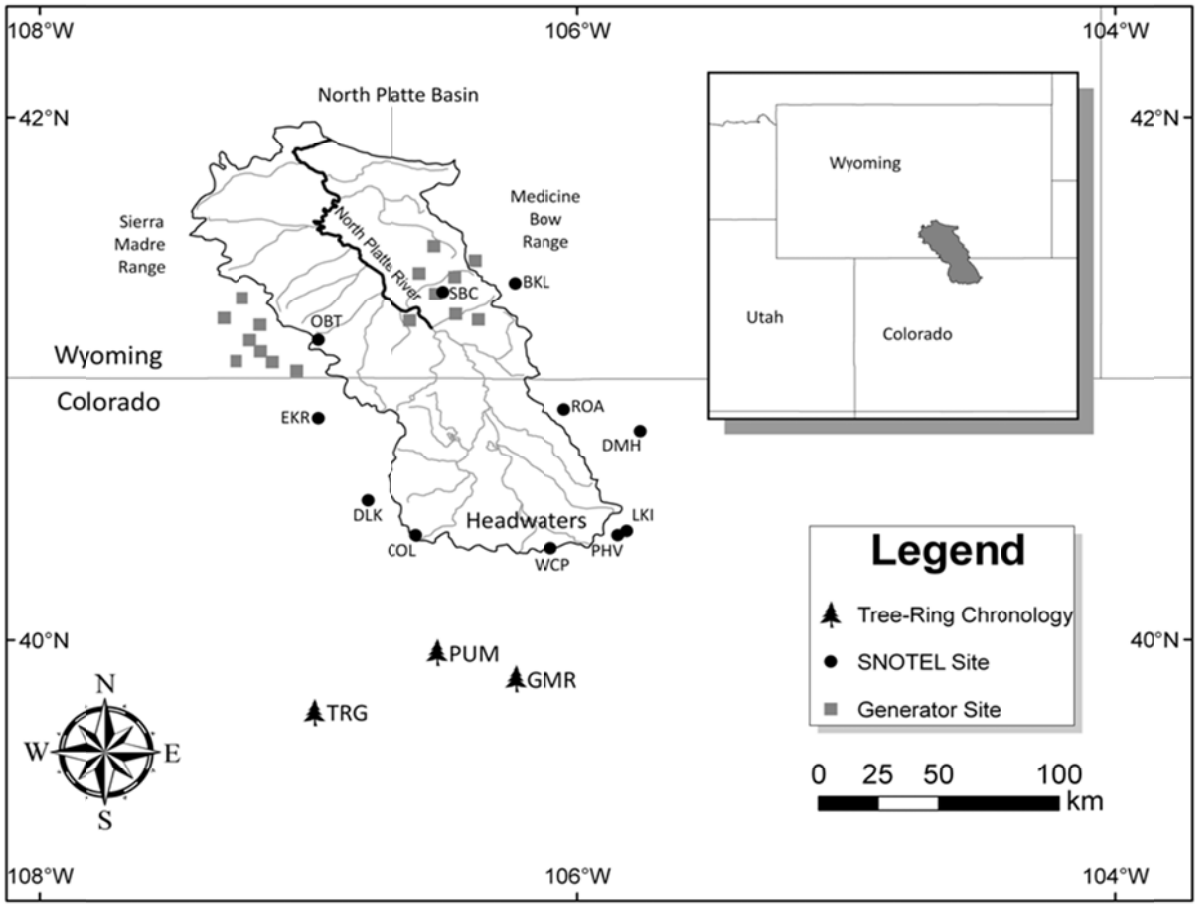

Figure 7. Map of Retained Tree-Ring Chronologies in and adjacent to Upper North Platte River Basin

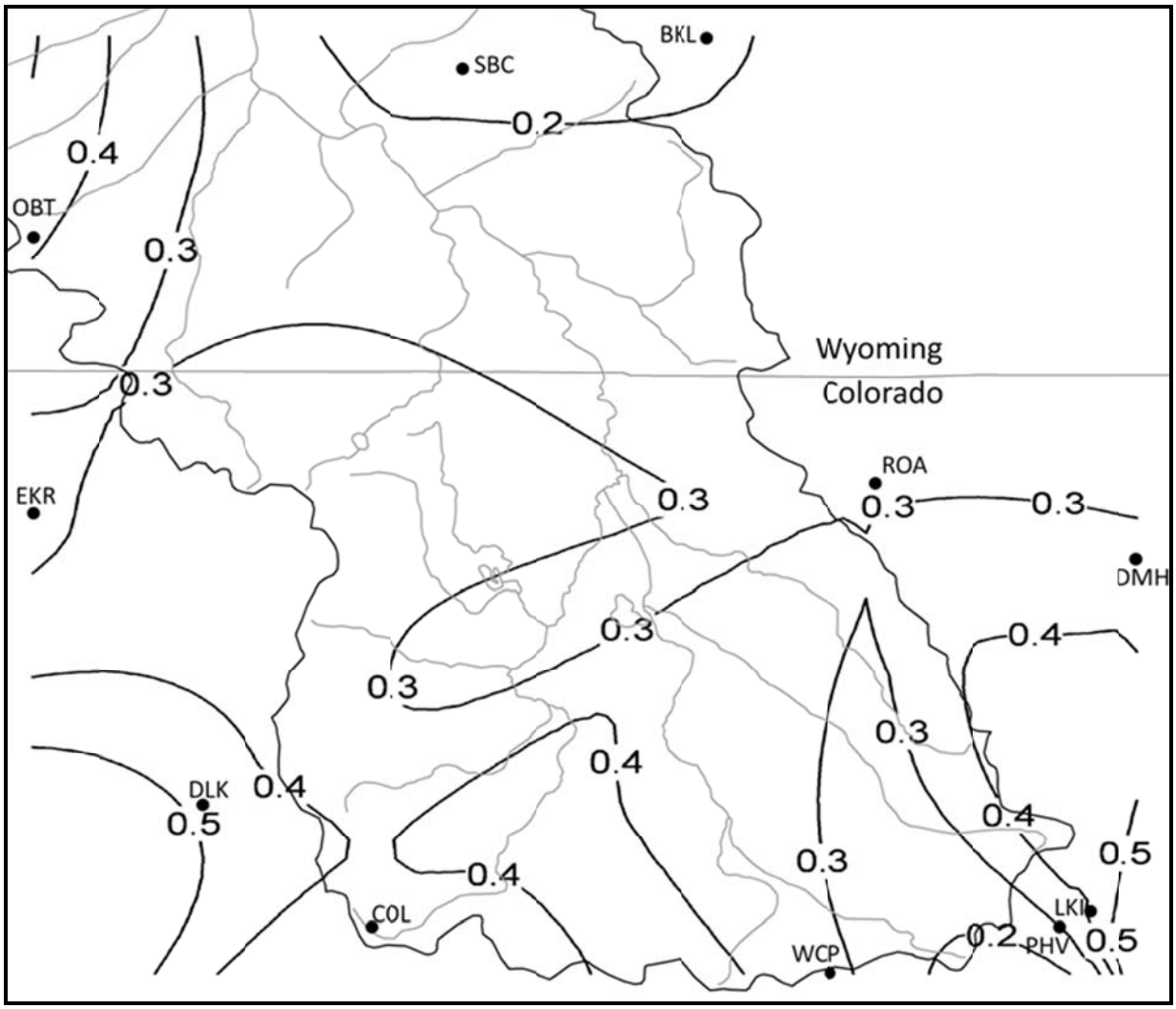

Figure 8. Contour Plot of R^2 Values for Eleven Individual Stations

5.0 CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

This study identified challenges in developing reconstructions of April 1st SWE in the UNPRB. Dry Lake (R^2 = 0.48), Old Battle (R^2 = 0.42), Lake Irene (R^2 = 0.41), and the nine station Regional (R^2 = 0.45) reconstructions, all displayed acceptable skill (R^2 ≥ 0.40) for western U.S snowpack reconstructions and the results were similar to Region 2 (R^2 = 0.44) of Timilsena and Piechota (2008). However, the R^2 values were lower than the Gunnsion River basin reconstruction (R^2 = 0.63) (Woodhouse, 2003), and the Upper Colorado River basin Region 1 (R^2 = 0.61) and Region 2 (R^2 = 0.58) (Timilsena and Piechota, 2008). Analyzing the R^2 contour plot (Figure 8), it appeared that this may be attributed to the lack of moisture sensitive tree-ring chronologies in and around the UNPRB.

The relative wetness of the last century and the severe droughts throughout the past six centuries may challenge water planners in determining allocations of future water allocations. This study provided a baseline for future research efforts by exploring the long-term variability of UNPRB April 1st SWE. Future research should focus on developing new tree-ring chronologies in the UNPRB and performing drought analysis (frequency, magnitude, duration, severity). Given the strong moisture signal of the Green Mountain Reservoir residual chronology, efforts should focus on extending the network of Douglas Fir chronologies in the region. Water resource managers in the UNPRB rely on long-term hydrologic data that instrumental records, alone, cannot provide. A drought analysis of snowpack would be beneficial to accurately denote extremes in the reconstructions for a clearer understanding of the climate history of the UNPRB.

LIST OF REFERENCES

Barnett, F., Gray, S., & Tootle, G. (2010). Upper Green RIver Basin (United States) streamflow reconstructions. *J. of Hydro. Engr. , 15*, 567-579.

Biondi, F., & Waikul, F. (2004). DENDROCLIME2002: A C++ Program for Statistical Calibration of Climate Signals in Tree-Ring Chronologies. *Computer and Geosciences , 30* (3), 303-311.

Cayan, D. (1996). Interannual climate variability and snowpack in the western United States. *J. Climate , 9*, 928-948.

Cayan, D., Kammerdiener, S., Dettinger, M., Caprio, J., & Peterson, D. (2001). Changes in the onset of spring in the western United States. *Bulletin of the American Meteorological Society , 82*.

Fritts, H. (1976). *Tree Rings and Climate.* London: Academic Press.

Gray, S., Fastie, C., Jackson, S., & Bentancourt, J. (2004b). Tree-ring based reconstructions of precipitation in the Bighorn Basin, Wyoming since AD 1260. *Journal of Climate* , 3855-3865.

Gray, S., Gramulich, L., Betancourt, J., & Pederson, G. (2004a). A tree-ring based reconstruction of the Atlantic Multidecadal Oscillation Since 1567 A.D. *Geophysical Research Letters* , L12205.

Gray, S., Graumlich, L., & Betancourt, J. (2007). Annual precipitation in the Yellowstone National Park region since AD 1173. *Quaternary Research* , 18-27.

ITRDB, Iternational Tree-Ring Data Base. *Tree-ring data search.* Retrieved from http://www.ncdc.noaa.gov/paleo/treering.html

Kuhn, G. (2005). Historical perspective of statewide stream flows during the 2002 and 1977 droughts in Colorado. *Scientific Investigations Report, 2005 - 5171, USGS* , 84.

NCAR, T. N. (2011). *Wyoming Weather Modificiation Pilot Project* . Retrieved March 28, 2011, from NCAR Research Applications Laboratory (RAL): http://www.ral.ucar.edu/projects/wyoming/

Nebraska v. Wyoming, 108 (Original), 325 U.S. 589, 665 (U.S. Supreme Court 1945).

Nebraska v. Wyoming and Colorado, 534 U.S. 40 (U.S. Supreme Court 2001).

NRCS, N. R. (2000). *Snow Surveys and Water Supply Forecasting*. Retrieved February 22, 2010, from Natural Resources Conservation Service (NRCS): http://www.wcc.nrcs.usda.gov/factpub/aib536.html

Shinker, J., Shuman, B., Minckley, T., & Henderson, a. A. (2010). Climatic Shifts in the Availability of Contested Waters: A Long-Term Perspective from the Headwaters of the North Platte River. *Annuals of the Association of American Geographers , 100* (4), 866-879.

Timilsena, J., & Piechota, T. (2008). Reginalization and reconstruction of snow water equivalent in the upper Colorado River basin. *J. of Hydrology , 352*, 94-106.

USGS, United States Geological Survey (2010). *Boundary Descriptions and Names of Regions, Subregions, Accounting Units and Cataloging Units*. (U.S. Department of the Interior) Retrieved 03 04, 2011, from USGS - Water Resources of the United States: http://water.usgs.gov/GIS/huc_name.html

Watson, T., Barnett, F., Gray, S., & Tootle, G. (2009). Reconstructed streamflows for the headwaters of the Wind River, Wyoming, United States. *Journal of the American Water Resources Association (JAWRA)* , 1-13.

Woodhouse, C. (2003). A 431-yr reconstruction of western Colorado snowpack from tree rings. *J. of Climate , 16*, 1551-1561.

Woodhouse, C., Gray, S., & Meko, D. (2006). Updated streamflow reconstructions for the Upper Colorado River basin. *Water Resources Research* , 1-16.

Wyoming v. Colorado, 259 U.S. 419 (U.S. Supreme Court 1922, ammended in 1957).

APPENDICES

Appendix 1. Observed Data for Eleven SNOTEL Stations and Created Regionalization

Instrumental Data for Dry Lake, Old Battle, Lake Irene and Regionalization

Year	Eleven Station Regionalization	Nine Station Regionalization	Dry Lake	Old Battle	Lake Irene
1940	41.52	41.71	52.07	65.28	58.67
1941	35.31	36.15	41.91	60.96	42.42
1942	43.27	43.97	54.61	72.90	54.61
1943	54.49	54.38	64.01	91.95	69.60
1944	38.12	38.38	42.67	70.36	43.69
1945	51.59	51.59	66.29	93.22	53.85
1946	44.17	43.83	48.01	70.87	58.67
1947	50.06	50.83	52.07	87.63	70.36
1948	50.80	52.10	61.72	80.77	72.14
1949	65.72	67.14	68.83	125.73	90.42
1950	52.72	52.75	56.64	97.79	63.25
1951	57.98	57.69	55.63	87.88	91.44
1952	73.18	74.48	86.36	125.73	93.22
1953	42.23	42.02	47.24	68.58	61.72
1954	42.67	42.33	48.51	68.33	51.82
1955	42.88	43.63	45.97	66.80	53.59
1956	59.46	60.09	68.33	91.69	84.33
1957	63.08	64.69	81.53	101.35	83.57
1958	55.00	55.23	73.41	89.15	71.88
1959	50.82	50.49	61.98	71.37	60.96
1960	46.85	48.60	59.18	73.41	60.20
1961	38.72	38.33	38.10	62.74	42.67
1962	61.79	62.71	70.36	93.22	95.50
1963	38.01	38.78	42.16	62.48	52.83
1964	43.73	43.89	53.34	69.60	46.74
1965	61.33	62.37	72.64	91.95	81.53
1966	33.41	33.36	33.78	64.52	33.27
1967	47.98	48.29	51.56	84.33	57.15
1968	45.86	45.44	29.97	78.74	61.21
1969	48.61	50.57	58.67	88.39	58.42
1970	60.71	59.83	58.93	95.00	82.55
1971	67.19	64.52	63.75	115.06	82.30
1972	47.80	47.47	53.59	84.33	60.96
1973	43.18	43.86	53.59	76.71	53.85
1974	57.96	58.70	70.10	109.73	68.83
1975	54.03	54.07	65.79	84.07	65.28

1976	47.59	47.81	47.75	90.42	58.93
1977	27.32	27.09	30.48	41.66	29.97
1978	69.37	70.19	89.66	115.57	89.15
1979	60.80	62.46	72.64	107.19	73.66
1980	61.88	63.25	77.22	95.50	86.11
1981	28.36	29.32	35.81	38.10	33.78
1982	60.78	61.61	72.39	103.89	81.79
1983	54.70	55.40	66.55	96.52	71.88
1984	57.91	59.18	80.77	100.58	73.41
1985	48.24	49.53	63.75	78.99	65.53
1986	66.83	66.66	61.21	117.86	89.15
1987	33.46	34.12	36.07	54.86	48.51
1988	53.09	54.30	65.02	67.82	75.44
1989	46.11	46.45	52.32	70.61	62.48
1990	45.63	45.21	48.51	60.96	57.40
1991	44.03	45.97	56.39	65.28	46.48
1992	38.75	39.00	39.88	54.36	56.39
1993	54.24	55.94	58.67	91.19	74.17
1994	43.80	43.49	38.61	68.33	62.48
1995	40.59	42.67	46.48	81.03	54.10
1996	62.25	64.97	75.18	83.31	88.39
1997	60.71	60.42	63.50	100.84	73.41
1998	42.12	42.87	48.01	79.50	52.32
1999	40.85	41.66	37.08	71.12	59.94
2000	47.80	50.38	59.44	66.04	62.74
2001	39.39	40.72	40.39	59.94	54.86
2002	33.76	34.35	43.18	51.82	42.93
2003	48.49	50.26	53.34	74.42	70.61
2004	32.56	33.92	37.85	69.09	39.62
2005	45.14	46.88	53.59	83.82	50.55
2006	53.92	54.95	62.48	95.50	62.99
2007	40.25	40.81	37.34	60.45	56.90
2008	54.63	56.61	65.02	85.85	61.98
2009	51.31	52.38	61.47	85.34	64.26

Instrumental Data for South Brush Creek, Brooklyn Lake, Elk River, Columbine, Phantom Valley, Deadman Hill, Willow Creek Pass, and Roach

Year	SBC	BKL	EKR	COL	PHV	DMH	WCP	ROA
1940	33.53	47.75	37.08	48.01	16.51	31.75	25.91	40.13
1941	23.37	39.62	33.53	43.69	16.76	25.91	22.10	38.10
1942	25.91	54.36	41.91	54.86	18.80	28.96	26.92	42.16
1943	34.80	75.18	49.02	71.12	19.30	46.99	27.18	50.29
1944	16.00	57.91	43.18	44.45	13.97	32.77	20.83	33.53
1945	37.59	65.53	64.52	60.96	20.83	37.85	24.64	42.16
1946	30.48	60.96	39.88	57.66	15.75	41.66	22.35	39.62
1947	27.69	65.53	41.40	60.71	22.61	43.18	31.75	47.75
1948	26.16	63.75	51.56	67.56	23.37	35.31	29.97	46.48
1949	40.89	77.72	66.80	77.72	26.92	51.05	42.16	54.61
1950	32.51	72.64	51.56	65.28	20.83	39.62	38.35	41.40
1951	32.00	86.61	55.12	79.76	27.69	45.97	28.45	47.24
1952	42.42	92.20	76.45	89.66	37.85	57.15	43.94	59.94
1953	21.08	65.28	35.81	63.50	17.78	29.46	24.13	29.97
1954	28.96	59.44	44.70	40.13	19.30	37.08	26.67	44.45
1955	30.48	48.51	48.01	59.94	19.56	36.07	26.16	36.58
1956	34.29	78.99	49.78	74.93	25.15	56.90	32.77	56.90
1957	38.35	73.41	58.67	80.77	28.19	52.58	36.32	59.18
1958	40.13	67.82	55.37	68.83	21.59	51.05	24.64	41.15
1959	34.04	70.61	52.83	74.93	23.37	41.40	27.94	39.62
1960	29.46	48.51	40.89	57.66	24.13	46.48	32.00	43.43
1961	26.67	54.36	35.81	45.97	14.73	39.62	23.88	41.40
1962	40.89	74.42	60.45	80.52	26.67	43.69	40.64	53.34
1963	20.57	48.51	32.00	59.18	15.49	34.54	22.10	28.19
1964	32.26	53.85	48.26	56.13	18.03	38.35	22.35	42.16
1965	36.58	76.71	65.02	84.07	32.51	44.45	32.77	56.39
1966	26.67	40.64	37.85	37.08	12.45	33.02	17.27	30.99
1967	26.16	67.06	46.23	60.45	25.15	41.40	30.23	38.10
1968	37.34	58.17	53.59	58.17	22.61	37.08	24.89	42.67
1969	28.96	50.55	57.40	58.93	23.88	39.12	31.24	39.12
1970	39.37	89.92	57.40	74.68	29.72	55.37	35.81	49.02
1971	49.78	108.71	64.52	83.82	27.94	51.31	35.81	56.13
1972	28.19	70.36	45.97	65.02	15.75	39.37	22.10	40.13
1973	31.75	48.51	41.40	46.23	19.30	37.34	26.92	39.37
1974	36.58	72.64	54.61	74.17	19.30	46.99	32.77	51.82
1975	38.10	69.60	60.20	79.25	21.34	37.08	32.51	41.15
1976	32.51	60.71	43.43	54.36	17.53	39.37	29.46	49.02

1977	26.92	29.72	25.91	40.13	10.67	21.59	18.03	25.40
1978	41.40	89.92	77.22	93.73	34.29	52.58	30.48	49.02
1979	33.27	73.41	69.60	66.29	30.48	47.75	38.35	56.13
1980	40.89	70.61	67.56	70.87	35.81	48.26	33.27	54.61
1981	19.30	28.70	29.46	30.48	16.26	32.26	18.29	29.46
1982	34.80	79.25	62.48	90.68	24.64	45.97	26.67	45.97
1983	42.67	60.45	45.97	63.50	25.40	51.56	28.70	48.51
1984	42.67	61.72	54.61	69.09	26.92	47.75	29.72	49.78
1985	33.78	51.05	51.56	59.94	21.08	39.62	24.38	40.89
1986	41.40	93.73	57.15	67.31	30.48	57.91	51.05	67.82
1987	18.80	42.16	33.78	39.88	13.72	30.48	20.32	29.46
1988	30.73	64.52	52.32	72.64	30.73	46.48	32.26	45.97
1989	38.10	51.05	47.75	56.13	19.05	40.89	33.27	35.56
1990	42.67	52.32	46.48	59.69	21.08	39.12	27.69	45.97
1991	30.48	40.13	45.72	64.77	24.13	37.85	35.05	38.10
1992	34.29	40.89	33.78	45.72	25.15	36.07	26.16	33.53
1993	34.80	58.42	50.29	63.50	30.23	42.93	45.47	46.99
1994	33.53	56.90	36.32	50.55	22.61	44.70	32.00	35.81
1995	24.89	37.59	44.45	55.12	15.75	29.46	28.96	28.70
1996	26.67	73.41	58.42	96.27	37.85	57.15	34.54	53.59
1997	34.54	89.41	66.55	71.88	25.91	41.15	45.47	55.12
1998	23.37	54.10	41.66	53.59	20.07	35.31	18.29	37.08
1999	28.96	45.47	38.10	46.99	14.48	40.13	28.96	38.10
2000	26.92	45.47	48.51	75.44	29.72	34.80	37.34	39.37
2001	23.62	43.18	43.18	53.09	23.88	31.75	29.72	29.72
2002	27.18	35.05	38.35	45.72	17.53	24.64	20.83	24.13
2003	35.31	45.72	45.47	57.15	30.48	35.56	39.88	45.47
2004	16.26	36.58	29.97	39.62	2.79	27.43	25.65	33.27
2005	30.73	43.94	55.37	48.51	20.83	39.88	33.27	36.07
2006	33.02	65.53	53.09	77.98	27.43	41.91	30.73	42.42
2007	25.91	49.53	36.07	42.16	17.02	37.85	36.58	42.93
2008	36.83	54.61	68.58	68.33	24.89	44.96	40.64	49.28
2009	33.53	59.44	56.39	68.58	25.15	41.40	31.50	37.34

Appendix 2. Forty Tree-Ring Chronologies Used In Study

Code	Site Name	Lat.	Long.	Elev.	Period of Record	Specie
ARE	Anderson Ridge East	42.45	-108.87	2525	1200 - 2006	PIFL
ARR	Anderson Ridge Rim	42.49	-108.93	2615	1519 - 20006	PSME
BEAR	Bear Canyon	45.07	-108.52	2100	1200 - 1998	PIFL
BLE	Boulder Lake East	42.85	-109.63	2260	1568 - 2006	PSME
CARTE	Carter Mountain	44.32	-109.21	2500	1200 - 2000	PIFL
CFY	Clarks Fork of the Yellowstone	44.58	-109.08	1474	1486 - 1999	PSME
COL	Collins Gulch	39.83	-108.2	2050	1200 - 2001	PIED
COOK	Cooks Canyon	44.22	-107.37	2100	1395 - 2001	PIPO
DIL	Dillon	39.6	-105.9	2880	1372 - 2002	PSME
DOU	Douglas Pass	39.6	-108.96	2590	1382 - 2000	PSME
Dutch	Dutch John Mountain	40.95	-109.38	2200	1369 - 2001	PIED
ENC	Encampment	41.15	-106.78	2500	1380 - 2001	PSME
FBN	Fossil Butte NM	41.87	-110.8	2225	1483 - 1998	PIFL
FMT	Fremont Lake	42.96	-109.77	2420	1507 - 2006	PSME
FSE	Fremont Lake Southeast	42.92	-109.8	2390	1654 - 2006	PIFL
GMR	Green Mountain Reservoir	39.85	-106.23	2515	1378 - 2000	PSME
HOT	Hot Sulphur Springs	40.07	-106.13	2500	1571 - 1999	PSME
LAN	Land's End	39	-108.15	2987	1200 - 2002	PSME
LBC	LaBarge Creek	42.5	-110.65	2743	1200 - 1997	PIFL
LLR	Lewis Lake Road	42.55	-108.81	2733	1200 - 2006	PIFL
MDP	McDougal Pass	42.8	-110.6	2743	1202 - 1997	PIFL
MEV	Mount Everts	44.98	-110.67	2150	1200 - 1999	PSME
NPU	North Park Update	40.95	-106.33	2450	1486 - 2001	PSME
NUTTE	Nutter's Ridge	39.97	-110.33	2250	1200 - 2001	PIED
PIC	Piceance	40.05	-108.3	1900	1200 - 2001	PIED
PLU	Plug Hat Butte	40.78	-108.97	2130	1220 - 2000	PIED
PUM	Pump House	39.95	-106.52	2195	1320 - 2001	PIED
RCU	Red Canyon Upper	42.63	-108.62	2000	1600 - 2006	PIFL
RED	Red Canyon	39.7	-106.73	2165	1336 - 1999	PIED
RIF	Rifle	39.67	-107.88	2073	1352 - 2000	PIED
RPC	Red Pine Canyon	40.57	-109.92	2325	1410 - 2001	PIED
SEE	Seedhouse Road	40.75	-106.85	2380	1539 - 2000	PSME
TRAPP	Trapper Canyon	44.48	-107.62	2100	1252 - 1998	PSME
TRG	Trail Gulch	39.72	-106.98	2210	1402 - 2002	PIED
UNA	Unaweep Canyon	38.5	-108.34	2225	1296 - 2002	PIED
VAS	Vasquez Mountain	40.03	-106.07	2865	1454 - 1999	PSME
WELLS	Well's Draw	39.73	-110.02	2150	1200 - 2001	PIED
WIL	Wild Rose	39.01	-108.14	2636	1200 - 2002	PIED
WOOD	Wood River Canyon	43.94	-109.21	2400	1200 -1999	PIFL
WSK	Whiskey Mountain	43.43	-109.55	2695	1461 - 2000	PSME

Appendix 3. MiniTab Output for Principal Components Analysis

Principal Component Analysis: OBT, SBC, BKL, EKR, COL, DLK, PHV, DMH, LKI, WCP,

Eigenanalysis of the Correlation Matrix

Eigenvalue	8.3199	0.5796	0.4926	0.4214	0.3653	0.2531	0.1827	0.1537
Proportion	0.756	0.053	0.045	0.038	0.033	0.023	0.017	0.014
Cumulative	0.756	0.809	0.854	0.892	0.925	0.948	0.965	0.979

Eigenvalue	0.1064	0.0678	0.0576
Proportion	0.010	0.006	0.005
Cumulative	0.989	0.995	1.000

Variable	PC1
OBT	0.311
SBC	0.263
BKL	0.305
EKR	0.312
COL	0.308
DLK	0.304
PHV	0.300
DMH	0.303
LKI	0.324
WCP	0.271
ROA	0.312

Principal Component Analysis: OBT, SBC, BKL, EKR, COL, DLK, PHV, DMH, LKI, WCP,

Eigenanalysis of the Correlation Matrix

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Eigenvalue	0.1064	0.0678	0.0576
Proportion	0.010	0.006	0.005
Cumulative	0.989	0.995	1.000

Variable	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9
OBT	0.311	0.008	-0.195	0.441	-0.210	0.297	0.177	-0.373	-0.387
SBC	0.263	-0.309	-0.767	-0.366	0.029	-0.303	0.035	0.060	-0.013
BKL	0.305	0.126	-0.046	0.557	0.250	-0.298	-0.293	0.033	0.254
EKR	0.312	0.259	-0.155	0.002	-0.458	0.002	-0.429	-0.230	0.060
COL	0.308	0.442	0.114	-0.024	0.034	-0.402	0.301	0.177	0.292
DLK	0.304	0.375	-0.037	-0.281	-0.196	0.469	0.341	0.211	0.166
PHV	0.300	-0.015	0.420	-0.489	-0.034	-0.096	-0.466	-0.181	-0.177
DMH	0.303	-0.134	0.051	-0.131	0.626	0.281	0.120	-0.490	0.272
LKI	0.324	0.029	0.192	0.004	0.209	-0.256	0.257	0.168	-0.690
WCP	0.271	-0.625	0.343	0.098	-0.434	-0.160	0.303	-0.040	0.295
ROA	0.312	-0.275	0.013	0.127	0.138	0.413	-0.318	0.651	0.007

Variable	PC10	PC11
OBT	0.009	0.466
SBC	-0.095	0.086
BKL	-0.517	-0.091
EKR	0.380	-0.466
COL	0.416	0.391
DLK	-0.464	-0.159
PHV	-0.252	0.374
DMH	0.205	-0.169
LKI	0.033	-0.419
WCP	-0.046	-0.113
ROA	0.285	0.123

Factor Analysis: OBT, SBC, BKL, EKR, COL, DLK, PHV, DMH, LKI, WCP, ROA

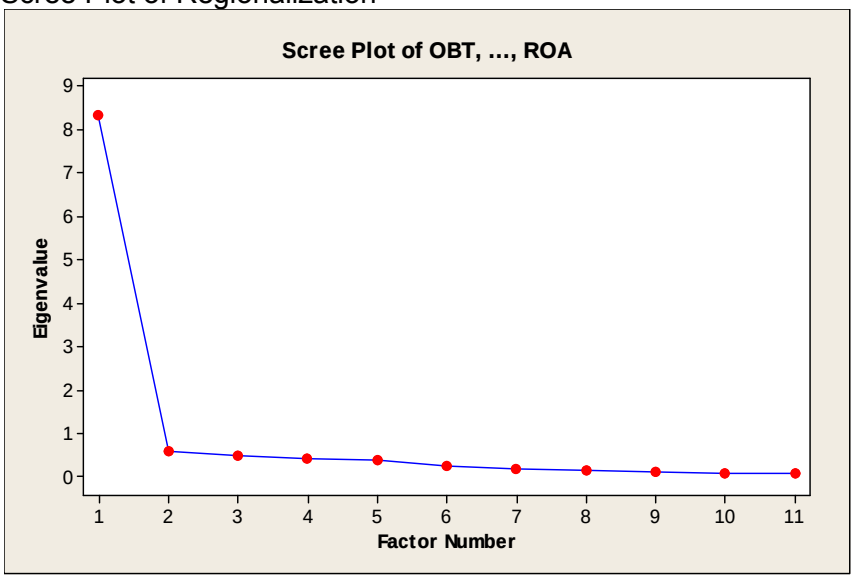
Principal Component Factor Analysis of the Correlation Matrix

Variable	Factor1	Communality
OBT	0.897	0.805
SBC	0.757	0.574
BKL	0.879	0.772
EKR	0.899	0.808
COL	0.888	0.788
DLK	0.876	0.768
PHV	0.866	0.749
DMH	0.875	0.766
LKI	0.933	0.871
WCP	0.781	0.609
ROA	0.900	0.809
Variance	8.3199	8.3199
% Var	0.756	0.756

Factor Score Coefficients

Variable	Factor1
OBT	0.108
SBC	0.091
BKL	0.106
EKR	0.108
COL	0.107
DLK	0.105
PHV	0.104
DMH	0.105
LKI	0.112
WCP	0.094
ROA	0.108

Scree Plot of Regionalization



Appendix 4. MiniTab Output for Model Calibration

Stepwise Regression: SWE 11 versus DIL, HOT, ...

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1
Response is SWE 11 on 8 predictors, with N = 60

Step	1	2
Constant	30.71	25.13
GMR	18.9	13.2
T-Value	5.69	3.31
P-Value	0.000	0.002
PUM		11.3
T-Value		2.41
P-Value		0.019
S	8.42	8.09
R-Sq	35.80	41.73
R-Sq(adj)	34.69	39.68
Mallows Cp	8.5	4.5
PRESS	4338.74	4090.80
R-Sq(pred)	32.30	36.17

Regression Analysis: SWE 11 versus GMR, PUM

The regression equation is
SWE 11 = 25.1 + 13.2 GMR + 11.3 PUM

Predictor	Coef	SE Coef	T	P	VIF
Constant	25.127	4.138	6.07	0.000	
GMR	13.170	3.985	3.31	0.002	1.555
PUM	11.302	4.692	2.41	0.019	1.555

S = 8.09423 R-Sq = 41.7% R-Sq(adj) = 39.7%
PRESS = 4090.80 R-Sq(pred) = 36.17%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	2674.1	1337.1	20.41	0.000
Residual Error	57	3734.4	65.5		
Total	59	6408.6			

Source	DF	Seq SS
GMR	1	2294.0
PUM	1	380.1

Unusual Observations

Obs	GMR	SWE 11	Fit	SE Fit	Residual	St Resid
13	1.07	73.18	54.13	1.67	19.04	2.40R
32	1.01	67.19	49.72	1.05	17.47	2.18R
42	0.94	28.36	45.49	1.63	-17.14	-2.16R

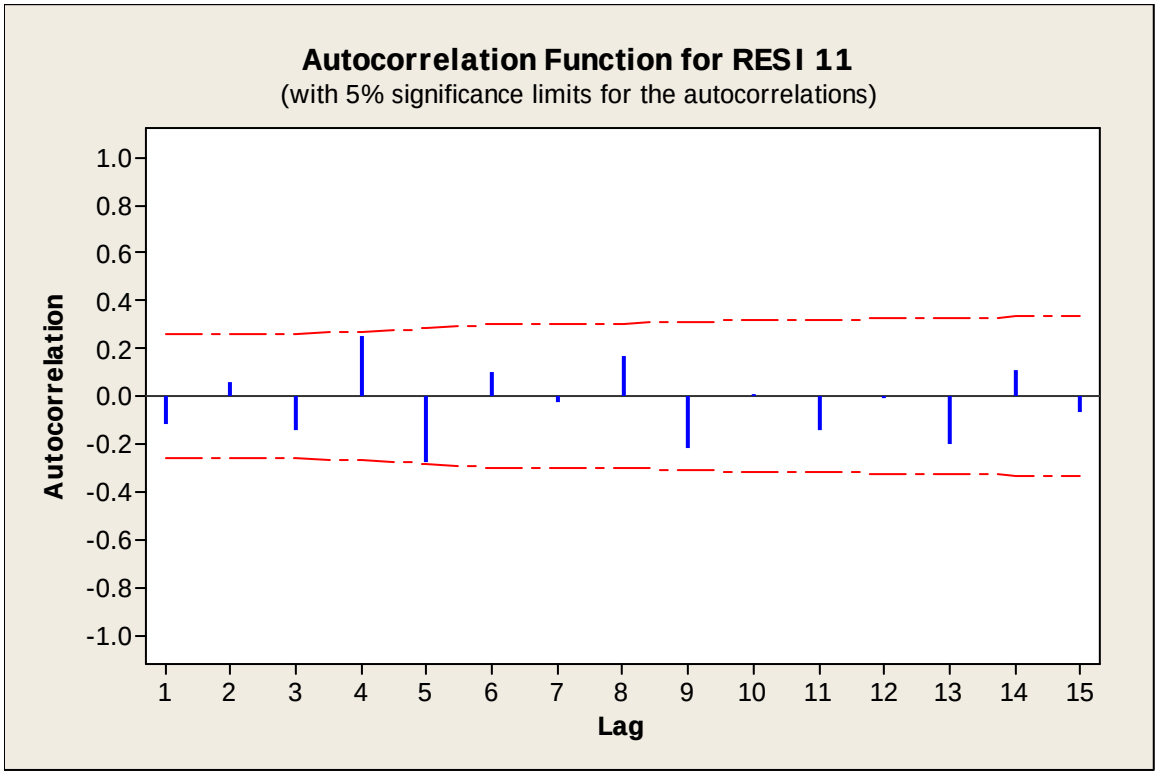
R denotes an observation with a large standardized residual.

