Level 2 Asset Assessment (Visual)

The purpose of level 2 is to undertake a more detailed assessment of the assets through visual inspection and observation. Where assets cannot be assessed visually as a result of being buried, concealed or in a confined/inaccessible space, ratings should be determined either through advanced visual inspection tools or in consultation with staff. In cases where poor condition is suspected, asset samples may be selected for more detailed level 3 condition assessment (such as removing coupons from existing pipes for testing) or excavation to improve the visual assessment. This is an acceptable method to enhance the level 1 approach for most assets and especially those that do not have a more sophisticated system.

The level 2 process involves the enhancement of the organization's ability to more effectively rank those assets that constitute a significant problem. E.g. condition scores, 3, 4, and 5 (particularly 4 and 5) from the level 1 assessment.

For each asset, one rating (from 1 to 5) is to be determined for each of the parameters based on a specific distress mechanism. More than one parameter is commonly assessed for each asset. However, one overall condition rating for each asset is selected. The intent of the level 2 condition rating is to select the life limiting parameter (worst case) for each type of asset. This parameter establishes the level of condition when an asset would be considered to require replacement or rehabilitation. For example, for a structure, the structural or foundation condition would both be life limiting parameters, rather than surface condition. When a rating of any life limiting parameter is equal to 5, an overall rating of 5 is adopted.

Level 3 Asset Assessment (Advanced)

Level 3 assessments are only undertaken for those assets that are further determined as requiring higher level assessment. Assets to be considered for level 3 assessments should be placed on a schedule of condition testing, based on a filtering process. Example selection criteria include:

- Having a Business Risk Exposure score requiring a level 3 level assessment.
- High replacement value assets.
- Condition/Reliability Rating of 4 or 5.
- Whether condition testing would provide worthwhile additional information.
- The budget available for condition testing.
- An assessment of whether the condition assessment is a cost effective step (i.e. is the management strategy run to failure?).

4.3 Business Risk Exposure Framework

Policy Statement – Understand and manage MWU's business risk exposure.
Objectives:

- Identify and focus on those assets that are critical to MWU's service levels and prioritize their management to prevent their failures.
- Identify, understand, and manage the business risks associated with operating MWU's resources.

A Business Risk Exposure (BRE) method provides a set of rules for determining the direct and indirect implications of the failure of an asset and helps management teams focus on high-risk assets and related issues. Figure 11 is a schematic representation of the key variables of business risk exposure with components that contribute to each variable. The term "core risk" is defined as

the product of consequence of failure (CoF) and the probability of failure (PoF) without adjusting for risk mitigation measures that may be in place for the asset or system. The term 'risk mitigation' refers to those practices applied to an asset to either reduce the probability of failure (by adding "resistance" to the asset) or the consequence of failure by, for example, providing a parallel asset/process (e.g., redundancy) with the same functionality as the critical asset that can be used should the critical asset fail or be out of service. Once the core risk is calculated as a baseline measurement, risk mitigation strategies can be considered and/or developed that can reduce the level of risk. Business risk exposure is closely related to the consequences associated with the total loss or failure of the asset. It is noteworthy that critical assets may be in good condition and therefore unlikely to fail in the immediate future, but the asset remains critical to the provision of services.

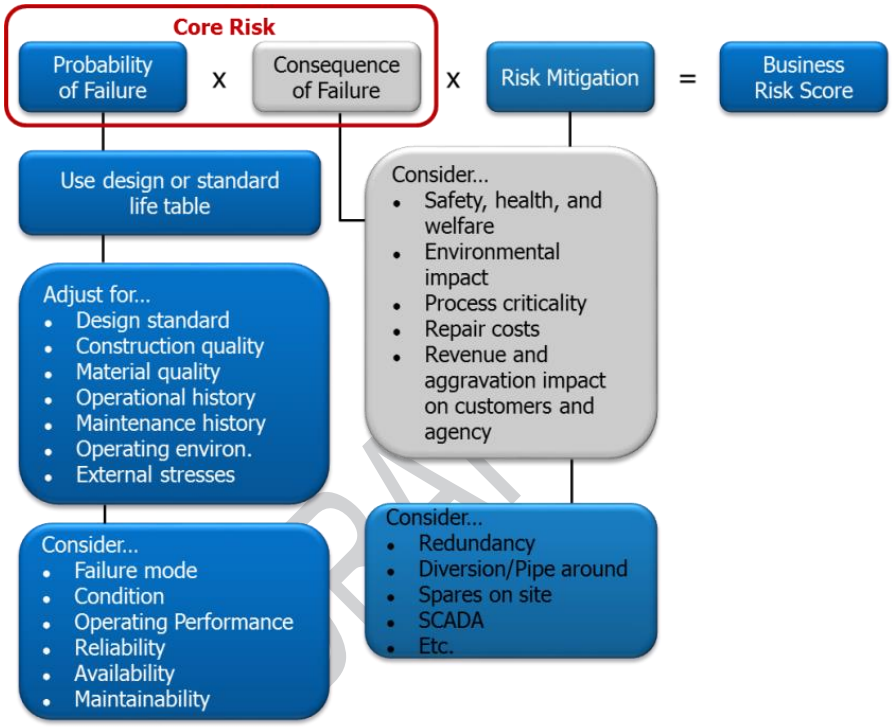

Figure 11 Business Risk Exposure Elements

The probability of failure aspect of BRE is directly related to the asset's condition as previously discussed in Section 4.2.2. The consequence of an event can be expressed in Triple Bottom Line (TBL) categories. Triple bottom line categories used for the MWU AM Framework are as follows:

