METHODOLOGY APPLICATION

APPLICATION NO:	VM005
APPLICATION TITLE:	Option Selection of the Location for a Fine Residual Disposal Dam
INDUSTRY:	Mining
VALUE METHODOLOGY APPLIED:	Value Management (including Perspective Modelling Matrix)

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INTRODUCTION

This case study explains the Value Management (VM) approach of selecting the best location for a new Fine Residual Disposal Dam within the existing footprint of a mine (Brown Field Project).

The Mine required a new Fine Residue Disposal Dam or in old terms a Fine Tailings Dam, as the current dams is reaching their end of life.

During the concept phase, two (2) Deposition Methodologies were identified as well as four (4) potential locations. During the Pre-feasibility and Feasibility study it was necessary to review these options and make a decision before a final design could be completed.

To facilitate the decision making, it was decided to have a workshop with all relevant stakeholders to decide upfront what criteria will be utilised for the selection process and based on relevant data for the various options allowing for the final selection of the location and deposition methodology before continuing with this stage of the study.

PURPOSE STATEMENT

Determine criteria that will be utilized to select best options for the Dam Location and Deposition Methodology and utilise them to finalise the option selection.

PROCESS EXPLAINED

The pre-workshop activities included the preparation of the format and the approach of Criteria Selection (Value Management) and the actual option selection process.

The format and approach selected was:

- That we analyse the Location and Deposition Methodology Criteria Selection separately
- List Issues and Concerns (related to the criteria for deposition methodology and dam location)
- Translate the issues and concerns into "Functional Requirements" that reflect the ultimate requirements for the deposition methodology and dam location
- Translate functional requirements into Criteria with clear definitions
- Evaluate importance of the criteria against objective and allocate weight factor to each criteria
- Agree on the decision making matrix / process
- Gather information on options (PIN Analysis – Positive; Interesting; Negative)
- Analyse options against agreed on criteria
- Confirm final selection for Location and Deposition Methodology
- Determine additional alternatives (backup solutions)

OBJECTIVE

That the correct Criteria are determined for the Dam Location and Deposition Methodology selection, obtain an understanding of the requirements, and reflect alignment within all respective stakeholders.
Select the best option for the Dam Location and Deposition Methodology.

CRITERIA SELECTION (LOCATION)

Issues & Concerns

The first step was to list issues and concerns that could influence the decision and the criteria. *(not full list)*

1	*Environmental*
2	*Social Impact*
3	*Community Impact*
4	*Expansion of Dam*
5	*Construction Cost*
6	*Operational Cost*
7	*Schedule*
8	*Timing of Commissioning*
9	*Timing of Completion*
10	*Site Condition(Topography, Geotech)*
11	*Sub-surface infrastructure*
12	*Existing services*
13	*Water consumption*
14	*Water recovery*
15	*Proximity of material available for construction*
16	*Site access*
17	*Procurement cost*
18	*Re-use of existing infrastructure*
19	*Sterilisation of future resources / reserves*
20	*Future plant expansion*
21	*Pit expansion*
22	*Incorporation of closure requirements*
23	*Land use and access rights*
24	*Legal*

Issues & Concerns and Criteria Matrix

Foe each Issue and Concern a relevant Criteria was selected

Issues & Concerns Matrix / Criteria	Least Impact to Environment	Minimal Social Impact	Best Future Expansion Flexibility	Optimal Life Cycle Cost	Earliest Operational Date	Most Suitable Topography Condition	Most Suitable Geotech Condition	Minimal Sub-Surface & Surface Infrastructure Impact	Least Water Demand (Construction - Operation)	Ease of accessibility of materials for construction	Best Site Access (Distance / Security etc.)	Zero Sterilisation (Qualifier)	Least Impact on / by Future Infrastructure	Compliance to Legislation
# Issues & Concerns	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1 Environmental	✓													
2 Social Impact		✓												
3 Community Impact		✓												
4 Expansion of Dam			✓											
5 Construction Cost				✓										
6 Operational Cost				✓										
7 Schedule					✓									
8 Timing of Commissioning					✓									
9 Timing of Completion					✓									
10 Site Condition(Topography, Geotech)						✓	✓							
11 Sub-surface infrastructure								✓						
12 Existing services								✓						
13 Water consumption									✓					
14 Water recovery				✓										
15 Proximity of material available for construction										✓				
16 Site access											✓			
17 Procurement cost				✓										
18 Re-use of existing infrastructure				✓										
19 Sterilisation of future resources / reserves												✓		
20 Future plant expansion													✓	
21 Pit expansion													✓	
22 Incorporation of closure requirements				✓										
23 Land use and access rights														✓
24 Legal														✓

Objective Matrix

In this example the Objective Matrix was modified to have the criteria listed with definitions

Objective

Determine Criteria that can be utilized to select best options for the FRD location.