Durbin-Watson statistic = 2.19528

Autocorrelation Function: RESI 11

Lag	ACF	T	LBQ
1	-0.114188	-0.88	0.82
2	0.059586	0.46	1.05
3	-0.143972	-1.10	2.40
4	0.247107	1.85	6.46
5	-0.275705	-1.95	11.60
6	0.103425	0.69	12.34
7	-0.028895	-0.19	12.40
8	0.168886	1.12	14.44
9	-0.218222	-1.41	17.91
10	0.007106	0.04	17.91
11	-0.142457	-0.89	19.45
12	-0.007758	-0.05	19.46
13	-0.200922	-1.24	22.65
14	0.111346	0.67	23.66
15	-0.066438	-0.40	24.02

Autocorrelation for RESI 11



Stepwise Regression: SWE 9 versus DIL, HOT, PIC, RED, ENC, GMR, PUM, TRG

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1

Response is SWE 9 on 8 predictors, with N = 60

Step	1	2
Constant	30.49	24.16
GMR	19.7	13.2
T-Value	5.94	3.37
P-Value	0.000	0.001
PUM		12.8
T-Value		2.78
P-Value		0.007
S	8.38	7.93
R-Sq	37.81	45.25
R-Sq(adj)	36.73	43.33
Mallows Cp	9.6	3.7
PRESS	4298.07	3937.90
R-Sq(pred)	34.43	39.93

Regression Analysis: SWE 9 versus GMR, PUM

The regression equation is
SWE 9 = 24.2 + 13.2 GMR + 12.8 PUM

Predictor	Coef	SE Coef	T	P	VIF
Constant	24.160	4.056	5.96	0.000	
GMR	13.151	3.906	3.37	0.001	1.555
PUM	12.807	4.600	2.78	0.007	1.555

S = 7.93496 R-Sq = 45.3% R-Sq(adj) = 43.3%

PRESS = 3937.90 R-Sq(pred) = 39.93%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	2966.3	1483.1	23.56	0.000
Residual Error	57	3588.9	63.0		
Total	59	6555.2			

Source	DF	Seq SS
GMR	1	2478.2
PUM	1	488.1

Unusual Observations

Obs	GMR	SWE 9	Fit	SE Fit	Residual	St Resid
13	1.07	74.48	55.13	1.64	19.35	2.49R
34	1.28	43.86	59.63	1.92	-15.77	-2.05R
42	0.94	29.32	45.58	1.60	-16.25	-2.09R

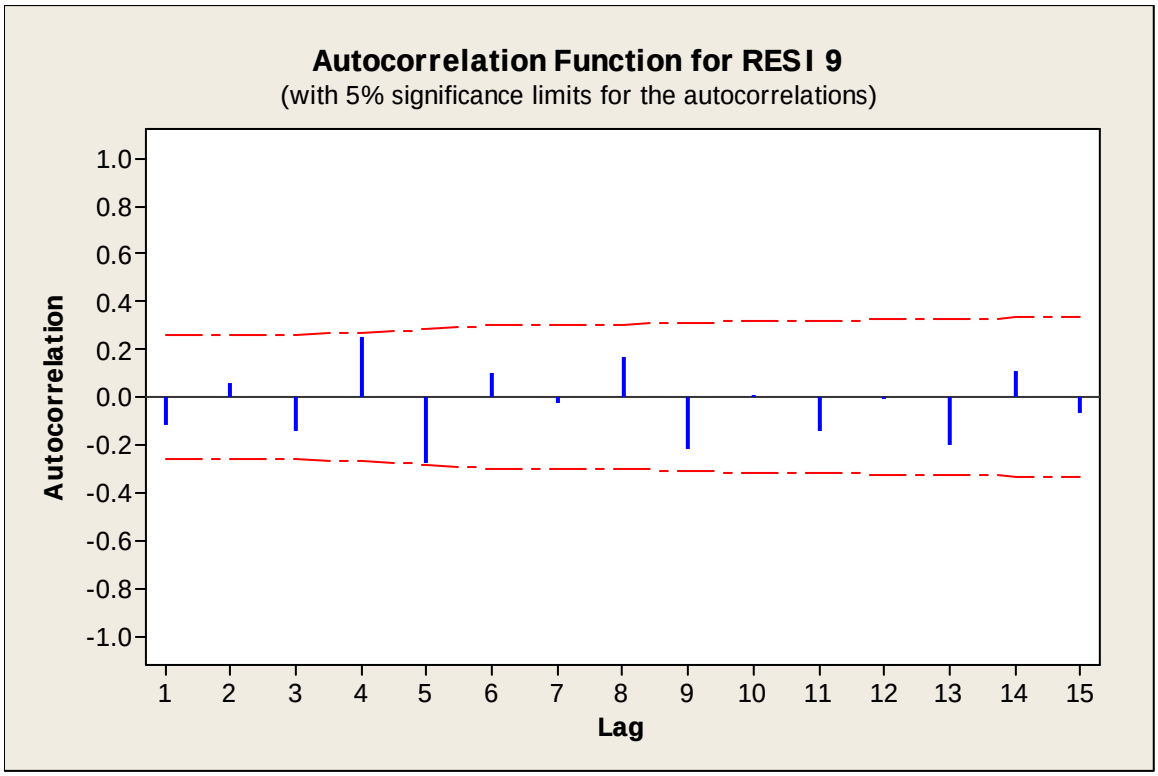
R denotes an observation with a large standardized residual.

Durbin-Watson statistic = 2.20923

Autocorrelation Function: RESI 9

Lag	ACF	T	LBQ
1	-0.114188	-0.88	0.82
2	0.059586	0.46	1.05
3	-0.143972	-1.10	2.40
4	0.247107	1.85	6.46
5	-0.275705	-1.95	11.60
6	0.103425	0.69	12.34
7	-0.028895	-0.19	12.40
8	0.168886	1.12	14.44
9	-0.218222	-1.41	17.91
10	0.007106	0.04	17.91
11	-0.142457	-0.89	19.45
12	-0.007758	-0.05	19.46
13	-0.200922	-1.24	22.65
14	0.111346	0.67	23.66
15	-0.066438	-0.40	24.02

Autocorrelation for RESI 9



Stepwise Regression: DLK versus DIL, HOT, PIC, RED, ENC, GMR, PUM, TRG

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1

Response is DLK on 8 predictors, with N = 60

Step	1	2
Constant	29.54	20.37
GMR	26.8	17.4
T-Value	6.11	3.41
P-Value	0.000	0.001
PUM		18.6
T-Value		3.08
P-Value		0.003
S	11.1	10.4
R-Sq	39.18	47.88
R-Sq(adj)	38.14	46.05
Mallows Cp	9.3	1.9
PRESS	7594.69	6710.45
R-Sq(pred)	35.59	43.09

Regression Analysis: DLK versus GMR, PUM

The regression equation is
DLK = 20.4 + 17.4 GMR + 18.6 PUM

Predictor	Coef	SE Coef	T	P	VIF
Constant	20.373	5.308	3.84	0.000	
GMR	17.413	5.112	3.41	0.001	1.555
PUM	18.559	6.020	3.08	0.003	1.555

S = 10.3840 R-Sq = 47.9% R-Sq(adj) = 46.0%

PRESS = 6710.45 R-Sq(pred) = 43.09%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	5645.2	2822.6	26.18	0.000
Residual Error	57	6146.1	107.8		
Total	59	11791.4			

Source	DF	Seq SS
GMR	1	4620.3
PUM	1	1024.9

Unusual Observations

Obs	GMR	DLK	Fit	SE Fit	Residual	St Resid
13	1.07	86.36	63.48	2.15	22.88	2.25R
39	1.31	89.66	67.70	2.04	21.96	2.16R

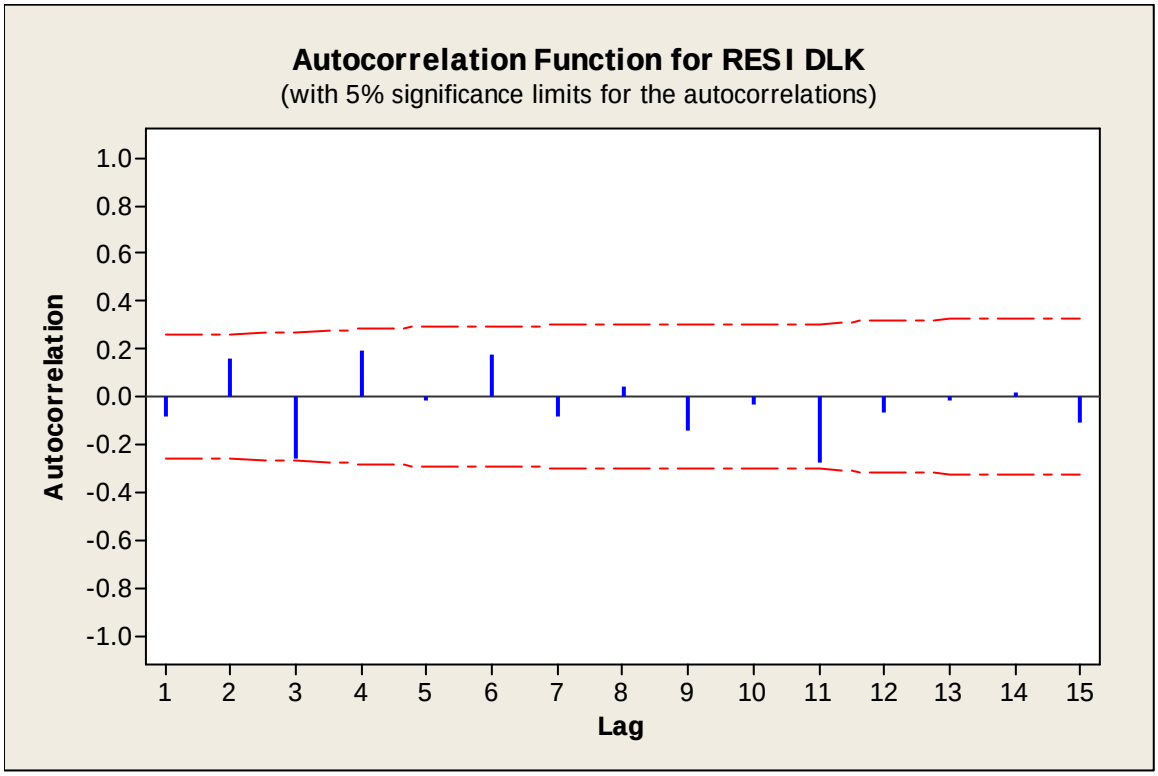
R denotes an observation with a large standardized residual.

Durbin-Watson statistic = 2.09890

Autocorrelation Function: RESI DLK

Lag	ACF	T	LBQ
1	-0.081744	-0.63	0.42
2	0.156668	1.21	2.00
3	-0.258109	-1.94	6.34
4	0.193359	1.37	8.83
5	-0.013104	-0.09	8.84
6	0.177381	1.22	11.01
7	-0.081359	-0.55	11.47
8	0.042573	0.28	11.60
9	-0.144084	-0.96	13.11
10	-0.029687	-0.19	13.18
11	-0.272959	-1.79	18.84
12	-0.069904	-0.44	19.22
13	-0.017803	-0.11	19.24
14	0.017795	0.11	19.27
15	-0.110942	-0.69	20.28

Autocorrelation for RESI DLK



Stepwise Regression: OBT versus DIL, HOT, PIC, RED, ENC, GMR, PUM, TRG

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1

Response is OBT on 8 predictors, with N = 60

Step	1	2
Constant	49.18	41.75
GMR	32.7	21.6
T-Value	5.23	3.14
P-Value	0.000	0.003
TRG		18.7
T-Value		3.08
P-Value		0.003
S	15.9	14.8
R-Sq	32.04	41.74
R-Sq(adj)	30.87	39.70
Mallows Cp	14.4	6.4
PRESS	15412.9	13836.6
R-Sq(pred)	28.24	35.58

Regression Analysis: OBT versus GMR, TRG

The regression equation is
OBT = 41.7 + 21.6 GMR + 18.7 TRG

Predictor	Coef	SE Coef	T	P	VIF
Constant	41.745	6.722	6.21	0.000	
GMR	21.603	6.877	3.14	0.003	1.383
TRG	18.719	6.077	3.08	0.003	1.383

S = 14.8170 R-Sq = 41.7% R-Sq(adj) = 39.7%

PRESS = 13836.6 R-Sq(pred) = 35.58%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	8965.7	4482.8	20.42	0.000
Residual Error	57	12514.0	219.5		
Total	59	21479.7			

Source	DF	Seq SS
GMR	1	6882.5
TRG	1	2083.2

Unusual Observations

Obs	GMR	OBT	Fit	SE Fit	Residual	St Resid
10	1.05	125.73	88.89	2.59	36.84	2.52R
13	1.07	125.73	92.97	3.40	32.76	2.27R
32	1.01	115.06	82.35	1.92	32.71	2.23R
42	0.94	38.10	69.03	4.03	-30.93	-2.17R

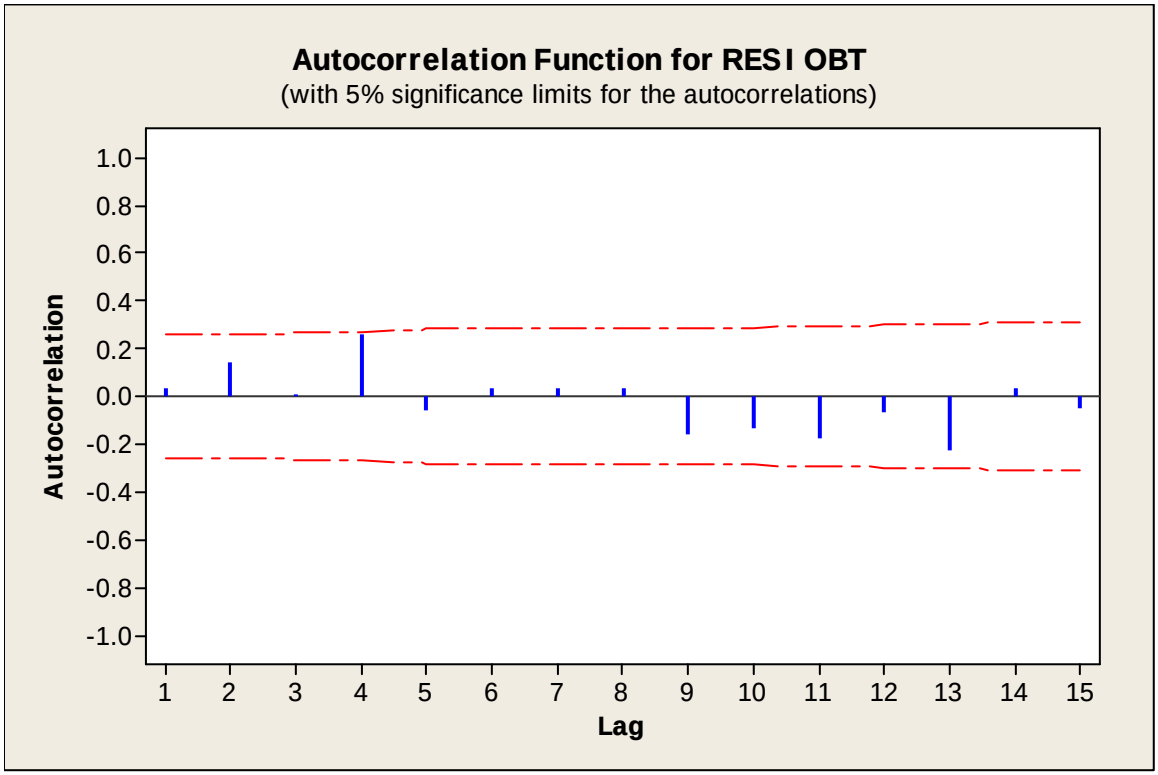
R denotes an observation with a large standardized residual.

Durbin-Watson statistic = 1.92341

Autocorrelation Function: RESI OBT

Lag	ACF	T	LBQ
1	0.030792	0.24	0.06
2	0.139259	1.08	1.30
3	0.010843	0.08	1.31
4	0.261131	1.98	5.84
5	-0.057180	-0.41	6.06
6	0.032985	0.23	6.14
7	0.036491	0.26	6.23
8	0.029971	0.21	6.29
9	-0.155265	-1.10	8.05
10	-0.130354	-0.91	9.32
11	-0.172354	-1.18	11.57
12	-0.070644	-0.47	11.96
13	-0.223908	-1.50	15.93
14	0.034085	0.22	16.02
15	-0.048990	-0.32	16.22

Autocorrelation for RESI OBT



Stepwise Regression: LKI versus DIL, HOT, PIC, RED, ENC, GMR, PUM, TRG

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1

Response is LKI on 8 predictors, with N = 60

Step	1	2
Constant	36.65	26.75
GMR	27.7	17.5
T-Value	5.35	2.87
P-Value	0.000	0.006
PUM		20.1
T-Value		2.79
P-Value		0.007
S	13.1	12.4
R-Sq	33.06	41.09
R-Sq(adj)	31.91	39.02
Mallows Cp	10.2	4.2
PRESS	10550.0	9662.26
R-Sq(pred)	29.27	35.22

Regression Analysis: LKI versus GMR, PUM

The regression equation is
LKI = 26.7 + 17.5 GMR + 20.1 PUM

Predictor	Coef	SE Coef	T	P	VIF
Constant	26.746	6.347	4.21	0.000	
GMR	17.545	6.112	2.87	0.006	1.555
PUM	20.051	7.198	2.79	0.007	1.555

S = 12.4161 R-Sq = 41.1% R-Sq(adj) = 39.0%

PRESS = 9662.26 R-Sq(pred) = 35.22%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	6128.0	3064.0	19.88	0.000
Residual Error	57	8787.1	154.2		
Total	59	14915.0			

Source	DF	Seq SS
GMR	1	4931.6
PUM	1	1196.4

Unusual Observations

Obs	GMR	LKI	Fit	SE Fit	Residual	St Resid
34	1.28	53.85	78.37	3.01	-24.52	-2.04R
52	1.17	46.48	71.43	1.95	-24.95	-2.03R

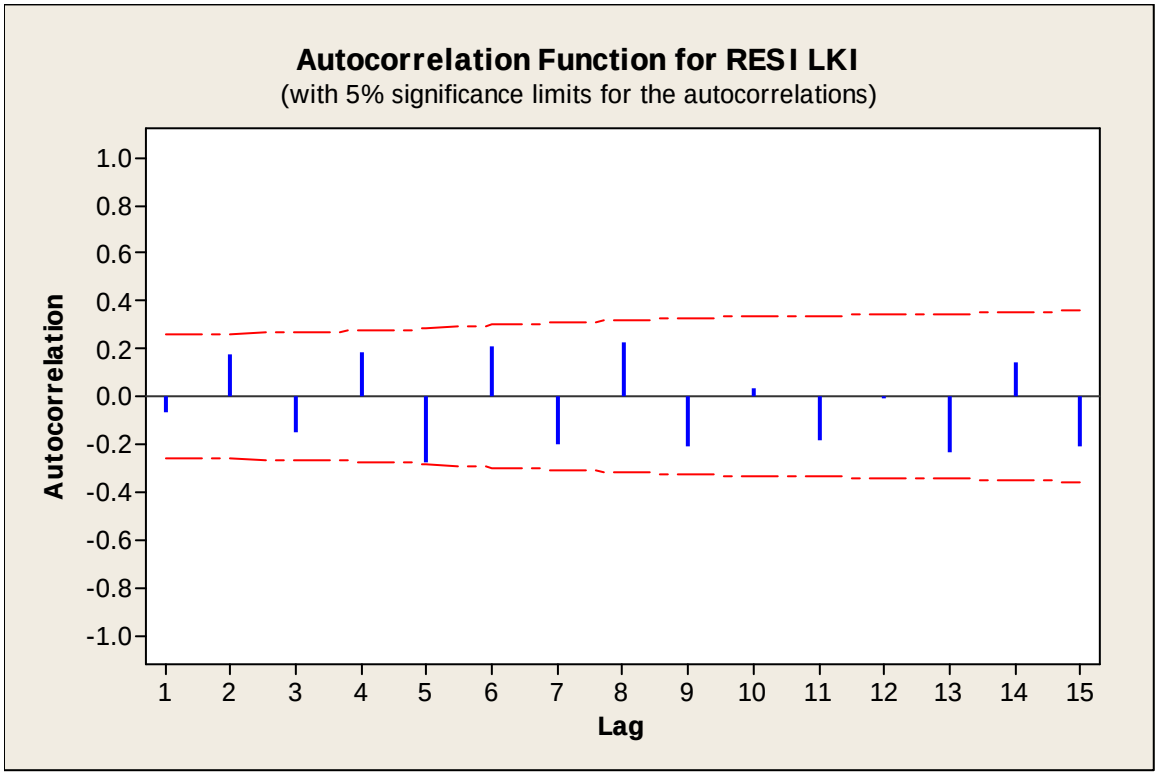
R denotes an observation with a large standardized residual.

Durbin-Watson statistic = 2.13668

Autocorrelation Function: RESI LKI

Lag	ACF	T	LBQ
1	-0.070256	-0.54	0.31
2	0.175105	1.35	2.28
3	-0.148467	-1.11	3.72
4	0.181106	1.33	5.90
5	-0.271996	-1.94	10.90
6	0.211396	1.42	13.98
7	-0.200606	-1.30	16.80
8	0.222932	1.41	20.36
9	-0.207297	-1.27	23.49
10	0.034955	0.21	23.58
11	-0.186234	-1.11	26.22
12	-0.010414	-0.06	26.22
13	-0.232043	-1.36	30.49
14	0.141217	0.80	32.10
15	-0.209607	-1.18	35.73

Autocorrelation for RESI LKI



Stepwise Regression: COL versus DIL, HOT, PIC, RED, ENC, GMR, PUM, TRG

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1

Response is COL on 8 predictors, with N = 60

Step	1	2
Constant	37.83	30.69
GMR	24.8	17.5
T-Value	5.07	2.94
P-Value	0.000	0.005
PUM		14.5
T-Value		2.07
P-Value		0.043
S	12.4	12.1
R-Sq	30.69	35.53
R-Sq(adj)	29.50	33.27
Mallows Cp	5.2	3.0
PRESS	9388.68	9000.41
R-Sq(pred)	26.90	29.92

Regression Analysis: COL versus PUM

The regression equation is
COL = 36.1 + 26.7 PUM

Predictor	Coef	SE Coef	T	P	VIF
Constant	36.084	6.258	5.77	0.000	
PUM	26.730	5.960	4.48	0.000	1.000

S = 12.8228 R-Sq = 25.7% R-Sq(adj) = 24.5%

PRESS = 10167.5 R-Sq(pred) = 20.84%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	3307.3	3307.3	20.11	0.000
Residual Error	58	9536.6	164.4		
Total	59	12843.9			

Unusual Observations

Obs	PUM	COL	Fit	SE Fit	Residual	St Resid
23	1.73	80.52	82.27	4.57	-1.76	-0.15 X
34	1.45	46.23	74.87	3.09	-28.64	-2.30R
57	1.14	96.27	66.58	1.82	29.68	2.34R

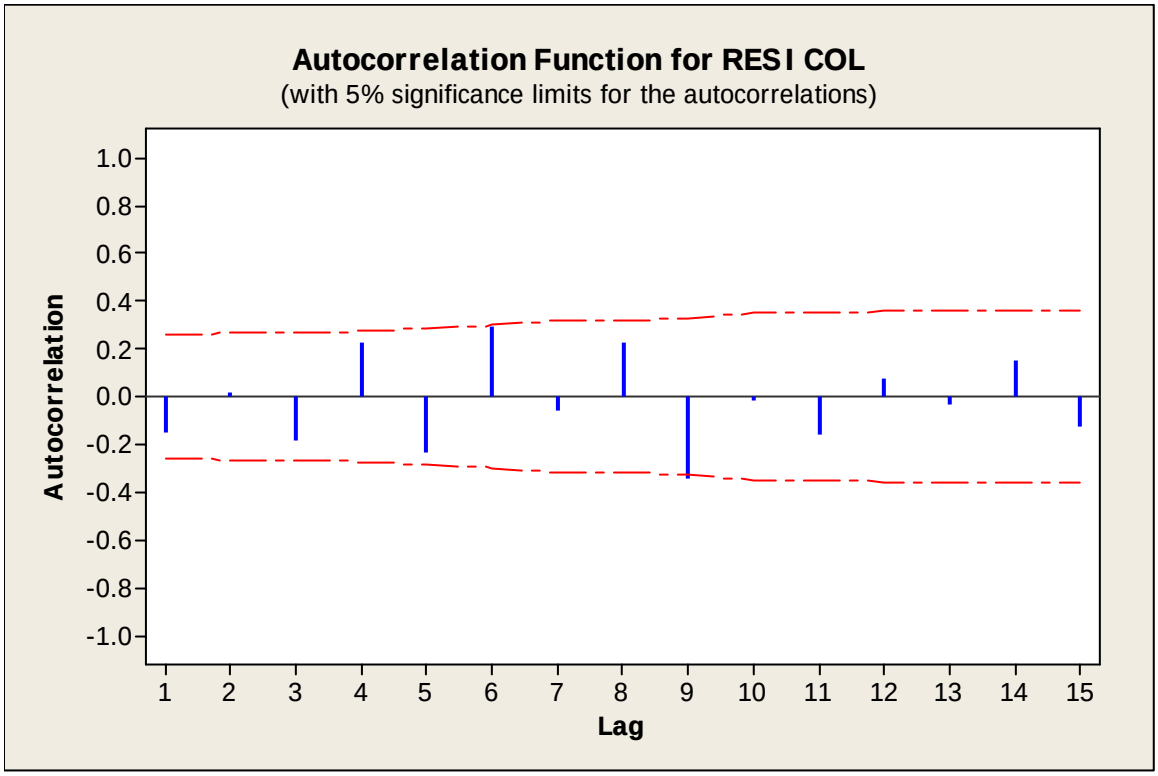
R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large leverage.

Durbin-Watson statistic = 2.26220

Autocorrelation Function: RESI COL

Lag	ACF	T	LBQ
1	-0.153420	-1.19	1.48
2	0.020501	0.16	1.51
3	-0.184055	-1.39	3.72
4	0.224227	1.64	7.06
5	-0.235139	-1.65	10.80
6	0.290234	1.95	16.60
7	-0.061707	-0.39	16.87
8	0.226575	1.43	20.54
9	-0.345895	-2.11	29.27
10	-0.013085	-0.07	29.28
11	-0.154956	-0.88	31.11
12	0.077678	0.44	31.57
13	-0.031987	-0.18	31.66
14	0.153416	0.86	33.56
15	-0.125986	-0.70	34.87

Autocorrelation for RESI COL



Stepwise Regression: DMH versus DIL, HOT, PIC, RED, ENC, GMR, PUM, TRG

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1

Response is DMH on 8 predictors, with N = 60

Step	1
Constant	26.92
GMR	14.3
T-Value	5.36
P-Value	0.000
S	6.78
R-Sq	33.15
R-Sq(adj)	32.00
Mallows Cp	5.2
PRESS	2845.80
R-Sq(pred)	28.55

Regression Analysis: DMH versus GMR

The regression equation is
DMH = 26.9 + 14.3 GMR

Predictor	Coef	SE Coef	T	P	VIF
Constant	26.917	2.869	9.38	0.000	
GMR	14.343	2.674	5.36	0.000	1.000

S = 6.77553 R-Sq = 33.1% R-Sq(adj) = 32.0%

PRESS = 2845.80 R-Sq(pred) = 28.55%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	1320.3	1320.3	28.76	0.000
Residual Error	58	2662.7	45.9		
Total	59	3982.9			

Unusual Observations

Obs	GMR	DMH	Fit	SE Fit	Residual	St Resid
2	0.94	25.908	40.471	0.898	-14.563	-2.17R
3	1.20	28.956	44.085	0.992	-15.129	-2.26R
13	1.07	57.150	42.321	0.886	14.829	2.21R
15	0.23	37.084	30.245	2.286	6.839	1.07 X
56	1.14	29.464	43.325	0.934	-13.861	-2.07R

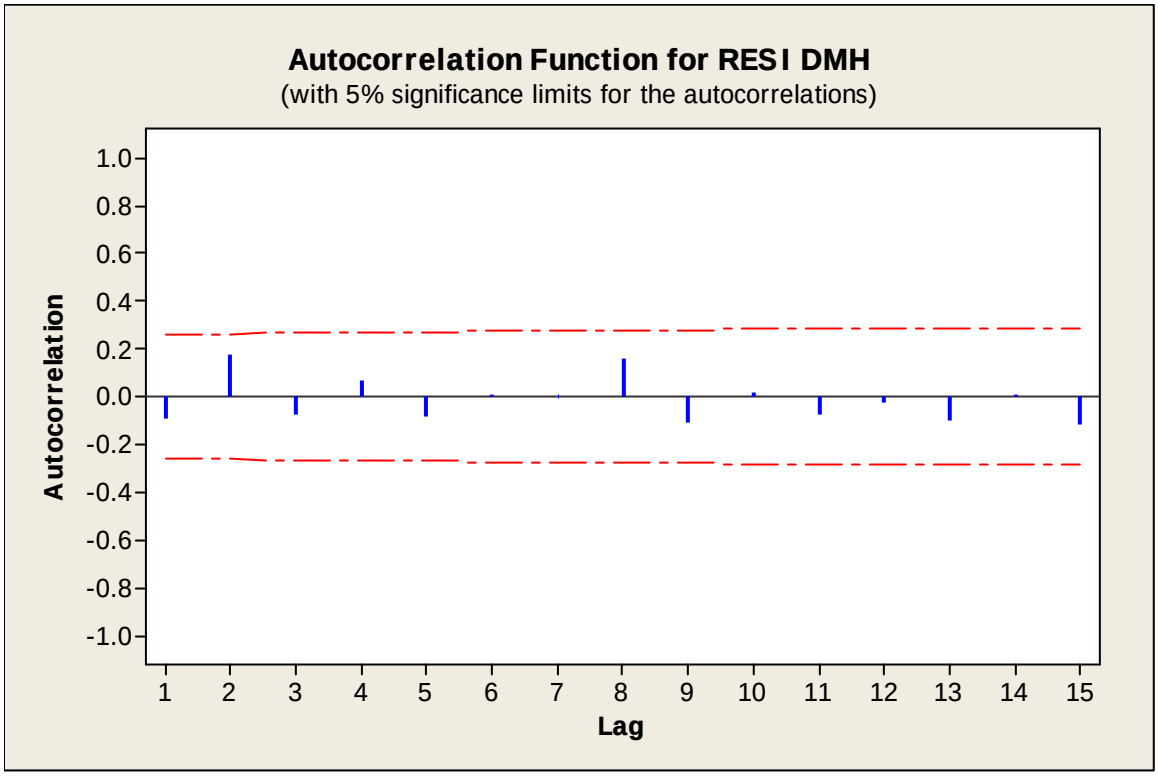
R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large leverage.

Durbin-Watson statistic = 2.15958

Autocorrelation Function: RESI DMH

Lag	ACF	T	LBQ
1	-0.093944	-0.73	0.56
2	0.173907	1.34	2.50
3	-0.075201	-0.56	2.87
4	0.068194	0.51	3.17
5	-0.084959	-0.63	3.66
6	0.005169	0.04	3.66
7	0.003292	0.02	3.67
8	0.158762	1.17	5.47
9	-0.111329	-0.80	6.37
10	0.018083	0.13	6.40
11	-0.074725	-0.53	6.82
12	-0.025125	-0.18	6.87
13	-0.096533	-0.68	7.61
14	0.005523	0.04	7.61
15	-0.119278	-0.84	8.79

Autocorrelation for RESI DMH



Stepwise Regression: WCP versus DIL, HOT, PIC, RED, ENC, GMR, PUM, TRG

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1

Response is WCP on 8 predictors, with N = 60

Step	1	2
Constant	19.57	16.06
TRG	10.1	7.2
T-Value	4.64	2.90
P-Value	0.000	0.005
GMR		6.3
T-Value		2.26
P-Value		0.028
S	6.24	6.03
R-Sq	27.08	33.09
R-Sq(adj)	25.83	30.74
Mallows Cp	4.6	1.6
PRESS	2415.16	2311.75
R-Sq(pred)	21.96	25.30

Regression Analysis: WCP versus GMR, TRG

The regression equation is
WCP = 16.1 + 6.33 GMR + 7.16 TRG

Predictor	Coef	SE Coef	T	P	VIF
Constant	16.064	2.735	5.87	0.000	
GMR	6.326	2.798	2.26	0.028	1.383
TRG	7.158	2.472	2.90	0.005	1.383

S = 6.02760 R-Sq = 33.1% R-Sq(adj) = 30.7%

PRESS = 2311.75 R-Sq(pred) = 25.30%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	1023.97	511.99	14.09	0.000
Residual Error	57	2070.92	36.33		
Total	59	3094.90			

Source	DF	Seq SS
GMR	1	719.41
TRG	1	304.56

Unusual Observations

Obs	GMR	WCP	Fit	SE Fit	Residual	St Resid
47	1.57	51.054	37.486	1.662	13.568	2.34R
58	1.16	45.466	30.791	0.851	14.675	2.46R

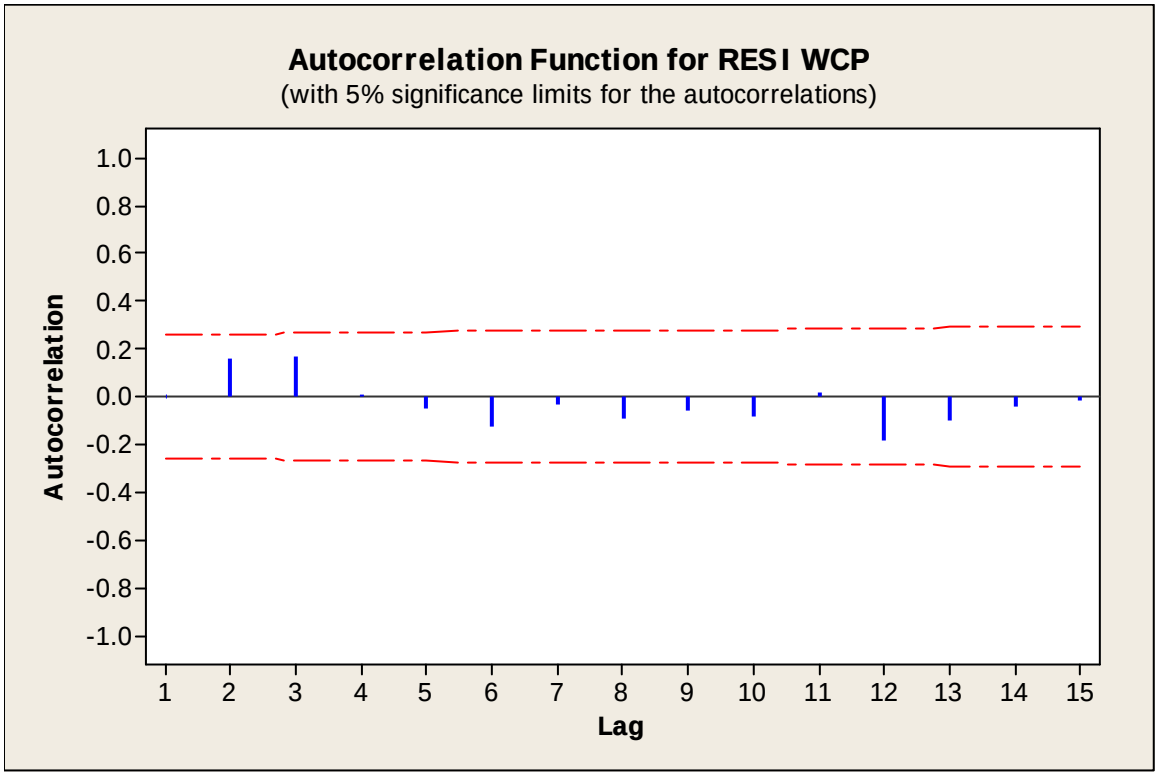
R denotes an observation with a large standardized residual.