Table 6 Triple Bottom Line Categories and Elements

Categories	Category Elements
Social/Community	Public Trust, Customers Affected, Critical Customers, Public Health, Public Safety, Loss of Service, Water Quality/Water Pressure
Financial	Total Cost of Failure, Operational/Resource Impact
Environmental/Regulatory	Board Policy and Regulatory Compliance, Environmental Impact

Table 7 presents the consequence of failure scoring matrix for the AM Framework. The scoring system is based on a 1 to 5 score, with 1 being a low consequence and 5 being a high consequence.

Table 7 MWU AM Consequence of Failure Scoring Table

CoF Elements					
Social/Community					
Public Trust	No Impact	Alert posted on website but no media attention	Local coverage	State coverage	National coverage
Customers Affected	No Impact	Level 1	Level 2	Level 3	Greater than Level 3
Critical Customers	Residential/Multi-family only	High water users*	Wholesale customers**	Schools or Child care centers, Public Utilities	Hospitals, Health clinics
Public Health	No impact	Minor illness	Moderate some sickness	Major sickness	Potential for fatalities
Public Safety	No impact	Minor injury	Moderate injury	Major Injury	Potential for fatalities
Loss of Service	Can be out of service for extended period	Cannot be out of service for a week	Cannot be out of service for several days	Cannot be out of service of several hours	Critical - cannot be out of service
Water Quality	Short-term (< 3 months) SMCL exceedance	Long-term (>3 months) SMCL exceedance	Short-term (<1 year) exceedance of MCL for chemical constituent where chronic exposure leads to illness	MCL exceedance leads to situation in which acute illness is possible	MCL exceedance leads to situation in which acute illness is probable in <24 hrs
	1	2	3	4	5
	CoF Rating				
Financial					
Total Cost of Failure	<$5,000	$5,000 – $25,000	>$25,000 to $100,000	> -$100,000 to $500,000	>$500,000
Operational / Resource Impact	Negligible impact	Low impact	High impact (scheduled work is delayed)	High impact and diverts funds	Outsourcing to specialty contractors
	1	2	3	4	5
	CoF Rating				
Environment/Regulatory					
Board Policy and Regulatory Compliance	No consequence	Regulatory sanction possible	Regulatory sanction likely	Extensive regulatory sanction virtually assured	Severe sanctions likely
Environmental Impact	Damage reversible within a week	Damage reversible within three months	Damage reversible in less than one year	Damage reversible in one to five years	Damage reversible in five years or more
	1	2	3	4	5
	CoF Rating				

*High water users include hotels, motels, Holiday Inns; commercial laundromats; food producers and distributors

**Wholesale customers include the University of Wisconsin, other municipalities, etc.

Depending on asset type, there are different attributes that help measure the impact associated with each of the elements shown in Table 7.

The consequences based on each of the attributes that are applicable to an asset type (e.g., well facility, transmission mains) are added in order to develop a comprehensive consequence rating for that asset. The consequence of an event is calculated based on a 1 to 5 score for each TBL

category and associated elements. The minimum consequence of failure score is three and the maximum is 15.

Table 8 presents example attributes for each element. Example data requirements for the consequence of failure analysis are summarized in Table 9.

Table 8 Example Triple Bottom Line Attributes and Elements

Attributes	LoS Elements										
	Public Trust	Customers Affected	Critical Customers	Public Health	Public Safety	Loss of Service	Water Quality/Water Pressure	Total Cost of Failure	Operational/Resource Impact	Board Policy and Regulatory Compliance	Environmental Impact
Number of customers connected to the segment	●	●	●	●		●	●	●	●	●	
Critical customer category	●	●	●	●		●	●		●		
Proximity to roads	●	●		●	●			●	●		●
Proximity to railroads		●			●			●	●	●	●
Proximity to environmentally sensitive areas				●	●			●	●	●	●
Proximity to buildings	●	●	●	●				●	●		
Repair costs								●			
Zoning and land use	●	●		●				●		●	●

