

Table 7.13 Examples of “Determining Indicators of Pasture Health” matrix. Indicator citations (Pellant et al. 2020, and V 5 in press; Spaeth 2020 in press).

	<b>Extreme-to-Total</b>	<b>Moderate-to-Extreme</b>	<b>Moderate</b>	<b>Slight-to-Moderate</b>	<b>None-to-Slight</b>
1. Erosion (sheet and rill)	Numerous and frequent throughout. Nearly all are wide, deep and long. Occur in exposed and vegetated areas.	Moderate in number at frequent intervals. Many are wide, deep, and long. Occur in exposed areas and in some adjacent vegetated areas.	Moderate in number at infrequent intervals. Moderate width, depth, and length. Occur mostly in exposed areas.	Scarce and scattered. Minimal width, depth, and length. Occur in exposed areas.	Current or past formation of rills as expected for the site.
2. Erosion (gullies) if present	Sporadic or no vegetation on banks and/or bottom. Numerous nickpoints. Significant active bank and bottom erosion, including downcutting. Substantial depth and/or width. Active headcuts may be present.	Intermittent vegetation on banks and/or bottom. Nickpoints common. Moderate active bank and bottom erosion, including downcutting. Significant width and/or depth. Active headcuts may be present.	Occasional vegetation on banks and/or bottom. Occasional nickpoints and/or slight downcutting. Moderate depth and/or width. Active headcuts absent.	Vegetation on most banks and/or bottom. Few nickpoints and/or minimal downcutting. Minimal gully depth and/or width. Headcuts absent.	None
3. Erosion, Wind-Scoured and/or Depositional Areas	Extensive. Wind scours usually connected. Large soil depositions around obstructions.	Common. Wind scours frequently connected. Moderate soil depositions around obstructions.	Occasionally present. Wind scours infrequently connected. Minor soil deposition around obstructions.	Infrequent and few. Wind scours rarely connected. Trace amounts of soil deposition around obstructions.	None or as described in ESD
4. Erosion (streambank or shoreline)	Banks bare, major sloughing, no bank vegetation.	More than half the bank vegetation trampled; sloughing.	More than half the bank vegetation trampled; sloughing.	More than half the bank vegetation trampled; sloughing.	More than half the bank vegetation trampled; sloughing.
5. Water flow patterns	Extensive. Long and wide. Erosional and/or depositional areas widespread. Usually connected.	Widespread. Longer and wider than expected. Erosional and/or depositional areas common. Occasionally connected.	Common. Lengths and/or widths slightly to moderately higher than expected. Minor erosional and/or depositional areas. Infrequently connected.	Scarce. Length and width nearly match expected. Some minor erosional and/or depositional areas. Rarely connected.	As described in ESD
6. Bare Ground (%)	Substantially higher than expected. Bare ground patches are large and frequently connected.	Much higher than expected. Bare ground patches are large and occasionally connected.	Moderately higher than expected. Bare ground patches are moderate in size and sporadically connected.	Slightly higher than expected. Bare ground patches are small and rarely connected.	Amount and size of bare areas match that expected for the site.

	<b>Extreme-to-Total</b>	<b>Moderate-to-Extreme</b>	<b>Moderate</b>	<b>Slight-to-Moderate</b>	<b>None-to-Slight</b>
7. Pedestals and/or Terracettes	Pedestals extensive; roots frequently exposed.  terraces if present, are widespread.	Pedestals widespread; roots commonly exposed.  terraces if present, are common.	Pedestals common; roots occasionally exposed.  terraces if present, are uncommon.	Pedestals uncommon; roots rarely exposed.  terraces scarce.	None or as described in ESD  terraces none
8. Litter movement (wind or water)	Extreme movement of all size classes, (including large). Significant accumulations around obstructions or in depressions.	Moderate to extreme movement of small to moderate size classes. Moderate accumulations around obstructions or in depressions.	Moderate movement of mostly small size classes. Small accumulations around obstructions or in depressions.	Slight movement of small size classes. Minimal or no accumulations around obstructions or in depressions.	None or as described in ESD
9. Effects of Plant Community Composition and Distribution on Infiltration and Runoff  * Assume that decreased infiltration causes a corresponding increase in runoff. Indicator 9 is correlated with Indicator 10	Changes in plant community (functional/structural groups) composition and/or distribution are associated with severe reduction in infiltration and a significant increase in runoff.	Changes in plant community (functional/structural groups) composition and/or distribution are associated with significantly or greatly decreased infiltration and a large increase in runoff.	Changes in plant community (functional/structural groups) composition and/or distribution are associated with moderate reduction in infiltration and a moderate increase in runoff	Community (functional/ structural groups) composition and/or plant distribution are associated with moderate reduction in infiltration and slight to moderate increase in runoff.	Infiltration and runoff are as expected for reference state in S&T model.
10. Soil surface loss or degradation	Soil surface horizon very thin to absent throughout. Soil surface structure similar to or more degraded than subsurface. No distinguishable difference between surface and subsurface organic matter content.	Severe soil loss and/or degradation throughout. Minor differences in soil organic matter content and structure between surface and subsurface layers.	Moderate soil loss and/or degradation in plant interspaces with some degradation beneath plant canopies. Soil organic matter content is markedly reduced.	Slight soil loss and/or soil structure shows slight signs of degradation, especially in plant interspaces. Minor change in soil organic matter content.	No apparent soil loss or degradation (Reference ESD narrative)
11. Compaction Layer	Extensive and/or strongly developed (thickness and density); may severely restrict root penetration and infiltrability.	Widespread and/or moderately to strongly developed (thickness and density); may greatly restrict root penetration and infiltrability.	Moderately widespread and/or moderately developed (thickness and density); may moderately restrict root penetration and infiltrability.	Not widespread and/or weakly developed (thickness and density); may weakly restrict root penetration and infiltrability.	No apparent compaction.