Durbin-Watson statistic = 2.00581

Autocorrelation Function: RESI WCP

Lag	ACF	T	LBQ
1	-0.003124	-0.02	0.00
2	0.156966	1.22	1.58
3	0.164556	1.24	3.35
4	0.006610	0.05	3.35
5	-0.052256	-0.39	3.54
6	-0.128710	-0.95	4.68
7	-0.033438	-0.24	4.76
8	-0.092036	-0.67	5.36
9	-0.057881	-0.42	5.61
10	-0.087626	-0.63	6.18
11	0.020410	0.15	6.21
12	-0.182472	-1.30	8.79
13	-0.096294	-0.67	9.52
14	-0.041364	-0.28	9.66
15	-0.019732	-0.14	9.69

Autocorrelation for RESI WCP



Stepwise Regression: PHV versus DIL, HOT, PIC, RED, ENC, GMR, PUM, TRG

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1

Response is PHV on 8 predictors, with N = 60

Step	1	2
Constant	11.371	9.650
PUM	11.1	7.2
T-Value	4.32	2.31
P-Value	0.000	0.024
GMR		5.6
T-Value		2.09
P-Value		0.041
S	5.55	5.40
R-Sq	24.35	29.76
R-Sq(adj)	23.04	27.29
Mallows Cp	2.3	0.2
PRESS	1905.23	1823.03
R-Sq(pred)	19.33	22.82

Regression Analysis: PHV versus GMR, PUM

The regression equation is
PHV = 9.65 + 5.56 GMR + 7.23 PUM

Predictor	Coef	SE Coef	T	P	VIF
Constant	9.650	2.758	3.50	0.001	
GMR	5.564	2.656	2.09	0.041	1.555
PUM	7.232	3.127	2.31	0.024	1.555

S = 5.39504 R-Sq = 29.8% R-Sq(adj) = 27.3%
PRESS = 1823.03 R-Sq(pred) = 22.82%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	702.84	351.42	12.07	0.000
Residual Error	57	1659.07	29.11		
Total	59	2361.90			

Source	DF	Seq SS
GMR	1	547.21
PUM	1	155.62

Unusual Observations

Obs	GMR	PHV	Fit	SE Fit	Residual	St Resid
13	1.07	37.846	25.135	1.115	12.711	2.41R
41	1.06	35.814	23.609	0.751	12.205	2.28R
49	0.90	30.734	19.598	1.107	11.136	2.11R
57	1.39	37.846	25.624	1.061	12.222	2.31R

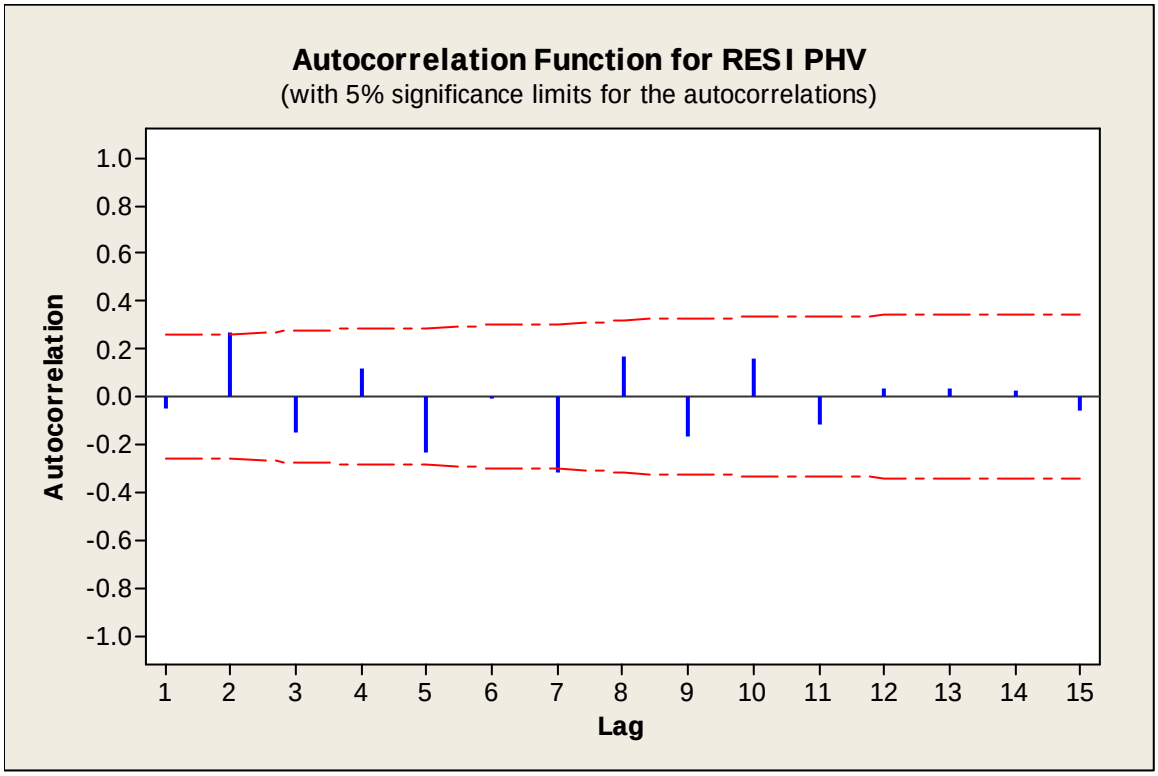
R denotes an observation with a large standardized residual.

Durbin-Watson statistic = 2.04263

Autocorrelation Function: RESI PHV

Lag	ACF	T	LBQ
1	-0.048986	-0.38	0.15
2	0.268272	2.07	4.77
3	-0.152227	-1.10	6.28
4	0.119824	0.85	7.23
5	-0.232216	-1.63	10.88
6	-0.009710	-0.07	10.89
7	-0.316950	-2.13	17.94
8	0.169027	1.06	19.98
9	-0.165306	-1.02	21.98
10	0.160796	0.97	23.90
11	-0.115477	-0.69	24.91
12	0.037127	0.22	25.02
13	0.036627	0.22	25.12
14	0.022852	0.13	25.17
15	-0.057433	-0.34	25.44

Autocorrelation for RESI PHV



Stepwise Regression: ROA versus DIL, HOT, PIC, RED, ENC, GMR, PUM, TRG

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1

Response is ROA on 8 predictors, with N = 60

Step	1
Constant	28.61
GMR	14.8
T-Value	4.87
P-Value	0.000
S	7.71
R-Sq	29.05
R-Sq(adj)	27.83
Mallows Cp	8.7
PRESS	3686.73
R-Sq(pred)	24.08

Regression Analysis: ROA versus GMR

The regression equation is
ROA = 28.6 + 14.8 GMR

Predictor	Coef	SE Coef	T	P	VIF
Constant	28.608	3.264	8.77	0.000	
GMR	14.826	3.042	4.87	0.000	1.000

S = 7.70708 R-Sq = 29.1% R-Sq(adj) = 27.8%

PRESS = 3686.73 R-Sq(pred) = 24.08%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	1410.7	1410.7	23.75	0.000
Residual Error	58	3445.1	59.4		
Total	59	4855.8			

Unusual Observations

Obs	GMR	ROA	Fit	SE Fit	Residual	St Resid
13	1.07	59.944	44.531	1.008	15.413	2.02R
15	0.23	44.450	32.048	2.600	12.402	1.71 X
47	1.57	67.818	51.855	1.937	15.963	2.14R
56	1.14	28.702	45.569	1.062	-16.867	-2.21R

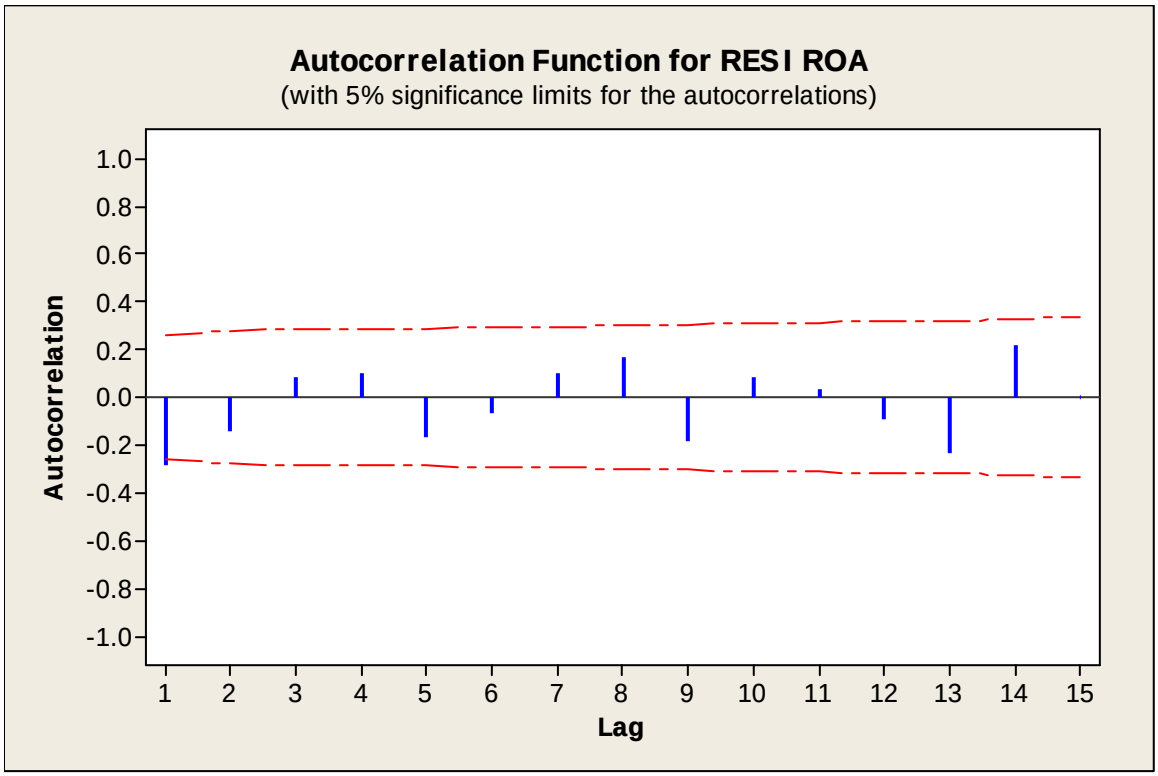
R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large leverage.

Durbin-Watson statistic = 2.56377

Autocorrelation Function: RESI ROA

Lag	ACF	T	LBQ
1	-0.287159	-2.22	5.20
2	-0.145937	-1.05	6.57
3	0.087248	0.62	7.06
4	0.101994	0.71	7.75
5	-0.168319	-1.17	9.67
6	-0.070925	-0.48	10.02
7	0.101757	0.69	10.74
8	0.170573	1.15	12.82
9	-0.186619	-1.23	15.36
10	0.081210	0.52	15.85
11	0.029610	0.19	15.92
12	-0.089887	-0.57	16.55
13	-0.234475	-1.49	20.90
14	0.217335	1.33	24.72
15	-0.001988	-0.01	24.72

Autocorrelation for RESI ROA



Stepwise Regression: EKR versus DIL, HOT, PIC, RED, ENC, GMR, PUM, TRG

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1

Response is EKR on 8 predictors, with N = 60

Step	1
Constant	27.39
PUM	22.0
T-Value	4.74
P-Value	0.000
S	9.98
R-Sq	27.94
R-Sq(adj)	26.70
Mallows Cp	0.4
PRESS	6165.33
R-Sq(pred)	23.06

Regression Analysis: EKR versus PUM

The regression equation is
EKR = 27.4 + 22.0 PUM

Predictor	Coef	SE Coef	T	P	VIF
Constant	27.389	4.869	5.62	0.000	
PUM	21.993	4.638	4.74	0.000	1.000

S = 9.97754 R-Sq = 27.9% R-Sq(adj) = 26.7%

PRESS = 6165.33 R-Sq(pred) = 23.06%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	2238.9	2238.9	22.49	0.000
Residual Error	58	5774.0	99.6		
Total	59	8012.8			

Unusual Observations

Obs	PUM	EKR	Fit	SE Fit	Residual	St Resid
13	1.31	76.45	56.31	1.90	20.14	2.06R
23	1.73	60.45	65.39	3.56	-4.94	-0.53 X
39	1.32	77.22	56.46	1.93	20.75	2.12R

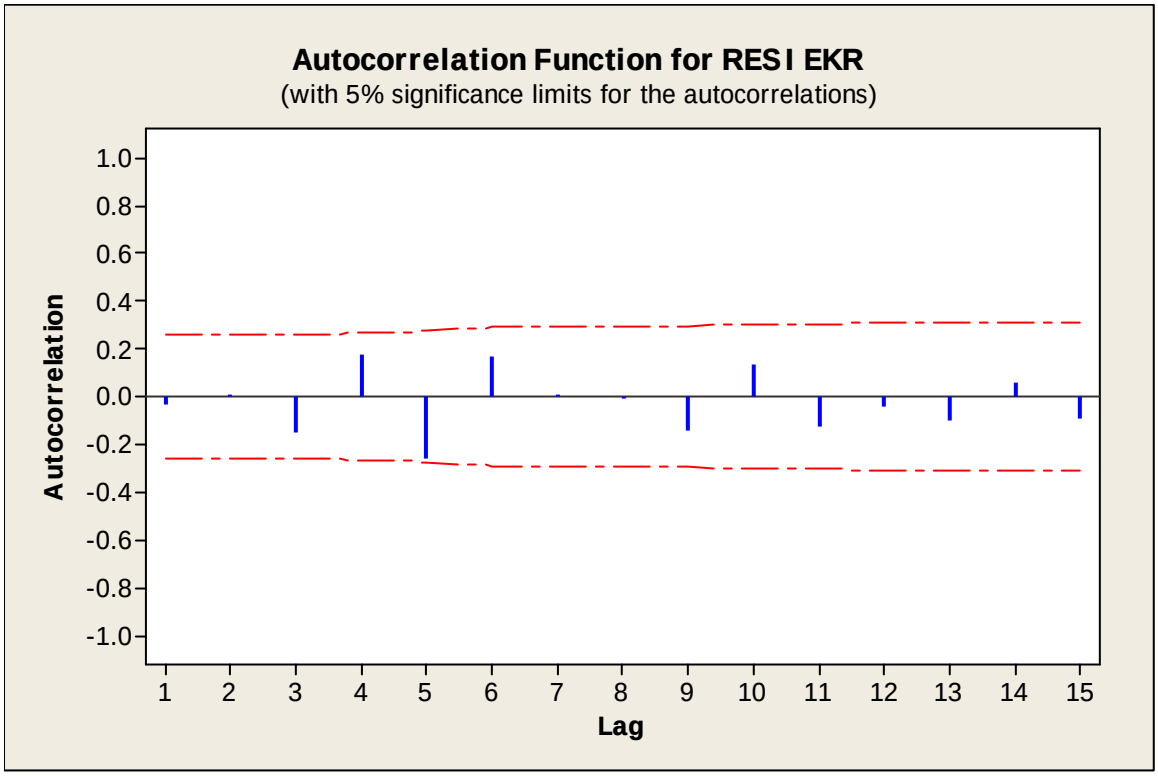
R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large leverage.

Durbin-Watson statistic = 2.02814

Autocorrelation Function: RESI EKR

Lag	ACF	T	LBQ
1	-0.035454	-0.27	0.08
2	0.007196	0.06	0.08
3	-0.154231	-1.19	1.63
4	0.178053	1.35	3.74
5	-0.259039	-1.90	8.28
6	0.168128	1.17	10.23
7	0.006171	0.04	10.23
8	-0.005264	-0.04	10.23
9	-0.140714	-0.95	11.68
10	0.135129	0.90	13.03
11	-0.122008	-0.80	14.16
12	-0.043527	-0.28	14.31
13	-0.101443	-0.66	15.13
14	0.056669	0.37	15.39
15	-0.090502	-0.58	16.06

Autocorrelation for RESI EKR



Stepwise Regression: BKL versus DIL, HOT, PIC, RED, ENC, GMR, PUM, TRG

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1

Response is BKL on 8 predictors, with N = 60

Step	1
Constant	39.95
GMR	22.3
T-Value	3.74
P-Value	0.000
S	15.1
R-Sq	19.42
R-Sq(adj)	18.03
Mallows Cp	7.2
PRESS	13974.5
R-Sq(pred)	14.68

Regression Analysis: BKL versus GMR

The regression equation is
BKL = 40.0 + 22.3 GMR

Predictor	Coef	SE Coef	T	P	VIF
Constant	39.954	6.388	6.25	0.000	
GMR	22.263	5.954	3.74	0.000	1.000

S = 15.0848 R-Sq = 19.4% R-Sq(adj) = 18.0%

PRESS = 13974.5 R-Sq(pred) = 14.68%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	3181.0	3181.0	13.98	0.000
Residual Error	58	13198.0	227.6		
Total	59	16379.0			

Unusual Observations

Obs	GMR	BKL	Fit	SE Fit	Residual	St Resid
15	0.23	59.44	45.12	5.09	14.32	1.01 X
32	1.01	108.71	62.35	1.95	46.36	3.10R
42	0.94	28.70	60.81	2.01	-32.11	-2.15R

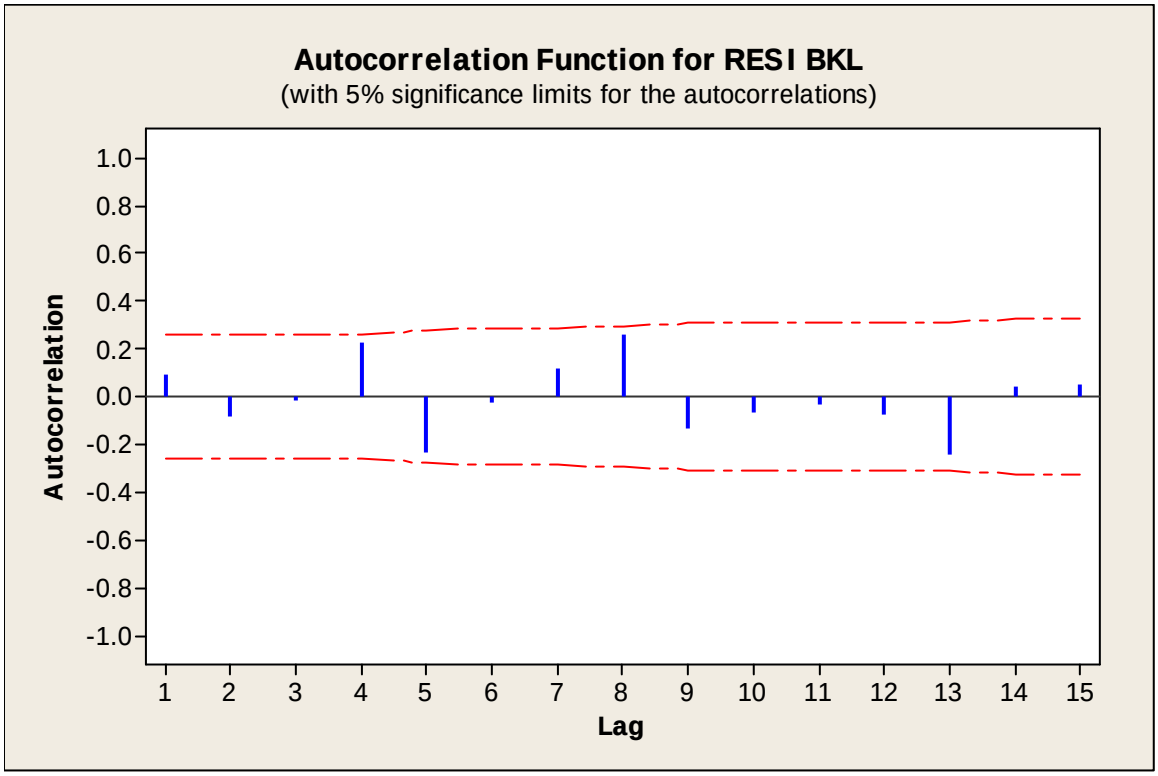
R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large leverage.

Durbin-Watson statistic = 1.78650

Autocorrelation Function: RESI BKL

Lag	ACF	T	LBQ
1	0.089272	0.69	0.50
2	-0.082497	-0.63	0.94
3	-0.015655	-0.12	0.95
4	0.223934	1.71	4.29
5	-0.232676	-1.70	7.95
6	-0.021978	-0.15	7.98
7	0.116585	0.81	8.94
8	0.260044	1.79	13.77
9	-0.133897	-0.88	15.08
10	-0.066904	-0.43	15.41
11	-0.033672	-0.22	15.50
12	-0.073066	-0.47	15.91
13	-0.244703	-1.57	20.65
14	0.039353	0.24	20.78
15	0.052799	0.33	21.01

Autocorrelation for RESI BKL



Stepwise Regression: SBC versus DIL, HOT, PIC, RED, ENC, GMR, PUM, TRG

Alpha-to-Enter: 0.05 Alpha-to-Remove: 0.1

Response is SBC on 8 predictors, with N = 60

Step	1
Constant	23.48
GMR	8.9
T-Value	3.50
P-Value	0.001
S	6.41
R-Sq	17.40
R-Sq(adj)	15.98
Mallows Cp	-0.5
PRESS	2546.02
R-Sq(pred)	11.86

Regression Analysis: SBC versus GMR

The regression equation is
SBC = 23.5 + 8.85 GMR

Predictor	Coef	SE Coef	T	P	VIF
Constant	23.483	2.716	8.65	0.000	
GMR	8.850	2.532	3.50	0.001	1.000

S = 6.41373 R-Sq = 17.4% R-Sq(adj) = 16.0%

PRESS = 2546.02 R-Sq(pred) = 11.86%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	502.68	502.68	12.22	0.001
Residual Error	58	2385.89	41.14		
Total	59	2888.57			

Unusual Observations

Obs	GMR	SBC	Fit	SE Fit	Residual	St Resid
15	0.23	28.956	25.536	2.164	3.420	0.57 X
32	1.01	49.784	32.386	0.829	17.398	2.74R
51	0.55	42.672	28.323	1.459	14.349	2.30R

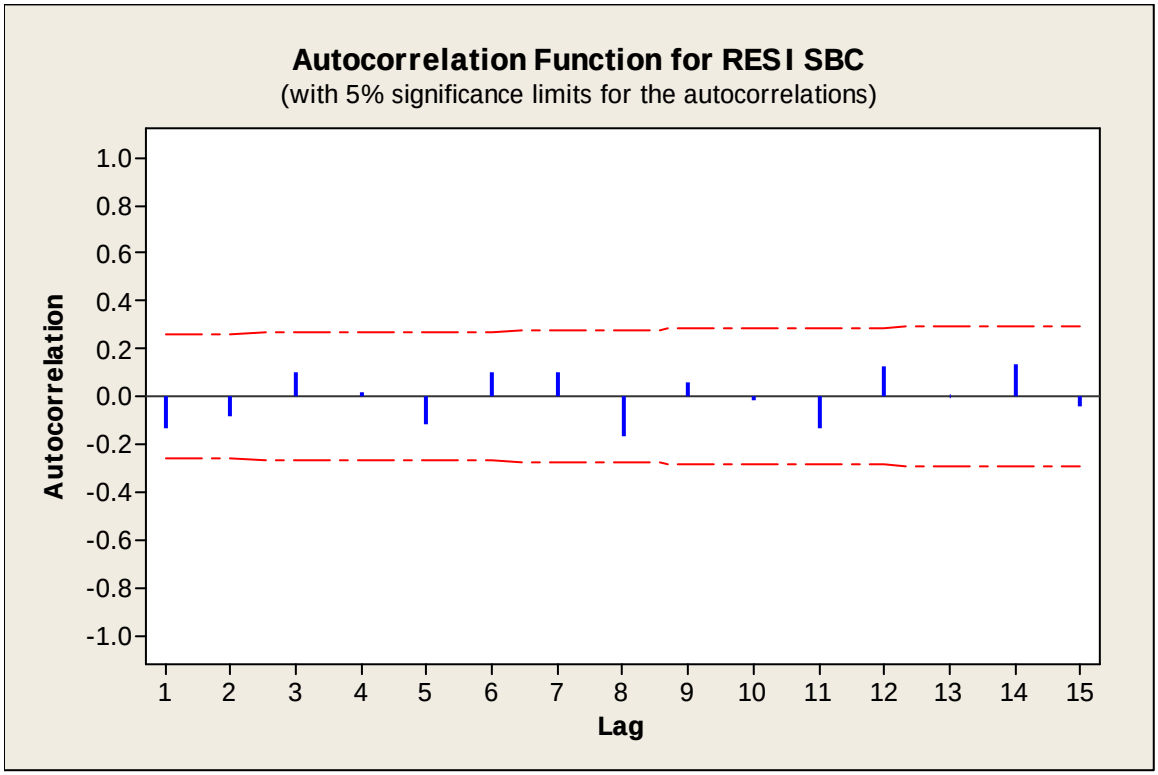
R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large leverage.

Durbin-Watson statistic = 2.26508

Autocorrelation Function: RESI SBC

Lag	ACF	T	LBQ
1	-0.135778	-1.05	1.16
2	-0.082587	-0.63	1.60
3	0.096964	0.73	2.21
4	0.016337	0.12	2.23
5	-0.115606	-0.87	3.14
6	0.101957	0.75	3.85
7	0.103695	0.76	4.61
8	-0.166390	-1.21	6.59
9	0.059220	0.42	6.84
10	-0.019166	-0.14	6.87
11	-0.132059	-0.93	8.19
12	0.124304	0.87	9.39
13	0.000216	0.00	9.39
14	0.134090	0.92	10.85
15	-0.040788	-0.28	10.98

Autocorrelation for RESI SBC



Appendix 5. Regression Equations for Reconstructions

SNOTEL STATION	Retained Predictors	R^2	Regression Equation
SWE 11	GMR, PUM	0.42	SWE 11 = 25.127 + 13.170*GMR + 11.302*PUM
SWE 9	GMR, PUM	0.45	SWE 9 = 24.160 + 13.151*GMR + 12.807*PUM
Dry Lake (DLK)	GMR, PUM	0.48	DLK = 20.373 + 17.413*GMR + 18.559*PUM
Old Battle (OBT)	GMR, TRG	0.42	OBT = 41.745 + 21.603*GMR + 18.719*TRG
Lake Irene (LKI)	GMR, PUM	0.41	LKI = 26.746 + 17.545*GMR + 20.051*PUM
Columbine (COL)	PUM	0.36	COL = 36.084 + 26.730*PUM
Deadman Hill (DMH)	GMR	0.33	DMH = 26.917 + 14.343*GMR
Willow Creek Pass (WCP)	GMR, TRG	0.33	WCP = 16.064 + 6.326*GMR + 7.158*TRG
Phantom Valley (PHV)	GMR,PUM	0.30	PHV = 9.650 + 5.564*GMR + 7.232*PUM
Roach (ROA)	GMR	0.29	ROA = 28.608 + 14.826*ROA
Elk River (EKR)	PUM	0.28	EKR = 27.389 + 21.993*PUM
Brooklyn Lake (BKL)	GMR	0.19	BLK = 39.954 + 22.263*GMR
South Brush Creek (SBC)	GMR	0.17	SBC = 23.483 + 8.85*GMR

Appendix 6. Model's Reconstruction Data for Calibration Data

Model's Reconstructed Data for Regional, Dry Lake, Old Battle, and Lake Irene

Year	FITS 11	FITS 9	FITS DLK	FITS OBT	FITS LKI
1940	47.8	47.8	53.7	72.0	61.6
1941	50.3	50.3	57.7	86.8	65.9
1942	52.6	52.6	60.4	88.1	68.4
1943	52.4	52.4	59.7	87.6	67.6
1944	40.1	40.1	42.7	68.3	50.2
1945	48.2	48.2	54.2	72.4	62.0
1946	50.1	50.1	56.3	75.8	64.1
1947	52.9	52.9	61.5	88.5	69.8
1948	47.4	47.4	52.8	79.0	60.5
1949	53.3	53.3	62.3	88.9	70.7
1950	47.7	47.7	52.8	82.4	60.4
1951	53.6	53.6	62.3	80.5	70.6
1952	54.1	54.1	63.5	93.0	72.0
1953	46.7	46.7	51.9	74.7	59.6
1954	34.0	34.0	34.0	51.1	41.1
1955	50.1	50.1	57.4	86.6	65.5
1956	57.6	57.6	67.1	93.7	75.3
1957	56.1	56.1	66.2	94.8	74.8
1958	51.4	51.4	58.6	81.6	66.6
1959	45.8	45.8	51.1	67.9	59.0
1960	53.9	53.9	62.0	89.9	70.1
1961	40.5	40.5	43.0	68.3	50.4
1962	61.2	61.2	74.4	96.0	83.5
1963	42.9	42.9	47.5	68.5	55.4
1964	41.1	41.1	43.7	73.5	51.0
1965	56.5	56.5	66.5	90.4	74.9
1966	44.6	44.6	48.3	78.0	55.8
1967	53.2	53.2	61.0	92.0	69.0
1968	43.5	43.5	47.9	70.4	55.6
1969	50.8	50.8	58.7	86.8	67.0
1970	57.2	57.2	66.4	94.6	74.4
1971	49.7	49.7	56.5	82.3	64.5
1972	47.9	47.9	54.2	72.9	62.1
1973	58.4	58.4	69.7	95.8	78.4
1974	56.6	56.6	65.4	94.5	73.5
1975	51.9	51.9	59.6	87.4	67.7
1976	42.8	42.8	46.0	73.9	53.4

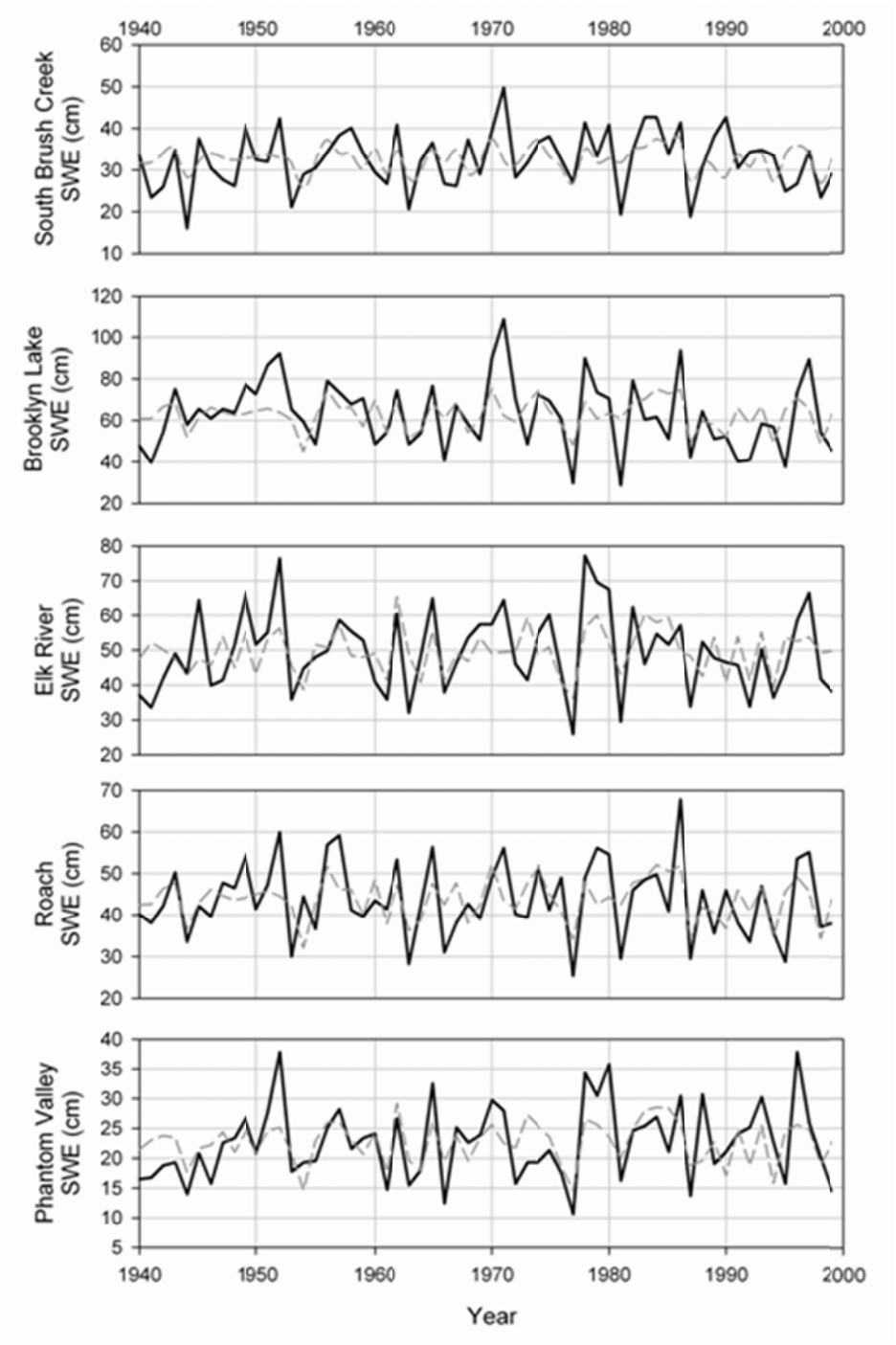
1977	34.4	34.4	34.1	50.6	41.1
1978	57.3	57.3	67.7	96.2	76.2
1979	54.3	54.3	64.3	93.0	73.0
1980	51.7	51.7	59.5	83.3	67.7
1981	45.5	45.5	49.9	69.0	57.4
1982	54.7	54.7	63.5	98.8	71.7
1983	59.9	59.9	71.7	95.7	80.5
1984	61.7	61.7	73.7	100.8	82.4
1985	60.9	60.9	73.0	99.0	81.7
1986	57.2	57.2	66.4	105.7	74.5
1987	41.4	41.4	45.3	74.6	53.1
1988	44.7	44.7	48.7	70.0	56.2
1989	49.2	49.2	56.5	85.3	64.7
1990	39.2	39.2	41.2	59.1	48.6
1991	54.2	54.2	63.1	94.0	71.4
1992	43.1	43.1	46.4	72.3	53.8
1993	55.4	55.4	64.9	95.4	73.3
1994	36.6	36.6	37.4	63.4	44.7
1995	53.6	53.6	62.4	89.9	70.7
1996	56.3	56.3	65.7	93.7	74.0
1997	53.9	53.9	62.8	86.1	71.1
1998	41.4	41.4	45.5	70.6	53.4
1999	50.0	50.0	56.9	83.1	65.0