Table 9 Example Data Requirements for Pipe CoF Assessment

Data Type	Attributes	Source
Asset attributes	Date of installation	GIS / Record drawings
	Material	GIS / Record drawings
	Size	GIS / Record drawings
	Length	GIS / Record drawings
	Customer count	GIS / Customer billing database
	Critical customer type	GIS / Customer billing database
	Repair costs	Contract data
Geospatial parameters	Proximity to roads	GIS
	Proximity to other utilities	
	Proximity to railway lines	
	Proximity to environmentally sensitive areas (e.g., wetlands, open water)	
	Proximity to high-risk institutions (hospitals, etc.)	
	Proximity to buildings	

The probability and consequence of events are used to develop the BRE chart. An example BRE chart is shown in Figure 12. The BRE chart is divided into five risk management zones. Each zone is described as follows:

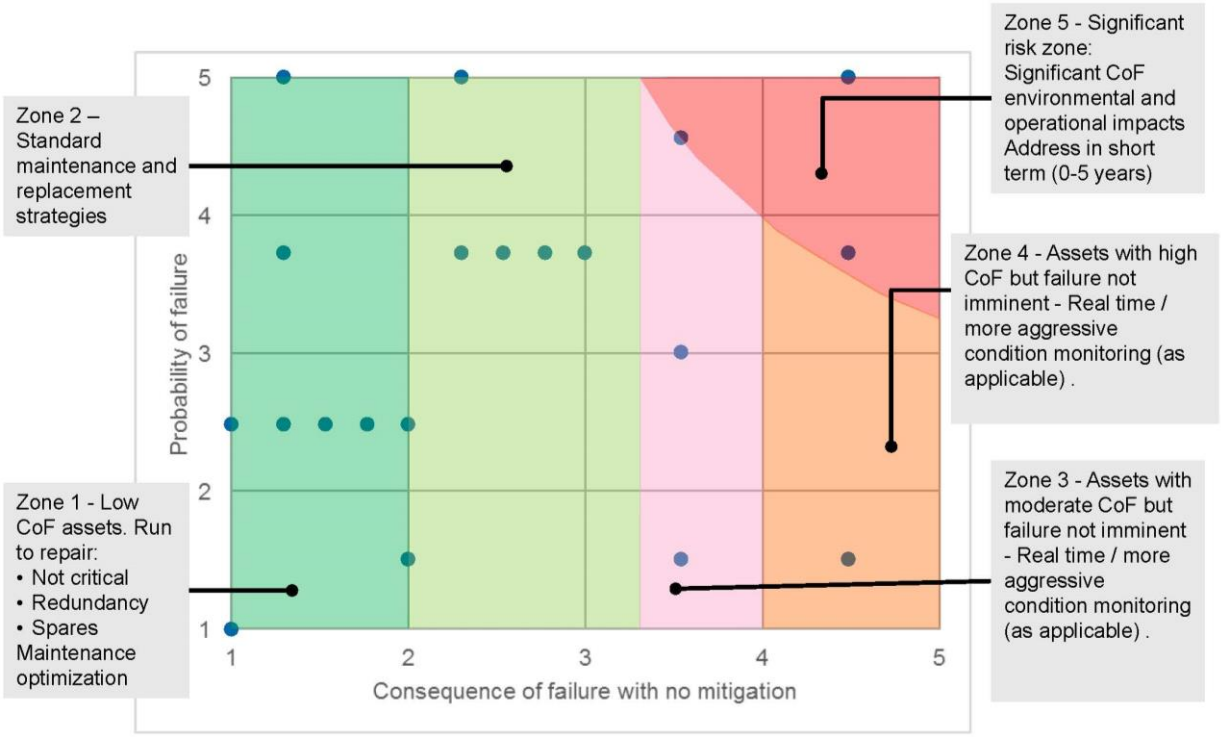

Figure 12 Example BRE Chart (with example assets)

Zone 5: Contains assets that represent a significant risk to the organization. In general, these assets are approaching the end of their useful life and upon failure, may cause significant social, financial, and environmental impacts.

Zone 4: Contains assets that have a high consequence of failure but have not deteriorated enough to be included in the significant risk zone (Zone 5). Increased visual and/or predictive condition assessments (thermal scanning, oil analysis, etc.) may be justified as their condition deteriorates and they move vertically in the graph approaching Zone 5.

Zone 3: Contains assets that would experience failure consequences that are tolerable because they may be being managed through designed redundancy and operational mitigation such as spares and condition monitoring. Zone 3 assets can also migrate into Zone 5 and as such, require additional focus by management.

Zones 1 & 2: Contains assets with lower consequences of failure. Applicable management strategies for these assets may be run to fail and maintenance optimization.

4.3.1 BRE Business Process Mapping

The BRE Framework as a key element for MWU is shown in Figure 13, as well as in Appendix C. There are multiple inputs and outputs with ownership of different elements of the process predominantly in Planning, Engineering and Operations & Maintenance. Example inputs include condition assessment data, staff knowledge and understanding of what happens if an asset fails, and geo-spatial proximity analysis using GIS. Example outputs are risk registers and risk profiles. Outputs are used in the development of asset management plans (including the development of the risk register) and in business case evaluations.