3 Physical Model Experimental Conditions and Results

General Description

All backwater experiments were conducted at a pool elevation of 546.0 with a tow that is a 3 wide by 5 long barge configuration and a simulated 2.74 m draft (all dimensions are in prototype quantities unless otherwise noted) moving along a sailing line 27 m right of the thalweg. One of the wave gages was located 4.8 m from the rear of the backwater channel and the other wave gage was located 9 m downstream of the mouth of the channel and 1.5 m away from the vertical wall forming the left bank of the channel as shown in Figure 5. Both ADVs were located at 60% depth below the surface in mid-channel of the backwater. In the backwater channel, one ADV was 9 m from the entrance and the other was 68.4 m from the entrance (Figure 5). An initial experiment was run to determine if the drawdown at the edge of the main channel was equal to the drawdown just inside the entrance of the backwater. The time history of the water level is equal in both locations as shown in Figure 6. Therefore only the wave gage in the main channel was used for further experiments. The positive wave at the beginning of the time history is an artifact of the physical model and is not as significant in prototype data. This hump is due to the rapid acceleration in the physical model which is required because of the short flume length. This rapid acceleration is possible in the model because of the additional power added by the towing carriage. The prototype accelerates much slower because of the more restricted power of the towboat and, in most cases, normally operates at a relatively steady rate of motion, i.e. no significant acceleration. Passage time of the bow of the tow at the mouth of the backwater in the physical model is equal to the time when the water level passes through zero just prior to the beginning of drawdown. The passage time of the stern of the barges is equal to the bow passage time plus the vessel length/vessel speed.

Experiment Series 1 - No Flow

The first series of physical model experiments were conducted with no flow in the physical model with 3 replicates. The vessel was operated at 3.95 m/s (87% of limiting speed), with propellers operating. Limiting speed is the maximum speed a self propelled vessel can travel relative to the water in a channel and depends on the channel area/vessel area and average channel depth. Limiting

speed can be computed using Maynord (1996) and is equal to 4.54 m/sec for the channel and vessel used herein. The three replicate experiments were averaged and one of the three was selected as being most representative of the mean and was used to create a stage hydrograph (Figure 7) at the downstream end of the backwater for use in the UNET model.

Experiment Series 2 - Discharge=690 cms

The second series of physical model experiments were conducted with a discharge of 690 cms with 3 replicates. The experiments were run with a downbound tow with vessel speeds of 4.27 m/s (85% of limiting speed). The three replicate experiments were averaged and one of the three was selected as being most representative of the mean and was used to create a stage hydrograph (Figure 8) at the downstream end of the backwater for use in the UNET model.