<><> Time Stamp <><>

Code started: 07/10/2022 - 11:46:50
Total Run Time: 13.712 s

<><> Bore Information <><>

Bore ID: GW036872.1.1
Region: Coastal
Bore Coordinates: (-30.923963, 153.044423)
Agency: WaterNSW
Drilled Date: 01/08/1990
Bore Depth: 30.5 m
Drilled Depth: 30.5 m
Reference Elevation: nan m
Time Series Reference Elevation: nan m
Land Surface Elevation: nan m
Silo Grid Point Coordinates: (-30.9, 153.05)

<><> Model Output <><>

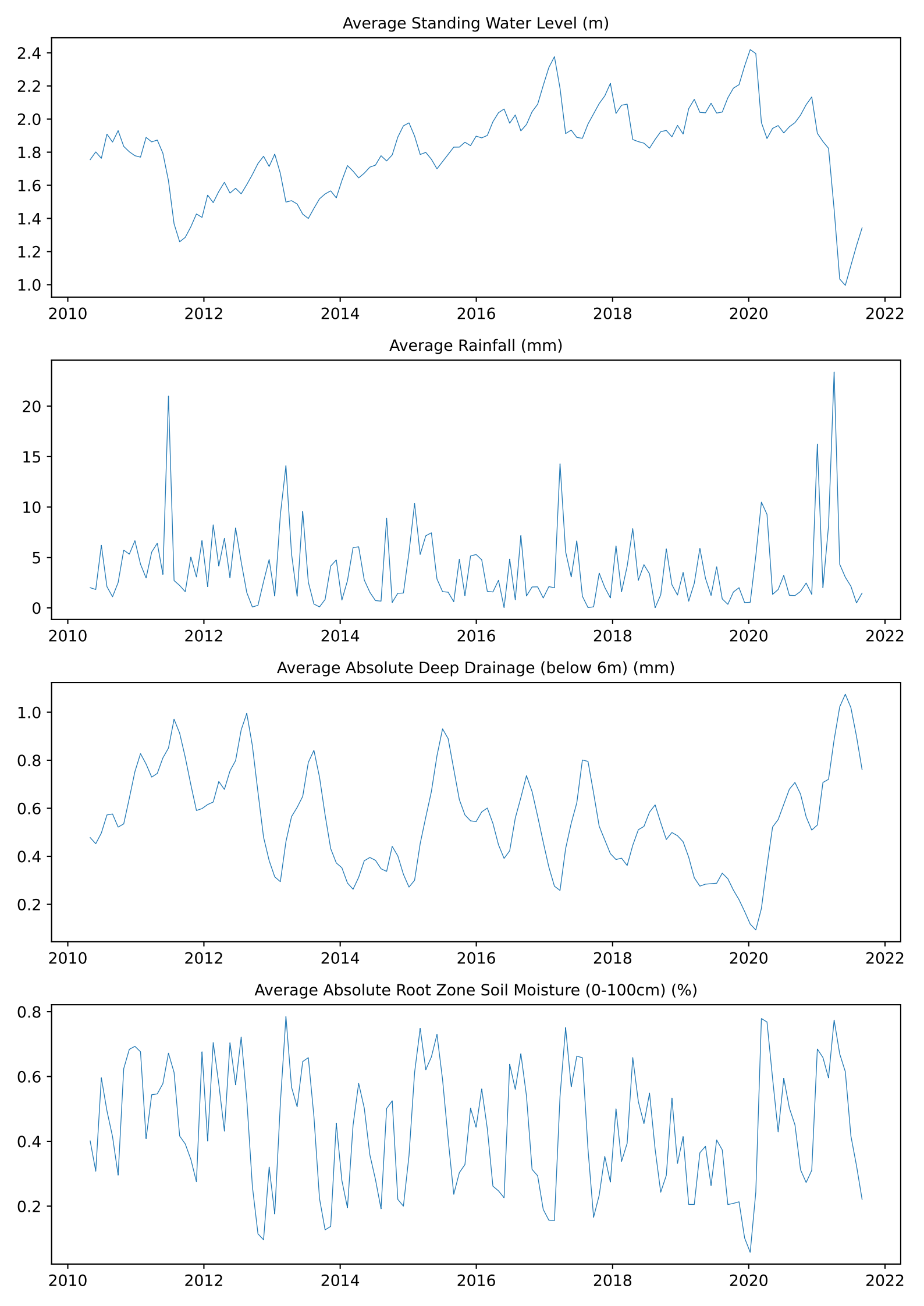
Averaged Period: 30 day(s)
Output: Average Standing Water Level (m) in 1 period(s) time

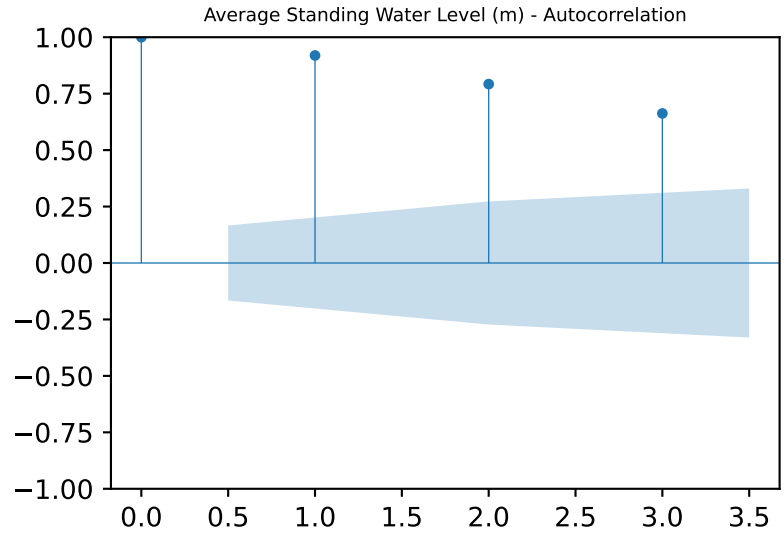
<><> Model Inputs <><>

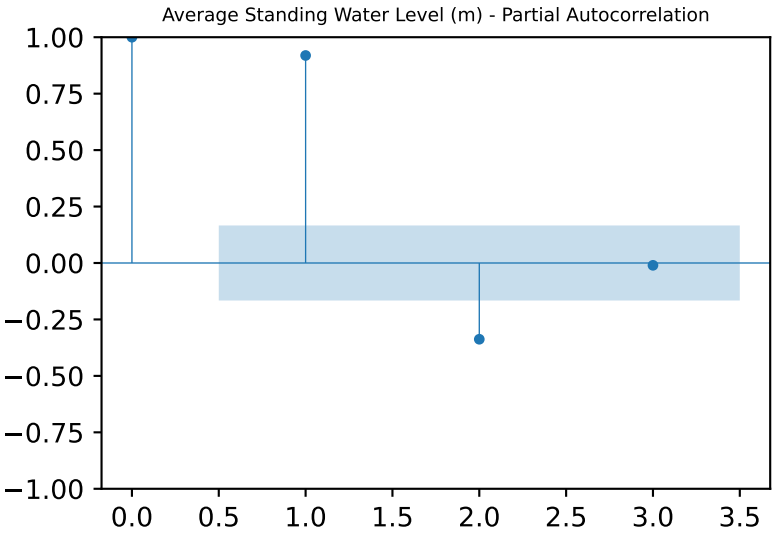
Data Range: 01/05/2010 - 31/08/2021
Train Set Size: 80.0%
Test Set Size: 20.0%
Input Timesteps: Current period + 2 preceeding period(s)
Input Variables:
    Average Standing Water Level (m)
    Average Rainfall (mm)
    Average Absolute Deep Drainage (below 6m) (mm)
    Average Absolute Root Zone Soil Moisture (0-100cm) (%)