Model's Reconstructed Data for COL, DMH, WCP, PHV, ROA, EKR, BKL, SBC

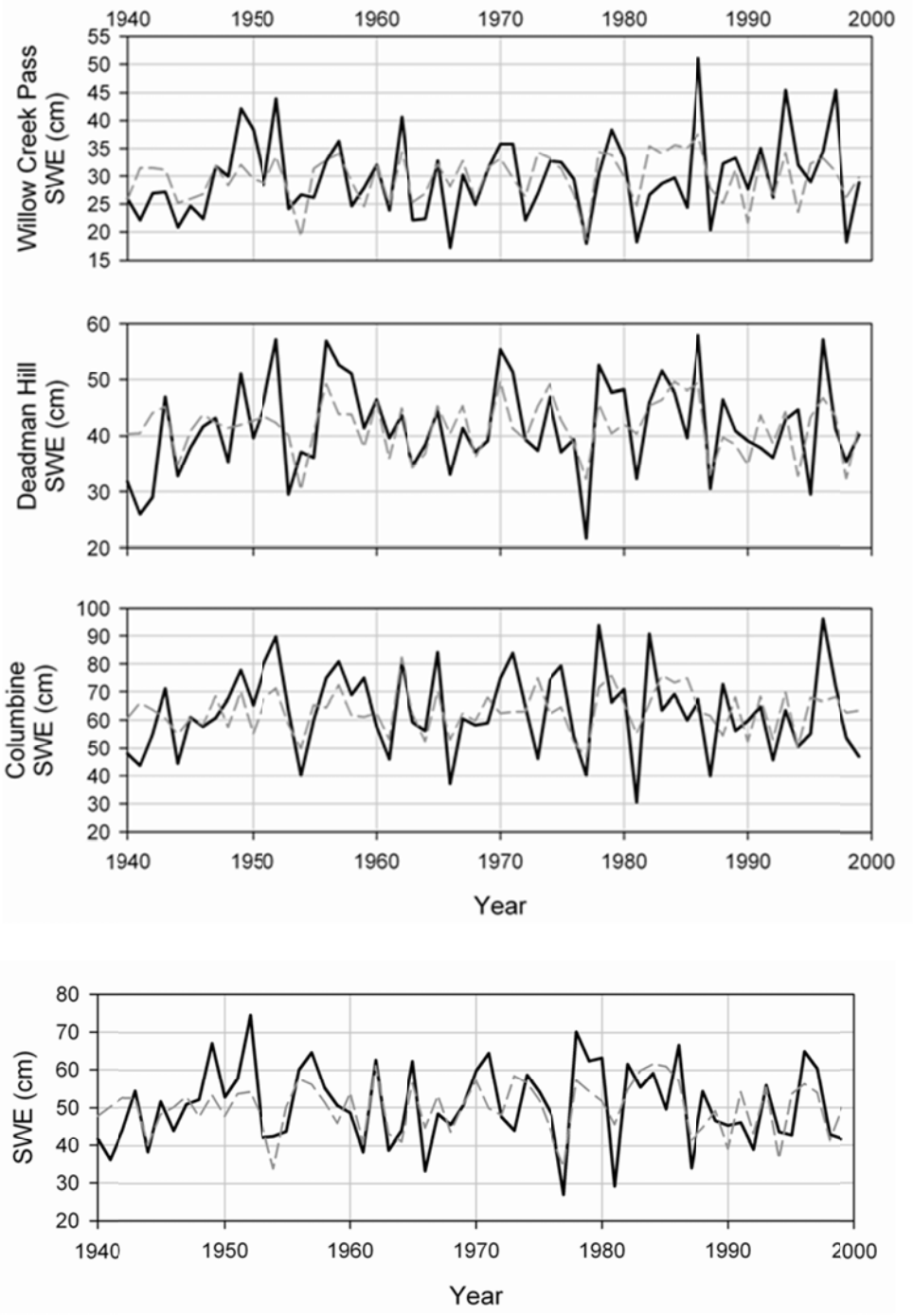
Year	FITS COL	FITS DMH	FITS WCP	FITS PHV	FITS ROA	FITS EKR	FITS BKL	FITS SBC
1940	60.6	40.3	25.8	21.5	42.5	47.6	60.8	31.8
1941	66.2	40.5	31.4	23.0	42.6	52.1	61.0	31.8
1942	63.7	44.1	31.5	23.8	46.4	50.1	66.6	34.1
1943	60.6	45.3	31.1	23.4	47.6	47.6	68.5	34.8
1944	54.8	34.6	25.2	17.7	36.6	42.8	51.9	28.2
1945	60.5	40.8	25.9	21.6	43.0	47.5	61.5	32.0
1946	58.3	43.9	26.8	22.2	46.1	45.6	66.2	33.9
1947	68.4	42.3	31.9	24.4	44.5	54.0	63.9	33.0
1948	57.4	41.4	28.3	21.0	43.6	45.0	62.4	32.4
1949	70.1	42.0	32.1	24.7	44.2	55.4	63.3	32.8
1950	55.1	42.7	29.5	20.9	45.0	43.1	64.5	33.2
1951	67.5	43.5	28.6	24.6	45.7	53.2	65.7	33.7
1952	71.2	42.3	33.6	25.1	44.5	56.3	63.9	33.0
1953	58.4	40.1	26.9	20.8	42.3	45.7	60.5	31.6
1954	49.8	30.2	19.2	14.7	32.0	38.7	45.1	25.5
1955	65.4	40.6	31.4	22.9	42.8	51.5	61.2	31.9
1956	64.4	49.2	32.9	26.0	51.7	50.7	74.6	37.3
1957	72.4	43.9	34.0	26.1	46.2	57.3	66.3	34.0
1958	61.6	43.8	29.0	23.1	46.1	48.4	66.2	33.9
1959	61.0	38.0	24.6	20.7	40.0	47.9	57.1	30.3
1960	62.5	46.2	31.9	24.2	48.5	49.1	69.8	35.4
1961	53.0	35.9	25.0	17.7	37.9	41.3	53.9	29.0
1962	82.3	45.0	34.4	29.2	47.3	65.4	68.0	34.6
1963	62.3	34.3	25.3	19.6	36.2	48.9	51.4	28.0
1964	52.3	36.8	26.9	17.9	38.8	40.8	55.3	29.6
1965	70.3	45.3	32.2	26.0	47.7	55.5	68.6	34.9
1966	52.9	40.3	28.1	19.4	42.5	41.2	60.8	31.8
1967	62.3	45.4	32.8	23.9	47.7	49.0	68.7	34.9
1968	59.6	36.1	25.8	19.6	38.1	46.8	54.2	29.1
1969	67.9	40.3	31.5	23.4	42.4	53.6	60.7	31.7
1970	62.4	49.7	33.2	25.6	52.2	49.1	75.4	37.6
1971	62.9	41.3	29.6	22.5	43.5	49.5	62.4	32.4
1972	62.9	39.4	26.3	21.8	41.5	49.5	59.3	31.2
1973	74.9	45.3	34.2	27.3	47.6	59.3	68.5	34.8
1974	62.0	49.2	33.2	25.3	51.7	48.7	74.6	37.3
1975	64.6	42.9	31.3	23.6	45.1	50.9	64.8	33.3
1976	52.4	38.7	26.8	18.6	40.8	40.8	58.3	30.8
1977	46.6	32.2	18.7	14.6	34.1	36.1	48.2	26.7

1978	71.4	45.7	34.3	26.5	48.0	56.5	69.1	35.1
1979	75.7	40.4	33.8	25.6	42.6	60.0	60.9	31.8
1980	65.9	42.1	29.9	23.6	44.3	52.0	63.5	32.8
1981	55.1	40.4	24.7	20.0	42.5	43.0	60.8	31.8
1982	65.9	45.4	35.4	24.9	47.7	51.9	68.6	34.9
1983	75.9	46.4	34.1	28.0	48.8	60.1	70.3	35.5
1984	73.2	49.6	35.6	28.5	52.1	57.9	75.2	37.5
1985	74.8	48.1	35.1	28.3	50.5	59.2	72.8	36.6
1986	63.1	49.4	37.5	25.7	51.9	49.6	74.9	37.4
1987	61.5	32.9	27.8	18.8	34.8	48.3	49.2	27.2
1988	54.4	39.8	25.1	19.6	41.9	42.5	59.9	31.4
1989	68.0	38.4	31.2	22.7	40.5	53.7	57.7	30.6
1990	52.4	34.8	21.6	17.1	36.7	40.8	52.1	28.3
1991	68.3	43.7	33.8	24.9	46.0	53.9	66.0	33.8
1992	53.0	38.6	26.2	18.8	40.7	41.3	58.1	30.7
1993	69.8	44.3	34.3	25.5	46.6	55.1	66.9	34.2
1994	50.4	32.8	23.5	15.8	34.7	39.2	49.0	27.1
1995	67.9	43.3	32.3	24.6	45.6	53.5	65.4	33.6
1996	66.6	46.8	33.2	25.6	49.2	52.5	70.9	35.8
1997	68.1	43.5	30.8	24.8	45.8	53.7	65.7	33.7
1998	62.6	32.4	26.3	19.0	34.3	49.2	48.5	26.9
1999	63.3	41.5	29.9	22.7	43.7	49.8	62.6	32.5

Appendix 7. Model Calibration Figures



Calibrations for SBC, BLK, ELR, ROA, and PHV
The black line is instrumental data and gray line represents the model's reconstructed data.



Calibrations for WCP, DMH, COL, and Eleven-Station Regionalization
The black line is instrumental data and gray line represents the model's reconstructed data.

Appendix 8. Reconstruction Data

Reconstruction and End Year Filter (5, 10, 20) for April 1st SWE Nine Station Regionalization

Year	Full Reconstruction	5-Year Filter	10 -Year Filter	20-Year Filter
1378	53.2			
1379	45.3			
1380	44.8			
1381	46.6			
1382	52.5	48.5		
1383	51.6	48.2		
1384	49.1	48.9		
1385	54.4	50.8		
1386	51.5	51.8		
1387	50.3	51.4	49.9	
1388	44.0	49.9	49.0	
1389	41.0	48.2	48.6	
1390	52.0	47.8	49.3	
1391	55.2	48.5	50.2	
1392	44.3	47.3	49.3	
1393	51.1	48.7	49.3	
1394	50.3	50.6	49.4	
1395	55.4	51.2	49.5	
1396	54.7	51.1	49.8	
1397	38.6	50.0	48.6	49.3
1398	43.2	48.4	48.6	48.8
1399	38.2	46.0	48.3	48.4
1400	46.7	44.3	47.8	48.5
1401	53.2	44.0	47.6	48.9
1402	46.0	45.5	47.7	48.5
1403	48.8	46.6	47.5	48.4
1404	50.2	49.0	47.5	48.5
1405	49.5	49.6	46.9	48.2
1406	53.9	49.7	46.8	48.3
1407	49.0	50.3	47.9	48.3
1408	52.9	51.1	48.8	48.7
1409	55.9	52.2	50.6	49.4
1410	53.0	52.9	51.2	49.5
1411	41.0	50.4	50.0	48.8
1412	53.6	51.3	50.8	49.3
1413	41.8	49.0	50.1	48.8
1414	59.4	49.8	51.0	49.2

1415	40.8	47.3	50.1	48.5
1416	45.3	48.2	49.3	48.0
1417	46.6	46.8	49.0	48.4
1418	54.4	49.3	49.2	49.0
1419	51.1	47.6	48.7	49.7
1420	60.2	51.5	49.4	50.3
1421	48.6	52.2	50.2	50.1
1422	50.2	52.9	49.8	50.3
1423	41.3	50.3	49.8	49.9
1424	51.2	50.3	49.0	50.0
1425	42.1	46.7	49.1	49.6
1426	60.8	49.1	50.7	50.0
1427	45.0	48.1	50.5	49.8
1428	52.3	50.3	50.3	49.7
1429	59.1	51.9	51.1	49.9
1430	44.2	52.3	49.5	49.5
1431	50.6	50.2	49.7	49.9
1432	51.8	51.6	49.8	49.8
1433	52.4	51.6	50.9	50.4
1434	61.7	52.1	52.0	50.5
1435	60.2	55.3	53.8	51.4
1436	41.4	53.5	51.9	51.3
1437	47.6	52.6	52.1	51.3
1438	49.9	52.2	51.9	51.1
1439	45.3	48.9	50.5	50.8
1440	55.6	48.0	51.6	50.6
1441	54.2	50.5	52.0	50.8
1442	39.2	48.8	50.7	50.3
1443	57.7	50.4	51.3	51.1
1444	41.5	49.6	49.3	50.6
1445	38.6	46.2	47.1	50.5
1446	53.8	46.2	48.3	50.1
1447	53.6	49.0	48.9	50.5
1448	45.2	46.5	48.5	50.2
1449	59.1	50.1	49.8	50.2
1450	40.4	50.4	48.3	50.0
1451	49.1	49.5	47.8	49.9
1452	50.2	48.8	48.9	49.8
1453	41.7	48.1	47.3	49.3
1454	43.5	45.0	47.5	48.4
1455	46.1	46.1	48.3	47.7

1456	46.3	45.6	47.5	47.9
1457	49.9	45.5	47.1	48.0
1458	44.2	46.0	47.0	47.8
1459	44.1	46.1	45.6	47.7
1460	38.4	44.6	45.4	46.8
1461	47.7	44.9	45.2	46.5
1462	57.8	46.5	46.0	47.5
1463	53.9	48.4	47.2	47.3
1464	46.9	49.0	47.6	47.5
1465	47.9	50.9	47.7	48.0
1466	50.4	51.4	48.1	47.8
1467	55.8	51.0	48.7	47.9
1468	48.3	49.9	49.1	48.1
1469	42.1	48.9	48.9	47.2
1470	53.5	50.0	50.4	47.9
1471	52.1	50.4	50.9	48.1
1472	43.2	47.8	49.4	47.7
1473	47.0	47.6	48.7	48.0
1474	50.4	49.2	49.1	48.3
1475	38.4	46.2	48.1	47.9
1476	52.6	46.3	48.3	48.2
1477	50.7	47.8	47.8	48.3
1478	44.2	47.2	47.4	48.3
1479	52.9	47.8	48.5	48.7
1480	52.8	50.7	48.4	49.4
1481	52.4	50.6	48.5	49.7
1482	55.2	51.5	49.7	49.5
1483	53.0	53.3	50.3	49.5
1484	65.3	55.7	51.8	50.4
1485	64.5	58.1	54.4	51.2
1486	58.2	59.2	54.9	51.6
1487	53.6	58.9	55.2	51.5
1488	42.7	56.9	55.1	51.2
1489	55.5	54.9	55.3	51.9
1490	62.8	54.6	56.3	52.4
1491	55.0	53.9	56.6	52.5
1492	54.4	54.1	56.5	53.1
1493	44.1	54.4	55.6	52.9
1494	57.5	54.8	54.8	53.3
1495	39.6	50.1	52.3	53.4
1496	36.2	46.4	50.1	52.5

1497	52.6	46.0	50.0	52.6
1498	65.1	50.2	52.3	53.7
1499	38.1	46.3	50.5	52.9
1500	42.6	46.9	48.5	52.4
1501	47.8	49.2	47.8	52.2
1502	50.5	48.8	47.4	52.0
1503	44.3	44.6	47.4	51.5
1504	52.4	47.5	46.9	50.9
1505	43.5	47.7	47.3	49.8
1506	35.6	45.2	47.2	48.7
1507	44.7	44.1	46.4	48.2
1508	47.9	44.8	44.7	48.5
1509	49.6	44.3	45.9	48.2
1510	45.1	44.6	46.1	47.3
1511	48.5	47.2	46.2	47.0
1512	52.3	48.7	46.4	46.9
1513	51.7	49.5	47.1	47.3
1514	56.6	50.8	47.5	47.2
1515	47.1	51.2	47.9	47.6
1516	45.6	50.7	48.9	48.1
1517	51.4	50.5	49.6	48.0
1518	53.4	50.8	50.1	47.4
1519	47.5	49.0	49.9	47.9
1520	44.5	48.5	49.9	48.0
1521	76.6	54.7	52.7	49.4
1522	41.8	52.8	51.6	49.0
1523	61.4	54.4	52.6	49.9
1524	56.3	56.1	52.6	50.1
1525	57.5	58.7	53.6	50.8
1526	52.7	53.9	54.3	51.6
1527	49.4	55.5	54.1	51.9
1528	52.9	53.8	54.1	52.1
1529	54.7	53.4	54.8	52.3
1530	53.0	52.5	55.6	52.7
1531	32.3	48.4	51.2	51.9
1532	39.3	46.4	51.0	51.3
1533	56.5	47.2	50.5	51.5
1534	53.7	47.0	50.2	51.4
1535	51.1	46.6	49.6	51.6
1536	52.8	50.7	49.6	51.9
1537	52.3	53.3	49.9	52.0

1538	46.4	51.2	49.2	51.6
1539	56.0	51.7	49.3	52.1
1540	58.4	53.2	49.9	52.8
1541	53.8	53.4	52.0	51.6
1542	36.1	50.1	51.7	51.3
1543	53.9	51.6	51.4	51.0
1544	38.2	48.1	49.9	50.0
1545	44.8	45.4	49.3	49.4
1546	60.3	46.7	50.0	49.8
1547	52.3	49.9	50.0	49.9
1548	51.4	49.4	50.5	49.9
1549	66.5	55.1	51.6	50.5
1550	51.8	56.5	50.9	50.4
1551	41.4	52.7	49.7	50.8
1552	52.5	52.7	51.3	51.5
1553	56.3	53.7	51.5	51.5
1554	50.6	50.5	52.8	51.3
1555	64.2	53.0	54.7	52.0
1556	57.0	56.1	54.4	52.2
1557	58.5	57.3	55.0	52.5
1558	36.1	53.3	53.5	52.0
1559	44.1	52.0	51.2	51.4
1560	56.7	50.5	51.7	51.3
1561	51.6	49.4	52.7	51.2
1562	44.5	46.6	51.9	51.6
1563	50.1	49.4	51.3	51.4
1564	58.3	52.2	52.1	52.4
1565	52.3	51.4	50.9	52.8
1566	49.6	51.0	50.2	52.3
1567	47.5	51.6	49.1	52.0
1568	50.3	51.6	50.5	52.0
1569	49.5	49.8	51.0	51.1
1570	55.5	50.5	50.9	51.3
1571	54.3	51.4	51.2	52.0
1572	51.2	52.1	51.8	51.9
1573	49.1	51.9	51.7	51.5
1574	44.0	50.8	50.3	51.2
1575	54.9	50.7	50.6	50.7
1576	42.3	48.3	49.8	50.0
1577	54.5	48.9	50.5	49.8
1578	53.1	49.8	50.8	50.7

1579	53.0	51.6	51.2	51.1
1580	38.1	48.2	49.4	50.2
1581	44.1	48.5	48.4	49.8
1582	53.5	48.3	48.6	50.2
1583	47.7	47.2	48.5	50.1
1584	31.5	43.0	47.3	48.8
1585	41.8	43.7	45.9	48.3
1586	51.0	45.1	46.8	48.3
1587	44.2	43.2	45.8	48.2
1588	51.6	44.0	45.6	48.2
1589	53.7	48.5	45.7	48.4
1590	41.8	48.5	46.1	47.8
1591	37.4	45.7	45.4	46.9
1592	43.7	45.6	44.4	46.5
1593	48.2	45.0	44.5	46.5
1594	51.8	44.6	46.5	46.9
1595	48.9	46.0	47.2	46.6
1596	50.5	48.6	47.2	47.0
1597	37.9	47.5	46.5	46.2
1598	38.4	45.5	45.2	45.4
1599	50.0	45.1	44.9	45.3
1600	39.0	43.2	44.6	45.3
1601	49.6	43.0	45.8	45.6
1602	46.9	44.8	46.1	45.3
1603	49.8	47.1	46.3	45.4
1604	56.7	48.4	46.8	46.6
1605	56.9	52.0	47.6	47.4
1606	52.4	52.5	47.8	47.5
1607	33.7	49.9	47.3	46.9
1608	53.6	50.7	48.9	47.0
1609	45.0	48.3	48.4	46.6
1610	56.5	48.2	50.1	47.3
1611	56.4	49.0	50.8	48.3
1612	48.6	52.0	51.0	48.5
1613	53.6	52.0	51.3	48.8
1614	53.2	53.7	51.0	48.9
1615	55.4	53.4	50.8	49.2
1616	50.5	52.3	50.7	49.2
1617	56.1	53.8	52.9	50.1
1618	52.1	53.5	52.7	50.8
1619	45.1	51.9	52.8	50.6

1620	44.4	49.6	51.5	50.8
1621	55.0	50.5	51.4	51.1
1622	42.1	47.7	50.8	50.9
1623	51.7	47.6	50.6	51.0
1624	49.4	48.5	50.2	50.6
1625	40.1	47.7	48.7	49.7
1626	50.3	46.7	48.6	49.6
1627	48.1	47.9	47.8	50.4
1628	56.3	48.8	48.2	50.5
1629	47.8	48.5	48.5	50.6
1630	44.7	49.4	48.5	50.0
1631	41.0	47.6	47.1	49.3
1632	50.4	48.0	48.0	49.4
1633	52.6	47.3	48.1	49.3
1634	36.6	45.1	46.8	48.5
1635	46.8	45.5	47.5	48.1
1636	49.0	47.1	47.3	48.0
1637	53.2	47.7	47.8	47.8
1638	49.2	47.0	47.1	47.7
1639	57.8	51.2	48.1	48.3
1640	50.5	52.0	48.7	48.6
1641	53.1	52.8	49.9	48.5
1642	47.4	51.6	49.6	48.8
1643	49.6	51.7	49.3	48.7
1644	45.3	49.2	50.2	48.5
1645	46.5	48.4	50.2	48.8
1646	35.7	44.9	48.8	48.1
1647	58.1	47.0	49.3	48.6
1648	49.5	47.0	49.4	48.2
1649	62.1	50.4	49.8	49.0
1650	53.6	51.8	50.1	49.4
1651	56.0	55.9	50.4	50.2
1652	44.4	53.1	50.1	49.9
1653	39.4	51.1	49.1	49.2
1654	32.5	45.2	47.8	49.0
1655	68.0	48.0	49.9	50.0
1656	50.9	47.0	51.4	50.1
1657	59.0	49.9	51.5	50.4
1658	45.9	51.2	51.2	50.3
1659	55.3	55.8	50.5	50.1
1660	54.8	53.2	50.6	50.4

1661	57.0	54.4	50.7	50.5
1662	50.4	52.7	51.3	50.7
1663	49.8	53.5	52.3	50.7
1664	32.0	48.8	52.3	50.0
1665	55.5	48.9	51.1	50.5
1666	44.4	46.4	50.4	50.9
1667	35.8	43.5	48.1	49.8
1668	45.5	42.6	48.0	49.6
1669	55.2	47.3	48.0	49.3
1670	45.9	45.3	47.1	48.9
1671	36.2	43.7	45.1	47.9
1672	55.6	47.7	45.6	48.4
1673	54.7	49.5	46.1	49.2
1674	49.4	48.4	47.8	50.1
1675	44.7	48.1	46.7	48.9
1676	62.4	53.4	48.5	49.5
1677	50.9	52.4	50.0	49.1
1678	68.0	55.1	52.3	50.2
1679	50.0	55.2	51.8	49.9
1680	60.8	58.4	53.3	50.2
1681	52.9	56.5	54.9	50.0
1682	46.6	55.7	54.0	49.8
1683	55.0	53.1	54.1	50.1
1684	45.4	52.1	53.7	50.7
1685	32.7	46.5	52.5	49.6
1686	37.1	43.4	49.9	49.2
1687	53.1	44.7	50.2	50.1
1688	51.3	43.9	48.5	50.4
1689	51.7	45.2	48.7	50.2
1690	56.7	50.0	48.3	50.8
1691	58.9	54.4	48.9	51.9
1692	40.6	51.9	48.3	51.2
1693	49.7	51.5	47.7	50.9
1694	55.4	52.3	48.7	51.2
1695	42.1	49.3	49.7	51.1
1696	53.7	48.3	51.3	50.6
1697	55.7	51.3	51.6	50.9
1698	51.3	51.6	51.6	50.0
1699	48.5	50.3	51.3	50.0
1700	48.6	51.6	50.4	49.4
1701	55.3	51.9	50.1	49.5

1702	57.0	52.1	51.7	50.0
1703	46.3	51.1	51.4	49.6
1704	36.7	48.8	49.5	49.1
1705	47.3	48.5	50.0	49.8
1706	42.8	46.0	48.9	50.1
1707	45.1	43.6	47.9	49.7
1708	45.7	43.5	47.3	49.5
1709	48.5	45.9	47.3	49.3
1710	49.0	46.2	47.4	48.9
1711	46.5	46.9	46.5	48.3
1712	54.3	48.8	46.2	49.0
1713	44.2	48.5	46.0	48.7
1714	35.8	46.0	45.9	47.7
1715	51.8	46.5	46.4	48.2
1716	46.6	46.6	46.8	47.8
1717	51.8	46.1	47.4	47.7
1718	54.0	48.0	48.3	47.8
1719	57.7	52.4	49.2	48.2
1720	59.7	54.0	50.2	48.8
1721	46.0	53.8	50.2	48.3
1722	45.9	52.6	49.3	47.8
1723	47.6	51.4	49.7	47.8
1724	55.0	50.8	51.6	48.8
1725	55.9	50.1	52.0	49.2
1726	66.5	54.2	54.0	50.4
1727	46.8	54.3	53.5	50.5
1728	46.2	54.1	52.7	50.5
1729	45.4	52.1	51.5	50.3
1730	45.5	50.1	50.1	50.2
1731	53.5	47.5	50.8	50.5
1732	50.7	48.3	51.3	50.3
1733	55.5	50.1	52.1	50.9
1734	59.5	52.9	52.5	52.1
1735	46.4	53.1	51.6	51.8
1736	39.3	50.3	48.9	51.4
1737	45.0	49.1	48.7	51.1
1738	54.0	48.8	49.5	51.1
1739	59.8	48.9	50.9	51.2
1740	43.3	48.3	50.7	50.4
1741	62.2	52.9	51.6	51.2
1742	52.6	54.4	51.8	51.5

1743	56.2	54.8	51.8	52.0
1744	49.7	52.8	50.8	51.7
1745	53.7	54.9	51.6	51.6
1746	59.8	54.4	53.6	51.2
1747	57.8	55.4	54.9	51.8
1748	37.1	51.6	53.2	51.3
1749	56.7	53.0	52.9	51.9
1750	39.7	50.2	52.5	51.6
1751	55.0	49.3	51.8	51.7
1752	54.2	48.5	52.0	51.9
1753	53.1	51.7	51.7	51.8
1754	51.1	50.6	51.8	51.3
1755	47.6	52.2	51.2	51.4
1756	41.5	49.5	49.4	51.5
1757	47.3	48.1	48.3	51.6
1758	52.7	48.0	49.9	51.6
1759	36.8	45.2	47.9	50.4
1760	56.9	47.0	49.6	51.1
1761	58.6	50.5	50.0	50.9
1762	59.9	53.0	50.6	51.3
1763	47.4	51.9	50.0	50.8
1764	60.9	56.8	51.0	51.4
1765	40.7	53.5	50.3	50.7
1766	53.5	52.5	51.5	50.4
1767	38.9	48.3	50.6	49.5
1768	65.6	51.9	51.9	50.9
1769	52.3	50.2	53.5	50.7
1770	39.2	49.9	51.7	50.7
1771	50.8	49.3	50.9	50.4
1772	52.4	52.0	50.2	50.4
1773	48.3	48.6	50.2	50.1
1774	52.6	48.6	49.4	50.2
1775	50.0	50.8	50.3	50.3
1776	45.1	49.7	49.5	50.5
1777	34.2	46.0	49.0	49.8
1778	51.2	46.6	47.6	49.8
1779	49.1	45.9	47.3	50.4
1780	47.1	45.4	48.1	49.9
1781	48.5	46.0	47.8	49.4
1782	46.3	48.5	47.2	48.7
1783	49.9	48.2	47.4	48.8

1784	54.6	49.3	47.6	48.5
1785	53.9	50.6	48.0	49.2
1786	43.0	49.5	47.8	48.6
1787	55.9	51.5	50.0	49.5
1788	48.0	51.1	49.6	48.6
1789	39.4	48.1	48.7	48.0
1790	64.2	50.1	50.4	49.2
1791	49.7	51.5	50.5	49.2
1792	63.4	52.9	52.2	49.7
1793	44.8	52.3	51.7	49.6
1794	48.2	54.1	51.1	49.3
1795	52.4	51.7	50.9	49.5
1796	50.0	51.8	51.6	49.7
1797	61.0	51.3	52.1	51.0
1798	30.0	48.3	50.3	50.0
1799	57.9	50.3	52.2	50.4
1800	46.9	49.2	50.4	50.4
1801	45.2	48.2	50.0	50.2
1802	54.0	46.8	49.0	50.6
1803	53.8	51.6	49.9	50.8
1804	42.3	48.4	49.3	50.2
1805	48.8	48.8	49.0	50.0
1806	48.3	49.4	48.8	50.2
1807	41.9	47.0	46.9	49.5
1808	50.5	46.4	49.0	49.6
1809	45.1	46.9	47.7	49.9
1810	48.9	46.9	47.9	49.2
1811	57.4	48.8	49.1	49.5
1812	57.2	51.8	49.4	49.2
1813	48.3	51.4	48.9	49.4
1814	43.5	51.1	49.0	49.2
1815	52.8	51.8	49.4	49.2
1816	55.8	51.5	50.1	49.5
1817	49.1	49.9	50.9	48.9
1818	55.6	51.4	51.4	50.2
1819	51.2	52.9	52.0	49.8
1820	49.1	52.1	52.0	49.9
1821	59.9	53.0	52.2	50.7
1822	45.7	52.3	51.1	50.3
1823	47.7	50.7	51.0	50.0
1824	38.0	48.1	50.5	49.7

1825	39.8	46.2	49.2	49.3
1826	55.5	45.3	49.1	49.6
1827	50.4	46.3	49.3	50.1
1828	53.0	47.3	49.0	50.2
1829	46.5	49.0	48.6	50.3
1830	41.3	49.3	47.8	49.9
1831	57.4	49.7	47.5	49.9
1832	55.1	50.6	48.5	49.8
1833	53.2	50.7	49.0	50.0
1834	44.1	50.2	49.6	50.0
1835	55.2	53.0	51.2	50.2
1836	54.9	52.5	51.1	50.1
1837	64.8	54.4	52.5	50.9
1838	51.0	54.0	52.3	50.7
1839	54.1	56.0	53.1	50.8
1840	59.1	56.8	54.9	51.3
1841	58.6	57.5	55.0	51.3
1842	39.1	52.4	53.4	50.9
1843	69.5	56.1	55.0	52.0
1844	45.9	54.4	55.2	52.4
1845	32.4	49.1	52.9	52.1
1846	37.8	44.9	51.2	51.2
1847	36.5	44.4	48.4	50.5
1848	50.8	40.7	48.4	50.4
1849	58.2	43.2	48.8	51.0
1850	57.4	48.2	48.6	51.8
1851	27.2	46.0	45.5	50.2
1852	58.4	50.4	47.4	50.4
1853	58.5	51.9	46.3	50.7
1854	49.9	50.3	46.7	51.0
1855	34.0	45.6	46.9	49.9
1856	50.6	50.3	48.2	49.7
1857	46.2	47.8	49.1	48.8
1858	55.8	47.3	49.6	49.0
1859	49.8	47.3	48.8	48.8
1860	51.4	50.8	48.2	48.4
1861	41.0	48.8	49.6	47.5
1862	56.0	50.8	49.3	48.4
1863	43.6	48.4	47.8	47.1
1864	54.4	49.3	48.3	47.5
1865	51.4	49.3	50.0	48.4

1866	60.2	53.1	51.0	49.6
1867	67.3	55.4	53.1	51.1
1868	53.0	57.3	52.8	51.2
1869	47.6	55.9	52.6	50.7
1870	55.8	56.8	53.0	50.6
1871	37.2	52.2	52.7	51.1
1872	54.5	49.6	52.5	50.9
1873	58.4	50.7	54.0	50.9
1874	44.0	50.0	53.0	50.6
1875	45.3	47.9	52.3	51.2
1876	55.6	51.6	51.9	51.4
1877	46.0	49.9	49.7	51.4
1878	47.7	47.7	49.2	51.0
1879	39.6	46.8	48.4	50.5
1880	52.0	48.2	48.0	50.5
1881	49.2	46.9	49.2	50.9
1882	49.4	47.6	48.7	50.6
1883	51.6	48.4	48.0	51.0
1884	52.8	51.0	48.9	50.9
1885	50.2	50.7	49.4	50.9
1886	41.9	49.2	48.0	50.0
1887	38.8	47.1	47.3	48.5
1888	50.0	46.8	47.6	48.4
1889	46.1	45.4	48.2	48.3
1890	47.2	44.8	47.7	47.9
1891	47.9	46.0	47.6	48.4
1892	49.7	48.2	47.6	48.2
1893	47.4	47.7	47.2	47.6
1894	52.0	48.8	47.1	48.0
1895	58.6	51.1	48.0	48.7
1896	35.3	48.6	47.3	47.7
1897	53.9	49.5	48.8	48.1
1898	40.3	48.0	47.8	47.7
1899	52.9	48.2	48.5	48.4
1900	52.3	47.0	49.0	48.4
1901	43.8	48.7	48.6	48.1
1902	32.6	44.4	46.9	47.3
1903	52.0	46.7	47.4	47.3
1904	47.8	45.7	47.0	47.0
1905	49.7	45.2	46.1	47.0
1906	53.7	47.1	47.9	47.6

1907	53.1	51.2	47.8	48.3
1908	43.9	49.6	48.2	48.0
1909	54.6	51.0	48.3	48.4
1910	49.7	51.0	48.1	48.6
1911	47.1	49.7	48.4	48.5
1912	55.7	50.2	50.7	48.8
1913	44.8	50.4	50.0	48.7
1914	54.6	50.4	50.7	48.8
1915	46.7	49.8	50.4	48.2
1916	49.3	50.2	49.9	48.9
1917	60.1	51.1	50.6	49.2
1918	54.0	52.9	51.6	49.9
1919	39.4	49.9	50.1	49.2
1920	52.1	51.0	50.4	49.2
1921	60.7	53.2	51.7	50.1
1922	47.0	50.6	50.8	50.8
1923	55.0	50.8	51.9	50.9
1924	58.6	54.7	52.3	51.5
1925	47.3	53.7	52.3	51.4
1926	57.4	53.1	53.1	51.5
1927	49.6	53.6	52.1	51.4
1928	59.2	54.4	52.6	52.1
1929	47.8	52.2	53.5	51.8
1930	55.8	53.9	53.8	52.1
1931	49.3	52.3	52.7	52.2
1932	48.3	52.1	52.8	51.8
1933	49.6	50.1	52.3	52.1
1934	40.8	48.8	50.5	51.4
1935	47.8	47.2	50.6	51.4
1936	45.5	46.4	49.4	51.3
1937	47.7	46.3	49.2	50.6
1938	51.4	46.7	48.4	50.5
1939	45.8	47.6	48.2	50.8
1940	48.2	47.7	47.5	50.6
1941	51.0	48.8	47.6	50.2
1942	53.1	49.9	48.1	50.5
1943	52.8	50.2	48.4	50.3
1944	40.2	49.1	48.4	49.4
1945	48.6	49.1	48.4	49.5
1946	50.3	49.0	48.9	49.1
1947	53.8	49.1	49.5	49.3

1948	47.7	48.1	49.1	48.8
1949	54.3	50.9	50.0	49.1
1950	47.8	50.8	49.9	48.7
1951	54.4	51.6	50.3	49.0
1952	55.1	51.9	50.5	49.3
1953	46.9	51.7	49.9	49.2
1954	33.8	47.6	49.3	48.8
1955	50.8	48.2	49.5	49.0
1956	58.2	49.0	50.3	49.6
1957	57.1	49.4	50.6	50.1
1958	51.9	50.4	51.0	50.1
1959	46.2	52.9	50.2	50.1
1960	54.4	53.6	50.9	50.4
1961	40.5	50.0	49.5	49.9
1962	62.8	51.2	50.3	50.4
1963	43.4	49.5	49.9	49.9
1964	41.0	48.4	50.6	50.0
1965	57.4	49.0	51.3	50.4
1966	44.5	49.9	49.9	50.1
1967	53.7	48.0	49.6	50.1
1968	43.9	48.1	48.8	49.9
1969	51.7	50.2	49.3	49.8
1970	57.7	50.3	49.7	50.3
1971	50.2	51.4	50.6	50.1
1972	48.5	50.4	49.2	49.7
1973	59.6	53.5	50.8	50.4
1974	57.0	54.6	52.4	51.5
1975	52.5	53.6	51.9	51.6
1976	42.8	52.1	51.8	50.8
1977	34.1	49.2	49.8	49.7
1978	58.3	48.9	51.2	50.0
1979	55.5	48.6	51.6	50.5
1980	52.4	48.6	51.1	50.4
1981	45.6	49.2	50.6	50.6
1982	55.4	53.4	51.3	50.3
1983	61.1	54.0	51.5	51.1
1984	62.8	55.4	52.0	52.2
1985	62.1	57.4	53.0	52.5
1986	57.7	59.8	54.5	53.1
1987	41.8	57.1	55.3	52.5
1988	44.7	53.8	53.9	52.6