	<b>Extreme-to-Total</b>	<b>Moderate-to-Extreme</b>	<b>Moderate</b>	<b>Slight-to-Moderate</b>	<b>None-to-Slight</b>
12. Live plant foliar cover (hydrologic and erosion benefits) <sup>1</sup>	Less than 40% live foliar cover. Remaining is either dead standing material or bare ground.	40-60% live foliar cover. Remaining is either dead standing material or bare ground.	60-75% live foliar cover. Remaining is either dead standing material or bare ground.	75-95% live foliar cover. Remaining is either dead standing material or bare ground.	More than 95% live foliar cover. Remaining is either dead standing material or bare ground.
13. Forage Plant Diversity  (Legumes adaptability based on what is expected for site in ESD)	Very low diversity  One very dominant desirable species ( $\geq 75\%$ ).  OR  More undesirables than desirables.	Low diversity  Two dominant desirable CS or WS grass species (totaling $\geq 75\%$ ) with other secondary grasses. No legumes.	Moderate diversity  Three dominant desirable CS or WS grass species (each $\geq 20\%$ ) and no legumes.  OR  Two dominant grass species (totaling $\geq 50\%$ ) and a legume $\geq 15\%$ present.	High diversity Three or four dominant desirable CS or WS grass species present (totaling $\geq 60\%$ ) and at least one legume or desirable forb $\geq 15\%$ .	Very high diversity  Four or five desirable CS and or WS grass species present and one legume and a 2nd legume or desirable forb also represented. All must be $\geq 15\%$ .
14. Percent Desirable Forage Plants (for identified livestock class)	Desirable forage species $< 20\%$ dry weight of expected from Ecological Site Altered State description.	Desirable forage species 20 – 40% dry weight from Ecological Site Altered State description.	Desirable forage species 40 – 60% dry weight from Ecological Site Altered State description.	Desirable forage species 60 – 80% dry weight from Ecological Site Altered State description.	Desirable forage species exceed 80% dry weight from Ecological Site Altered State description.
15. Invasive Plants	Invasive species dominate the site.	Invasive species common throughout the site.	Invasive species scattered throughout the site.	Invasive species present in infrequent disturbed areas within the site.	Invasive species rare, except in very infrequently disturbed areas.
16. Annual Production	Less than 20% of potential production based on recent weather.	21-40% of potential production based on recent weather.	41-60% of potential production based on recent weather.	61-80% of potential production based on recent weather.	Annual production $> 80\%$ of potential.
17. Plant Vigor with an emphasis on reproductive capability of perennial	Plant reproduction and/or recovery after use is extremely reduced.  Pale, yellow or brown, or severely stunted plants.	Plant reproduction and/or recovery after use is greatly reduced.  Yellowish green forage, or moderately or slightly stunted plants.	Plant reproduction and/or recovery after use is moderately reduced.  Adequate recovery. Yellowish and dark green areas due to manure and urine patches.	Plant reproduction and/or recovery is slightly-to-moderately reduced after use.  Good recovery. Light green and dark green plants present	Plant reproduction and/or recovery is what is expected for the site.  Rapid recovery. All healthy green plants.

<sup>1</sup> To define all possible undesirables (invasive' s, shrubs, other weedy herbaceous forbs would be difficult. 60% cover has been shown to be the breakpoint of foliar cover where soil surface is relatively protected (Gifford 1985; Thurow 1986).

