Section 5: Secondary Results

5.01 Groundwater Level

As we have seen in Figure 2, the groundwater level is somewhat correlated to the flow index. There is little doubt that groundwater level is a factor in the SSO problem. Common sense suggests that, when groundwater level is high, infiltration to the sewer system should also be high. In this study, we have two orthogonal dimensions along which to investigate. We study each independent variable by examining its projections in the dimension of System Load and the dimension of System Capacity respectively.

Again, in our opinion, the Load aspect of the groundwater level is included in the flow index. The question we examine here is whether groundwater levels indicate, to a degree, changes in the condition of the system.

Toward that end, we consider the average of the groundwater levels from the three wells in the study database. Let it be denoted by **WELL**, and consider, based on the model in (11),

$$(12)\quad \log(\lambda) = \mu + f(\mathbf{FLOW}) + \Sigma_{k=1 \text{ to } 11}\, \beta_k \mathbf{M}_k + \alpha\, \mathbf{Z} + \delta\, \mathbf{SCHAAF} + \theta\, \mathbf{HUGO} + \kappa\, \mathbf{T} + \gamma\, \mathbf{WELL},$$

where γ is a parameter corresponding to the variable **WELL**.

The SAS GENMOD Procedure showed the following major results, (see Appendix C for SAS output,) with 118 observations.

Parameter	Estimate	p-value
γ	0.0347	0.0782

The positive value of the estimated γ suggests that a higher **WELL** value may lead to a higher likelihood of an SSO. Such a statement is merely hinted at by the fact that the p-value is 0.0782, not very strongly supported. Nevertheless, the inclusion of **WELL** in the model increases the total proportion of explained deviance to

68.08%, a 4% increase from the model in (11).

The result may very well be a consequence of sampling errors. On the other hand, there are many possible interpretations why γ is estimated positive. None of these possibilities is more acceptable than the others. We leave the interpretation of this observation open.

5.02 Rainfall

Monthly rainfall generated from USGS data were obtained. Based on the model in (11), we also considered

$$(13)\quad \log(\lambda) = \mu + f(\mathbf{FLOW}) + \Sigma_{k=1 \text{ to } 11}\, \beta_k \mathbf{M}_k + \alpha\, \mathbf{Z} + \delta\, \mathbf{SCHAAF} + \theta\, \mathbf{HUGO} + \kappa\, \mathbf{T} + \pi\, \mathbf{RAIN},$$

where π is a parameter corresponding to the variable Rain.

The SAS GENMOD Procedure showed the following major results, (see Appendix C for SAS output,) with 170 observations.

Parameter	Estimate	p-value
π	0.0002	0.2229

The p-value (0.2229) suggests that rainfall does not seem to add any additional power to the model as it enters the model at this point. This is not to say that rain does not affect SSO frequency, but that its effects have already been reflected by the other independent variables, particularly the Load variable, **FLOW**. This claim is supported by the analysis results with Rain entering the model at different points. Each time, the Type 1 analysis showed that the variable, Rain, was an insignificant contributor.