

Table 2: Consequence Matrix

Consequence Category	Goal	Consequence Objective	Indicator	Weight	Consequence Score			
					Negligible = 1	Low = 4	Moderate = 7	Severe = 10
Environmental Responsibility – Potential for Large SSO <i>(Figure 3)</i>	Protect public from pathogens and toxins	Minimize the potential for large spills	Size of sewer	30%	Size Class I (≤ 6")	Size Class II (8")	Size Class III (10" to 14")	Size Class IV (≥ 15")
Disruption to Commuters <i>(Figure 4)</i>	Minimize nuisance impacts	Minimize impacts to commuters	Impacts to commuters based on type of road	10%	No impact or residential street only	Impact to collector road	Impact to minor arterial	Impact to emergency transportation route, highway, highway approaches, or principal arterials
Impacts to Community <i>(Figure 5)</i>	Minimize impacts to customers	Minimize impacts to areas serving key customers or large number of people or providing critical services.	Impacts to land use areas.	20%	Open Space, Park	Residential, Golf Course, Administrative	Professional Commercial, Civic Center, Low to Moderate Density Commercial, Industrial, Post Office	Hospital, Library, School, High Density Commercial
Environmental Responsibility – Distance to Surface Water <i>(Figure 6)</i>	Meet environmental regulations; Protect the public from pathogens and toxins	Minimize spill volume to surface waters	Spill travel distance to surface water	40%	>1,000 feet	>500 to 1,000 feet	>100 to 500 feet	≤100 feet

**Table 3: Likelihood Matrix**

Likelihood Category	Source	Weight	Likelihood Score				
			Negligible = 1	Unlikely = 2	Possible = 4	Likely = 7	Very Likely = 10
Physical Condition <i>(Figure 9)</i>	CCTV Inspection Data (for pipes with inspection data)	50%	Sum of Structural Points < 5 OR No Condition Data Available	Sum of Structural Defect Points >=5 and <10.	Sum of Structural Defect Points >=10 and <50.	Sum of Structural Defect Points >=50 and <130.	Sum of Structural Defect Points >130.
	Pipe Age (for pipes with no inspection data)		Installed after 1981	Installed between 1971 and 1980	Installed between 1960 and 1970	Installed between 1951 and 1960	Installed before 1951
Stoppage/SSO Failure Likelihood <i>(Figure 10)</i>	SSO/ Stoppage History	10%	No history of SSOs or stoppages	1 stoppage	>=2 stoppages	1 SSO	>=2 SSOs
Cleaning Failure Likelihood <i>(Figure 11)</i>	Sewer Cleaning Maintenance History	10%	No sewer cleaning findings.	Normalized Cleaning Score <=1	Normalized Cleaning Score <=2	Normalized Cleaning Score <=4	Normalized Cleaning Score >4
Capacity <i>(Figure 12)</i>	Capacity Model	30%	Model shows no surcharge or pipe not in model (small diameter).	Model shows that these pipes are likely to have surcharge only under future conditions (both DWF and WWF) when the loads become higher due to intensified land use or population increase.	Model shows that these pipes are likely to have surcharge, but there is <u>more than 5'</u> of freeboard <sup>(1)</sup> available	Model shows that these pipes are likely to have noticeable surcharge of <u>over 1'</u> and <u>less than 5'</u> of freeboard <sup>(1)</sup> . Relief or replacement sewer required.	Model shows that these pipes are likely to have SSOs under a 10-year storm

Notes:

(1) Freeboard = Difference between ground level and water level.

with no CCTV inspection data. **Figure 12** and **Figure 13** can be found in **Appendix D**. The risk score was calculated by multiplying the overall consequence score by the overall likelihood score. The risk scores for the District range from 1 to 78. The risk scores were then grouped into the following risk categories listed in **Figure 14**.

**Figure 14: Risk Matrix** <sup>(1)</sup>

<b>CONSEQUENCE OF FAILURE</b>	<b>Severe</b>	10	20	30	40	50	60	70	80	90	100
		9	18	27	36	45	54	63	72	81	90
	<b>Moderate</b>	8	16	24	32	40	48	56	64	72	80
		7	14	21	28	35	42	49	56	63	70
		6	12	18	24	30	36	42	48	54	60
	<b>Low</b>	5	10	15	20	25	30	35	40	45	50
		4	8	12	16	20	24	28	32	36	40
		3	6	9	12	15	18	21	24	27	30
	<b>Negligible</b>	2	4	6	8	10	12	14	16	18	20
		1	2	3	4	5	6	7	8	9	10
		<b>Negligible</b>			<b>Possible</b>			<b>Likely</b>		<b>Very Likely</b>	
<b>LIKELIHOOD OF FAILURE</b>											

Notes:

(1) Based on guidance from an example risk matrix in NACWA, 2007 Implementing Asset Management: A Practical Guide (Exhibit 4.5).

The majority of the District’s sewers (86%) falls in the *Very Low* risk group (colored green), 11% are in the *Low* risk group (colored blue), approximately 2% are in the *Medium* risk group (colored orange), and 1% are in the *High* risk group (colored red). Risk scores for project can be calculated using a variety of methods that include:

- Using the score of the highest risk pipe included on a project as the project score.
- Using the average of the pipe risk scores as the project risk score.
- Multiplying the risk score for each pipe segment by the segment length to generate a risk-feet score for each pipes, adding all risk-feet scores for pipes on a project, and then dividing the total project risk-feet score by the total project length.

All of these methods will yield slightly different outcomes yet will accomplish the goal of creating a project score that can be used to rank projects versus one another.

# Weighted Risk Score