	Criteria (Location)		Related Issues to the Criteria
1	*Least Impact to Environment*	1	*Environmental; risk profile*
2	*Minimal Social Impact*	2	*Social impact; Community impact; risk profile*
3	*Best Future Expansion Flexibility*	3	*Expansion of Dam; risk profile*
4	*Optimal Life Cycle Cost*	4	*Construction cost; operational cost; water recovery; procurement cost; re-use of existing infrastructure; incorporation of requirements; risk profile*
5	*Earliest Operational Date*	5	*Schedule; timing of commissioning; timing of completion; risk profile*
6	*Most Suitable Topography Condition*	6	*Site condition topography; geotech); technical; risk profile; dam failure impact downstream; catchment area*
7	*Most Suitable Geotech Condition*	7	*Site condition topography; geotech); technical; risk profile*
8	*Minimal Sub-Surface & Surface Infrastructure Impact*	8	*Sub-surface infrastructure; existing services; risk profile*
9	*Least Water Demand (Construction - Operation)*	9	*Water consumption; risk profile*
10	*Ease of accessibility of materials for construction*	10	*Proximity of the material available for construction; risk profile*
11	*Best Site Access (Distance / Security etc.)*	11	*Site access; risk profile; existing security parameters*
12	***Zero Sterilisation (Qualifier)***	12	*Sterilisation of future resources / reserves; risk profile*
13	*Least Impact on / by Future Infrastructure*	13	*Future plant expansion; pit expansion; risk profile*
14	*Compliance to Legislation*	14	*Land use and access rights; legal; permitting; risk profile*
15	*Support Zero Harm*	15	*Safety; social and safety issues during construction; risk profile; health issues(dust and noise); traffic*

Numerical Evaluation

Each criterion was evaluated against each other to determine a weight factor. The tool utilized was the Numerical Evaluation.

Objective:

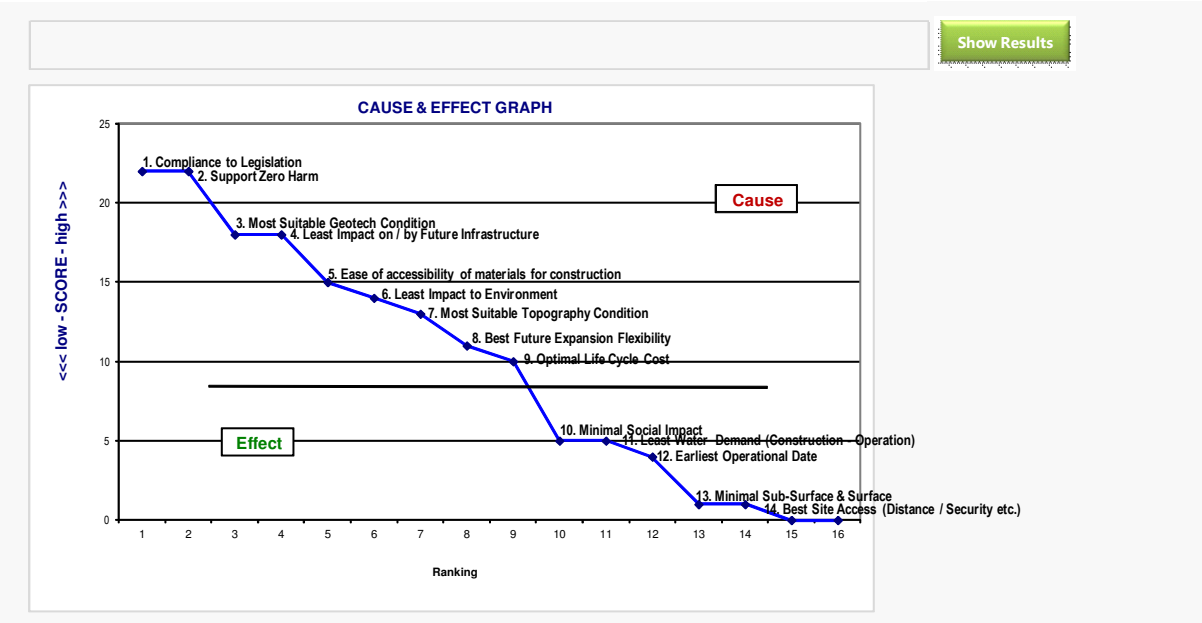
Determine Criteria that can be utilized to select best options for the FRD location.