1989	50.0	51.3	53.4	52.5
1990	39.2	46.7	52.0	51.6
1991	55.0	46.1	53.0	51.8
1992	43.0	46.4	51.7	51.5
1993	56.3	48.7	51.3	51.4
1994	36.4	46.0	48.6	50.3
1995	54.4	49.0	47.8	50.4
1996	57.0	49.4	47.8	51.1
1997	54.7	51.8	49.1	52.2
1998	41.9	48.9	48.8	51.4
1999	50.5	51.7	48.8	51.1
2000	48.4	50.5	49.8	50.9

Reconstruction and End Year Filter (5, 10, 20) for April 1st SWE Dry Lake

Year	Full Reconstruction	5-Year Filter	10 -Year Filter	20-Year Filter
1378	60.8			
1379	49.3			
1380	49.2			
1381	51.2			
1382	59.4	54.0		
1383	58.5	53.5		
1384	55.2	54.7		
1385	62.1	57.3		
1386	58.3	58.7		
1387	56.4	58.1	56.0	
1388	47.6	55.9	54.7	
1389	43.6	53.6	54.2	
1390	58.9	53.0	55.1	
1391	62.8	53.9	56.3	
1392	48.6	52.3	55.2	
1393	57.5	54.3	55.1	
1394	56.1	56.8	55.2	
1395	63.5	57.7	55.3	
1396	62.6	57.7	55.8	
1397	40.7	56.1	54.2	55.1
1398	47.0	54.0	54.1	54.4
1399	40.0	50.7	53.8	54.0
1400	51.8	48.4	53.1	54.1
1401	60.4	48.0	52.8	54.5
1402	50.7	50.0	53.0	54.1
1403	54.8	51.5	52.8	53.9
1404	56.8	54.9	52.8	54.0
1405	56.0	55.7	52.1	53.7
1406	61.3	55.9	51.9	53.9
1407	55.1	56.8	53.4	53.8
1408	60.7	58.0	54.7	54.4
1409	64.5	59.5	57.2	55.5
1410	60.3	60.4	58.1	55.6
1411	44.0	56.9	56.4	54.6
1412	61.3	58.2	57.5	55.3
1413	45.2	55.1	56.5	54.6
1414	69.2	56.0	57.8	55.3
1415	43.3	52.6	56.5	54.3
1416	49.7	53.7	55.3	53.6
1417	51.7	51.8	55.0	54.2
1418	62.5	55.3	55.2	55.0

1419	57.8	53.0	54.5	55.9
1420	70.2	58.4	55.5	56.8
1421	54.4	59.3	56.5	56.5
1422	56.9	60.3	56.1	56.8
1423	44.5	56.7	56.0	56.3
1424	57.9	56.8	54.9	56.3
1425	45.3	51.8	55.1	55.8
1426	71.1	55.1	57.2	56.3
1427	49.4	53.6	57.0	56.0
1428	59.4	56.6	56.7	55.9
1429	68.6	58.8	57.8	56.1
1430	48.6	59.4	55.6	55.5
1431	57.5	56.7	55.9	56.2
1432	58.2	58.5	56.0	56.1
1433	59.2	58.4	57.5	56.8
1434	71.9	59.1	58.9	56.9
1435	69.9	63.3	61.4	58.2
1436	44.7	60.8	58.8	58.0
1437	52.9	59.7	59.1	58.0
1438	56.1	59.1	58.8	57.7
1439	49.9	54.7	56.9	57.3
1440	63.9	53.5	58.4	57.0
1441	62.0	57.0	58.9	57.4
1442	41.0	54.6	57.2	56.6
1443	66.5	56.7	57.9	57.7
1444	44.5	55.6	55.2	57.0
1445	40.5	50.9	52.2	56.8
1446	61.2	50.7	53.9	56.3
1447	61.5	54.8	54.7	56.9
1448	49.6	51.4	54.1	56.4
1449	68.8	56.3	55.9	56.4
1450	42.7	56.8	53.8	56.1
1451	55.1	55.5	53.1	56.0
1452	56.3	54.5	54.7	55.9
1453	44.9	53.6	52.5	55.2
1454	47.1	49.2	52.8	54.0
1455	51.0	50.9	53.8	53.0
1456	51.0	50.0	52.8	53.3
1457	56.0	50.0	52.2	53.5
1458	47.8	50.6	52.1	53.1
1459	48.1	50.8	50.0	53.0
1460	40.0	48.6	49.7	51.8
1461	52.8	48.9	49.5	51.3

1462	66.9	51.1	50.6	52.6
1463	61.6	53.9	52.2	52.4
1464	51.8	54.6	52.7	52.7
1465	53.2	57.3	52.9	53.4
1466	57.0	58.1	53.5	53.2
1467	64.1	57.5	54.3	53.3
1468	53.6	55.9	54.9	53.5
1469	45.4	54.7	54.6	52.3
1470	60.6	56.1	56.7	53.2
1471	59.0	56.6	57.3	53.4
1472	47.0	53.1	55.3	52.9
1473	52.2	52.9	54.4	53.3
1474	56.7	55.1	54.9	53.8
1475	40.0	51.0	53.6	53.2
1476	59.9	51.2	53.9	53.7
1477	57.5	53.3	53.2	53.8
1478	48.4	52.5	52.7	53.8
1479	60.1	53.2	54.2	54.4
1480	60.0	57.2	54.1	55.4
1481	59.6	57.1	54.2	55.7
1482	63.1	58.3	55.8	55.6
1483	60.2	60.6	56.6	55.5
1484	77.1	64.0	58.6	56.8
1485	75.8	67.2	62.2	57.9
1486	67.4	68.7	62.9	58.4
1487	61.2	68.4	63.3	58.3
1488	46.3	65.6	63.1	57.9
1489	63.7	62.9	63.5	58.8
1490	73.5	62.4	64.8	59.4
1491	63.1	61.5	65.1	59.6
1492	62.4	61.8	65.1	60.4
1493	48.4	62.2	63.9	60.2
1494	66.6	62.8	62.8	60.7
1495	41.8	56.4	59.4	60.8
1496	37.1	51.2	56.4	59.7
1497	59.6	50.7	56.2	59.8
1498	77.0	56.4	59.3	61.2
1499	39.6	51.0	56.9	60.2
1500	45.8	51.8	54.1	59.5
1501	53.5	55.1	53.2	59.2
1502	56.6	54.5	52.6	58.8
1503	48.5	48.8	52.6	58.2
1504	59.4	52.8	51.9	57.4

1505	47.3	53.1	52.4	55.9
1506	36.0	49.6	52.3	54.4
1507	49.0	48.0	51.3	53.8
1508	53.4	49.0	48.9	54.1
1509	56.0	48.3	50.5	53.7
1510	49.4	48.7	50.9	52.5
1511	54.1	52.4	51.0	52.1
1512	59.4	54.4	51.2	51.9
1513	58.4	55.4	52.2	52.4
1514	65.0	57.3	52.8	52.3
1515	52.0	57.8	53.3	52.8
1516	49.9	56.9	54.7	53.5
1517	58.0	56.7	55.6	53.4
1518	60.7	57.1	56.3	52.6
1519	52.4	54.6	55.9	53.2
1520	48.4	53.9	55.8	53.4
1521	92.3	62.4	59.7	55.3
1522	45.0	59.8	58.2	54.7
1523	72.1	62.0	59.6	55.9
1524	65.1	64.6	59.6	56.2
1525	66.1	68.1	61.0	57.1
1526	59.8	61.6	62.0	58.3
1527	55.6	63.7	61.7	58.7
1528	60.6	61.4	61.7	59.0
1529	62.4	60.9	62.7	59.3
1530	60.1	59.7	63.9	59.9
1531	32.0	54.1	57.9	58.8
1532	41.2	51.3	57.5	57.9
1533	65.0	52.1	56.8	58.2
1534	61.3	51.9	56.4	58.0
1535	57.6	51.4	55.6	58.3
1536	60.0	57.0	55.6	58.8
1537	59.4	60.6	56.0	58.8
1538	51.5	57.9	55.0	58.4
1539	64.2	58.5	55.2	59.0
1540	67.7	60.6	56.0	59.9
1541	61.4	60.8	58.9	58.4
1542	36.7	56.3	58.5	58.0
1543	61.9	58.4	58.2	57.5
1544	40.1	53.5	56.0	56.2
1545	48.7	49.7	55.1	55.4
1546	70.2	51.5	56.2	55.9
1547	59.8	56.1	56.2	56.1

1548	58.0	55.3	56.9	56.0
1549	78.6	63.0	58.3	56.8
1550	58.6	65.0	57.4	56.7
1551	44.2	59.8	55.7	57.3
1552	59.6	59.8	57.9	58.2
1553	64.8	61.1	58.2	58.2
1554	57.1	56.9	59.9	58.0
1555	75.3	60.2	62.6	58.9
1556	65.7	64.5	62.2	59.2
1557	68.0	66.2	63.0	59.6
1558	37.0	60.6	60.9	58.9
1559	47.9	58.8	57.8	58.1
1560	65.5	56.8	58.5	57.9
1561	58.3	55.4	59.9	57.8
1562	48.6	51.5	58.8	58.4
1563	56.4	55.3	58.0	58.1
1564	67.9	59.3	59.1	59.5
1565	59.3	58.1	57.5	60.0
1566	55.6	57.6	56.5	59.3
1567	52.7	58.4	54.9	59.0
1568	56.6	58.4	56.9	58.9
1569	55.7	56.0	57.7	57.7
1570	63.6	56.8	57.5	58.0
1571	61.8	58.1	57.8	58.9
1572	57.8	59.1	58.7	58.8
1573	55.1	58.8	58.6	58.3
1574	47.7	57.2	56.6	57.8
1575	62.9	57.1	56.9	57.2
1576	45.8	53.9	56.0	56.2
1577	62.7	54.8	57.0	55.9
1578	60.4	55.9	57.3	57.1
1579	60.6	58.5	57.8	57.7
1580	39.6	53.8	55.4	56.5
1581	48.1	54.3	54.1	55.9
1582	61.3	54.0	54.4	56.6
1583	52.9	52.5	54.2	56.4
1584	30.5	46.5	52.5	54.5
1585	44.4	47.4	50.6	53.8
1586	58.0	49.4	51.9	53.9
1587	48.3	46.8	50.4	53.7
1588	58.7	48.0	50.2	53.8
1589	61.5	54.2	50.3	54.1
1590	44.7	54.2	50.8	53.1

1591	38.6	50.4	49.9	52.0
1592	47.5	50.2	48.5	51.5
1593	53.8	49.2	48.6	51.4
1594	58.7	48.6	51.4	52.0
1595	54.7	50.7	52.5	51.5
1596	57.1	54.4	52.4	52.1
1597	39.4	52.7	51.5	50.9
1598	39.6	49.9	49.6	49.9
1599	56.3	49.4	49.0	49.7
1600	41.3	46.7	48.7	49.8
1601	55.5	46.4	50.4	50.1
1602	51.7	48.9	50.8	49.7
1603	56.0	52.1	51.0	49.8
1604	65.3	53.9	51.7	51.5
1605	65.7	58.8	52.8	52.6
1606	59.7	59.7	53.0	52.7
1607	33.5	56.0	52.4	52.0
1608	61.0	57.0	54.6	52.1
1609	49.5	53.9	53.9	51.5
1610	65.2	53.8	56.3	52.5
1611	65.1	54.9	57.3	53.8
1612	54.6	59.1	57.6	54.2
1613	61.2	59.1	58.1	54.5
1614	60.9	61.4	57.6	54.7
1615	63.7	61.1	57.4	55.1
1616	57.1	59.5	57.2	55.1
1617	64.9	61.6	60.3	56.4
1618	59.2	61.2	60.2	57.4
1619	49.4	58.9	60.1	57.0
1620	48.9	55.9	58.5	57.4
1621	63.0	57.1	58.3	57.8
1622	45.0	53.1	57.3	57.4
1623	58.7	53.0	57.1	57.6
1624	55.5	54.2	56.5	57.1
1625	42.6	53.0	54.4	55.9
1626	56.4	51.6	54.4	55.8
1627	53.7	53.4	53.2	56.8
1628	65.0	54.6	53.8	57.0
1629	52.7	54.1	54.1	57.1
1630	49.1	55.4	54.2	56.3
1631	43.8	52.9	52.2	55.3
1632	56.5	53.4	53.4	55.4
1633	60.1	52.4	53.5	55.3

1634	37.4	49.4	51.7	54.1
1635	52.0	50.0	52.7	53.5
1636	54.8	52.2	52.5	53.4
1637	60.4	52.9	53.2	53.2
1638	55.2	51.9	52.2	53.0
1639	66.7	57.8	53.6	53.9
1640	57.2	58.8	54.4	54.3
1641	60.4	60.0	56.1	54.2
1642	52.9	58.5	55.7	54.6
1643	56.3	58.7	55.3	54.4
1644	49.4	55.2	56.5	54.1
1645	51.0	54.0	56.4	54.5
1646	36.3	49.2	54.6	53.5
1647	67.7	52.1	55.3	54.2
1648	55.6	52.0	55.3	53.8
1649	72.9	56.7	56.0	54.8
1650	61.4	58.8	56.4	55.4
1651	64.2	64.4	56.8	56.4
1652	48.9	60.6	56.4	56.0
1653	41.7	57.8	54.9	55.1
1654	31.8	49.6	53.1	54.8
1655	81.2	53.5	56.2	56.3
1656	57.4	52.2	58.3	56.4
1657	68.7	56.2	58.4	56.8
1658	50.3	57.9	57.8	56.6
1659	63.2	64.2	56.9	56.4
1660	62.7	60.5	57.0	56.7
1661	65.5	62.1	57.1	56.9
1662	56.4	59.6	57.9	57.1
1663	55.8	60.7	59.3	57.1
1664	31.5	54.4	59.3	56.2
1665	64.0	54.6	57.5	56.9
1666	48.5	51.2	56.7	57.5
1667	36.5	47.3	53.4	55.9
1668	49.6	46.0	53.4	55.6
1669	63.7	52.4	53.4	55.1
1670	50.4	49.7	52.2	54.6
1671	37.2	47.5	49.4	53.2
1672	63.9	53.0	50.1	54.0
1673	62.8	55.6	50.8	55.1
1674	55.4	54.0	53.2	56.2
1675	49.1	53.7	51.7	54.6
1676	73.5	61.0	54.2	55.4

1677	57.4	59.7	56.3	54.9
1678	80.5	63.2	59.4	56.4
1679	56.3	63.4	58.7	56.0
1680	71.4	67.8	60.8	56.5
1681	60.3	65.2	63.1	56.2
1682	51.3	64.0	61.8	56.0
1683	63.0	60.5	61.8	56.3
1684	50.1	59.2	61.3	57.3
1685	32.2	51.4	59.6	55.7
1686	38.1	47.0	56.1	55.1
1687	60.5	48.8	56.4	56.3
1688	58.1	47.8	54.1	56.8
1689	58.8	49.5	54.4	56.5
1690	65.2	56.1	53.8	57.3
1691	68.9	62.3	54.6	58.8
1692	43.1	58.8	53.8	57.8
1693	55.9	58.4	53.1	57.5
1694	63.8	59.4	54.5	57.9
1695	45.4	55.4	55.8	57.7
1696	61.6	54.0	58.1	57.1
1697	64.1	58.2	58.5	57.4
1698	58.1	58.6	58.5	56.3
1699	54.0	56.6	58.0	56.2
1700	54.3	58.4	56.9	55.3
1701	63.4	58.8	56.4	55.5
1702	66.1	59.2	58.7	56.2
1703	50.8	57.7	58.2	55.6
1704	37.7	54.5	55.6	55.0
1705	52.9	54.2	56.3	56.0
1706	46.2	50.8	54.8	56.4
1707	49.3	47.4	53.3	55.9
1708	50.0	47.2	52.5	55.5
1709	54.1	50.5	52.5	55.2
1710	54.8	50.9	52.5	54.7
1711	51.4	51.9	51.3	53.9
1712	62.1	54.5	50.9	54.8
1713	48.1	54.1	50.7	54.4
1714	36.4	50.5	50.5	53.0
1715	58.8	51.3	51.1	53.7
1716	51.4	51.3	51.6	53.2
1717	58.8	50.7	52.6	52.9
1718	61.6	53.4	53.7	53.1
1719	66.7	59.5	55.0	53.7

1720	69.3	61.6	56.5	54.5
1721	50.4	61.4	56.4	53.8
1722	50.4	59.7	55.2	53.1
1723	52.5	57.9	55.6	53.1
1724	62.9	57.1	58.3	54.4
1725	64.4	56.1	58.8	55.0
1726	78.8	61.8	61.6	56.6
1727	52.1	62.1	60.9	56.7
1728	51.0	61.8	59.8	56.8
1729	49.9	59.2	58.2	56.6
1730	50.1	56.4	56.2	56.3
1731	60.7	52.8	57.3	56.8
1732	57.2	53.8	58.0	56.6
1733	64.0	56.4	59.1	57.4
1734	69.4	60.3	59.8	59.0
1735	50.8	60.4	58.4	58.6
1736	40.9	56.5	54.6	58.1
1737	49.3	54.9	54.3	57.6
1738	61.8	54.4	55.4	57.6
1739	70.0	54.6	57.4	57.8
1740	46.9	53.8	57.1	56.7
1741	73.4	60.3	58.4	57.8
1742	59.7	62.4	58.6	58.3
1743	64.9	63.0	58.7	58.9
1744	55.5	60.1	57.3	58.5
1745	61.6	63.0	58.4	58.4
1746	69.5	62.2	61.3	57.9
1747	66.9	63.7	63.0	58.7
1748	38.3	58.4	60.7	58.0
1749	65.9	60.4	60.3	58.8
1750	42.1	56.5	59.8	58.4
1751	63.3	55.3	58.8	58.6
1752	62.0	54.3	59.0	58.8
1753	60.7	58.8	58.6	58.6
1754	58.1	57.2	58.8	58.1
1755	52.9	59.4	58.0	58.2
1756	44.1	55.6	55.4	58.3
1757	52.5	53.7	54.0	58.5
1758	59.9	53.5	56.1	58.4
1759	37.8	49.5	53.3	56.8
1760	65.7	52.0	55.7	57.7
1761	68.0	56.8	56.2	57.5
1762	69.9	60.3	57.0	58.0

1763	52.3	58.7	56.1	57.4
1764	71.3	65.4	57.5	58.1
1765	43.5	61.0	56.5	57.2
1766	61.1	59.6	58.2	56.8
1767	40.9	53.8	57.0	55.5
1768	77.8	58.9	58.8	57.5
1769	59.3	56.5	61.0	57.2
1770	41.5	56.1	58.6	57.1
1771	57.0	55.3	57.5	56.8
1772	59.4	59.0	56.4	56.7
1773	53.6	54.2	56.5	56.3
1774	59.8	54.3	55.4	56.4
1775	56.4	57.2	56.7	56.6
1776	49.2	55.7	55.5	56.8
1777	34.4	50.7	54.8	55.9
1778	58.0	51.5	52.9	55.8
1779	54.8	50.6	52.4	56.7
1780	51.8	49.6	53.4	56.0
1781	53.6	50.5	53.1	55.3
1782	51.1	53.9	52.3	54.3
1783	55.8	53.5	52.5	54.5
1784	62.7	55.0	52.8	54.1
1785	61.5	57.0	53.3	55.0
1786	46.6	55.6	53.0	54.3
1787	64.5	58.2	56.1	55.4
1788	53.7	57.8	55.6	54.2
1789	41.7	53.6	54.3	53.4
1790	75.8	56.5	56.7	55.1
1791	55.7	58.3	56.9	55.0
1792	74.5	60.3	59.3	55.8
1793	48.8	59.3	58.6	55.5
1794	53.4	61.6	57.6	55.2
1795	59.4	58.4	57.4	55.4
1796	56.4	58.5	58.4	55.7
1797	71.5	57.9	59.1	57.6
1798	28.4	53.8	56.6	56.1
1799	67.1	56.6	59.1	56.7
1800	51.8	55.0	56.7	56.7
1801	49.5	53.6	56.1	56.5
1802	61.7	51.7	54.8	57.0
1803	61.5	58.3	56.1	57.3
1804	45.3	54.0	55.3	56.4
1805	54.9	54.6	54.8	56.1

1806	53.6	55.4	54.5	56.5
1807	45.3	52.1	51.9	55.5
1808	57.0	51.2	54.8	55.7
1809	49.5	52.1	53.0	56.1
1810	54.8	52.1	53.3	55.0
1811	66.4	54.6	55.0	55.5
1812	66.0	58.8	55.4	55.1
1813	53.9	58.1	54.7	55.4
1814	47.1	57.7	54.9	55.1
1815	60.1	58.7	55.4	55.1
1816	63.9	58.2	56.4	55.5
1817	54.7	55.9	57.3	54.6
1818	63.9	57.9	58.0	56.4
1819	57.7	60.1	58.9	55.9
1820	54.9	59.0	58.9	56.1
1821	69.5	60.1	59.2	57.1
1822	50.0	59.2	57.6	56.5
1823	53.1	57.0	57.5	56.1
1824	39.4	53.4	56.7	55.8
1825	41.6	50.7	54.9	55.1
1826	63.7	49.6	54.9	55.6
1827	56.8	50.9	55.1	56.2
1828	60.4	52.4	54.7	56.4
1829	51.2	54.7	54.1	56.5
1830	44.4	55.3	53.0	55.9
1831	66.1	55.8	52.7	55.9
1832	63.5	57.1	54.0	55.8
1833	60.5	57.1	54.7	56.1
1834	47.9	56.5	55.6	56.2
1835	62.7	60.1	57.7	56.3
1836	62.8	59.5	57.6	56.2
1837	76.7	62.1	59.6	57.3
1838	57.5	61.5	59.3	57.0
1839	62.3	64.4	60.4	57.2
1840	68.9	65.7	62.9	57.9
1841	68.2	66.7	63.1	57.9
1842	41.3	59.6	60.9	57.4
1843	83.0	64.7	63.1	58.9
1844	50.5	62.4	63.4	59.5
1845	31.6	54.9	60.3	59.0
1846	39.0	49.1	57.9	57.8
1847	37.6	48.3	54.0	56.8
1848	57.3	43.2	54.0	56.6

1849	68.1	46.7	54.5	57.5
1850	66.6	53.7	54.3	58.6
1851	24.5	50.8	49.9	56.5
1852	68.0	56.9	52.6	56.7
1853	67.7	59.0	51.1	57.1
1854	55.8	56.5	51.6	57.5
1855	33.8	50.0	51.8	56.1
1856	57.4	56.5	53.7	55.8
1857	50.8	53.1	55.0	54.5
1858	64.2	52.4	55.7	54.8
1859	56.2	52.5	54.5	54.5
1860	58.2	57.4	53.7	54.0
1861	43.6	54.6	55.6	52.8
1862	64.9	57.4	55.3	53.9
1863	47.5	54.0	53.2	52.2
1864	62.1	55.2	53.9	52.7
1865	58.1	55.2	56.3	54.1
1866	70.6	60.6	57.6	55.6
1867	80.1	63.7	60.5	57.8
1868	60.5	66.3	60.2	57.9
1869	52.9	64.4	59.8	57.2
1870	64.2	65.6	60.4	57.0
1871	38.2	59.2	59.9	57.7
1872	62.6	55.7	59.7	57.5
1873	67.7	57.1	61.7	57.5
1874	48.3	56.2	60.3	57.1
1875	49.6	53.3	59.4	57.9
1876	63.9	58.4	58.8	58.2
1877	50.5	56.0	55.8	58.2
1878	53.1	53.1	55.1	57.6
1879	41.2	51.7	53.9	56.9
1880	59.4	53.6	53.4	56.9
1881	55.3	51.9	55.1	57.5
1882	54.9	52.8	54.4	57.0
1883	58.2	53.8	53.4	57.6
1884	60.3	57.6	54.6	57.5
1885	56.8	57.1	55.4	57.4
1886	45.2	55.1	53.5	56.1
1887	41.0	52.3	52.5	54.2
1888	56.0	51.8	52.8	53.9
1889	50.7	49.9	53.8	53.8
1890	52.5	49.0	53.1	53.3
1891	53.5	50.7	52.9	54.0

1892	55.7	53.7	53.0	53.7
1893	52.6	53.0	52.4	52.9
1894	59.0	54.6	52.3	53.5
1895	68.2	57.8	53.4	54.4
1896	35.8	54.3	52.5	53.0
1897	61.6	55.4	54.6	53.5
1898	43.1	53.5	53.3	53.0
1899	60.5	53.8	54.2	54.0
1900	59.3	52.1	54.9	54.0
1901	47.6	54.4	54.3	53.6
1902	31.9	48.5	52.0	52.5
1903	59.2	51.7	52.6	52.5
1904	53.0	50.2	52.0	52.1
1905	55.9	49.5	50.8	52.1
1906	61.5	52.3	53.4	52.9
1907	60.4	58.0	53.2	53.9
1908	47.4	55.7	53.7	53.5
1909	62.9	57.6	53.9	54.1
1910	55.5	57.6	53.5	54.2
1911	52.1	55.7	54.0	54.2
1912	63.7	56.3	57.2	54.6
1913	48.9	56.6	56.1	54.4
1914	62.4	56.5	57.1	54.6
1915	51.5	55.7	56.6	53.7
1916	55.0	56.3	56.0	54.7
1917	70.0	57.6	57.0	55.1
1918	61.7	60.1	58.4	56.0
1919	41.8	56.0	56.3	55.1
1920	59.5	57.6	56.7	55.1
1921	71.0	60.8	58.6	56.3
1922	52.0	57.2	57.4	57.3
1923	63.6	57.6	58.8	57.5
1924	68.2	62.9	59.4	58.3
1925	52.6	61.5	59.5	58.1
1926	66.0	60.5	60.6	58.3
1927	55.6	61.2	59.2	58.1
1928	68.9	62.3	59.9	59.1
1929	53.3	59.3	61.1	58.7
1930	63.9	61.5	61.5	59.1
1931	54.9	59.3	59.9	59.2
1932	54.1	59.0	60.1	58.7
1933	55.7	56.4	59.3	59.1
1934	43.3	54.4	56.8	58.1

1935	53.3	52.3	56.9	58.2
1936	50.1	51.3	55.3	58.0
1937	53.1	51.1	55.1	57.1
1938	57.9	51.5	54.0	56.9
1939	50.4	53.0	53.7	57.4
1940	53.7	53.1	52.7	57.1
1941	57.7	54.6	52.9	56.4
1942	60.4	56.0	53.6	56.8
1943	59.7	56.4	54.0	56.6
1944	42.7	54.8	53.9	55.4
1945	54.2	54.9	54.0	55.4
1946	56.3	54.7	54.6	55.0
1947	61.5	54.9	55.5	55.3
1948	52.8	53.5	54.9	54.5
1949	62.3	57.4	56.1	54.9
1950	52.8	57.1	56.0	54.3
1951	62.3	58.3	56.5	54.7
1952	63.5	58.7	56.8	55.2
1953	51.9	58.5	56.0	55.0
1954	34.0	52.9	55.1	54.5
1955	57.4	53.8	55.5	54.7
1956	67.1	54.8	56.5	55.6
1957	66.2	55.3	57.0	56.2
1958	58.6	56.7	57.6	56.3
1959	51.1	60.1	56.5	56.3
1960	62.0	61.0	57.4	56.7
1961	43.0	56.2	55.5	56.0
1962	74.4	57.8	56.6	56.7
1963	47.5	55.6	56.1	56.1
1964	43.7	54.1	57.1	56.1
1965	66.5	55.0	58.0	56.7
1966	48.3	56.1	56.1	56.3
1967	61.0	53.4	55.6	56.3
1968	47.9	53.5	54.5	56.1
1969	58.7	56.5	55.3	55.9
1970	66.4	56.5	55.7	56.6
1971	56.5	58.1	57.1	56.3
1972	54.2	56.7	55.1	55.8
1973	69.7	61.1	57.3	56.7
1974	65.4	62.4	59.5	58.3
1975	59.6	61.1	58.8	58.4
1976	46.0	59.0	58.5	57.3
1977	34.1	55.0	55.8	55.7

1978	67.7	54.6	57.8	56.2
1979	64.3	54.3	58.4	56.8
1980	59.5	54.3	57.7	56.7
1981	49.9	55.1	57.0	57.1
1982	63.5	61.0	58.0	56.5
1983	71.7	61.8	58.2	57.7
1984	73.7	63.7	59.0	59.2
1985	73.0	66.3	60.3	59.6
1986	66.4	69.7	62.4	60.5
1987	45.3	66.0	63.5	59.7
1988	48.7	61.4	61.6	59.7
1989	56.5	58.0	60.8	59.6
1990	41.2	51.6	59.0	58.3
1991	63.1	50.9	60.3	58.7
1992	46.4	51.2	58.6	58.3
1993	64.9	54.4	57.9	58.0
1994	37.4	50.6	54.3	56.6
1995	62.4	54.8	53.2	56.8
1996	65.7	55.4	53.2	57.8
1997	62.8	58.6	54.9	59.2
1998	45.5	54.8	54.6	58.1
1999	56.9	58.7	54.6	57.7
2000	53.6	56.9	55.9	57.4

Reconstruction and End Year Filter (5, 10, 20) for April 1st SWE Old Battle

Year	Full Reconstruction	5-Year Filter	10 -Year Filter	20-Year Filter
1402	75.9			
1403	76.2			
1404	74.6			
1405	76.0			
1406	84.3	77.4		
1407	78.0	77.8		
1408	82.1	79.0		
1409	83.1	80.7		
1410	75.9	80.7		
1411	66.0	77.0	77.2	
1412	82.8	78.0	77.9	
1413	58.8	73.3	76.2	
1414	97.8	76.2	78.5	
1415	75.7	76.2	78.4	
1416	72.9	77.6	77.3	
1417	71.7	75.4	76.7	
1418	78.0	79.2	76.3	
1419	77.4	75.1	75.7	
1420	93.5	78.7	77.4	
1421	80.0	80.1	78.8	78.0
1422	81.5	82.1	78.7	78.3
1423	64.4	79.4	79.3	77.7
1424	81.3	80.1	77.6	78.1
1425	66.7	74.8	76.7	77.6
1426	105.5	79.9	80.0	78.6
1427	70.5	77.7	79.9	78.3
1428	81.2	81.1	80.2	78.2
1429	95.6	83.9	82.0	78.9
1430	75.6	85.7	80.2	78.8
1431	86.3	81.9	80.9	79.9
1432	89.0	85.5	81.6	80.2
1433	85.9	86.5	83.8	81.5
1434	104.0	88.2	86.0	81.8
1435	97.7	92.6	89.1	82.9
1436	66.6	88.6	85.2	82.6
1437	81.4	87.1	86.3	83.1
1438	79.2	85.8	86.1	83.2
1439	70.9	79.2	83.7	82.8
1440	88.6	77.3	85.0	82.6
1441	94.4	82.9	85.8	83.3
1442	60.0	78.6	82.9	82.2

1443	97.4	82.2	84.0	83.9
1444	72.9	82.6	80.9	83.5
1445	64.6	77.8	77.6	83.4
1446	81.6	75.3	79.1	82.2
1447	84.9	80.3	79.4	82.9
1448	75.4	75.8	79.0	82.6
1449	96.1	80.5	81.6	82.6
1450	74.5	82.5	80.2	82.6
1451	89.2	84.0	79.6	82.7
1452	87.4	84.5	82.4	82.6
1453	73.0	84.0	79.9	82.0
1454	66.2	78.0	79.3	80.1
1455	67.8	76.7	79.6	78.6
1456	78.7	74.6	79.3	79.2
1457	88.8	74.9	79.7	79.6
1458	75.1	75.3	79.7	79.4
1459	76.5	77.4	77.7	79.6
1460	61.9	76.2	76.5	78.3
1461	82.7	77.0	75.8	77.7
1462	95.9	78.4	76.7	79.5
1463	90.9	81.6	78.4	79.2
1464	87.7	83.8	80.6	79.9
1465	73.1	86.0	81.1	80.4
1466	87.2	87.0	82.0	80.6
1467	97.7	87.3	82.9	81.3
1468	93.4	87.8	84.7	82.2
1469	73.0	84.9	84.4	81.0
1470	87.0	87.7	86.9	81.7
1471	86.3	87.5	87.2	81.5
1472	67.4	81.4	84.4	80.5
1473	74.5	77.7	82.7	80.6
1474	79.8	79.0	81.9	81.3
1475	67.7	75.1	81.4	81.3
1476	85.9	75.1	81.3	81.6
1477	83.9	78.4	79.9	81.4
1478	80.1	79.5	78.6	81.6
1479	81.0	79.7	79.4	81.9
1480	87.5	83.7	79.4	83.1
1481	88.7	84.2	79.6	83.4
1482	93.3	86.1	82.2	83.3
1483	92.2	88.5	84.0	83.4
1484	107.1	93.7	86.7	84.3
1485	97.6	95.8	89.7	85.6

1486	95.2	97.1	90.7	86.0
1487	86.4	95.7	90.9	85.4
1488	77.1	92.7	90.6	84.6
1489	90.0	89.2	91.5	85.4
1490	100.4	89.8	92.8	86.1
1491	92.9	89.4	93.2	86.4
1492	80.5	88.2	91.9	87.1
1493	70.8	86.9	89.8	86.9
1494	96.6	88.3	88.7	87.7
1495	67.4	81.7	85.7	87.7
1496	56.0	74.3	81.8	86.2
1497	85.7	75.3	81.7	86.3
1498	107.1	82.6	84.7	87.7
1499	65.9	76.4	82.3	86.9
1500	67.1	76.3	79.0	85.9
1501	76.1	80.4	77.3	85.3
1502	87.2	80.7	78.0	85.0
1503	79.1	75.1	78.8	84.3
1504	86.3	79.2	77.8	83.3
1505	65.4	78.8	77.6	81.7
1506	65.1	76.6	78.5	80.2
1507	66.4	72.5	76.6	79.2
1508	88.0	74.2	74.7	79.7
1509	92.2	75.4	77.3	79.8
1510	76.4	77.6	78.2	78.6
1511	79.3	80.5	78.5	77.9
1512	88.3	84.8	78.7	78.3
1513	86.3	84.5	79.4	79.1
1514	96.6	85.4	80.4	79.1
1515	73.8	84.9	81.2	79.4
1516	74.7	83.9	82.2	80.3
1517	82.4	82.8	83.8	80.2
1518	89.9	83.5	84.0	79.3
1519	79.5	80.1	82.7	80.0
1520	72.4	79.8	82.3	80.3
1521	129.1	90.7	87.3	82.9
1522	67.2	87.6	85.2	81.9
1523	100.6	89.8	86.6	83.0
1524	91.2	92.1	86.1	83.2
1525	93.4	96.3	88.0	84.6
1526	91.1	88.7	89.7	85.9
1527	72.3	89.7	88.7	86.2
1528	78.1	85.2	87.5	85.7