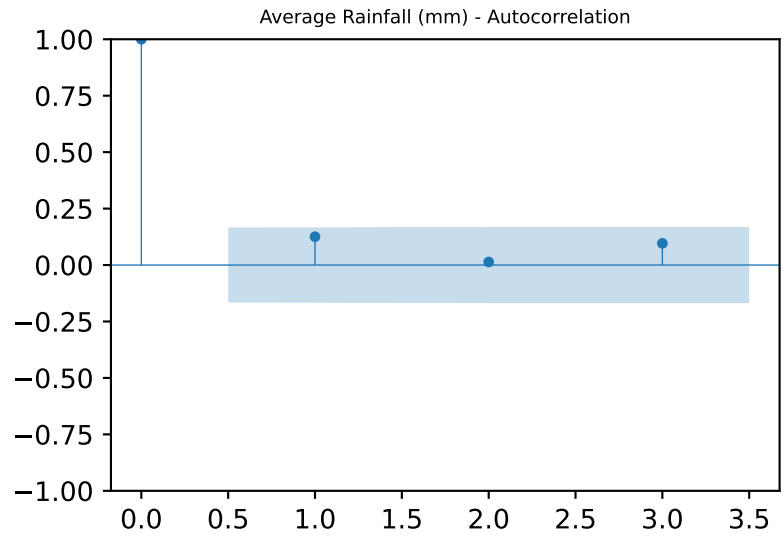
<><> Data Quality <><>

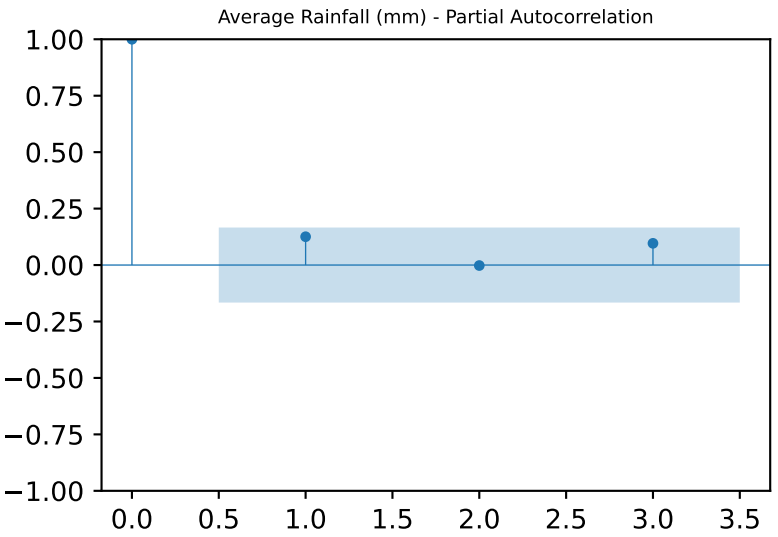
Interpolation Method: Spline
Quality Code: A,   Number: 3434,   Percentage: 82.33%
Quality Code: B,   Number: 645,   Percentage: 15.46%
Quality Code: C,   Number: 92,   Percentage: 2.21%

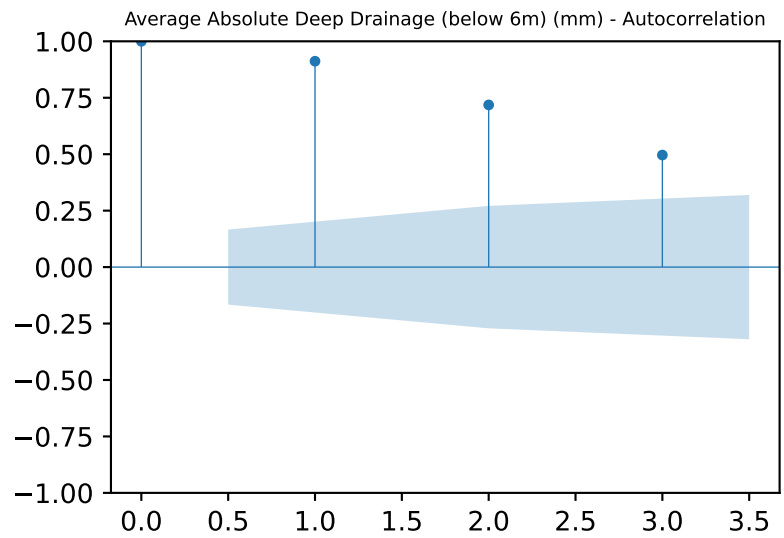

Average Standing Water Level (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2010
2012
2014
2016
2018
2020
2022
Average Rainfall (mm)
20
15
10
5
0
2010
2012
2014
2016
2018
2020
2022
Average Absolute Deep Drainage (below 6m) (mm)
1.0
0.8
0.6
0.4
0.2
2010
2012
2014
2016
2018
2020
2022
Average Absolute Root Zone Soil Moisture (0-100cm) (%)
0.8
0.6
0.4
0.2
2010
2012
2014
2016
2018
2020
2022