Scoring Rules: 1 Minor
Minor/Medium/Maior Difference 2 Med
3 Maior

Numerical Evaluation

																	Function	Score	Rank
A	A1	A1	A1	A1	A1	A1	A3	A3	J1	A2	L1	M1	N1	0	0	**A**	**Least Impact to Environment**	14	6
	B	C1	D1	B1	F2	G2	B2	B2	J1	K1	L2	M1	N2	0	0	**B**	**Minimal Social Impact**	5	10
		C	C2	C2	F1	G1	C2	C2	J1	C2	L2	M2	N2	0	0	**C**	**Best Future Expansion Flexibility**	11	8
			D	D2	F2	G2	D3	D2	J1	D2	L1	M2	N2	0	0	**D**	**Optimal Life Cycle Cost**	10	9
				E	F2	G2	E2	E1	J1	E1	L1	M2	N2	0	0	**E**	**Earliest Operational Date**	4	12
					F	G1	F3	F1	J1	F2	L2	M2	N2	0	0	**F**	**Most Suitable Topography Condition**	13	7
						G	G3	G2	G2	G2	G1	M1	N1	0	0	**G**	**Most Suitable Geotech Condition**	18	3
							H	I3	J3	H1	L3	M3	N3	0	0	**H**	**Minimal Sub-Surface & Surface Infrastructure Impact**	1	13
								I	J3	I2	L2	M2	N2	0	0	**I**	**Least Water Demand (Construction - Operation)**	5	11
									J	J3	L1	M1	N1	0	0	**J**	**Ease of accessibility of materials for construction**	15	5
										K	L3	M3	N3	0	0	**K**	**Best Site Access (Distance / Security etc.)**	1	14
											L	M1	N1	0	0	**L**	**Least Impact on / by Future Infrastructure**	18	4
												M	M1	0	0	**M**	**Compliance to Legislation**	22	1
													N	0	0	**N**	**Support Zero Harm**	22	2
														O	0			0	15
															P			0	15

Criteria Weight Factor Graph



The following criteria have been included for the actual evaluation:

Criteria (Location)	Weight Factor	Related Issues to the Criteria
Least Impact to Environment	14	*Environmental; risk profile*
Minimal Social Impact	5	*Social impact; Community impact; risk profile*
Best Future Expansion Flexibility	11	*Expansion of Dam; risk profile*
Optimal Life Cycle Cost	10	*Construction cost; operational cost; water recovery; procurement cost; re-use of existing infrastructure; incorporation of requirements; risk profile*
Earliest Operational Date	4	*Schedule; timing of commissioning; timing of completion; risk profile*
Most Suitable Topography Condition	13	*Site condition topography; geotech); technical; risk profile; dam failure impact downstream; catchment area*
Most Suitable Geotech Condition	18	*Site condition topography; geotech; technical; risk profile*
Minimal Sub-Surface & Surface Infrastructure Impact	1	*Sub-surface infrastructure; existing services; risk profile*
Least Water Demand (Construction - Operation)	5	*Water consumption; risk profile*
Ease of accessibility of materials for construction	15	*Proximity of the material available for construction; risk profile*
Best Site Access (Distance / Security etc.)	1	*Site access; risk profile; existing security parameters*
Least Impact on / by Future Infrastructure	18	*Future plant expansion; pit expansion; risk profile*
Compliance to Legislation	*14*	*Land use and access rights; legal; permitting; risk profile*
Support Zero Harm	*15*	*Safety; social and safety issues during construction; risk profile; health issues(dust and noise); traffic*

OPTION SELECTION (LOCATION)

PIN Analysis

Each option was analysed related to Positive Interesting and Negative attributes.