1529	90.9	85.2	88.6	85.7
1530	82.6	83.0	89.7	86.0
1531	49.4	74.6	81.7	84.5
1532	63.7	72.9	81.3	83.3
1533	95.3	76.4	80.8	83.7
1534	96.9	77.6	81.4	83.7
1535	92.4	79.5	81.3	84.7
1536	88.1	87.3	81.0	85.3
1537	82.9	91.1	82.0	85.4
1538	64.7	85.0	80.7	84.1
1539	90.2	83.7	80.6	84.6
1540	92.6	83.7	81.6	85.6
1541	84.4	83.0	85.1	83.4
1542	60.5	78.5	84.8	83.1
1543	81.3	81.8	83.4	82.1
1544	64.3	76.6	80.1	80.8
1545	71.6	72.4	78.1	79.7
1546	98.6	75.3	79.1	80.0
1547	79.6	79.1	78.8	80.4
1548	85.7	79.9	80.9	80.8
1549	114.2	89.9	83.3	81.9
1550	83.4	92.3	82.4	82.0
1551	71.9	87.0	81.1	83.1
1552	85.7	88.2	83.6	84.2
1553	90.5	89.1	84.5	84.0
1554	73.1	80.9	85.4	82.8
1555	96.8	83.6	87.9	83.0
1556	83.1	85.9	86.4	82.8
1557	88.9	86.5	87.3	83.1
1558	60.4	80.5	84.8	82.8
1559	73.8	80.6	80.8	82.0
1560	90.2	79.3	81.5	81.9
1561	78.9	78.5	82.2	81.6
1562	72.6	75.2	80.8	82.2
1563	80.9	79.3	79.9	82.2
1564	90.3	82.6	81.6	83.5
1565	86.7	81.9	80.6	84.3
1566	71.5	80.4	79.4	82.9
1567	80.1	81.9	78.5	82.9
1568	85.3	82.8	81.0	82.9
1569	71.2	79.0	80.8	80.8
1570	96.2	80.9	81.4	81.4
1571	88.4	84.3	82.3	82.2

1572	88.0	85.8	83.9	82.4
1573	73.1	83.4	83.1	81.5
1574	65.9	82.3	80.6	81.1
1575	87.0	80.5	80.7	80.6
1576	69.9	76.8	80.5	80.0
1577	87.0	76.6	81.2	79.9
1578	89.5	79.9	81.6	81.3
1579	79.5	82.6	82.5	81.6
1580	60.2	77.2	78.8	80.1
1581	70.8	77.4	77.1	79.7
1582	82.4	76.5	76.5	80.2
1583	76.4	73.8	76.9	80.0
1584	50.6	68.1	75.3	78.0
1585	78.2	71.7	74.4	77.6
1586	78.8	73.3	75.3	77.9
1587	69.9	70.8	73.6	77.4
1588	79.9	71.5	72.7	77.1
1589	89.1	79.2	73.6	78.0
1590	63.6	76.3	74.0	76.4
1591	63.3	73.2	73.2	75.2
1592	67.7	72.7	71.8	74.1
1593	78.3	72.4	71.9	74.4
1594	75.3	69.6	74.4	74.9
1595	88.9	74.7	75.5	75.0
1596	92.9	80.6	76.9	76.1
1597	72.1	81.5	77.1	75.4
1598	63.0	78.5	75.4	74.0
1599	94.0	82.2	75.9	74.8
1600	53.8	75.2	74.9	74.5
1601	99.1	76.4	78.5	75.9
1602	84.8	79.0	80.2	76.0
1603	91.3	84.6	81.5	76.7
1604	100.6	85.9	84.1	79.2
1605	95.6	94.3	84.7	80.1
1606	84.6	91.4	83.9	80.4
1607	52.4	84.9	81.9	79.5
1608	87.8	84.2	84.4	79.9
1609	77.4	79.6	82.7	79.3
1610	92.0	78.9	86.6	80.8
1611	94.4	80.8	86.1	82.3
1612	80.6	86.4	85.7	83.0
1613	89.3	86.8	85.5	83.5
1614	90.6	89.4	84.5	84.3

1615	91.0	89.2	84.0	84.4
1616	76.3	85.6	83.2	83.5
1617	87.3	86.9	86.7	84.3
1618	88.1	86.7	86.7	85.6
1619	74.5	83.5	86.4	84.6
1620	73.0	79.8	84.5	85.5
1621	91.4	82.9	84.2	85.2
1622	69.1	79.2	83.1	84.4
1623	82.5	78.1	82.4	83.9
1624	75.9	78.4	80.9	82.7
1625	61.8	76.1	78.0	81.0
1626	80.0	73.9	78.4	80.8
1627	82.1	76.5	77.8	82.3
1628	93.0	78.6	78.3	82.5
1629	78.6	79.1	78.7	82.6
1630	79.3	82.6	79.4	81.9
1631	64.8	79.6	76.7	80.5
1632	79.3	79.0	77.7	80.4
1633	84.5	77.3	77.9	80.2
1634	62.2	74.0	76.6	78.7
1635	73.0	72.7	77.7	77.8
1636	83.1	76.4	78.0	78.2
1637	90.7	78.7	78.8	78.3
1638	81.9	78.2	77.7	78.0
1639	96.6	85.1	79.5	79.1
1640	78.4	86.1	79.4	79.4
1641	82.3	86.0	81.2	79.0
1642	74.4	82.7	80.7	79.2
1643	66.1	79.6	78.9	78.4
1644	84.9	77.2	81.1	78.8
1645	83.3	78.2	82.2	79.9
1646	52.5	72.2	79.1	78.5
1647	85.3	74.4	78.6	78.7
1648	84.6	78.1	78.8	78.3
1649	107.1	82.6	79.9	79.7
1650	90.0	83.9	81.1	80.2
1651	91.4	91.7	82.0	81.6
1652	74.7	89.6	82.0	81.3
1653	62.8	85.2	81.7	80.3
1654	52.9	74.3	78.5	79.8
1655	105.8	77.5	80.7	81.4
1656	75.4	74.3	83.0	81.1
1657	87.3	76.8	83.2	80.9

1658	77.9	79.8	82.5	80.7
1659	89.3	87.1	80.7	80.3
1660	96.5	85.3	81.4	81.2
1661	89.9	88.1	81.2	81.6
1662	94.2	89.5	83.2	82.6
1663	80.9	90.1	85.0	83.3
1664	52.6	82.8	85.0	81.7
1665	89.5	81.4	83.3	82.0
1666	66.7	76.8	82.5	82.7
1667	63.2	70.6	80.1	81.6
1668	78.3	70.1	80.1	81.3
1669	94.7	78.5	80.7	80.7
1670	74.8	75.6	78.5	79.9
1671	63.1	74.8	75.8	78.5
1672	96.7	81.5	76.1	79.6
1673	92.0	84.3	77.2	81.1
1674	84.3	82.2	80.3	82.7
1675	72.3	81.7	78.6	81.0
1676	102.4	89.6	82.2	82.3
1677	87.8	87.8	84.7	82.4
1678	113.1	92.0	88.1	84.1
1679	85.0	92.1	87.2	83.9
1680	98.0	97.3	89.5	84.0
1681	86.3	94.1	91.8	83.8
1682	73.8	91.3	89.5	82.8
1683	95.2	87.7	89.8	83.5
1684	62.7	83.2	87.7	84.0
1685	51.8	74.0	85.6	82.1
1686	73.1	71.3	82.7	82.4
1687	77.1	72.0	81.6	83.1
1688	84.8	69.9	78.8	83.5
1689	89.1	75.2	79.2	83.2
1690	96.3	84.1	79.0	84.3
1691	89.6	87.4	79.3	85.6
1692	64.0	84.8	78.4	83.9
1693	82.2	84.2	77.1	83.4
1694	81.8	82.8	79.0	83.3
1695	72.1	78.0	81.0	83.3
1696	76.4	75.3	81.4	82.0
1697	94.5	81.4	83.1	82.4
1698	86.5	82.3	83.3	81.0
1699	84.8	82.9	82.8	81.0
1700	74.3	83.3	80.6	79.8

1701	89.4	85.9	80.6	80.0
1702	90.9	85.2	83.3	80.8
1703	78.8	83.7	83.0	80.0
1704	64.2	79.5	81.2	80.1
1705	77.6	80.2	81.8	81.4
1706	61.4	74.6	80.2	80.8
1707	79.8	72.4	78.8	80.9
1708	79.8	72.5	78.1	80.7
1709	85.2	76.8	78.1	80.5
1710	81.1	77.4	78.8	79.7
1711	78.4	80.8	77.7	79.2
1712	90.6	83.0	77.7	80.5
1713	74.4	81.9	77.2	80.1
1714	56.3	76.1	76.4	78.8
1715	88.6	77.6	77.5	79.6
1716	81.0	78.2	79.5	79.9
1717	84.9	77.0	80.0	79.4
1718	86.9	79.5	80.7	79.4
1719	91.8	86.6	81.4	79.8
1720	105.0	89.9	83.8	81.3
1721	77.6	89.2	83.7	80.7
1722	71.6	86.6	81.8	79.7
1723	75.3	84.2	81.9	79.6
1724	89.3	83.7	85.2	80.8
1725	94.8	81.7	85.8	81.7
1726	111.0	88.4	88.8	84.2
1727	80.2	90.1	88.3	84.2
1728	76.9	90.4	87.3	84.0
1729	74.0	87.4	85.5	83.5
1730	82.1	84.8	83.3	83.5
1731	85.3	79.7	84.0	83.9
1732	80.5	79.8	84.9	83.4
1733	89.5	82.3	86.3	84.1
1734	95.6	86.6	87.0	86.1
1735	67.6	83.7	84.3	85.0
1736	69.4	80.5	80.1	84.5
1737	73.8	79.2	79.5	83.9
1738	87.5	78.8	80.5	83.9
1739	89.6	77.6	82.1	83.8
1740	69.1	77.9	80.8	82.0
1741	95.7	83.2	81.8	82.9
1742	89.3	86.2	82.7	83.8
1743	90.0	86.7	82.8	84.6

1744	82.4	85.3	81.4	84.2
1745	91.7	89.8	83.9	84.1
1746	96.3	89.9	86.5	83.3
1747	95.5	91.2	88.7	84.1
1748	57.6	84.7	85.7	83.1
1749	83.0	84.8	85.1	83.6
1750	69.0	80.3	85.1	82.9
1751	85.8	78.2	84.1	83.0
1752	82.1	75.5	83.4	83.0
1753	97.1	83.4	84.1	83.4
1754	83.1	83.4	84.1	82.8
1755	72.8	84.2	82.2	83.0
1756	68.5	80.7	79.5	83.0
1757	73.7	79.0	77.3	83.0
1758	84.4	76.5	80.0	82.8
1759	59.9	71.8	77.6	81.4
1760	96.8	76.7	80.4	82.7
1761	93.7	81.7	81.2	82.6
1762	94.9	85.9	82.5	82.9
1763	76.7	84.4	80.4	82.3
1764	98.2	92.1	82.0	83.0
1765	58.5	84.4	80.5	81.4
1766	88.1	83.3	82.5	81.0
1767	60.4	76.4	81.2	79.2
1768	109.5	82.9	83.7	81.8
1769	89.0	81.1	86.6	82.1
1770	70.0	83.4	83.9	82.2
1771	86.2	83.0	83.1	82.2
1772	81.6	87.2	81.8	82.1
1773	66.1	78.6	80.8	80.6
1774	83.4	77.5	79.3	80.6
1775	82.2	79.9	81.7	81.1
1776	80.5	78.8	80.9	81.7
1777	53.7	73.2	80.2	80.7
1778	76.3	75.2	76.9	80.3
1779	85.0	75.5	76.5	81.5
1780	74.6	74.0	77.0	80.4
1781	85.6	75.0	76.9	80.0
1782	71.9	78.7	75.9	78.9
1783	84.8	80.4	77.8	79.3
1784	91.1	81.6	78.6	78.9
1785	88.0	84.3	79.2	80.4
1786	66.7	80.5	77.8	79.3

1787	90.5	84.2	81.4	80.8
1788	77.8	82.8	81.6	79.3
1789	71.1	78.8	80.2	78.4
1790	106.5	82.5	83.4	80.2
1791	83.6	85.9	83.2	80.1
1792	99.1	87.7	85.9	80.9
1793	79.5	88.0	85.4	81.6
1794	75.4	88.8	83.8	81.2
1795	77.9	83.1	82.8	81.0
1796	83.5	83.1	84.5	81.1
1797	100.4	83.3	85.5	83.5
1798	51.3	77.7	82.8	82.2
1799	91.5	80.9	84.9	82.5
1800	79.6	81.2	82.2	82.8
1801	77.5	80.0	81.6	82.4
1802	91.3	78.2	80.8	83.4
1803	77.9	83.5	80.6	83.0
1804	75.7	80.4	80.6	82.2
1805	74.6	79.4	80.3	81.6
1806	78.5	79.6	79.8	82.2
1807	72.4	75.8	77.0	81.3
1808	83.5	76.9	80.2	81.5
1809	76.4	77.1	78.7	81.8
1810	79.5	78.1	78.7	80.5
1811	98.0	82.0	80.8	81.2
1812	88.8	85.3	80.5	80.7
1813	72.8	83.1	80.0	80.3
1814	74.7	82.8	79.9	80.3
1815	82.2	83.3	80.7	80.5
1816	89.7	81.6	81.8	80.8
1817	87.8	81.4	83.3	80.2
1818	89.5	84.8	83.9	82.1
1819	86.8	87.2	85.0	81.9
1820	79.0	86.6	84.9	81.8
1821	93.3	87.3	84.4	82.6
1822	70.4	83.8	82.6	81.6
1823	81.5	82.2	83.5	81.8
1824	63.1	77.5	82.3	81.1
1825	74.6	76.6	81.6	81.1
1826	92.3	76.4	81.8	81.8
1827	84.7	79.2	81.5	82.4
1828	95.5	82.0	82.1	83.0
1829	68.9	83.2	80.3	82.6

1830	68.0	81.9	79.2	82.1
1831	96.0	82.6	79.5	82.0
1832	86.9	83.1	81.1	81.9
1833	83.3	80.6	81.3	82.4
1834	75.3	81.9	82.5	82.4
1835	94.9	87.3	84.6	83.1
1836	92.0	86.5	84.5	83.2
1837	104.4	90.0	86.5	84.0
1838	92.1	91.7	86.2	84.1
1839	87.1	94.1	88.0	84.2
1840	93.2	93.8	90.5	84.9
1841	93.1	94.0	90.2	84.9
1842	68.9	86.9	88.4	84.8
1843	102.7	89.0	90.4	85.8
1844	74.0	86.4	90.2	86.4
1845	52.0	78.1	85.9	85.3
1846	60.6	71.6	82.8	83.7
1847	66.6	71.2	79.0	82.8
1848	81.4	66.9	78.0	82.1
1849	95.8	71.3	78.8	83.4
1850	95.7	80.0	79.1	84.8
1851	49.1	77.7	74.7	82.5
1852	92.8	83.0	77.1	82.8
1853	100.8	86.9	76.9	83.6
1854	85.9	84.9	78.1	84.2
1855	57.2	77.2	78.6	82.3
1856	82.6	83.8	80.8	81.8
1857	78.6	81.0	82.0	80.5
1858	87.3	78.3	82.6	80.3
1859	82.3	77.6	81.2	80.0
1860	90.6	84.3	80.7	79.9
1861	61.0	80.0	81.9	78.3
1862	100.2	84.3	82.7	79.9
1863	77.2	82.3	80.3	78.6
1864	87.6	83.3	80.5	79.3
1865	87.0	82.6	83.4	81.0
1866	97.6	89.9	84.9	82.9
1867	109.3	91.7	88.0	85.0
1868	91.8	94.7	88.5	85.5
1869	76.3	92.4	87.9	84.5
1870	87.4	92.5	87.5	84.1
1871	68.3	86.6	88.3	85.1
1872	91.7	83.1	87.4	85.0

1873	90.3	82.8	88.7	84.5
1874	72.2	82.0	87.2	83.8
1875	80.2	80.6	86.5	85.0
1876	92.4	85.4	86.0	85.5
1877	68.2	80.7	81.9	85.0
1878	72.8	77.2	80.0	84.2
1879	65.3	75.8	78.9	83.4
1880	80.9	75.9	78.2	82.9
1881	71.5	71.8	78.6	83.4
1882	78.3	73.8	77.2	82.3
1883	79.1	75.0	76.1	82.4
1884	89.5	79.9	77.8	82.5
1885	81.7	80.0	78.0	82.2
1886	75.0	80.7	76.2	81.1
1887	56.7	76.4	75.1	78.5
1888	82.2	77.0	76.0	78.0
1889	73.7	73.9	76.9	77.9
1890	82.0	73.9	77.0	77.6
1891	84.8	75.9	78.3	78.4
1892	77.4	80.0	78.2	77.7
1893	78.9	79.4	78.2	77.1
1894	80.6	80.7	77.3	77.6
1895	95.6	83.5	78.7	78.3
1896	55.0	77.5	76.7	76.5
1897	86.9	79.4	79.7	77.4
1898	68.0	77.2	78.3	77.2
1899	80.4	77.2	79.0	77.9
1900	83.7	74.8	79.1	78.1
1901	75.7	78.9	78.2	78.3
1902	51.7	71.9	75.6	76.9
1903	82.1	74.7	76.0	77.1
1904	77.4	74.1	75.7	76.5
1905	85.7	74.5	74.7	76.7
1906	88.7	77.1	78.0	77.4
1907	87.4	84.3	78.1	78.9
1908	78.4	83.5	79.1	78.7
1909	86.9	85.4	79.8	79.4
1910	87.7	85.8	80.2	79.7
1911	81.8	84.5	80.8	79.5
1912	94.9	85.9	85.1	80.4
1913	70.9	84.5	84.0	80.0
1914	96.4	86.3	85.9	80.8
1915	76.2	84.0	84.9	79.8

1916	90.5	85.8	85.1	81.6
1917	98.2	86.4	86.2	82.1
1918	88.9	90.0	87.2	83.2
1919	66.8	84.1	85.2	82.5
1920	86.8	86.2	85.1	82.7
1921	96.0	87.3	86.5	83.7
1922	82.5	84.2	85.3	85.2
1923	88.1	84.0	87.0	85.5
1924	87.8	88.3	86.2	86.0
1925	71.0	85.1	85.7	85.3
1926	98.1	85.5	86.4	85.8
1927	83.1	85.6	84.9	85.5
1928	89.6	85.9	85.0	86.1
1929	81.5	84.6	86.5	85.8
1930	90.1	88.5	86.8	86.0
1931	76.2	84.1	84.8	85.7
1932	87.0	84.9	85.2	85.3
1933	75.7	82.1	84.0	85.5
1934	64.0	78.6	81.6	83.9
1935	79.4	76.4	82.5	84.1
1936	77.6	76.7	80.4	83.4
1937	77.0	74.7	79.8	82.4
1938	89.3	77.5	79.8	82.4
1939	77.3	80.1	79.4	82.9
1940	72.0	78.6	77.5	82.2
1941	86.8	80.5	78.6	81.7
1942	88.1	82.7	78.7	82.0
1943	87.6	82.4	79.9	82.0
1944	68.3	80.6	80.3	81.0
1945	72.4	80.6	79.6	81.1
1946	75.8	78.4	79.5	79.9
1947	88.5	78.5	80.6	80.2
1948	79.0	76.8	79.6	79.7
1949	88.9	80.9	80.7	80.0
1950	82.4	82.9	81.8	79.7
1951	80.5	83.9	81.1	79.9
1952	93.0	84.7	81.6	80.2
1953	74.7	83.9	80.3	80.1
1954	51.1	76.3	78.6	79.5
1955	86.6	77.2	80.0	79.8
1956	93.7	79.8	81.8	80.6
1957	94.8	80.2	82.4	81.5
1958	81.6	81.5	82.7	81.1

1959	67.9	84.9	80.6	80.7
1960	89.9	85.5	81.4	81.6
1961	68.3	80.5	80.1	80.6
1962	96.0	80.7	80.4	81.0
1963	68.5	78.1	79.8	80.1
1964	73.5	79.2	82.1	80.3
1965	90.4	79.3	82.4	81.2
1966	78.0	81.3	80.9	81.4
1967	92.0	80.5	80.6	81.5
1968	70.4	80.8	79.5	81.1
1969	86.8	83.5	81.4	81.0
1970	94.6	84.4	81.8	81.6
1971	82.3	85.2	83.3	81.7
1972	72.9	81.4	80.9	80.7
1973	95.8	86.5	83.7	81.7
1974	94.5	88.0	85.8	83.9
1975	87.4	86.6	85.5	84.0
1976	73.9	84.9	85.1	83.0
1977	50.6	80.4	80.9	80.8
1978	96.2	80.5	83.5	81.5
1979	93.0	80.2	84.1	82.7
1980	83.3	79.4	83.0	82.4
1981	69.0	78.4	81.7	82.5
1982	98.8	88.1	84.2	82.6
1983	95.7	88.0	84.2	84.0
1984	100.8	89.5	84.9	85.3
1985	99.0	92.7	86.0	85.8
1986	105.7	100.0	89.2	87.1
1987	74.6	95.2	91.6	86.3
1988	70.0	90.0	89.0	86.2
1989	85.2	86.9	88.2	86.2
1990	59.1	78.9	85.8	84.4
1991	94.0	76.6	88.3	85.0
1992	72.3	76.1	85.6	84.9
1993	95.4	81.2	85.6	84.9
1994	63.4	76.8	81.9	83.4
1995	89.9	83.0	81.0	83.5
1996	93.6	82.9	79.8	84.5
1997	86.1	85.7	80.9	86.3
1998	70.6	80.7	81.0	85.0
1999	83.1	84.7	80.7	84.5
2000	73.4	81.4	82.2	84.0

Reconstruction and End Year Filter (5, 10, 20) for April 1st SWE Lake Irene

Year	Full Reconstruction	5-Year Filter	10 -Year Filter	20-Year Filter
1378	69.2			
1379	56.7			
1380	57.1			
1381	58.8			
1382	67.4	61.8		
1383	66.6	61.3		
1384	63.4	62.7		
1385	70.2	65.3		
1386	66.3	66.8		
1387	64.3	66.2	64.0	
1388	55.1	63.9	62.6	
1389	50.9	61.3	62.0	
1390	67.0	60.7	63.0	
1391	70.6	61.6	64.2	
1392	56.5	60.0	63.1	
1393	65.5	62.1	63.0	
1394	63.8	64.7	63.0	
1395	71.8	65.6	63.2	
1396	70.7	65.7	63.6	
1397	48.1	64.0	62.0	63.0
1398	54.9	61.9	62.0	62.3
1399	47.4	58.6	61.6	61.8
1400	59.7	56.2	60.9	61.9
1401	68.4	55.7	60.7	62.4
1402	58.4	57.8	60.9	62.0
1403	62.9	59.4	60.6	61.8
1404	65.1	62.9	60.7	61.9
1405	64.3	63.8	60.0	61.6
1406	69.4	64.0	59.9	61.7
1407	63.2	65.0	61.4	61.7
1408	69.3	66.3	62.8	62.4
1409	73.1	67.9	65.4	63.5
1410	68.5	68.7	66.3	63.6
1411	51.7	65.2	64.6	62.6
1412	69.6	66.5	65.7	63.3
1413	53.0	63.2	64.7	62.7
1414	77.7	64.1	66.0	63.4
1415	50.6	60.6	64.6	62.3
1416	57.5	61.7	63.4	61.6

1417	59.6	59.7	63.1	62.2
1418	70.9	63.3	63.2	63.0
1419	65.9	60.9	62.5	64.0
1420	78.8	66.5	63.5	64.9
1421	62.4	67.5	64.6	64.6
1422	65.2	68.6	64.2	64.9
1423	52.2	64.9	64.1	64.4
1424	66.0	64.9	62.9	64.5
1425	52.8	59.7	63.1	63.9
1426	79.7	63.2	65.3	64.4
1427	57.3	61.6	65.1	64.1
1428	67.5	64.7	64.8	64.0
1429	77.1	66.9	65.9	64.2
1430	56.6	67.6	63.7	63.6
1431	65.9	64.9	64.0	64.3
1432	65.9	66.6	64.1	64.1
1433	67.1	66.5	65.6	64.8
1434	80.2	67.2	67.0	65.0
1435	78.3	71.5	69.6	66.3
1436	52.6	68.8	66.9	66.1
1437	60.8	67.8	67.2	66.2
1438	64.2	67.2	66.9	65.8
1439	57.8	62.7	64.9	65.4
1440	72.3	61.5	66.5	65.1
1441	70.2	65.0	66.9	65.5
1442	48.1	62.5	65.2	64.6
1443	74.8	64.6	65.9	65.8
1444	51.9	63.5	63.1	65.1
1445	47.8	58.6	60.0	64.8
1446	69.3	58.4	61.7	64.3
1447	70.0	62.7	62.6	64.9
1448	57.4	59.3	62.0	64.4
1449	77.4	64.4	63.9	64.4
1450	50.0	64.8	61.7	64.1
1451	63.2	63.6	61.0	64.0
1452	64.2	62.5	62.6	63.9
1453	52.6	61.5	60.4	63.2
1454	54.6	56.9	60.7	61.9
1455	58.9	58.7	61.8	60.9
1456	58.6	57.8	60.7	61.2
1457	63.9	57.7	60.1	61.4

1458	55.1	58.2	59.9	60.9
1459	55.7	58.4	57.7	60.8
1460	47.1	56.1	57.4	59.5
1461	60.4	56.5	57.1	59.1
1462	75.3	58.7	58.2	60.4
1463	69.8	61.6	59.9	60.2
1464	59.6	62.4	60.4	60.5
1465	61.0	65.2	60.6	61.2
1466	65.2	66.2	61.3	61.0
1467	72.4	65.6	62.2	61.1
1468	61.3	63.9	62.8	61.3
1469	53.1	62.6	62.5	60.1
1470	68.5	64.1	64.6	61.0
1471	67.1	64.5	65.3	61.2
1472	54.8	61.0	63.3	60.7
1473	60.2	60.7	62.3	61.1
1474	64.8	63.1	62.8	61.6
1475	47.1	58.8	61.4	61.0
1476	68.2	59.0	61.8	61.5
1477	65.8	61.2	61.1	61.6
1478	56.3	60.5	60.6	61.7
1479	68.2	61.1	62.1	62.3
1480	68.1	65.3	62.1	63.4
1481	67.8	65.2	62.1	63.7
1482	71.3	66.3	63.8	63.5
1483	68.2	68.7	64.6	63.5
1484	85.9	72.3	66.7	64.8
1485	84.4	75.5	70.4	65.9
1486	75.8	77.1	71.2	66.5
1487	69.3	76.7	71.5	66.3
1488	54.0	73.9	71.3	66.0
1489	72.0	71.1	71.7	66.9
1490	81.9	70.6	73.1	67.6
1491	71.3	69.7	73.4	67.8
1492	70.7	70.0	73.4	68.6
1493	56.4	70.5	72.2	68.4
1494	75.1	71.1	71.1	68.9
1495	49.1	64.5	67.6	69.0
1496	44.2	59.1	64.4	67.8
1497	67.5	58.5	64.2	67.9
1498	85.8	64.3	67.4	69.4

1499	46.8	58.7	64.9	68.3
1500	53.2	59.5	62.0	67.5
1501	61.7	63.0	61.0	67.2
1502	64.5	62.4	60.4	66.9
1503	56.4	56.5	60.4	66.3
1504	67.5	60.7	59.7	65.4
1505	54.9	61.0	60.3	63.9
1506	42.9	57.3	60.1	62.3
1507	56.8	55.7	59.1	61.6
1508	61.2	56.7	56.6	62.0
1509	64.2	56.0	58.3	61.6
1510	57.0	56.4	58.7	60.4
1511	62.0	60.2	58.8	59.9
1512	67.5	62.4	59.1	59.7
1513	66.4	63.4	60.1	60.2
1514	73.2	65.2	60.6	60.1
1515	59.7	65.8	61.1	60.7
1516	57.5	64.9	62.6	61.3
1517	66.0	64.6	63.5	61.3
1518	68.7	65.0	64.2	60.4
1519	60.0	62.4	63.8	61.1
1520	55.9	61.6	63.7	61.2
1521	101.4	70.4	67.6	63.2
1522	52.6	67.7	66.1	62.6
1523	80.9	70.2	67.6	63.8
1524	73.5	72.9	67.6	64.1
1525	74.2	76.5	69.1	65.1
1526	67.8	69.8	70.1	66.3
1527	63.8	72.0	69.9	66.7
1528	69.1	69.7	69.9	67.1
1529	70.4	69.0	71.0	67.4
1530	68.2	67.9	72.2	67.9
1531	39.2	62.1	66.0	66.8
1532	48.3	59.1	65.5	65.8
1533	73.2	59.9	64.8	66.2
1534	69.5	59.7	64.4	66.0
1535	65.5	59.1	63.5	66.3
1536	68.2	64.9	63.5	66.8
1537	67.6	68.8	63.9	66.9
1538	59.6	66.1	63.0	66.4
1539	72.2	66.6	63.1	67.1

1540	76.2	68.8	63.9	68.1
1541	69.5	69.0	67.0	66.5
1542	43.6	64.2	66.5	66.0
1543	70.3	66.4	66.2	65.5
1544	47.6	61.4	64.0	64.2
1545	56.0	57.4	63.1	63.3
1546	78.6	59.2	64.1	63.8
1547	68.2	64.1	64.2	64.1
1548	66.0	63.3	64.8	63.9
1549	87.1	71.2	66.3	64.7
1550	66.5	73.3	65.4	64.7
1551	51.6	67.9	63.6	65.3
1552	67.7	67.8	66.0	66.2
1553	73.1	69.2	66.3	66.2
1554	65.3	64.9	68.0	66.0
1555	83.7	68.3	70.8	66.9
1556	74.0	72.8	70.3	67.2
1557	76.6	74.6	71.2	67.7
1558	44.3	68.8	69.0	66.9
1559	55.4	66.8	65.8	66.1
1560	74.0	64.9	66.6	66.0
1561	66.4	63.3	68.1	65.8
1562	56.2	59.2	66.9	66.4
1563	64.4	63.3	66.0	66.1
1564	76.7	67.5	67.2	67.6
1565	67.5	66.2	65.5	68.2
1566	63.5	65.6	64.5	67.4
1567	60.5	66.5	62.9	67.0
1568	64.6	66.5	64.9	67.0
1569	63.8	64.0	65.8	65.8
1570	71.7	64.8	65.5	66.1
1571	69.8	66.1	65.9	67.0
1572	65.9	67.2	66.8	66.9
1573	63.2	66.9	66.7	66.4
1574	55.2	65.2	64.6	65.9
1575	71.1	65.0	64.9	65.2
1576	53.5	61.8	63.9	64.2
1577	71.3	62.9	65.0	63.9
1578	68.5	63.9	65.4	65.2
1579	69.1	66.7	65.9	65.8
1580	46.9	61.8	63.4	64.5

1581	55.8	62.3	62.0	64.0
1582	69.7	62.0	62.4	64.6
1583	60.7	60.4	62.2	64.4
1584	37.3	54.1	60.4	62.5
1585	51.6	55.0	58.4	61.7
1586	66.4	57.1	59.7	61.8
1587	56.1	54.4	58.2	61.6
1588	67.0	55.7	58.1	61.7
1589	70.0	62.2	58.1	62.0
1590	52.1	62.3	58.7	61.1
1591	45.6	58.2	57.6	59.8
1592	55.2	58.0	56.2	59.3
1593	61.8	56.9	56.3	59.2
1594	66.8	56.3	59.2	59.8
1595	62.7	58.4	60.4	59.4
1596	65.3	62.4	60.3	60.0
1597	46.6	60.6	59.3	58.8
1598	46.4	57.6	57.2	57.7
1599	64.3	57.1	56.7	57.4
1600	48.8	54.3	56.4	57.5
1601	63.3	53.9	58.1	57.9
1602	59.3	56.4	58.5	57.4
1603	64.1	60.0	58.8	57.5
1604	73.5	61.8	59.4	59.3
1605	74.0	66.9	60.6	60.5
1606	67.9	67.8	60.8	60.5
1607	40.3	64.0	60.2	59.8
1608	69.0	65.0	62.5	59.9
1609	57.5	61.8	61.8	59.2
1610	73.5	61.7	64.3	60.3
1611	73.7	62.8	65.3	61.7
1612	62.8	67.3	65.6	62.1
1613	69.6	67.4	66.2	62.5
1614	69.3	69.8	65.8	62.6
1615	72.0	69.5	65.6	63.1
1616	65.3	67.8	65.3	63.1
1617	73.5	69.9	68.6	64.4
1618	67.4	69.5	68.5	65.5
1619	57.2	67.1	68.4	65.1
1620	56.9	64.1	66.8	65.5
1621	71.1	65.2	66.5	65.9

1622	52.3	61.0	65.5	65.5
1623	66.9	60.9	65.2	65.7
1624	63.7	62.2	64.6	65.2
1625	50.0	60.8	62.4	64.0
1626	64.3	59.4	62.3	63.8
1627	61.8	61.3	61.2	64.9
1628	73.4	62.6	61.8	65.1
1629	60.3	61.9	62.1	65.2
1630	56.9	63.3	62.1	64.4
1631	51.3	60.7	60.1	63.3
1632	64.4	61.3	61.3	63.4
1633	68.5	60.3	61.5	63.3
1634	44.4	57.1	59.5	62.1
1635	59.9	57.7	60.5	61.5
1636	62.7	60.0	60.4	61.3
1637	68.4	60.8	61.0	61.1
1638	63.2	59.7	60.0	60.9
1639	74.8	65.8	61.4	61.8
1640	65.5	66.9	62.3	62.2
1641	68.6	68.1	64.0	62.1
1642	61.1	66.6	63.7	62.5
1643	64.7	66.9	63.3	62.4
1644	56.7	63.3	64.6	62.0
1645	58.5	61.9	64.4	62.5
1646	43.4	56.9	62.5	61.4
1647	76.4	60.0	63.3	62.2
1648	63.6	59.7	63.3	61.7
1649	81.6	64.7	64.0	62.7
1650	69.8	67.0	64.4	63.4
1651	72.3	72.7	64.8	64.4
1652	56.9	68.8	64.4	64.0
1653	49.2	66.0	62.8	63.1
1654	38.7	57.4	61.0	62.8
1655	90.3	61.5	64.2	64.3
1656	65.4	60.1	66.4	64.5
1657	77.4	64.2	66.5	64.9
1658	57.9	65.9	65.9	64.6
1659	71.3	72.4	64.9	64.5
1660	70.8	68.5	65.0	64.7
1661	73.7	70.2	65.1	65.0
1662	64.1	67.5	65.9	65.1

1663	63.7	68.7	67.3	65.1
1664	38.6	62.2	67.3	64.2
1665	72.4	62.5	65.5	64.9
1666	56.2	59.0	64.6	65.5
1667	43.6	54.9	61.2	63.9
1668	57.0	53.6	61.1	63.5
1669	72.2	60.3	61.2	63.1
1670	58.0	57.4	60.0	62.5
1671	44.6	55.1	57.0	61.1
1672	72.2	60.8	57.9	61.9
1673	71.2	63.7	58.6	63.0
1674	63.5	61.9	61.1	64.2
1675	57.0	61.7	59.6	62.5
1676	82.4	69.2	62.2	63.4
1677	65.5	67.9	64.4	62.8
1678	89.2	71.5	67.6	64.4
1679	64.5	71.7	66.8	64.0
1680	80.3	76.4	69.0	64.5
1681	68.5	73.6	71.4	64.2
1682	58.9	72.3	70.1	64.0
1683	71.2	68.7	70.1	64.3
1684	58.1	67.4	69.5	65.3
1685	39.1	59.2	67.8	63.7
1686	45.1	54.5	64.0	63.1
1687	68.7	56.4	64.4	64.4
1688	66.2	55.5	62.1	64.8
1689	67.1	57.2	62.3	64.6
1690	73.4	64.1	61.6	65.3
1691	77.7	70.6	62.6	67.0
1692	50.4	66.9	61.7	65.9
1693	64.1	66.5	61.0	65.5
1694	72.3	67.6	62.4	66.0
1695	52.9	63.5	63.8	65.8
1696	70.1	62.0	66.3	65.2
1697	72.5	66.4	66.7	65.5
1698	66.2	66.8	66.7	64.4
1699	61.9	64.7	66.1	64.2
1700	62.2	66.6	65.0	63.3
1701	71.7	66.9	64.4	63.5
1702	74.7	67.3	66.9	64.3
1703	58.4	65.8	66.3	63.6