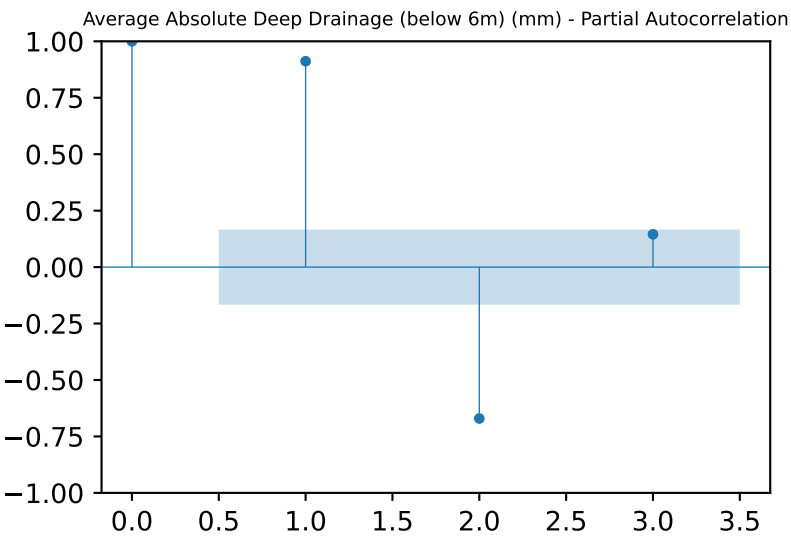

Average Standing Water Level (m) - Autocorrelation

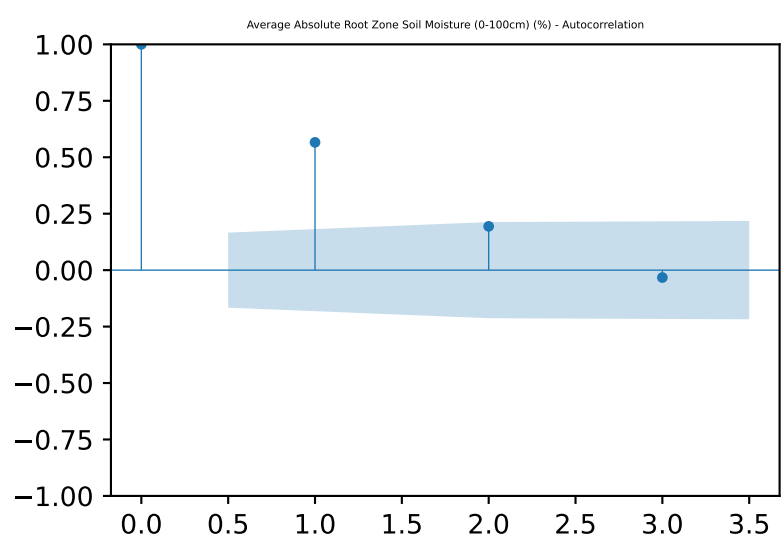

Average Standing Water Level (m) - Partial Autocorrelation

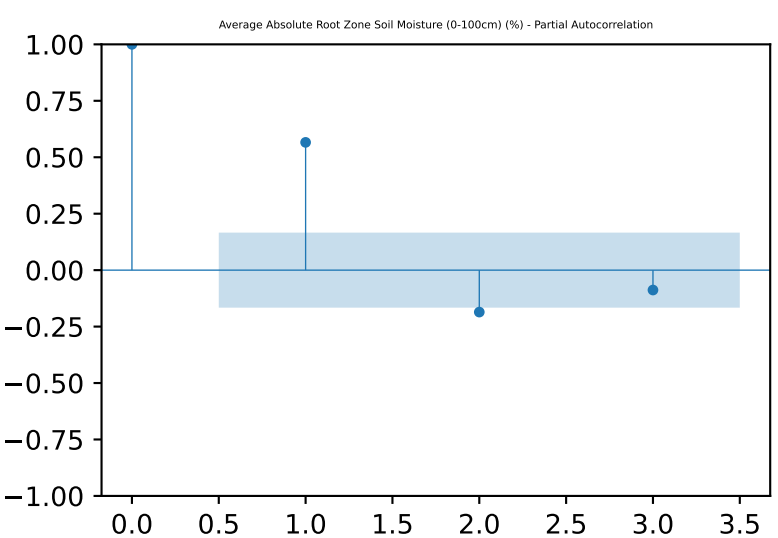

Average Rainfall (mm) - Autocorrelation

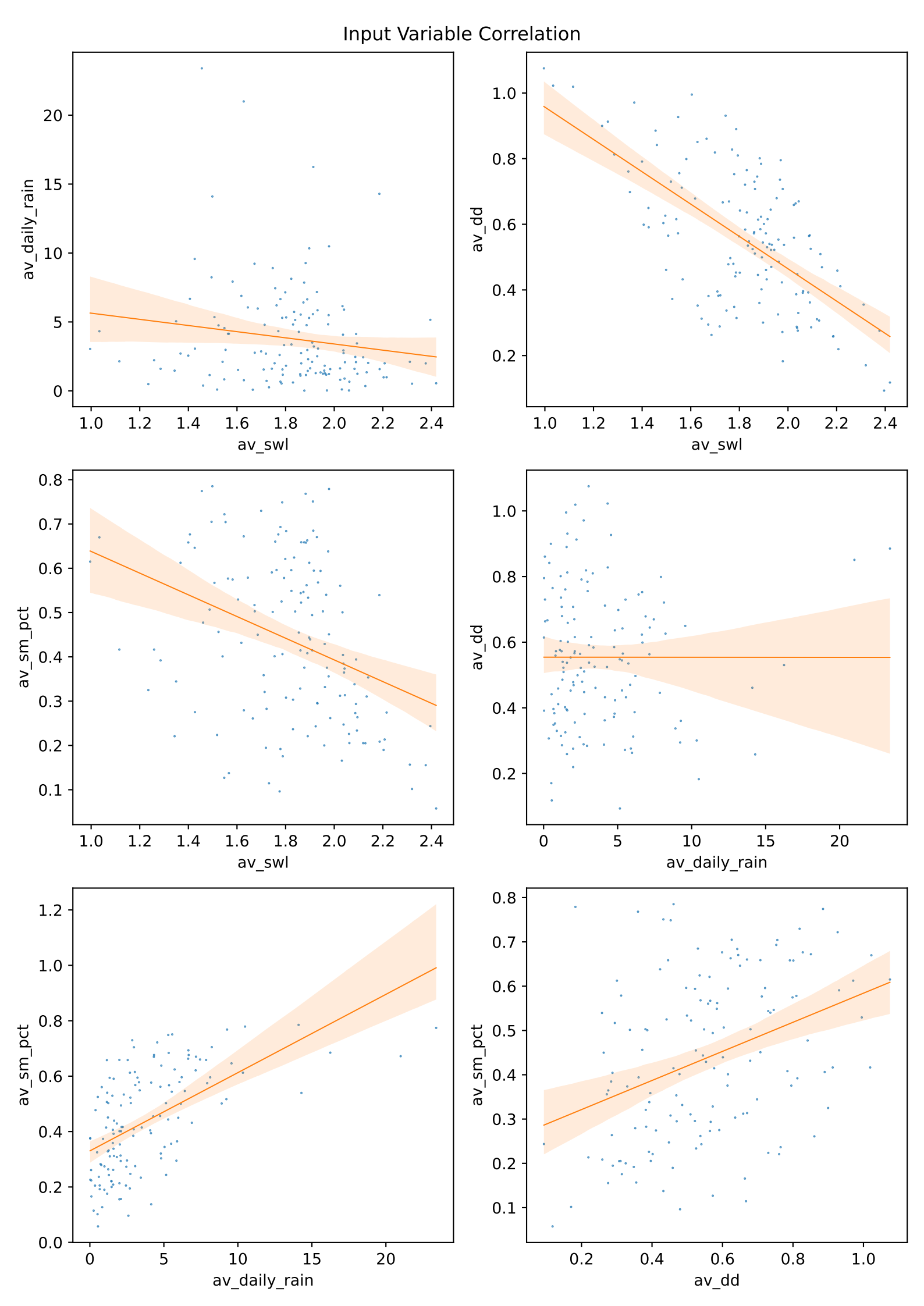

Average Rainfall (mm) - Partial Autocorrelation

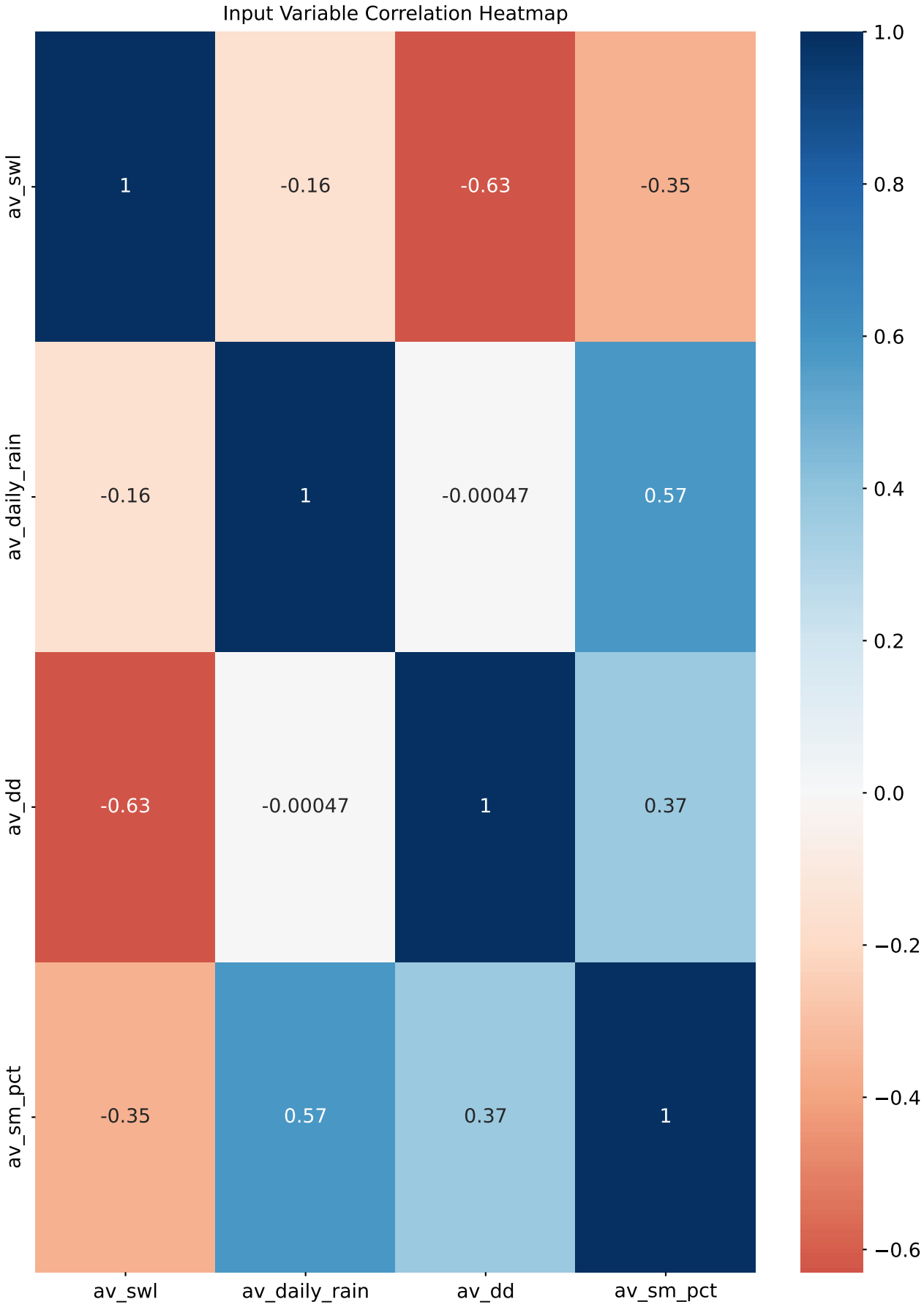

Average Absolute Deep Drainage (below 6m) (mm) - Autocorrelation


Average Absolute Deep Drainage (below 6m) (mm) - Partial Autocorrelation


Average Absolute Root Zone Soil Moisture (0-100cm) (%) - Autocorrelation


Average Absolute Root Zone Soil Moisture (0-100cm) (%) - Partial Autocorrelation


Input Variable Correlation
av_daily_rain
av_swl
av_dd
av_swl
av_sm_pct
av_swl
av_dd
av_daily_rain
av_sm_pct
av_daily_rain
av_sm_pct
av_dd