Alternative / Recommendation:	**Option A: Situated on the west of the pit, south of the .....**				
Positive		**Interesting**		**Negative**
Close to the materials for construction		Could lend itself for co-disposal together with mining waste rock'		Impact on future infrastructure i.e. Waste rock dump advancement
Falls within the mining lease area				Close to licensed land fill area
Topography, Surface slopes away from Pit				Contains diamondiferous gravels
Away from built up area				Difficult access for slurry slimes pipeline and return waterline
Suitable geotechnical conditions for construction				Requires a new booster station
Compliant to legislation				

Alternative / Recommendation:	**Option B: Situated north of the old slimes dams and .....**				
Positive		**Interesting**		**Negative**
It is compliant with legislation		Preferred option accepted by EXCO.		Impact on environment .
Suitable geotech conditions for construction		Zone of relaxation and future expansion of the coarse residue disposal		Requires a new booster station
No impact on known future expansion				
Ease of accessibility of materials for construction				
Suitable topography conditions				
Minimal social impact				
Cost effectiveness related to moving materials of construction				

Alternative / Recommendation:	**Option C: Situated in the east of the pit towards .....**				
Positive		**Interesting**		**Negative**
Suitable geotech conditions for construction		Potential encroachment to watershed into the Town		No mining rights (only surface rights)
		Encroachment on catchment area of the River		Constrains future exploration by other companies
Suitable topography				Future impact by advancement of .....
				Requires a new booster station
				Potentially moving away from Basalt bedrock

Alternative / Recommendation:	Option D: Situated directly below	
Positive	**Interesting**	**Negative**
No new infrastructure required with regards to booster pump station and return water line		Non-compliance to legislation
		Fissures leading to South Eastern Pit wall (already unstable)
		Future infrastructure impact
		Poor accessibility of materials

Selection Matrix

Having obtained the criteria with weight factors and a good understanding of the various options an evaluation utilising the Perspective Modelling Matrix took place.

This highlighted the two best option for further investigation.

	Fines Residual Disposal Dam Project Location Selection	Compliance to Legislation		Support Zero Harm		Most Suitable Geotech Condition		Least Impact on / by Future Infrastructure		Ease of accessibility of materials for construction		Least Impact to Environment		Most Suitable Topography Condition		Best Future Expansion Flexibility		Optimal Life Cycle Cost		Minimal Social Impact		Least Water Demand (Construction - Operation)		Earliest Operational Date		Minimal Sub-Surface & Surface Infrastructure Impact		Best Site Access (Distance / Security etc.)			
	Weight Factor	22		22		18		18		15		14		13		11		10		10		5		4		1		1			820
	Recommendations / Solutions / Ideas / Alternatives																													Total	% Conform.
1	Option A: Situated on the west of the pit, south of the ...	5	110	4	88	3	54	1	18	5	75	3	42	4	52	4	44	3	30	5	50	4	20	3	12	3	3	5	5	603	73.5
2	Option B: Situated north of the old slimes dams and ...	5	110	4	88	3	54	4	72	5	75	2	28	4	52	4	44	3	30	4	40	4	20	3	12	3	3	5	5	633	77.2
3	Option C: Situated in the east of the pit towards	1	22	3	66	3	54	2	36	3	45	3	42	3	39	2	22	3	30	3	30	3	15	3	12	3	3	3	3	419	51.1
4	Option D: Situated directly below ...	1	22	2	44	1	18	3	54	1	15	3	42	2	26	2	22	4	40	1	10	2	10	4	16	3	3	2	2	324	39.5
5	Option E: South West of Pit		0		0		0		0		0		0		0		0		0		0		0		0		0		0	0	0.0
6			0		0		0		0		0		0		0		0		0		0		0		0		0		0	0	0.0
7			0		0		0		0		0		0		0		0		0		0		0		0		0		0	0	0.0
8			0		0		0		0		0		0		0		0		0		0		0		0		0		0	0	0.0
9			0		0		0		0		0		0		0		0		0		0		0		0		0		0	0	0.0
10			0		0		0		0		0		0		0		0		0		0		0		0		0		0	0	0.0

Ratings:	
Excellent:	5
Very Good:	4
Good:	3
Fair	2
Bad	1

Note: Ask the process question by relating your recommendation to the relevant criteria. Would the recommendation etc. be in line with the criteria?

CONCLUSION

This method was not only applied to decide on the best location for the dam but was repeated for the Deposition Methodology and for the Decant System within the total design.

This approach allows for alignment between stakeholders and the required credibility of having obtained the relevant information to make the correct decision.

The next step would be a more detailed investigation of the two options selected and based on this outcome the best design option will be agreed on.