1704	44.8	62.4	63.5	63.0
1705	61.1	62.1	64.4	64.1
1706	53.8	58.6	62.7	64.5
1707	56.9	55.0	61.2	63.9
1708	57.5	54.8	60.3	63.5
1709	62.1	58.3	60.3	63.2
1710	62.7	58.6	60.4	62.7
1711	59.3	59.7	59.1	61.8
1712	70.3	62.4	58.7	62.8
1713	55.6	62.0	58.4	62.4
1714	43.4	58.3	58.3	60.9
1715	67.0	59.1	58.9	61.6
1716	59.1	59.1	59.4	61.1
1717	67.0	58.4	60.4	60.8
1718	69.7	61.2	61.6	61.0
1719	75.1	67.6	62.9	61.6
1720	77.7	69.7	64.4	62.4
1721	57.9	69.5	64.3	61.7
1722	58.1	67.7	63.1	60.9
1723	59.9	65.8	63.5	61.0
1724	71.1	65.0	66.3	62.3
1725	72.7	64.0	66.8	62.8
1726	87.6	69.9	69.7	64.5
1727	60.3	70.3	69.0	64.7
1728	58.7	70.1	67.9	64.8
1729	57.6	67.4	66.2	64.5
1730	57.9	64.4	64.2	64.3
1731	68.6	60.6	65.3	64.8
1732	65.4	61.7	66.0	64.5
1733	72.5	64.4	67.3	65.4
1734	78.2	68.5	68.0	67.1
1735	58.1	68.6	66.5	66.7
1736	47.9	64.4	62.5	66.1
1737	57.0	62.7	62.2	65.6
1738	70.1	62.3	63.3	65.6
1739	78.8	62.4	65.4	65.8
1740	54.5	61.6	65.1	64.7
1741	82.4	68.5	66.5	65.9
1742	67.8	70.7	66.7	66.4
1743	73.4	71.4	66.8	67.0
1744	63.3	68.3	65.3	66.6

1745	70.1	71.4	66.5	66.5
1746	77.8	70.5	69.5	66.0
1747	75.4	72.0	71.4	66.8
1748	45.5	66.4	68.9	66.1
1749	74.6	68.7	68.5	67.0
1750	49.6	64.6	68.0	66.5
1751	71.7	63.4	66.9	66.7
1752	70.2	62.3	67.2	66.9
1753	69.0	67.0	66.7	66.8
1754	66.4	65.4	67.0	66.2
1755	60.8	67.6	66.1	66.3
1756	51.4	63.6	63.5	66.5
1757	60.4	61.6	62.0	66.7
1758	68.2	61.4	64.2	66.6
1759	44.8	57.1	61.3	64.9
1760	74.1	59.8	63.7	65.9
1761	76.4	64.8	64.2	65.6
1762	78.5	68.4	65.0	66.1
1763	59.9	66.8	64.1	65.4
1764	80.0	73.8	65.5	66.2
1765	51.1	69.2	64.5	65.3
1766	69.3	67.8	66.3	64.9
1767	48.3	61.7	65.1	63.5
1768	86.7	67.1	66.9	65.6
1769	67.5	64.6	69.2	65.2
1770	49.0	64.2	66.7	65.2
1771	64.9	63.3	65.5	64.8
1772	67.5	67.1	64.4	64.7
1773	61.2	62.0	64.6	64.3
1774	67.9	62.1	63.3	64.4
1775	64.6	65.2	64.7	64.6
1776	56.7	63.6	63.4	64.9
1777	41.5	58.4	62.7	63.9
1778	66.1	59.4	60.7	63.8
1779	62.7	58.3	60.2	64.7
1780	59.3	57.3	61.2	64.0
1781	61.1	58.2	60.9	63.2
1782	59.0	61.7	60.0	62.2
1783	63.6	61.1	60.3	62.4
1784	71.2	62.8	60.6	62.0
1785	69.7	64.9	61.1	62.9

1786	54.3	63.5	60.8	62.1
1787	73.0	66.3	64.0	63.4
1788	61.7	66.0	63.6	62.1
1789	49.1	61.6	62.2	61.2
1790	84.5	64.5	64.7	63.0
1791	63.7	66.4	65.0	62.9
1792	83.1	68.4	67.4	63.7
1793	56.3	67.4	66.7	63.5
1794	60.9	69.7	65.6	63.1
1795	67.5	66.3	65.4	63.3
1796	64.6	66.5	66.5	63.7
1797	80.3	65.9	67.2	65.6
1798	35.1	61.7	64.5	64.0
1799	75.4	64.6	67.1	64.7
1800	59.4	63.0	64.6	64.7
1801	57.2	61.5	64.0	64.5
1802	70.0	59.4	62.7	65.0
1803	69.7	66.3	64.0	65.3
1804	52.7	61.8	63.2	64.4
1805	63.0	62.5	62.7	64.1
1806	61.4	63.4	62.4	64.4
1807	53.1	60.0	59.7	63.4
1808	65.2	59.1	62.7	63.6
1809	57.3	60.0	60.9	64.0
1810	62.9	60.0	61.2	62.9
1811	74.9	62.7	63.0	63.5
1812	74.4	66.9	63.5	63.1
1813	61.9	66.3	62.7	63.3
1814	54.5	65.7	62.9	63.0
1815	68.2	66.8	63.4	63.1
1816	72.0	66.2	64.4	63.4
1817	62.5	63.8	65.4	62.5
1818	72.2	65.9	66.1	64.4
1819	65.7	68.1	66.9	63.9
1820	62.8	67.0	66.9	64.1
1821	77.8	68.2	67.2	65.1
1822	57.5	67.2	65.5	64.5
1823	61.1	65.0	65.4	64.1
1824	46.5	61.2	64.6	63.7
1825	48.7	58.4	62.7	63.0
1826	71.9	57.2	62.7	63.6

1827	64.8	58.6	62.9	64.1
1828	68.6	60.1	62.5	64.3
1829	58.8	62.5	61.9	64.4
1830	52.1	63.2	60.8	63.8
1831	74.2	63.7	60.4	63.8
1832	72.0	65.1	61.9	63.7
1833	68.7	65.2	62.6	64.0
1834	55.3	64.5	63.5	64.1
1835	70.4	68.1	65.7	64.2
1836	71.0	67.5	65.6	64.1
1837	85.6	70.2	67.7	65.3
1838	65.6	69.6	67.4	65.0
1839	70.9	72.7	68.6	65.2
1840	77.5	74.1	71.1	66.0
1841	76.8	75.3	71.4	65.9
1842	48.8	67.9	69.1	65.5
1843	91.9	73.2	71.4	67.0
1844	58.2	70.6	71.7	67.6
1845	38.4	62.8	68.5	67.1
1846	46.1	56.7	66.0	65.8
1847	44.8	55.9	61.9	64.8
1848	65.3	50.5	61.9	64.6
1849	77.0	54.3	62.5	65.5
1850	75.2	61.6	62.2	66.7
1851	31.0	58.6	57.7	64.5
1852	76.7	65.0	60.4	64.8
1853	76.1	67.2	58.9	65.1
1854	63.6	64.5	59.4	65.5
1855	40.7	57.6	59.6	64.0
1856	65.7	64.5	61.6	63.8
1857	58.5	60.9	63.0	62.4
1858	72.6	60.2	63.7	62.8
1859	64.4	60.4	62.4	62.5
1860	66.2	65.5	61.5	61.9
1861	50.9	62.5	63.5	60.6
1862	73.5	65.5	63.2	61.8
1863	55.2	62.1	61.1	60.0
1864	70.3	63.2	61.8	60.6
1865	66.2	63.2	64.4	62.0
1866	79.3	68.9	65.7	63.6
1867	89.1	72.0	68.8	65.9

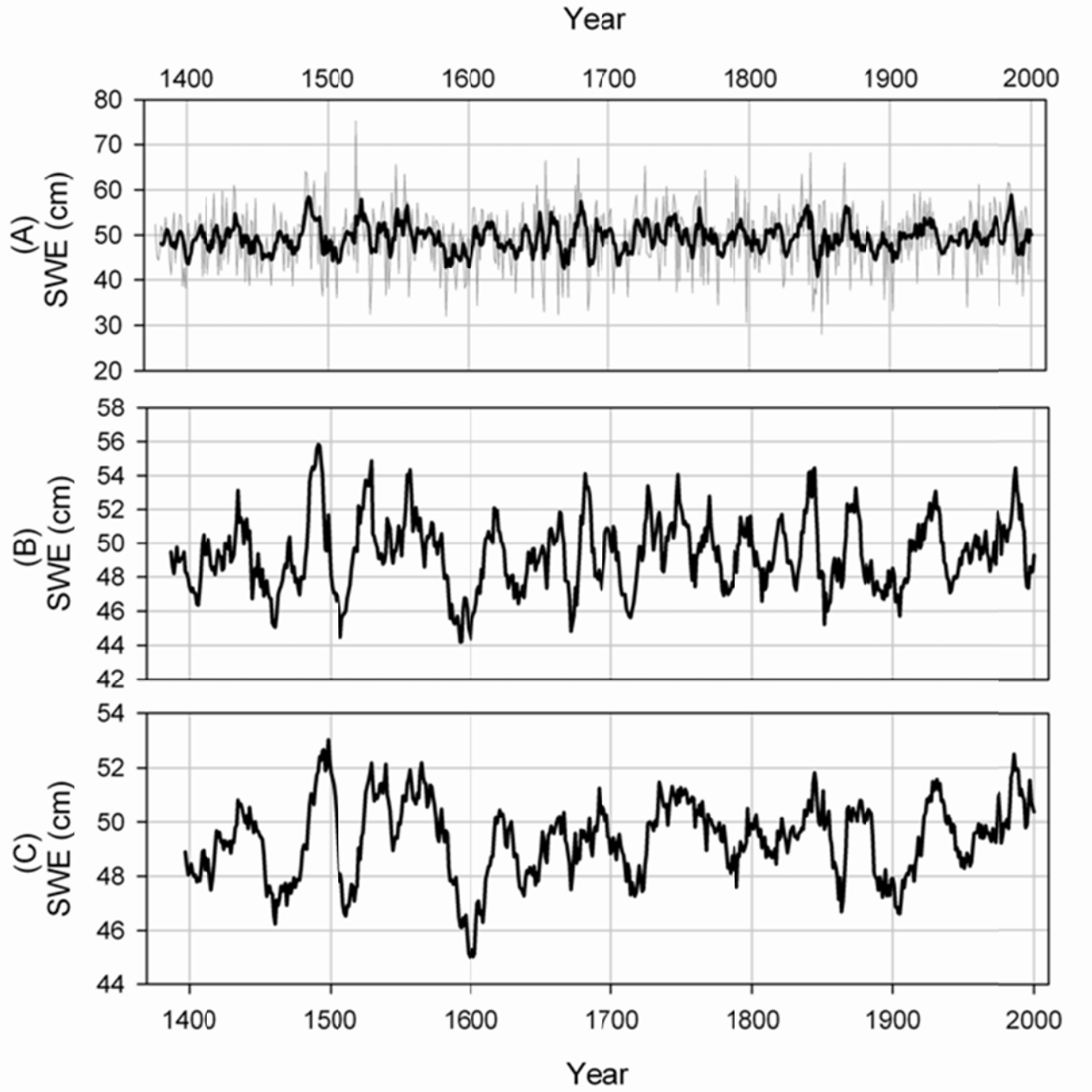
1868	68.8	74.7	68.4	66.0
1869	60.7	72.8	68.0	65.2
1870	72.5	74.1	68.7	65.1
1871	45.1	67.2	68.1	65.8
1872	71.0	63.6	67.8	65.5
1873	76.1	65.1	69.9	65.5
1874	56.2	64.2	68.5	65.2
1875	57.1	61.1	67.6	66.0
1876	72.2	66.5	66.9	66.3
1877	58.2	64.0	63.8	66.3
1878	61.0	60.9	63.0	65.7
1879	48.0	59.3	61.7	64.9
1880	67.9	61.5	61.3	65.0
1881	63.4	59.7	63.1	65.6
1882	62.4	60.5	62.3	65.0
1883	66.2	61.6	61.3	65.6
1884	68.6	65.7	62.5	65.5
1885	65.0	65.1	63.3	65.4
1886	52.8	63.0	61.4	64.1
1887	48.4	60.2	60.4	62.1
1888	63.9	59.7	60.7	61.8
1889	58.3	57.7	61.7	61.7
1890	60.4	56.8	60.9	61.1
1891	61.5	58.5	60.7	61.9
1892	63.7	61.5	60.9	61.6
1893	60.5	60.9	60.3	60.8
1894	67.1	62.6	60.2	61.3
1895	76.7	65.9	61.3	62.3
1896	42.9	62.2	60.3	60.8
1897	69.9	63.4	62.5	61.4
1898	50.8	61.5	61.2	60.9
1899	68.8	61.8	62.2	62.0
1900	67.4	60.0	62.9	61.9
1901	55.2	62.4	62.3	61.5
1902	38.7	56.2	59.8	60.3
1903	67.4	59.5	60.5	60.4
1904	60.8	57.9	59.9	60.0
1905	64.1	57.2	58.6	60.0
1906	70.0	60.2	61.3	60.8
1907	68.5	66.2	61.2	61.8
1908	54.8	63.6	61.6	61.4

1909	71.4	65.8	61.8	62.0
1910	63.2	65.6	61.4	62.2
1911	59.9	63.6	61.9	62.1
1912	71.6	64.2	65.2	62.5
1913	56.6	64.6	64.1	62.3
1914	70.6	64.4	65.1	62.5
1915	59.1	63.6	64.6	61.6
1916	62.8	64.2	63.9	62.6
1917	78.6	65.6	64.9	63.0
1918	70.0	68.2	66.4	64.0
1919	49.3	64.0	64.2	63.0
1920	68.0	65.7	64.7	63.0
1921	79.7	69.1	66.6	64.3
1922	59.8	65.4	65.5	65.3
1923	72.2	65.8	67.0	65.6
1924	76.8	71.3	67.6	66.4
1925	60.5	69.8	67.8	66.2
1926	74.1	68.7	68.9	66.4
1927	63.7	69.5	67.4	66.1
1928	77.4	70.5	68.1	67.3
1929	61.4	67.4	69.4	66.8
1930	72.1	69.7	69.8	67.2
1931	62.7	67.4	68.0	67.3
1932	62.2	67.1	68.3	66.9
1933	63.6	64.4	67.4	67.2
1934	50.5	62.2	64.8	66.2
1935	61.2	60.1	64.9	66.3
1936	57.9	59.1	63.3	66.1
1937	61.1	58.9	63.0	65.2
1938	65.9	59.3	61.8	65.0
1939	58.2	60.9	61.5	65.4
1940	61.6	60.9	60.5	65.1
1941	65.9	62.5	60.8	64.4
1942	68.4	64.0	61.4	64.9
1943	67.6	64.3	61.8	64.6
1944	50.2	62.7	61.8	63.3
1945	62.0	62.8	61.9	63.4
1946	64.1	62.5	62.5	62.9
1947	69.8	62.8	63.4	63.2
1948	60.5	61.3	62.8	62.3
1949	70.7	65.4	64.1	62.8

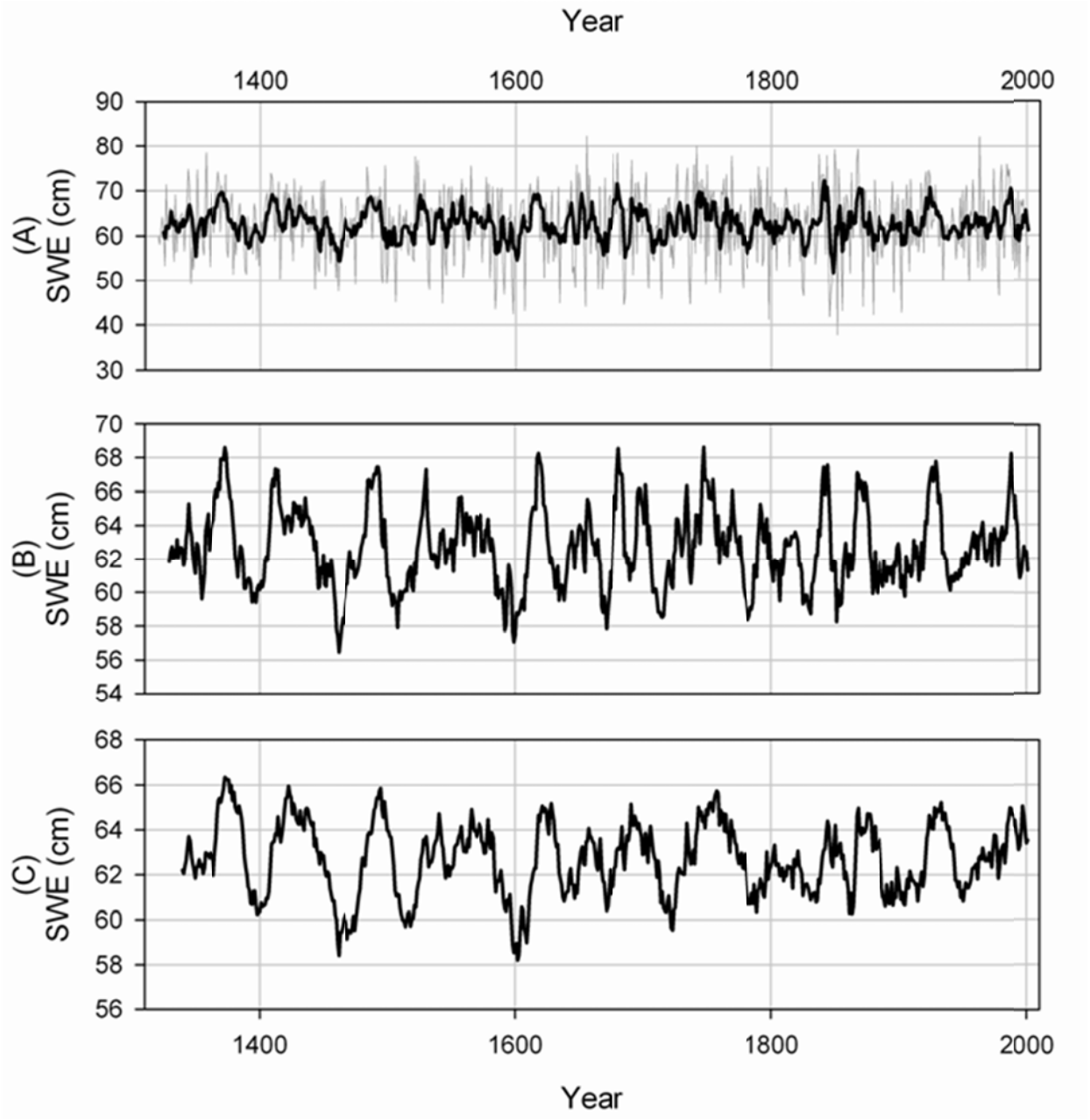
1950	60.4	65.1	64.0	62.2
1951	70.6	66.4	64.4	62.6
1952	72.0	66.8	64.8	63.1
1953	59.6	66.6	64.0	62.9
1954	41.1	60.7	63.1	62.4
1955	65.5	61.8	63.4	62.7
1956	75.3	62.7	64.5	63.5
1957	74.8	63.3	65.0	64.2
1958	66.6	64.7	65.7	64.2
1959	59.0	68.2	64.5	64.3
1960	70.1	69.1	65.4	64.7
1961	50.4	64.2	63.4	63.9
1962	83.5	65.9	64.6	64.7
1963	55.4	63.7	64.2	64.1
1964	51.0	62.1	65.1	64.1
1965	74.9	63.0	66.1	64.8
1966	55.8	64.1	64.1	64.3
1967	69.0	61.2	63.6	64.3
1968	55.6	61.3	62.5	64.1
1969	67.0	64.5	63.3	63.9
1970	74.4	64.4	63.7	64.6
1971	64.5	66.1	65.1	64.3
1972	62.1	64.7	63.0	63.8
1973	78.4	69.3	65.3	64.7
1974	73.5	70.6	67.5	66.3
1975	67.7	69.2	66.8	66.4
1976	53.4	67.0	66.6	65.4
1977	41.1	62.8	63.8	63.7
1978	76.2	62.4	65.8	64.2
1979	73.0	62.3	66.4	64.9
1980	67.7	62.3	65.8	64.7
1981	57.4	63.1	65.1	65.1
1982	71.7	69.2	66.0	64.5
1983	80.5	70.1	66.2	65.8
1984	82.4	71.9	67.1	67.3
1985	81.7	74.7	68.5	67.7
1986	74.5	78.2	70.6	68.6
1987	53.1	74.4	71.8	67.8
1988	56.2	69.6	69.8	67.8
1989	64.7	66.1	69.0	67.7
1990	48.6	59.4	67.1	66.4

1991	71.4	58.8	68.5	66.8
1992	53.8	58.9	66.7	66.3
1993	73.3	62.4	66.0	66.1
1994	44.7	58.4	62.2	64.7
1995	70.7	62.8	61.1	64.8
1996	74.0	63.3	61.0	65.8
1997	71.1	66.7	62.8	67.3
1998	53.4	62.8	62.6	66.2
1999	65.0	66.8	62.6	65.8
2000	61.1	64.9	63.8	65.5

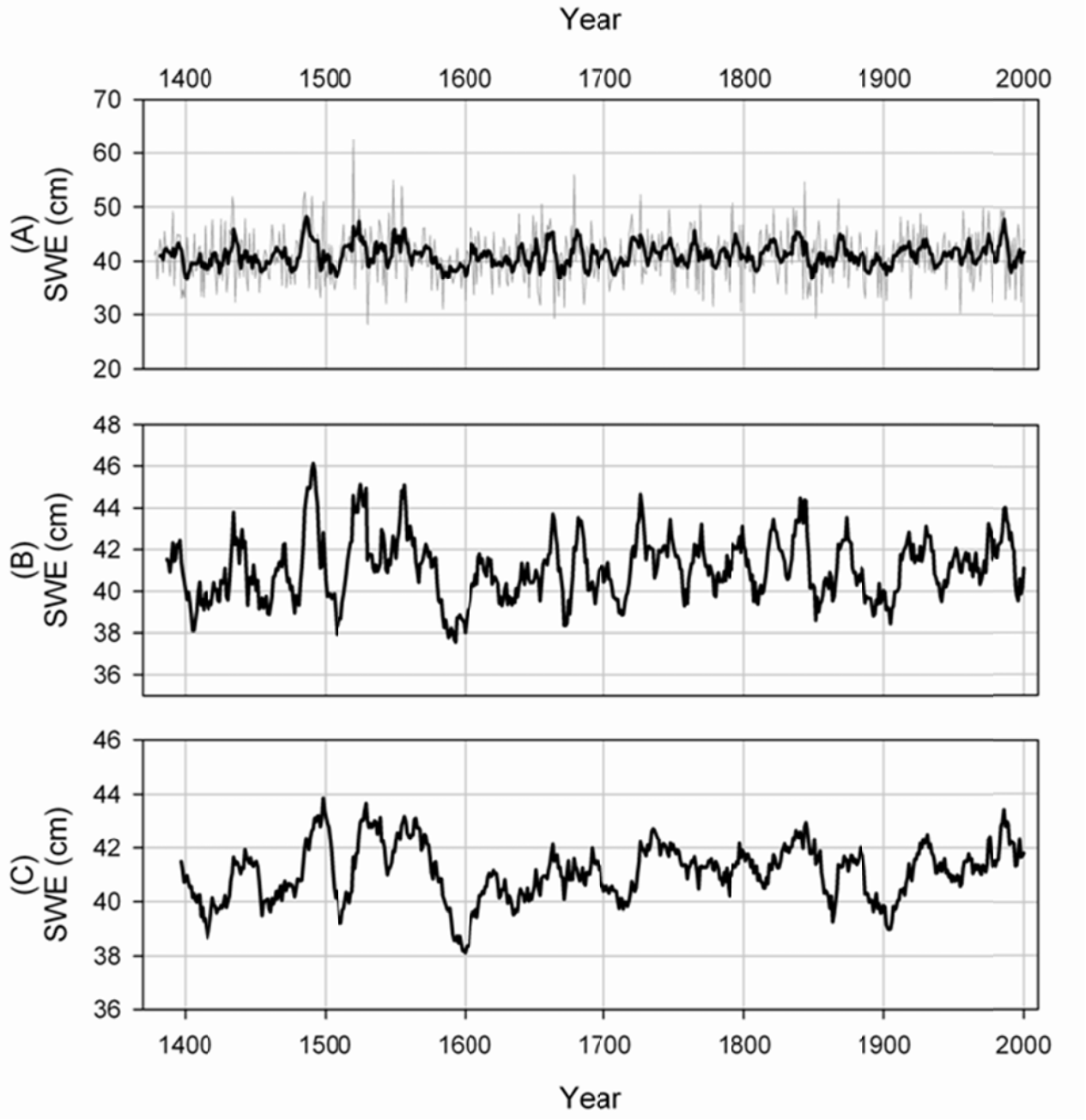
Appendix 9. Reconstruction Figures for April 1st SWE



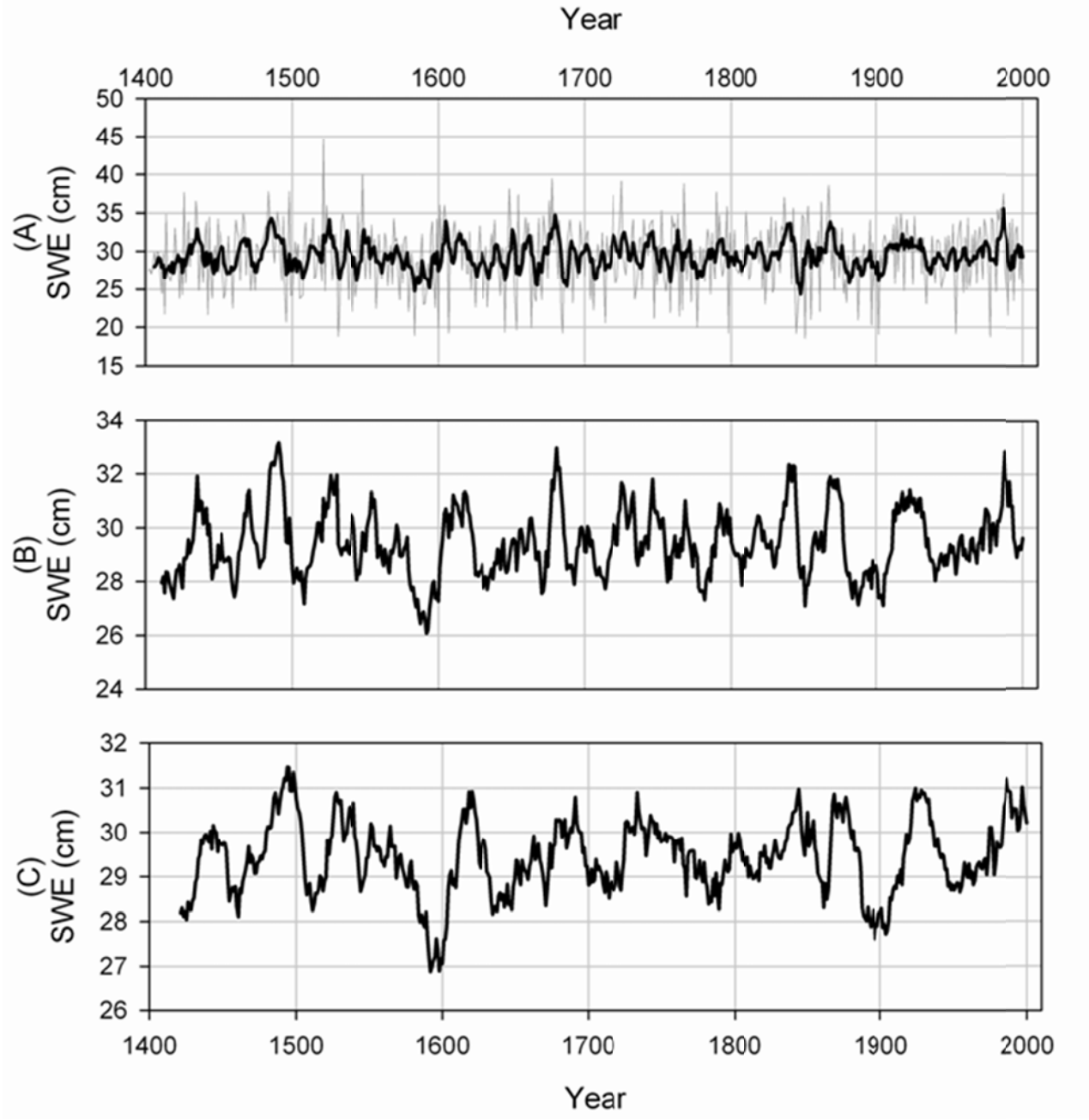
Eleven-Station Regional Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)



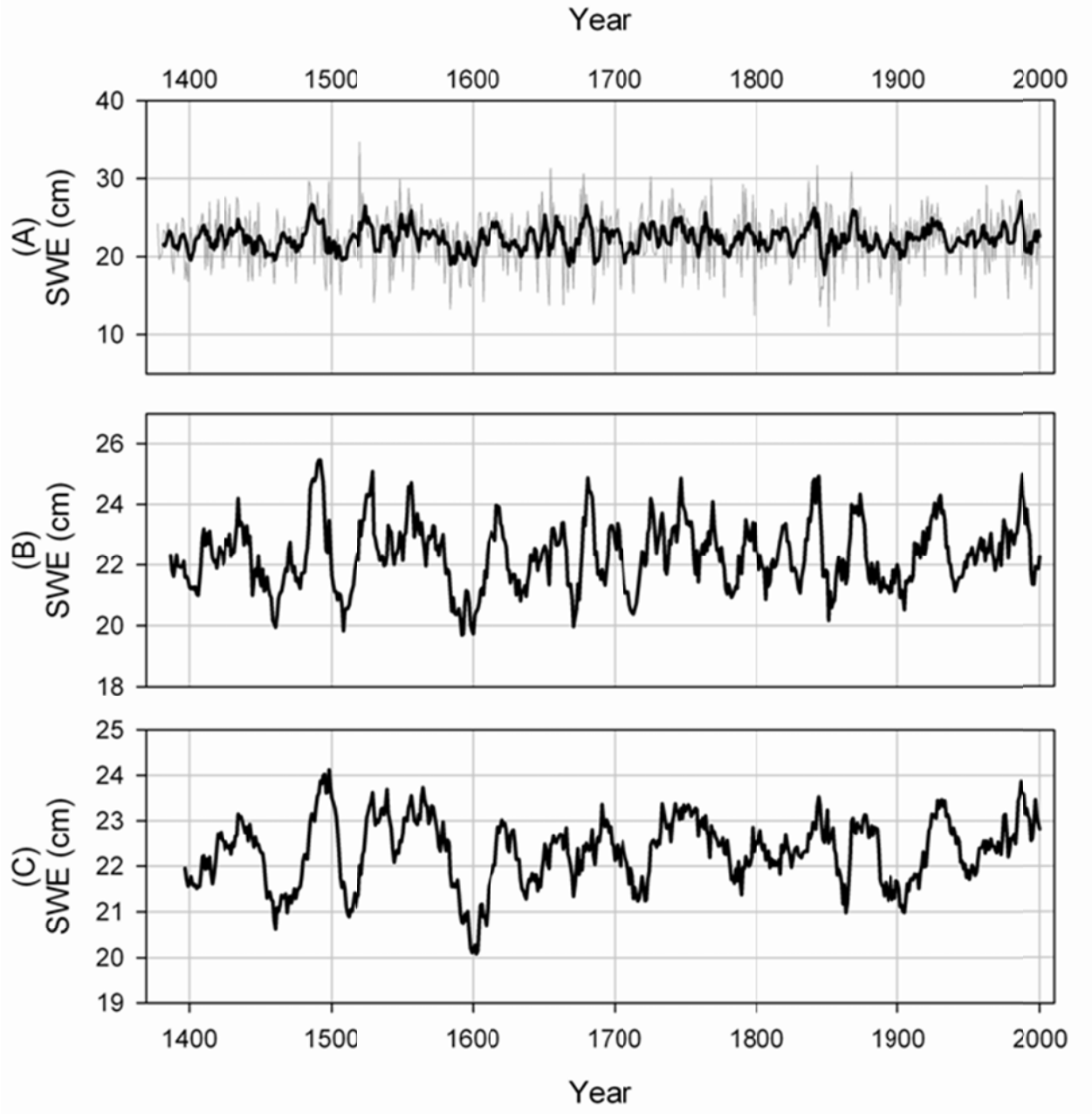
Columbine Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)



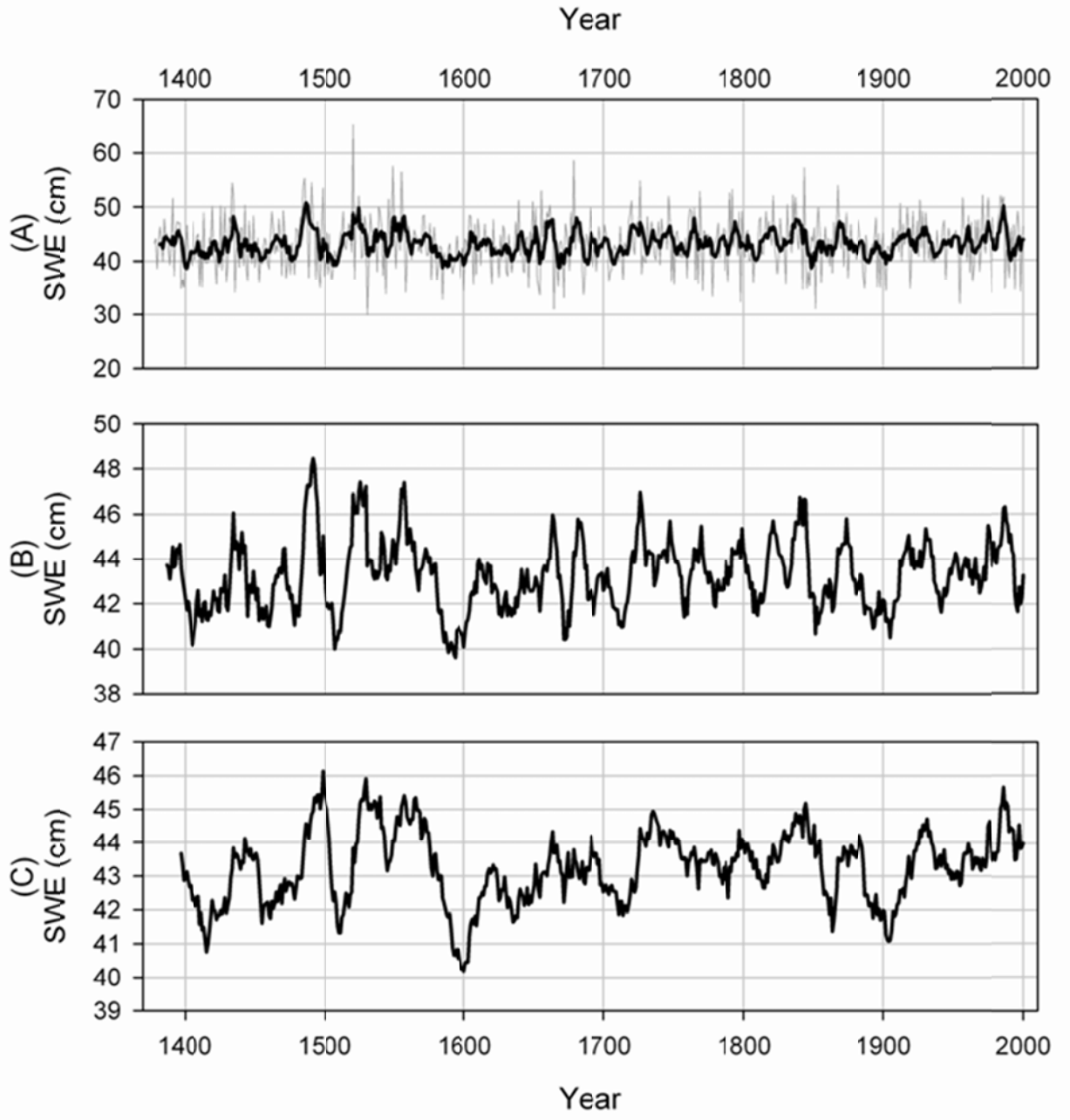
Deadman Hill Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)