Input Variable Correlation Heatmap
av_swl
av_daily_rain
av_dd
av_sm_pct
1
-0.16
-0.63
-0.35
-0.16
1
-0.00047
0.57
-0.63
-0.00047
1
0.37
-0.35
0.57
0.37
1
av_swl
av_daily_rain
av_dd
av_sm_pct
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6

<><> TensorFlow Keras LSTM Model <><>

Optimiser: adam
Loss: mse
Number of Epochs: 100
Percentage of Training Data for Validation: 20.0%
Time Series Order: Chronological
Verbose: Off

<><> Model Architecture <><>

Input Shape (Samples, Timesteps, Features): (108, 3, 4)
LSTM Layers: 1
LSTM Cells per Layer: 64
Fully Connected Hidden Layers: 2
Fully Connected Hidden Neurons per Layer: 32
Fully Connected Output Neurons: 1
LSTM Dropout Rate: 20.0%
LSTM Recurrent Dropout Rate: 20.0%

Model: "sequential_40"

Layer (type)	Output Shape	Param #
lstm_40 (LSTM)	(None, 64)	17664
dense_120 (Dense)	(None, 32)	2080
dense_121 (Dense)	(None, 32)	1056
dense_122 (Dense)	(None, 1)	33

Total params: 20,833
Trainable params: 20,833
Non-trainable params: 0

<><> Training Loss <><>

Epoch: 10,   Loss: 0.040219422429800034
Epoch: 20,   Loss: 0.019186384975910187
Epoch: 30,   Loss: 0.017296336591243744
Epoch: 40,   Loss: 0.01322578452527523
Epoch: 50,   Loss: 0.012029974721372128
Epoch: 60,   Loss: 0.014273067936301231
Epoch: 70,   Loss: 0.012230654247105122
Epoch: 80,   Loss: 0.011582632549107075
Epoch: 90,   Loss: 0.01137347798794508
Epoch: 100,   Loss: 0.013839962892234325

<><> Validation Loss <><>

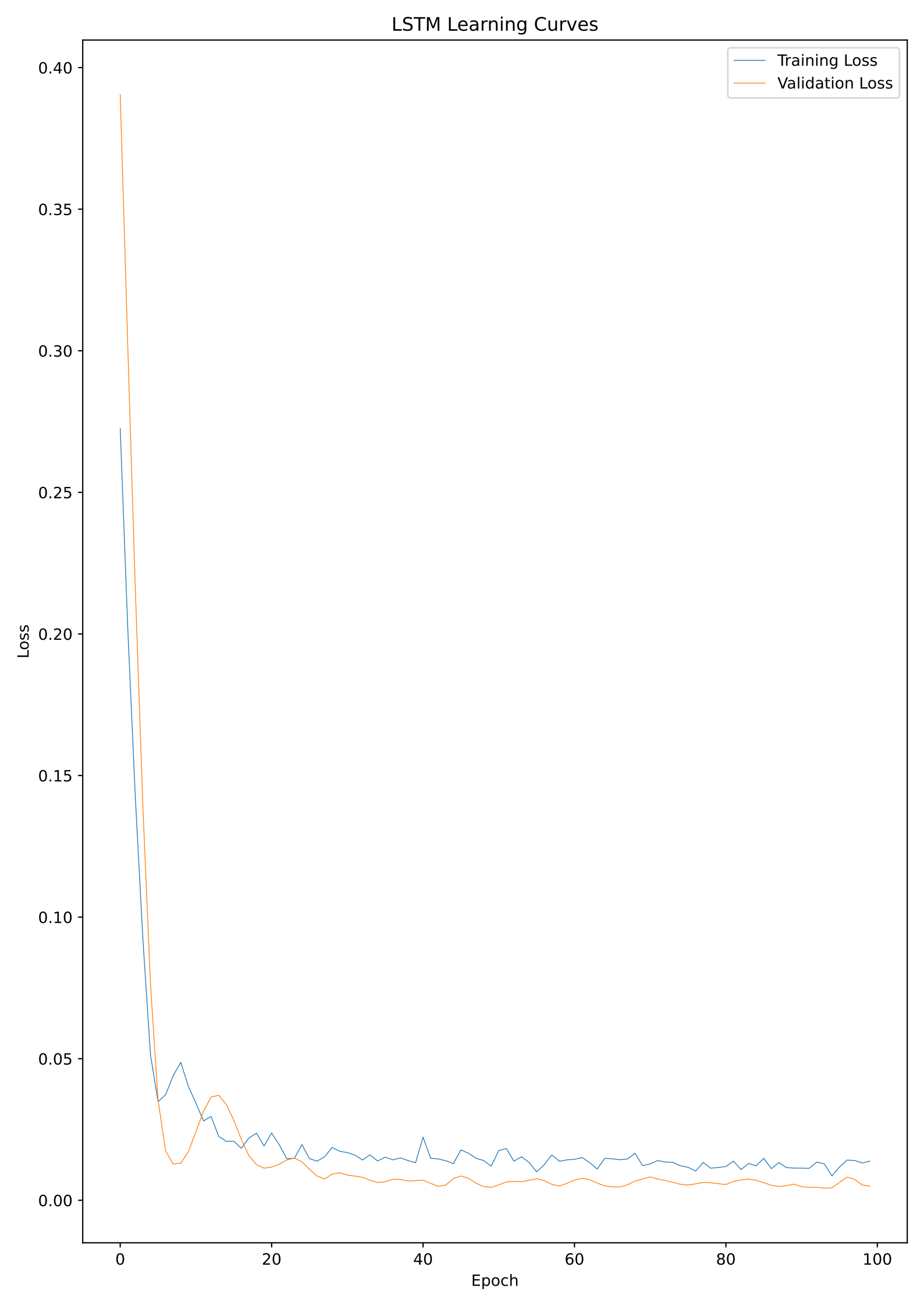
Epoch: 10,   Loss: 0.017097126692533493
Epoch: 20,   Loss: 0.011328348889946938
Epoch: 30,   Loss: 0.009714669547975063
Epoch: 40,   Loss: 0.006937929894775152
Epoch: 50,   Loss: 0.0045469109900295734
Epoch: 60,   Loss: 0.005968539044260979
Epoch: 70,   Loss: 0.007508714217692614
Epoch: 80,   Loss: 0.005869830027222633
Epoch: 90,   Loss: 0.005673725623637438
Epoch: 100,   Loss: 0.004993649199604988