	<b>Extreme-to-Total</b>	<b>Moderate-to-Extreme</b>	<b>Moderate</b>	<b>Slight-to-Moderate</b>	<b>None-to-Slight</b>
18. Dead or Dying Plants or Plant	Extensive mortality and/or dying plants/plant parts concentrated in one or more functional groups.	Widespread mortality and/or dying plants/plant parts concentrated in one or more functional groups.	Moderate mortality and/or dying plants/plant parts concentrated in one or more functional groups.	Occasional mortality and/or dying plants/plant parts concentrated in one or more functional groups.	No apparent mortality and/or dying plants/plant or plant parts.
19. Litter cover and depth	Largely absent or extensive relative to site potential and weather.	Greatly reduced or increased relative to site potential and weather.	Moderately more or less relative to site potential and weather.	Slightly more or less relative to site potential and weather.	Litter cover and depth as expected for the site and weather.
20. Percentage nontoxic legumes <sup>2</sup>  Note: if bloating legumes > 40% of stand by weight, rating = Extreme to Total. Substantial risk to livestock with and without bloat prevention protocols.  Note: If landowner decides that legumes are not desired in pasture, omit this indicator	If ES Altered Pasture State supports legumes, stands have less than 2% by weight.	If ES Altered Pasture State supports legumes, stands have 2-5% by weight.	If ES Altered Pasture State supports legumes, stands have 5 to 15% by weight.	If ES Altered Pasture State supports legumes, stands have 15 to 30% by weight.	If ES Altered Pasture State supports legumes, stands have 30-40% by weight.
21. Uniformity of Use	Little-grazed or ungrazed patches where forage species are rejected cover over 50% of the area. Rejected patches are generally connected.  OR  Uniform use due to overutilization.	Little-grazed or ungrazed patches where forage species are rejected cover 26 to 50% of the area. Patches are occasionally connected.	Little-grazed or ungrazed patches where forage species are rejected cover 10 to 25% of the area. Patches sporadically connected.	Light-grazed or ungrazed and unconnected patches where forage species are rejected are small and isolated (<10% cover). Urine and dung patches avoided.	Areas where forage species are rejected only present at urine and dung patches.

<sup>2</sup> Note: some literature mentions maximum legume comp. at 40-50% to minimize bloat potential.

	<b>Extreme-to-Total</b>	<b>Moderate-to-Extreme</b>	<b>Moderate</b>	<b>Slight-to-Moderate</b>	<b>None-to-Slight</b>
22. Livestock concentration areas	Cover > 10% of the pasture and transport contaminated runoff directly into water channels.	Livestock concentration areas and trails cover 5% to 10% of the area and drain into water channels unbuffered.	Isolated and unconnected livestock concentration areas and trails (<5% of area); can potentially drain into water channels unbuffered.	Some livestock trails and one or two small unconnected concentration areas. If present, areas have been treated to prevent contaminated runoff.	No presence of livestock concentration areas or heavy use areas.

Table 7.14 Example Field Worksheet for Determining Indicators of Pasture Health.

Indicators (Spaeth 2020)	Attribute	Rating	Notes
1. Erosion (Sheet and Rill)	SSS, HF		
2. Erosion (Gullies) if present	SSS, HF		
3. Erosion (Wind) if present	SSS, HF		
4. Erosion (Streambank/shoreline) if present	SSS, HF		
5. Water-flow Patterns	SSS, HF		
6. Bare ground %	SSS, HF		
7. Pedestals and Terracettes	SSS, HF		
8. Litter movement	SSS, HF		
9. Effects of Plant Community Composition and Distribution on Infiltration and Runoff	HF		
10. Soil surface loss or degradation	SSS, HF, BI		
11. Compaction Layer	SSS, HF, BI		
12. Plant foliar cover (hydrologic and erosion benefits)	SSS, HF		
13. Forage Plant Diversity	BI, LMQF		
14. Percent Desirable Forage Plants (for identified livestock class)	LMQF		
15. Invasive plants	BI, LMQF		
16. Annual production	BI, LMQF		
17. Plant Vigor with an emphasis on reproductive capability of perennial plants	BI		
18. Dead or Dying Plants or Plant Parts	BI		
19. Litter cover and depth	HF, BI		
20. Percent non-toxic legumes (based on adaptability of Ecol. Site and/or what is expected stand for the site)	BI, LMQF		
21. Uniformity of use	HF, BI, LMQF		
22. Livestock Concentration Areas	SSS, HF, LMQF		

E-T	M-E	M	S-M	N-S	E-T	M-E	M	S-M	N-S	E-T	M-E	M	S-M	N-S
Soil & Site Stability Attribute Rating					Hydrologic Function Attribute Rating					Biotic Integrity Attribute Rating				

E-T	M-E	M	S-M	N-S
Livestock Management Quality Factor				

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