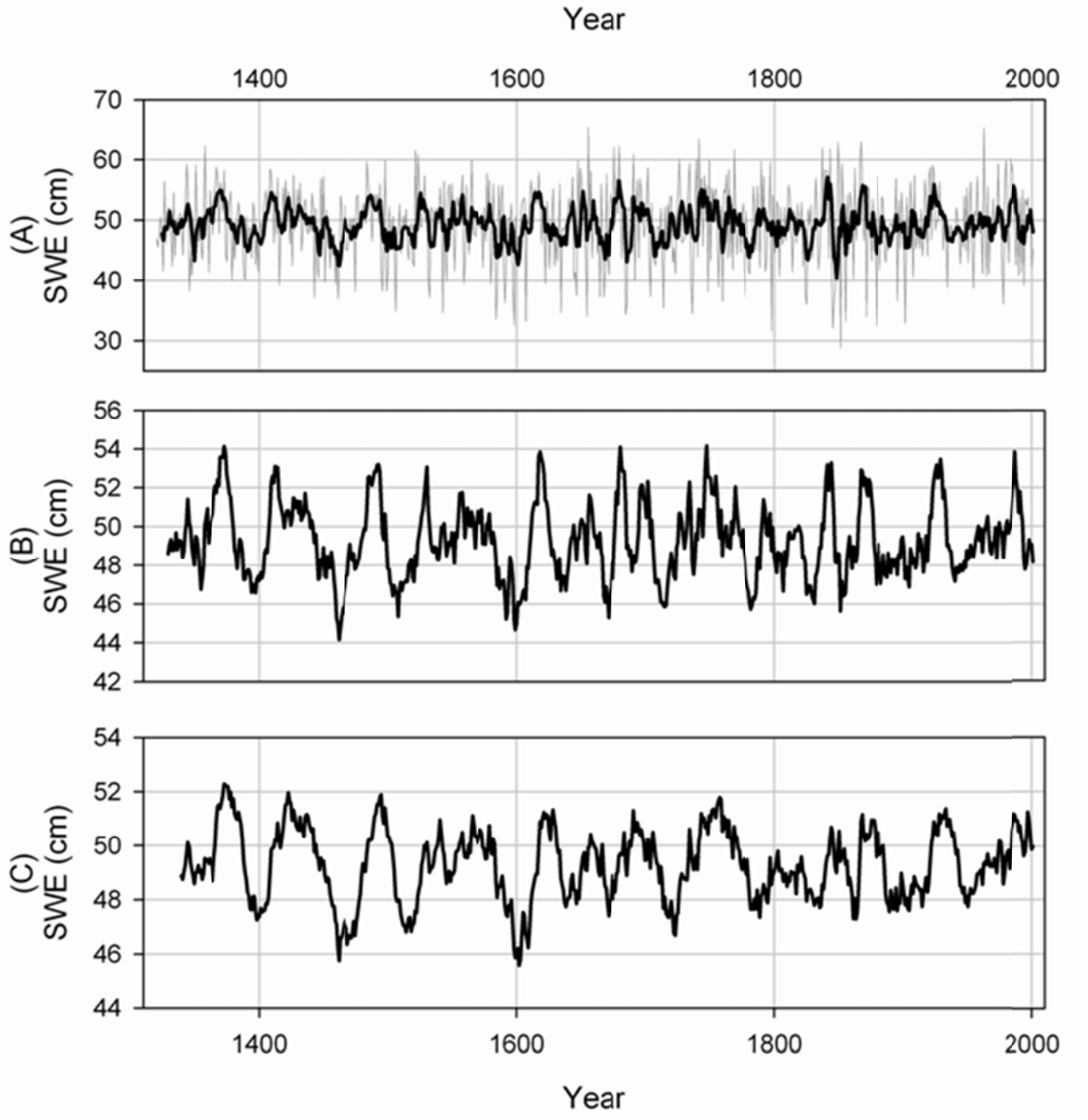
Willow Creek Pass Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)



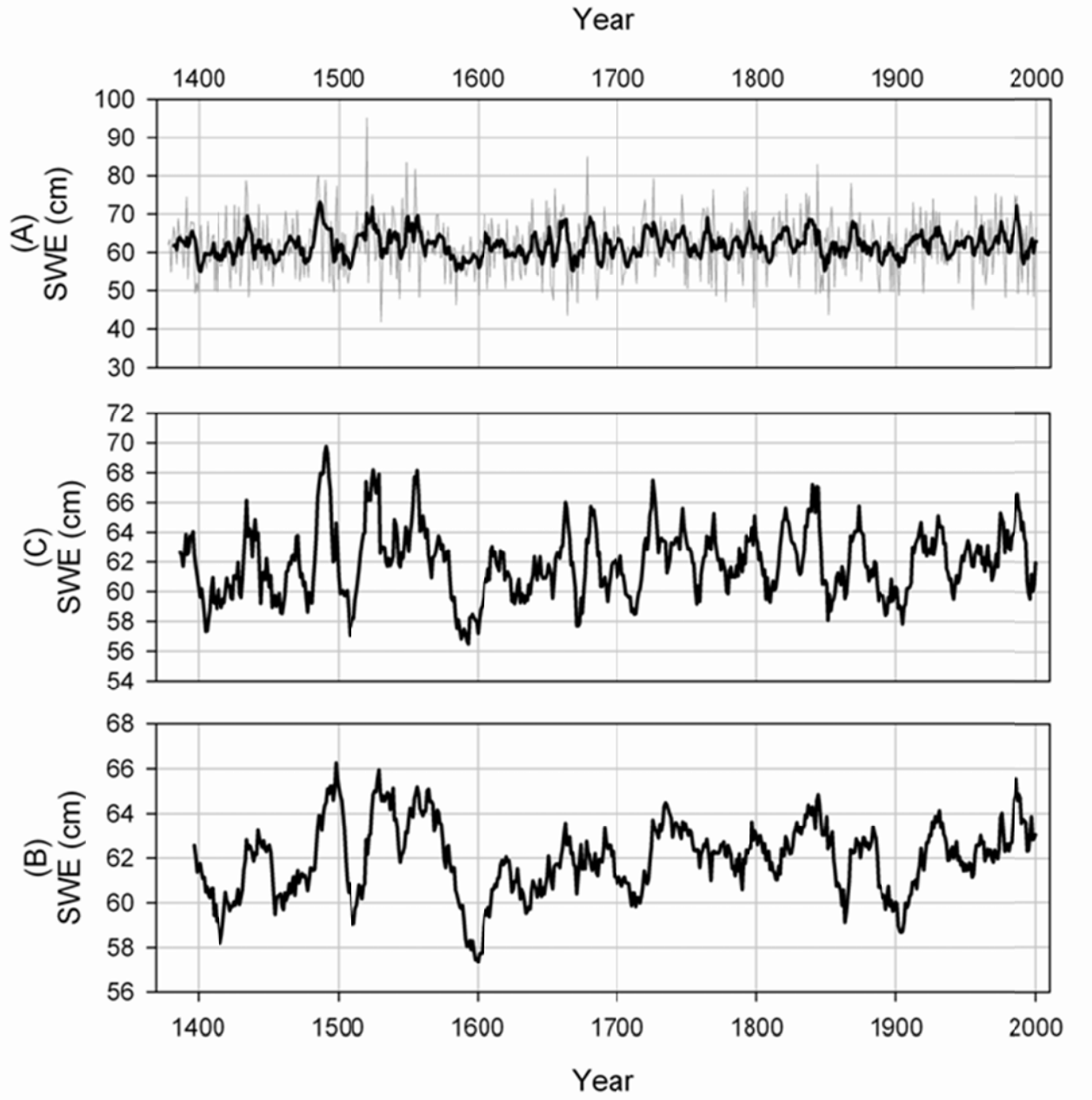
Phantom Valley Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)



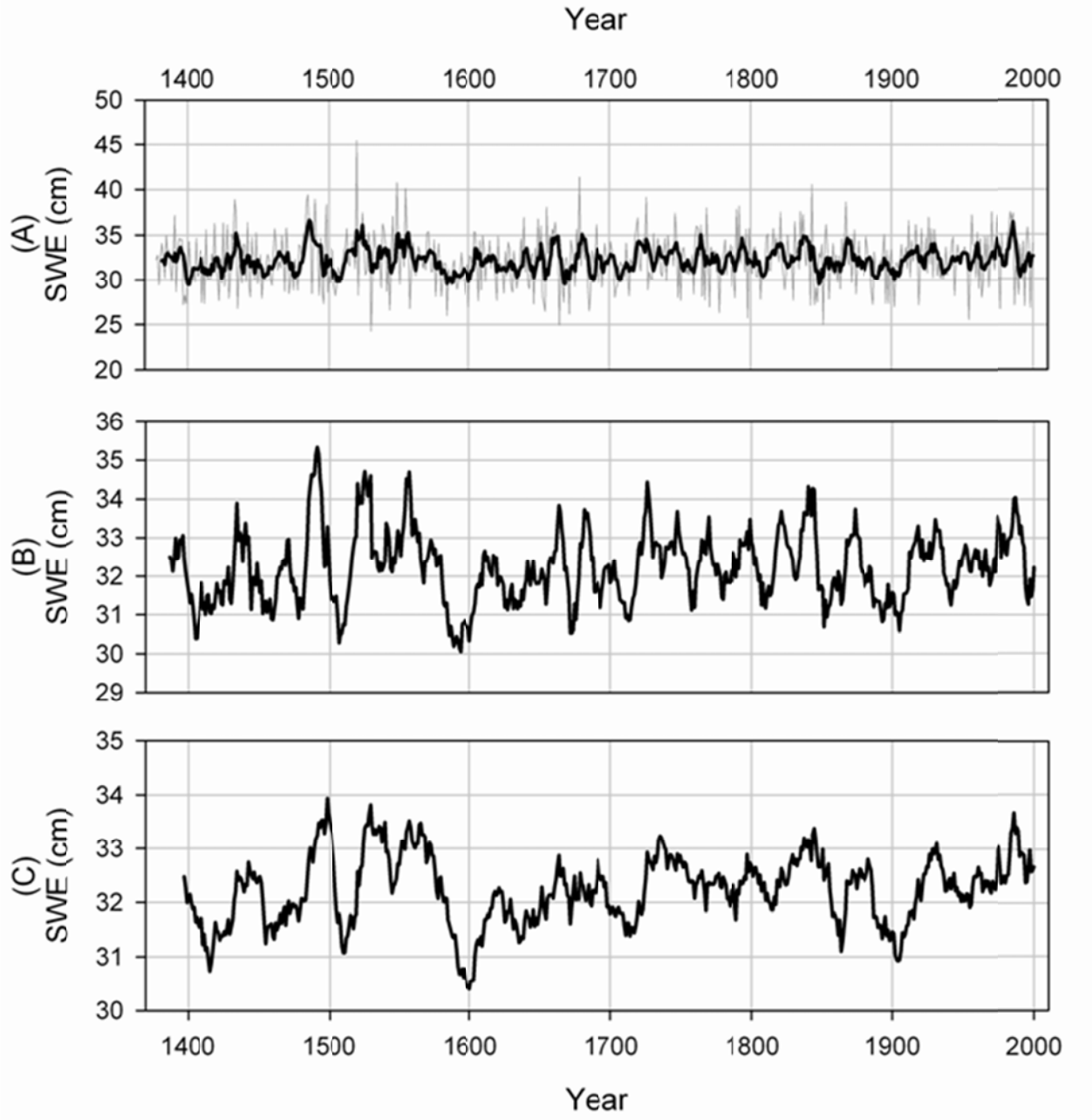
Roach Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)



Elk River Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)



Brooklyn Lake Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)



South Brush Creek Reconstructions (A) Yearly (Gray line) and 5-year (black line, end year filter) (B) 10-year (end year filter) (C) 20-year (end year filter)

Appendix 10. Residual Tree-Ring Chronology Data used in Reconstructions

Year	GMR	PUM	TRG
1320		0.887	
1321		0.825	
1322		0.943	
1323		1.053	
1324		0.922	
1325		0.645	
1326		1.319	
1327		0.857	
1328		1.066	
1329		1.124	
1330		1.108	
1331		0.94	
1332		0.683	
1333		1.235	
1334		0.76	
1335		1.041	
1336		0.921	
1337		1.064	
1338		1.081	
1339		1.066	
1340		0.768	
1341		1.079	
1342		1.149	
1343		1.448	
1344		1.307	
1345		0.492	
1346		0.797	
1347		0.616	
1348		0.856	
1349		0.861	
1350		1.442	
1351		1.036	
1352		0.87	
1353		1.002	
1354		0.83	
1355		0.736	
1356		1.103	

1357		1.586
1358		1.015
1359		1.081
1360		0.638
1361		1.25
1362		1.098
1363		1.14
1364		0.92
1365		1.226
1366		1.278
1367		1.427
1368		1.329
1369		0.93
1370		1.312
1371		1.244
1372		1.088
1373		1.405
1374		0.78
1375		0.716
1376		1.089
1377		1.168
1378	0.995	1.247
1379	1.052	0.573
1380	0.672	0.924
1381	0.985	0.737
1382	1.2	0.977
1383	1.039	1.077
1384	0.764	1.162
1385	1.298	1.03
1386	1.066	1.041
1387	1.118	0.894
1388	0.906	0.619
1389	0.72	0.574
1390	1.085	1.058
1391	1.549	0.831
1392	0.584	0.974
1393	1.106	0.965
1394	1.261	0.744
1395	1.243	1.16
1396	1.25	1.1
1397	0.422	0.697

1398	0.536	0.933	
1399	0.435	0.647	
1400	0.785	0.957	
1401	1.219	1.013	
1402	0.831	0.854	0.864
1403	0.794	1.109	0.926
1404	0.824	1.19	0.806
1405	0.71	1.251	1.013
1406	1.265	1.02	0.813
1407	0.786	1.132	1.029
1408	0.81	1.413	1.221
1409	1.076	1.37	0.969
1410	1.11	1.112	0.543
1411	0.448	0.855	0.777
1412	1.03	1.238	1.002
1413	0.438	0.928	0.404
1414	1.369	1.345	1.413
1415	0.746	0.537	0.951
1416	0.753	0.875	0.795
1417	0.747	0.985	0.738
1418	1.062	1.273	0.71
1419	0.963	1.111	0.792
1420	1.45	1.326	1.09
1421	0.851	1.033	1.064
1422	0.773	1.242	1.23
1423	0.474	0.853	0.664
1424	1.006	1.077	0.954
1425	0.697	0.688	0.53
1426	1.456	1.367	1.728
1427	0.655	0.951	0.78
1428	1.09	1.078	0.85
1429	1.432	1.257	1.226
1430	0.501	1.053	1.23
1431	0.738	1.308	1.531
1432	1.32	0.799	0.999
1433	1.25	0.919	0.916
1434	1.741	1.142	1.317
1435	1.583	1.186	1.164
1436	0.374	0.962	0.896
1437	0.885	0.924	1.098
1438	0.969	1.018	0.882

1439	0.694	0.94	0.754
1440	1.192	1.229	1.125
1441	1.177	1.138	1.453
1442	0.711	0.443	0.153
1443	1.461	1.116	1.289
1444	0.666	0.673	0.894
1445	0.518	0.596	0.621
1446	1.274	1.007	0.657
1447	0.928	1.344	1.233
1448	0.74	0.881	0.943
1449	1.335	1.357	1.364
1450	0.688	0.559	0.955
1451	0.817	1.105	1.592
1452	1.059	0.943	1.217
1453	0.5	0.853	1.091
1454	0.824	0.667	0.355
1455	0.729	0.964	0.549
1456	0.94	0.766	0.891
1457	1.06	0.925	1.289
1458	0.997	0.544	0.629
1459	0.751	0.788	0.99
1460	0.665	0.432	0.311
1461	1.07	0.743	0.954
1462	1.383	1.21	1.296
1463	1.175	1.117	1.27
1464	0.866	0.883	1.455
1465	0.972	0.856	0.551
1466	0.889	1.138	1.404
1467	1.299	1.14	1.489
1468	1.037	0.817	1.562
1469	0.587	0.799	0.994
1470	1.392	0.862	0.812
1471	1.107	1.045	1.102
1472	0.561	0.909	0.725
1473	0.73	1.03	0.907
1474	0.971	1.048	0.911
1475	0.604	0.489	0.692
1476	0.999	1.195	1.204
1477	0.832	1.218	1.293
1478	0.602	0.948	1.355
1479	1.18	1.035	0.736

1480	1.156	1.053	1.108
1481	1.02	1.156	1.329
1482	1.327	1.059	1.225
1483	1.222	1	1.283
1484	1.698	1.466	1.531
1485	1.8	1.299	0.907
1486	1.404	1.218	1.233
1487	1.175	1.095	1.027
1488	0.559	0.871	1.244
1489	1.227	1.184	1.162
1490	1.746	1.224	1.12
1491	1.231	1.145	1.311
1492	1.107	1.225	0.794
1493	0.539	1.007	0.931
1494	1.267	1.301	1.469
1495	0.615	0.575	0.662
1496	0.433	0.494	0.263
1497	1.241	0.947	0.914
1498	1.677	1.478	1.554
1499	0.578	0.493	0.621
1500	0.785	0.631	0.451
1501	0.7	1.13	1.03
1502	1.132	0.892	1.123
1503	0.605	0.95	1.296
1504	1.113	1.06	1.098
1505	0.669	0.821	0.492
1506	0.535	0.34	0.629
1507	0.667	0.915	0.546
1508	0.901	0.932	1.43
1509	0.816	1.152	1.754
1510	0.836	0.778	0.887
1511	0.943	0.934	0.919
1512	1.109	1.062	1.208
1513	1.148	0.971	1.057
1514	1.384	1.108	1.332
1515	0.972	0.793	0.589
1516	0.915	0.732	0.704
1517	1.12	0.979	0.881
1518	1.242	1.007	1.141
1519	1.076	0.717	0.774
1520	0.882	0.682	0.618

1521	2.478	1.553	1.807
1522	0.542	0.817	0.737
1523	1.35	1.521	1.584
1524	1.19	1.291	1.268
1525	1.578	0.984	0.941
1526	1.223	0.975	1.224
1527	0.804	1.142	0.703
1528	0.859	1.362	0.952
1529	1.334	1.012	1.088
1530	1.198	1.019	0.798
1531	0.087	0.546	0.306
1532	0.723	0.443	0.337
1533	1.363	1.126	1.287
1534	1.168	1.108	1.601
1535	1.123	0.95	1.411
1536	1.108	1.097	1.199
1537	1.047	1.119	0.991
1538	0.633	1.084	0.497
1539	1.445	1.004	0.919
1540	1.364	1.273	1.143
1541	1.211	1.072	0.879
1542	0.588	0.328	0.324
1543	0.975	1.321	0.988
1544	0.353	0.73	0.799
1545	1.022	0.566	0.414
1546	1.537	1.241	1.261
1547	0.878	1.299	1.008
1548	1.084	1.011	1.097
1549	1.953	1.303	1.618
1550	1.154	0.975	0.892
1551	0.678	0.647	0.83
1552	1.138	1.047	1.036
1553	1.269	1.203	1.14
1554	0.904	1.133	0.634
1555	1.876	1.201	0.775
1556	1.329	1.196	0.678
1557	1.281	1.366	1.042
1558	0.371	0.549	0.569
1559	0.833	0.702	0.753
1560	1.214	1.292	1.186
1561	1.083	1.03	0.736

1562	0.793	0.775	0.735
1563	0.956	1.043	0.987
1564	1.158	1.476	1.256
1565	1.089	1.078	1.147
1566	1.035	0.927	0.395
1567	0.89	0.905	1.022
1568	0.98	1.031	1.198
1569	0.869	1.088	0.573
1570	1.333	1.077	1.37
1571	1.346	0.969	0.938
1572	1.037	1.044	1.273
1573	0.841	1.081	0.706
1574	0.851	0.675	0.308
1575	1.245	1.125	0.979
1576	0.528	0.872	0.894
1577	0.959	1.381	1.313
1578	1.197	1.034	1.172
1579	0.897	1.327	0.982
1580	0.528	0.543	0.374
1581	0.731	0.808	0.707
1582	0.96	1.302	1.064
1583	0.939	0.87	0.768
1584	0.283	0.281	0.146
1585	0.877	0.474	0.935
1586	0.785	1.29	1.071
1587	0.661	0.887	0.743
1588	0.918	1.203	0.98
1589	0.989	1.29	1.39
1590	0.736	0.619	0.32
1591	0.615	0.403	0.442
1592	0.72	0.787	0.555
1593	0.843	1.01	0.979
1594	1.084	1.047	0.542
1595	0.878	1.027	1.508
1596	0.878	1.155	1.718
1597	0.551	0.508	0.986
1598	0.849	0.239	0.158
1599	0.932	1.059	1.718
1600	0.396	0.754	0.186
1601	1.048	0.908	1.854
1602	1.013	0.737	1.133

1603	0.928	1.05	1.575
1604	1.343	1.159	1.595
1605	1.339	1.185	1.334
1606	0.98	1.197	1.16
1607	0.47	0.266	0.028
1608	1.236	1.027	1.033
1609	0.606	1.003	1.204
1610	1.299	1.194	1.188
1611	1.158	1.326	1.479
1612	0.715	1.173	1.25
1613	1.052	1.215	1.329
1614	0.976	1.269	1.481
1615	1.232	1.178	1.212
1616	0.883	1.15	0.827
1617	1.081	1.387	1.187
1618	1.019	1.137	1.301
1619	0.761	0.852	0.873
1620	0.475	1.089	1.121
1621	1.29	1.085	1.166
1622	0.832	0.546	0.499
1623	0.953	1.171	1.076
1624	0.851	1.096	0.844
1625	0.566	0.665	0.419
1626	1.097	0.911	0.778
1627	0.79	1.056	1.244
1628	1.214	1.264	1.336
1629	1.13	0.683	0.666
1630	0.656	0.93	1.248
1631	0.58	0.718	0.564
1632	1.107	0.91	0.728
1633	0.895	1.3	1.249
1634	0.627	0.33	0.368
1635	0.782	0.968	0.765
1636	0.959	0.956	1.101
1637	1.261	0.973	1.162
1638	0.929	1.003	1.075
1639	1.524	1.064	1.173
1640	0.843	1.194	0.984
1641	1.134	1.095	0.859
1642	0.672	1.123	0.97
1643	0.62	1.352	0.583

1644	1.039	0.587	1.107
1645	1.077	0.64	0.979
1646	0.427	0.459	0.082
1647	1.135	1.484	1.017
1648	0.954	1.002	1.188
1649	1.507	1.418	1.753
1650	0.976	1.294	1.449
1651	1.419	1.029	1.014
1652	0.52	1.048	1.163
1653	0.449	0.727	0.606
1654	0.337	0.302	0.205
1655	1.646	1.731	1.522
1656	1.074	0.986	0.56
1657	1.289	1.397	0.945
1658	0.921	0.748	0.867
1659	1.377	1.015	0.949
1660	1.315	1.046	1.406
1661	1.463	1.06	0.882
1662	1.236	0.779	1.378
1663	1.049	0.925	0.879
1664	0.162	0.448	0.394
1665	1.118	1.301	1.261
1666	0.71	0.849	0.516
1667	0.449	0.447	0.628
1668	1.005	0.631	0.795
1669	1.023	1.374	1.647
1670	0.911	0.763	0.715
1671	0.307	0.621	0.787
1672	1.238	1.185	1.507
1673	1.124	1.232	1.39
1674	0.93	1.017	1.202
1675	0.653	0.937	0.878
1676	1.371	1.575	1.658
1677	1.011	1.048	1.295
1678	2.022	1.345	1.481
1679	0.915	1.08	1.255
1680	1.242	1.582	1.57
1681	1.076	1.14	1.14
1682	0.992	0.737	0.568
1683	1.269	1.106	1.39
1684	0.619	1.023	0.403

1685	0.343	0.318	0.14
1686	0.598	0.393	0.987
1687	1.108	1.121	0.61
1688	0.994	1.099	1.154
1689	0.917	1.208	1.473
1690	1.434	1.072	1.257
1691	1.163	1.522	1.215
1692	0.695	0.57	0.387
1693	0.832	1.136	1.202
1694	1.075	1.332	0.9
1695	0.642	0.745	0.882
1696	0.939	1.341	0.77
1697	1.201	1.231	1.434
1698	1	1.092	1.236
1699	0.972	0.901	1.18
1700	0.912	0.971	0.689
1701	1.224	1.171	1.134
1702	1.111	1.421	1.345
1703	1.004	0.698	0.82
1704	0.514	0.452	0.604
1705	0.633	1.159	1.186
1706	0.67	0.765	0.277
1707	0.885	0.727	1.011
1708	0.969	0.688	0.912
1709	0.912	0.964	1.269
1710	0.929	0.982	1.028
1711	0.769	0.952	1.069
1712	1.204	1.118	1.221
1713	0.836	0.707	0.781
1714	0.531	0.365	0.163
1715	1.006	1.125	1.34
1716	0.932	0.799	1.023
1717	0.982	1.148	1.172
1718	1.265	1.034	0.95
1719	1.386	1.197	1.077
1720	1.519	1.213	1.624
1721	0.962	0.714	0.803
1722	0.855	0.816	0.606
1723	1.173	0.628	0.439
1724	1.259	1.112	1.085
1725	1.201	1.243	1.446

1726	1.767	1.489	1.658
1727	0.608	1.141	1.353
1728	0.84	0.86	0.909
1729	0.765	0.871	0.839
1730	0.749	0.9	1.291
1731	1.326	0.928	0.794
1732	0.941	1.103	0.986
1733	1.09	1.329	1.294
1734	1.264	1.458	1.416
1735	1.148	0.56	0.055
1736	0.837	0.323	0.514
1737	0.786	0.82	0.805
1738	1.084	1.214	1.195
1739	1.265	1.487	1.096
1740	0.723	0.751	0.627
1741	1.298	1.64	1.387
1742	1.113	1.074	1.254
1743	1.127	1.343	1.277
1744	1.129	0.833	0.871
1745	0.915	1.364	1.611
1746	1.574	1.169	1.099
1747	1.295	1.294	1.375
1748	0.509	0.488	0.261
1749	1.031	1.484	1.015
1750	0.473	0.727	0.912
1751	1.11	1.271	1.075
1752	1.149	1.163	0.831
1753	1.003	1.231	1.8
1754	0.817	1.265	1.264
1755	0.877	0.932	0.646
1756	0.809	0.52	0.495
1757	0.849	0.935	0.728
1758	1.061	1.137	1.052
1759	0.555	0.417	0.329
1760	1.265	1.257	1.483
1761	1.418	1.236	1.139
1762	1.387	1.368	1.241
1763	1.04	0.743	0.665
1764	1.429	1.405	1.369
1765	0.524	0.754	0.289
1766	1.116	1.147	1.19

1767	0.481	0.655	0.443
1768	1.636	1.557	1.729
1769	1.073	1.092	1.284
1770	0.39	0.771	1.058
1771	1.154	0.892	1.043
1772	1.107	1.065	0.851
1773	1.066	0.788	0.072
1774	1.108	1.084	0.948
1775	0.838	1.154	1.196
1776	0.958	0.654	0.967
1777	0.319	0.455	0.269
1778	0.99	1.098	0.702
1779	1.01	0.909	1.146
1780	1.096	0.667	0.489
1781	1.247	0.623	0.902
1782	0.805	0.903	0.683
1783	1.11	0.867	1.019
1784	1.064	1.284	1.411
1785	1.182	1.108	1.109
1786	0.65	0.805	0.583
1787	1.162	1.288	1.261
1788	0.775	1.067	1.032
1789	0.507	0.673	0.985
1790	1.616	1.468	1.596
1791	0.97	0.996	1.119
1792	1.66	1.358	1.15
1793	0.945	0.645	0.924
1794	1.133	0.714	0.492
1795	1.116	1.058	0.644
1796	0.841	1.151	1.258
1797	1.378	1.464	1.541
1798	0.253	0.193	0.218
1799	1.383	1.218	1.063
1800	0.971	0.78	0.9
1801	0.818	0.803	0.964
1802	1.126	1.17	1.346
1803	1.156	1.13	0.597
1804	0.786	0.608	0.909
1805	0.779	1.127	0.855
1806	1.01	0.845	0.797
1807	0.49	0.885	1.07

1808	0.905	1.125	1.187
1809	0.74	0.875	0.999
1810	0.872	1.039	1.013
1811	1.269	1.291	1.541
1812	1.318	1.224	0.992
1813	0.88	0.981	0.642
1814	0.852	0.639	0.775
1815	1.105	1.103	0.885
1816	1.384	1.046	0.964
1817	1.06	0.856	1.238
1818	1.271	1.153	1.082
1819	1.111	0.969	1.126
1820	0.968	0.95	0.873
1821	1.582	1.163	0.929
1822	0.974	0.684	0.407
1823	0.794	1.021	1.205
1824	0.609	0.454	0.438
1825	0.805	0.391	0.824
1826	1.305	1.108	1.193
1827	1.029	0.996	1.106
1828	1.079	1.142	1.629
1829	0.976	0.744	0.326
1830	0.478	0.846	0.849
1831	1.471	1.082	1.202
1832	1.041	1.345	1.211
1833	1.149	1.086	0.896
1834	0.876	0.659	0.78
1835	1.592	0.786	1.001
1836	1.275	1.091	1.211
1837	1.561	1.571	1.545
1838	1.069	1	1.454
1839	0.919	1.398	1.364
1840	1.287	1.405	1.266
1841	1.263	1.39	1.286
1842	0.411	0.742	0.975
1843	1.929	1.563	1.028
1844	0.842	0.832	0.754
1845	0.419	0.214	0.065
1846	0.633	0.412	0.275
1847	0.455	0.5	0.804
1848	1.076	0.979	0.876

1849	1.02	1.612	1.713
1850	1.188	1.375	1.514
1851	0.168	0.064	0.199
1852	1.191	1.449	1.353
1853	1.434	1.207	1.498
1854	1.124	0.852	1.061
1855	0.49	0.265	0.26
1856	0.831	1.214	1.222
1857	0.923	0.776	0.904
1858	1.199	1.237	1.052
1859	0.799	1.181	1.245
1860	1.054	1.047	1.396
1861	0.709	0.584	0.209
1862	1.044	1.417	1.919
1863	0.62	0.878	1.178
1864	1.258	1.07	0.998
1865	1.024	1.073	1.237
1866	1.28	1.503	1.505
1867	1.709	1.616	1.634
1868	1.036	1.189	1.481
1869	0.931	0.877	0.774
1870	1.223	1.213	1.028
1871	0.701	0.301	0.611
1872	1.062	1.28	1.442
1873	1.369	1.264	1.016
1874	0.557	0.98	0.982
1875	0.908	0.721	1.009
1876	1.231	1.189	1.284
1877	0.887	0.793	0.39
1878	0.867	0.949	0.659
1879	0.949	0.232	0.165
1880	0.792	1.358	1.178
1881	0.833	1.101	0.629
1882	1.284	0.653	0.471
1883	1.149	0.962	0.672
1884	1.006	1.207	1.389
1885	0.842	1.172	1.162
1886	0.579	0.792	1.107
1887	0.423	0.712	0.31
1888	1.093	0.895	0.9
1889	0.884	0.802	0.688

1890	0.798	0.98	1.231
1891	0.82	1.014	1.353
1892	0.982	0.982	0.772
1893	0.865	0.927	0.984
1894	1.07	1.075	0.841
1895	1.314	1.343	1.363
1896	0.438	0.42	0.201
1897	1.116	1.177	1.126
1898	0.435	0.817	0.899
1899	0.983	1.238	0.928
1900	1.121	1.047	0.95
1901	0.761	0.755	0.938
1902	0.393	0.252	0.077
1903	0.948	1.2	1.062
1904	0.96	0.857	0.799
1905	0.873	1.097	1.34
1906	0.958	1.319	1.402
1907	1.185	1.046	1.073
1908	0.916	0.599	0.902
1909	0.989	1.364	1.271
1910	1.148	0.814	1.131
1911	0.884	0.882	1.122
1912	1.485	0.94	1.124
1913	0.773	0.814	0.668
1914	1.234	1.109	1.493
1915	0.972	0.763	0.717
1916	1.053	0.879	1.387
1917	1.433	1.332	1.36
1918	1.126	1.17	1.222
1919	0.421	0.757	0.85
1920	0.808	1.351	1.475
1921	1.387	1.428	1.3
1922	0.875	0.882	1.168
1923	0.946	1.439	1.384
1924	1.274	1.382	0.992
1925	0.829	0.956	0.606
1926	1.527	1.027	1.246
1927	0.936	1.022	1.128
1928	1.382	1.316	0.961
1929	0.767	1.055	1.239
1930	1.372	1.059	0.999

1931	1.123	0.808	0.543
1932	0.795	1.071	1.499
1933	0.966	0.995	0.698
1934	0.762	0.52	0.308
1935	0.842	0.984	1.042
1936	0.753	0.893	1.047
1937	0.818	0.997	0.941
1938	1.156	0.94	1.206
1939	0.801	0.869	0.976
1940	0.935	0.919	0.537
1941	0.945	1.125	1.314
1942	1.197	1.032	1.095
1943	1.28	0.918	0.972
1944	0.536	0.701	0.802
1945	0.968	0.913	0.522
1946	1.181	0.83	0.454
1947	1.075	1.208	1.259
1948	1.009	0.799	0.824
1949	1.05	1.272	1.307
1950	1.103	0.713	0.898
1951	1.156	1.175	0.735
1952	1.074	1.315	1.497
1953	0.921	0.833	0.7
1954	0.232	0.514	0.23
1955	0.955	1.098	1.292
1956	1.557	1.059	0.977
1957	1.184	1.359	1.466
1958	1.179	0.955	0.766
1959	0.77	0.934	0.506
1960	1.341	0.987	1.024
1961	0.625	0.632	0.695
1962	1.259	1.728	1.447
1963	0.513	0.979	0.839
1964	0.689	0.608	0.901
1965	1.285	1.279	1.115
1966	0.936	0.629	0.858
1967	1.289	0.981	1.195
1968	0.64	0.881	0.791
1969	0.931	1.191	1.331
1970	1.59	0.986	0.991
1971	1.006	1.004	1.008

1972	0.869	1.005	0.661
1973	1.284	1.451	1.405
1974	1.556	0.968	1.023
1975	1.114	1.068	1.151
1976	0.823	0.609	0.769
1977	0.369	0.394	0.048
1978	1.309	1.322	1.397
1979	0.942	1.483	1.65
1980	1.057	1.117	0.999
1981	0.937	0.71	0.376
1982	1.288	1.115	1.564
1983	1.361	1.489	1.311
1984	1.583	1.389	1.329
1985	1.477	1.448	1.355
1986	1.568	1.01	1.607
1987	0.417	0.95	1.276
1988	0.895	0.687	0.476
1989	0.799	1.195	1.402
1990	0.547	0.609	0.295
1991	1.171	1.204	1.439
1992	0.817	0.634	0.688
1993	1.212	1.262	1.47
1994	0.408	0.537	0.684
1995	1.144	1.189	1.253
1996	1.388	1.141	1.171
1997	1.157	1.198	1.035
1998	0.385	0.992	1.095
1999	1.015	1.018	1.036
2000	1.19	0.674	0.317
2001		0.806	0.876
2002			0.174

VITA

Amanda Bowen was born in Tullahoma, Tennessee. Her parents are Thomas and Susan Reel and Miles and Karen Bowen. She has one younger sister named Rebecca. She graduated from Roane County High School in Kingston, TN. Following high school graduation, Amanda Bowen moved to Knoxville, TN to attend the University of Tennessee pursuing her Bachelors of Science in Civil Engineering.

She was the President of Chi Epsilon, the Civil Engineering Honors Society in 2008. She was active with the UT Chapter of American Society of Civil Engineers (ASCE). Throughout her undergraduate education she was involved in local community service projects. She received her Engineer in Training (EIT) license in October of 2009. She received her bachelor's in December of 2009 with cum laude honors.

Amanda Bowen is on track to obtain a Master's of Science in Environmental Engineering with a concentration in Water Resources in May of 2011. She is hoping to pursue her career locally, in Knoxville, TN, providing support for operations along the Tennessee River and its tributaries. She enjoys shopping, reading, and Tennessee Volunteer football.