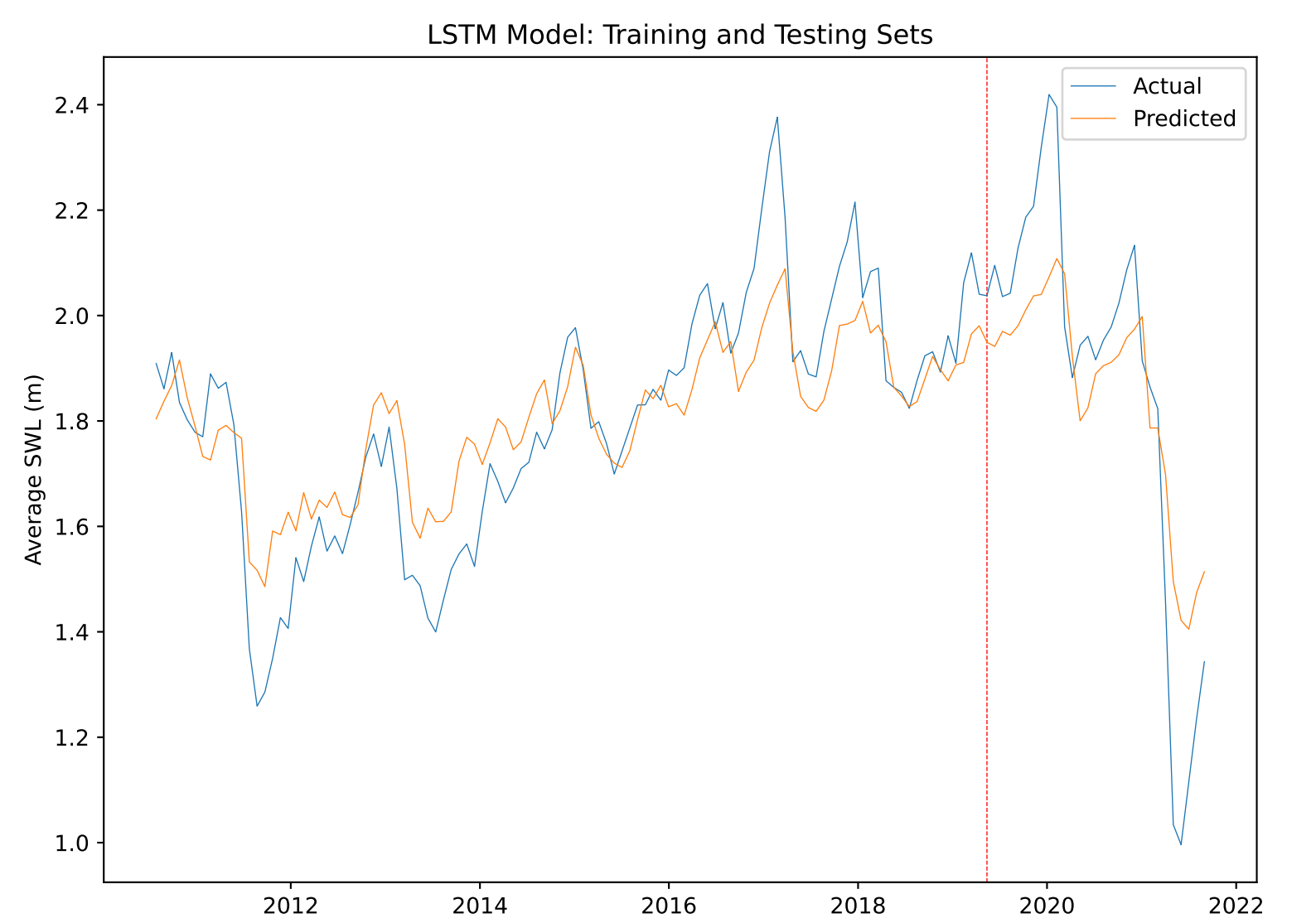
<><> Training Set Scores <><>

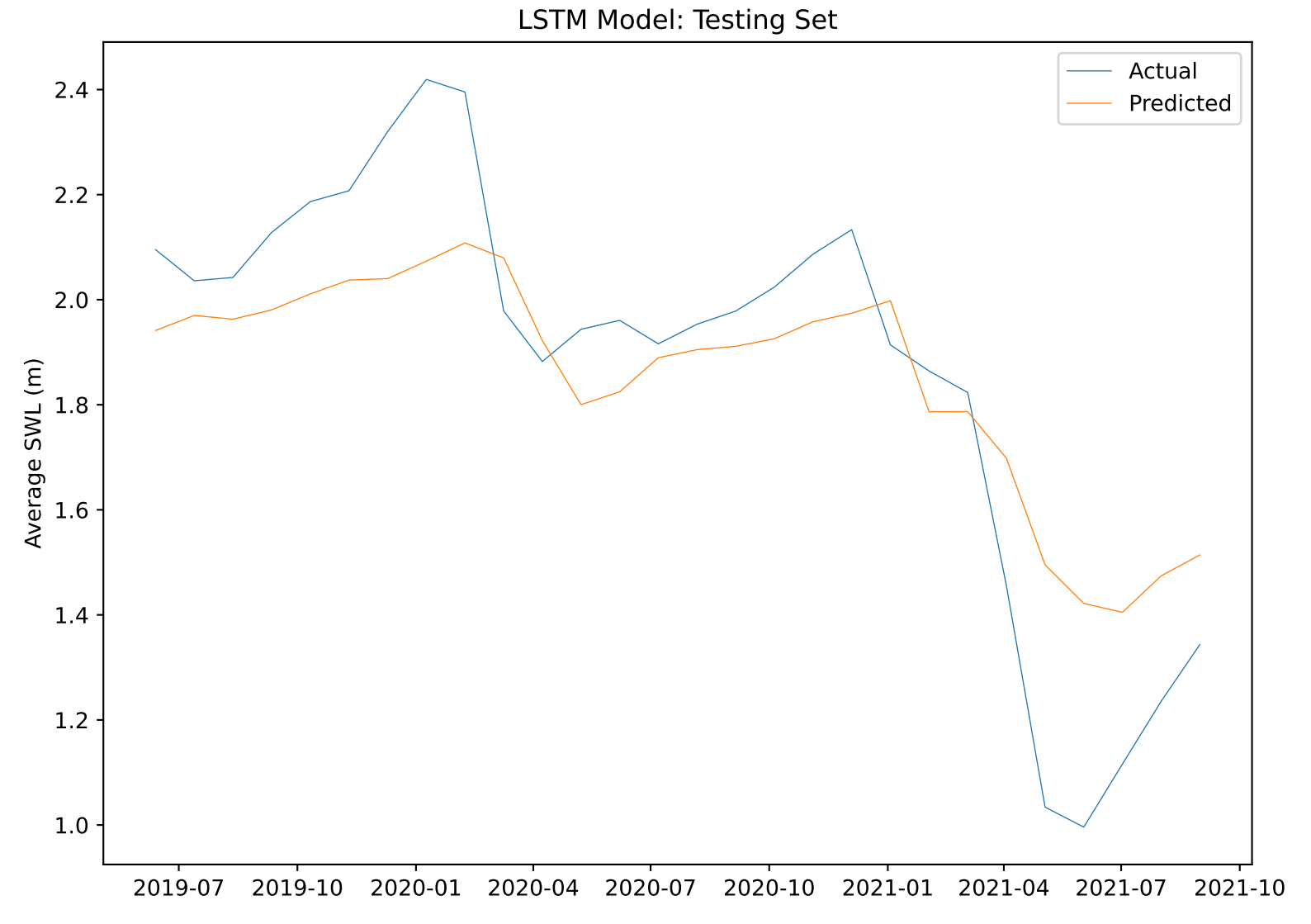
Train Root Mean Squared Error: 0.08303
Train Mean Squared Error: 0.00689
Train Normalised Root Mean Squared Error: 0.10576
Train Coefficient of Determination: 0.72368
Train Normalised Nash Sutcliffe Efficiency: 0.7835
Train Mean Absolute Error: 0.06577
Train Pearson's Correlation Coefficient: 0.92041
Train Index of Agreement: 0.88443
Train Kling-Gupta Efficiency: 0.56215
Train Mean Bias Error: 0.0028
Train Mean Absolute Percentage Error: 0.05399

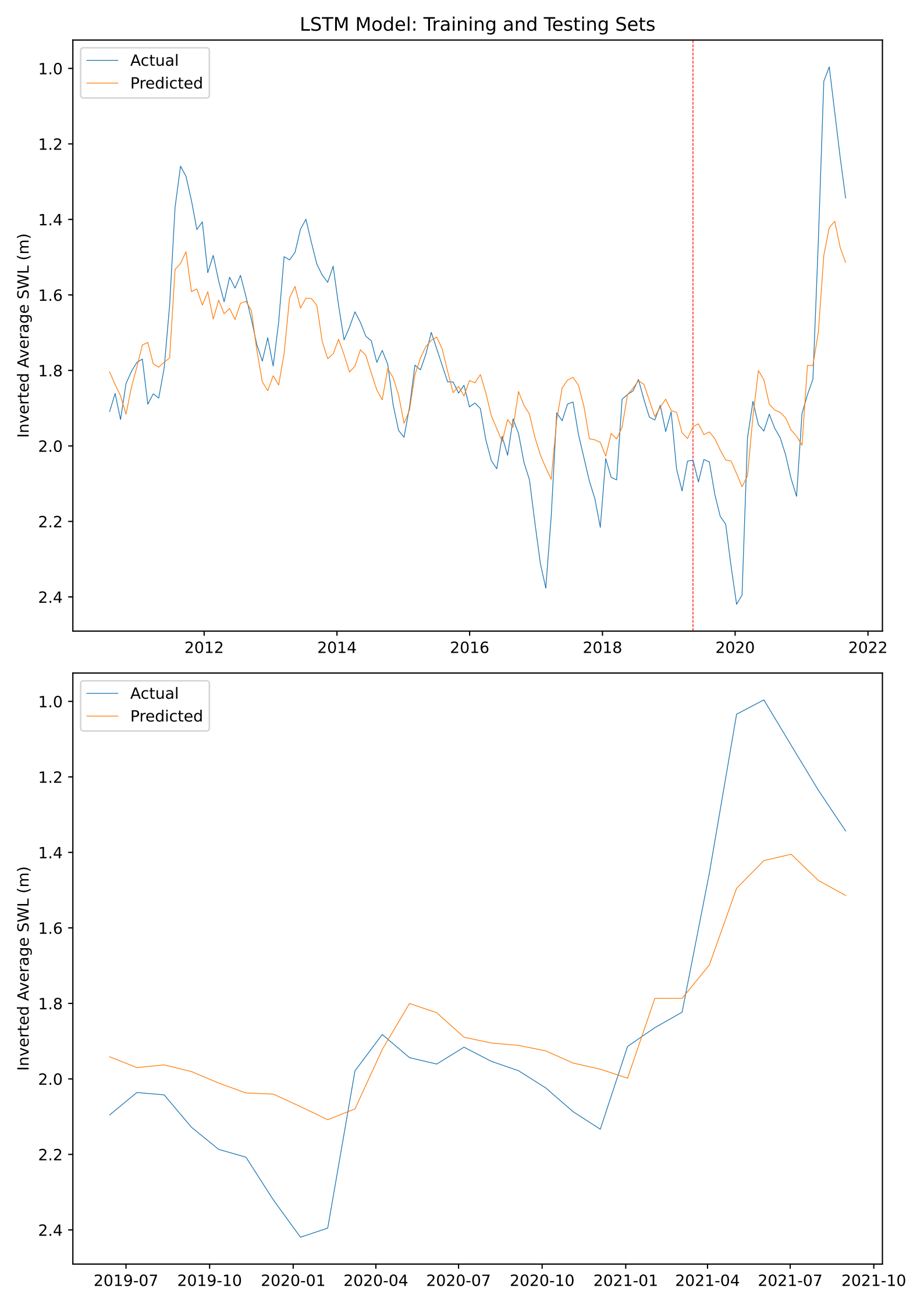
<><> Test Set Scores <><>

Test Root Mean Squared Error: 0.14198
Test Mean Squared Error: 0.02016
Test Normalised Root Mean Squared Error: 0.14198
Test Coefficient of Determination: 0.73048
Test Normalised Nash Sutcliffe Efficiency: 0.7877
Test Mean Absolute Error: 0.11744
Test Pearson's Correlation Coefficient: 0.95842
Test Index of Agreement: 0.88294
Test Kling-Gupta Efficiency: 0.52554
Test Mean Bias Error: -0.01441
Test Mean Absolute Percentage Error: 0.10546


LSTM Learning Curves
Training Loss
Validation Loss
Loss
Epoch
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
20
40
60
80
100


LSTM Model: Training and Testing Sets
Actual
Predicted
Average SWL (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2012
2014
2016
2018
2020
2022


LSTM Model: Testing Set
Actual
Predicted
Average SWL (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10


LSTM Model: Training and Testing Sets
Actual
Predicted
Inverted Average SWL (m)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2012
2014
2016
2018
2020
2022
Actual
Predicted
Inverted Average SWL (m)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10

<><> Scikit Learn SVR Model <><>

Kernel Function: rbf
Kernel Coefficient: scale
Epsilon: 0.1
Stopping Criterion Tolerance: 1e-05
Regularisation Parameter: 1.0
Shrinking: True
Time Series Order: Chronological
Verbose: Off

<><> Model Architecture <><>

Number of Support Vectors: 20
Input/Support Vector Size: 12

<><> 5-Fold Cross Validation Mean Training Loss <><>

Epoch: 8,   Loss: 0.0019374427545810011
Epoch: 16,   Loss: 0.00658206100054521
Epoch: 24,   Loss: 0.005878276236353975
Epoch: 32,   Loss: 0.0053705562940711115
Epoch: 40,   Loss: 0.005025177619068231
Epoch: 48,   Loss: 0.004763305960099366
Epoch: 56,   Loss: 0.004267592007814004
Epoch: 64,   Loss: 0.004320165174492026
Epoch: 72,   Loss: 0.0043240064164985995
Epoch: 80,   Loss: 0.004055122782769806

<><> 5-Fold Cross Validation Mean Validation Loss <><>

Epoch: 8,   Loss: 0.02183136536234781
Epoch: 16,   Loss: 0.03278169737716904
Epoch: 24,   Loss: 0.03314699926910146
Epoch: 32,   Loss: 0.028628936585510485
Epoch: 40,   Loss: 0.02644091323330467
Epoch: 48,   Loss: 0.02561856809187283
Epoch: 56,   Loss: 0.017910745025780616
Epoch: 64,   Loss: 0.018026115889585415
Epoch: 72,   Loss: 0.01151435651717271
Epoch: 80,   Loss: 0.008860935177434285

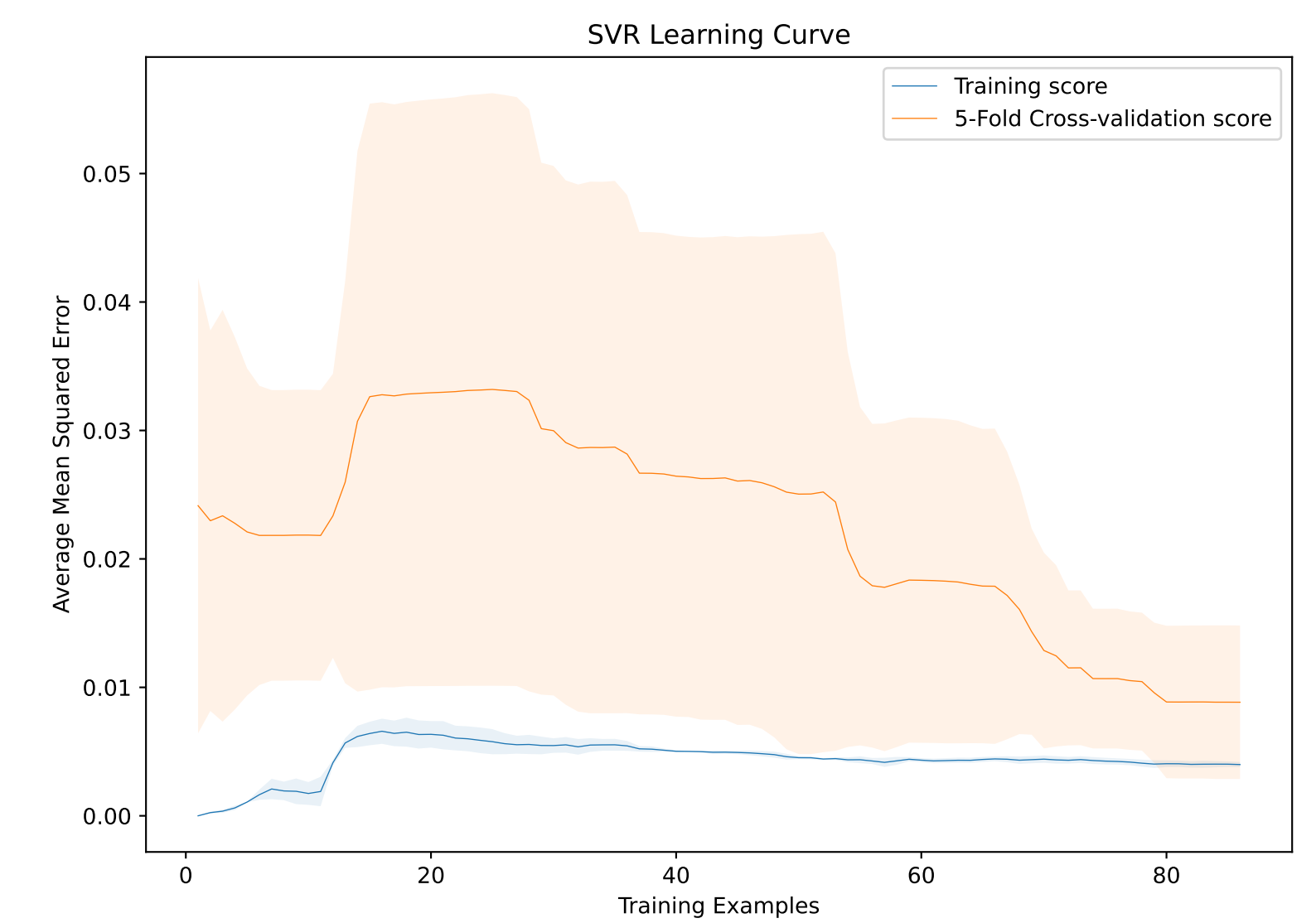
<><> Training Set Scores <><>

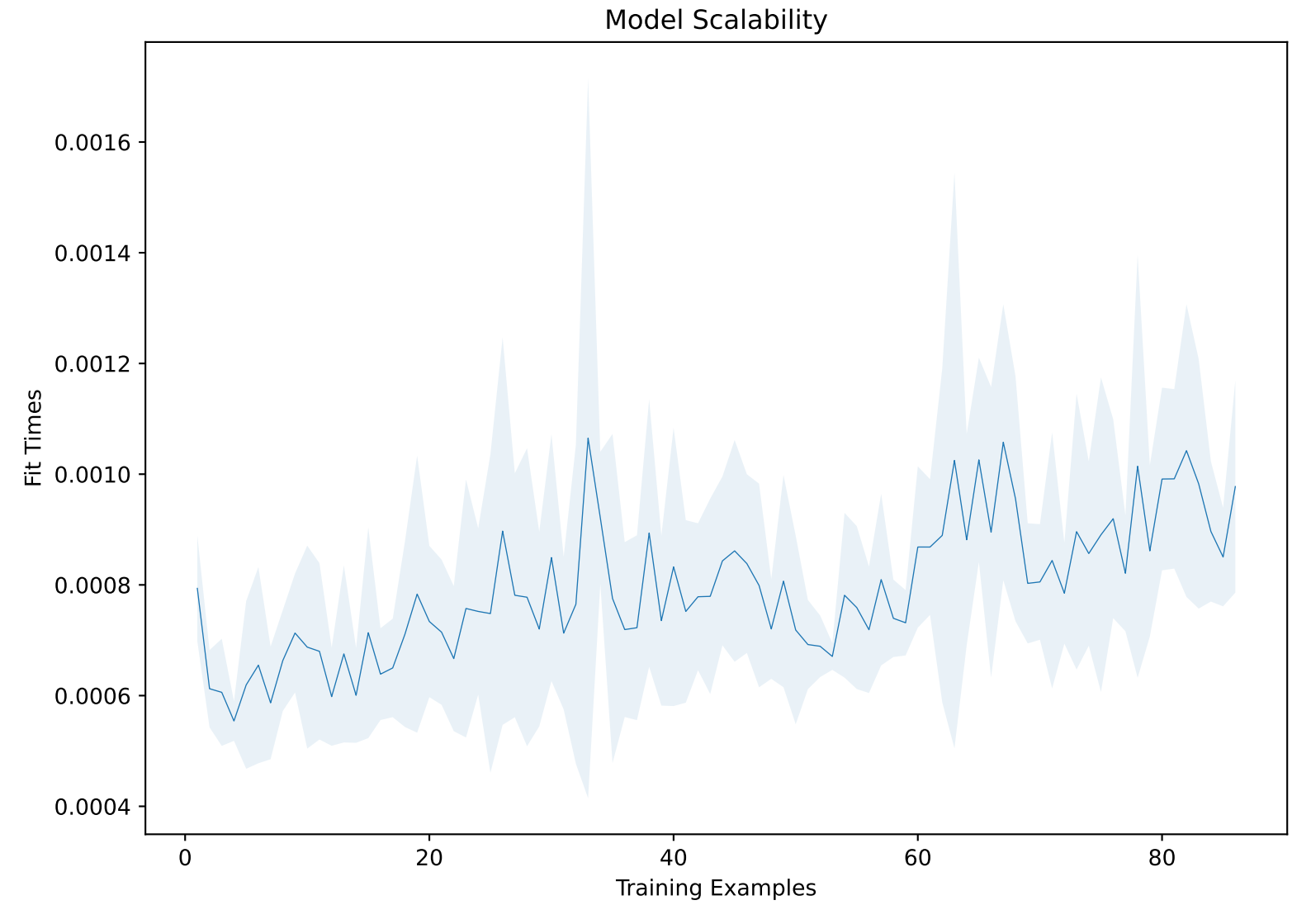
Train Root Mean Squared Error: 0.06136
Train Mean Squared Error: 0.00377
Train Normalised Root Mean Squared Error: 0.07817
Train Coefficient of Determination: 0.84906
Train Normalised Nash Sutcliffe Efficiency: 0.86886

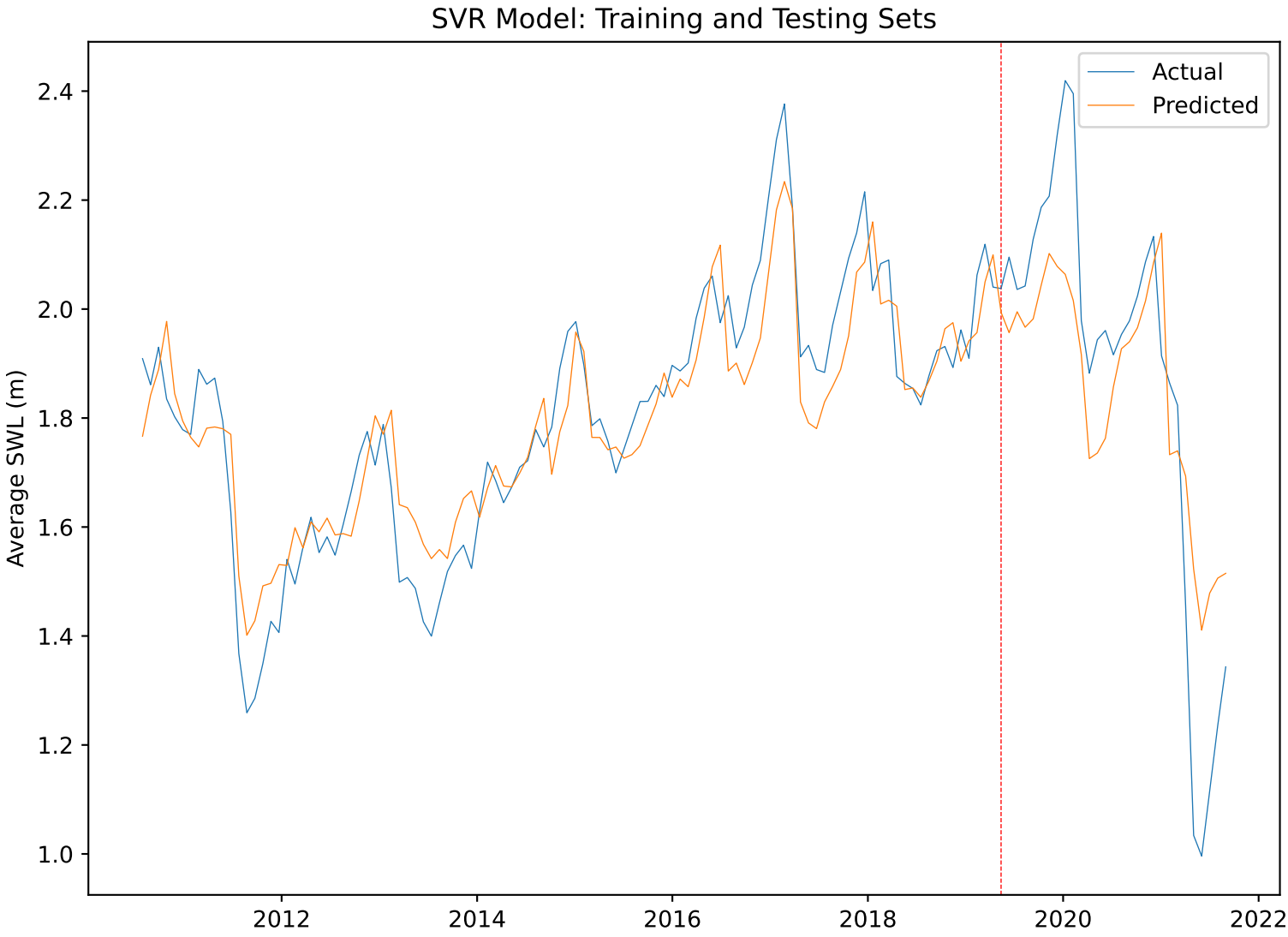
Train Mean Absolute Error: 0.05042
Train Pearson's Correlation Coefficient: 0.93395
Train Index of Agreement: 0.95126
Train Kling-Gupta Efficiency: 0.774
Train Mean Bias Error: -0.0042
Train Mean Absolute Percentage Error: 0.04072

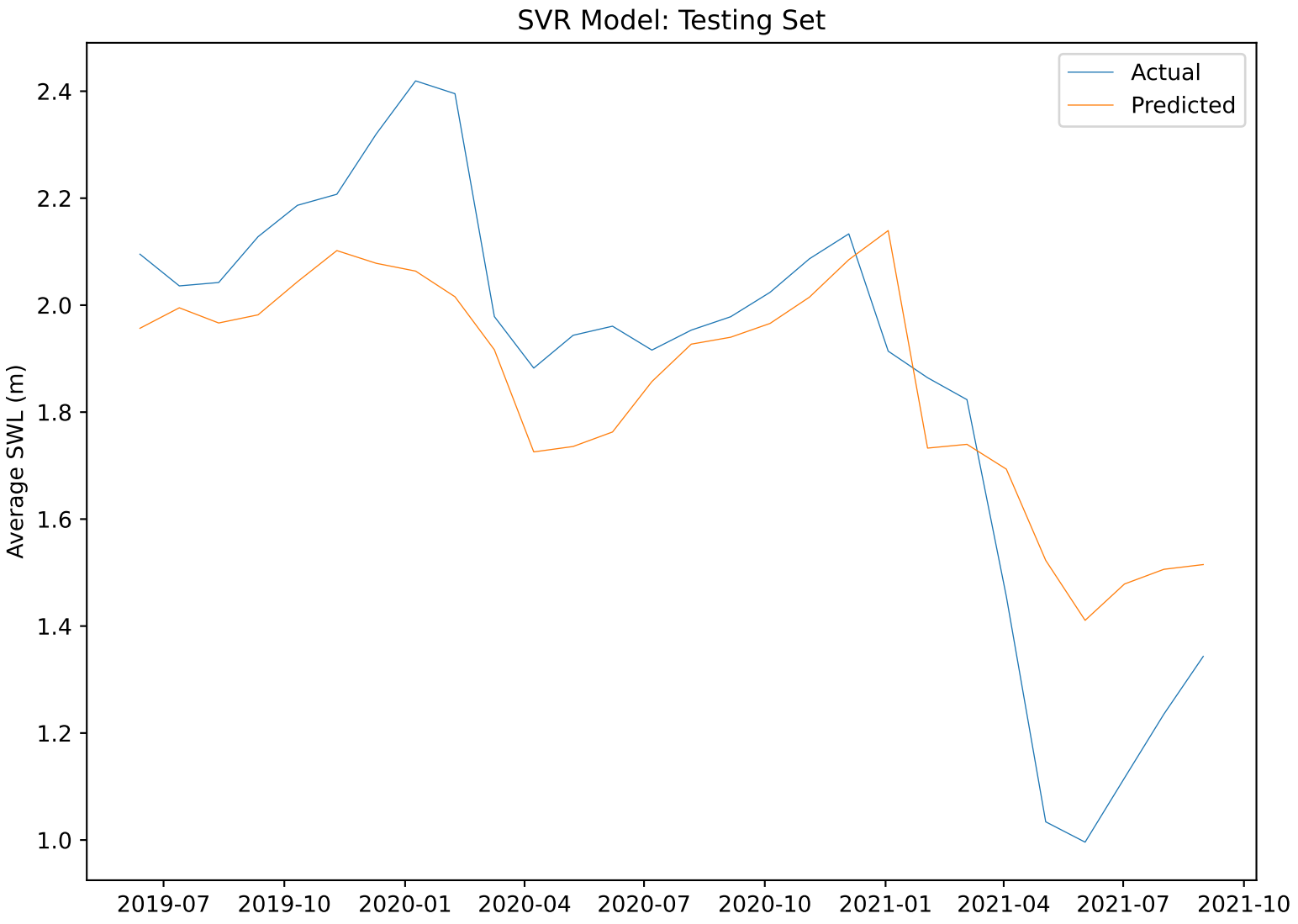
<><> Test Set Scores <><>

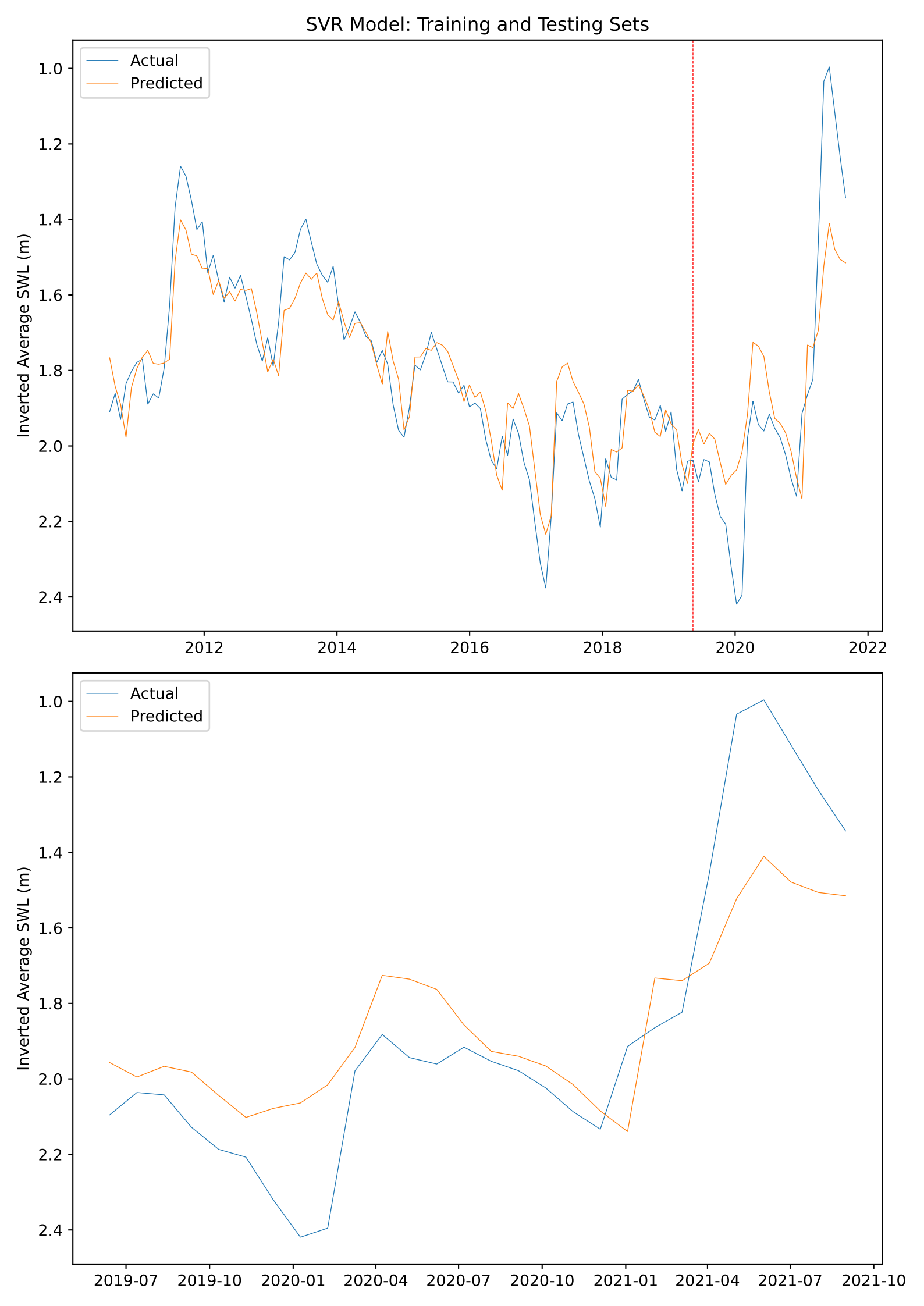
Test Root Mean Squared Error: 0.15213
Test Mean Squared Error: 0.02314
Test Normalised Root Mean Squared Error: 0.15213
Test Coefficient of Determination: 0.69054
Test Normalised Nash Sutcliffe Efficiency: 0.76368
Test Mean Absolute Error: 0.12396
Test Pearson's Correlation Coefficient: 0.91134
Test Index of Agreement: 0.86559
Test Kling-Gupta Efficiency: 0.53208
Test Mean Bias Error: -0.01495
Test Mean Absolute Percentage Error: 0.11234


SVR Learning Curve
Training score
5-Fold Cross-validation score
Average Mean Squared Error
0.05
0.04
0.03
0.02
0.01
0.00
0
20
40
60
80
Training Examples


Model Scalability
Fit Times
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0
20
40
60
80
Training Examples


SVR Model: Training and Testing Sets
Actual
Predicted
Average SWL (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2012
2014
2016
2018
2020
2022


SVR Model: Testing Set
Actual
Predicted
Average SWL (m)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10


SVR Model: Training and Testing Sets
Actual
Predicted
Inverted Average SWL (m)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2012
2014
2016
2018
2020
2022
Actual
Predicted
Inverted Average SWL (m)
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2019-07
2019-10
2020-01
2020-04
2020-07
2020-10
2021-01
2021-04
2021-07
2021-10