Agricultural Water Risk Management Tool

V. 8

UNIVERSITY OF MINNESOTA
EXTENSION

MICHIGAN STATE UNIVERSITY | Extension

Introduction

It can be hard to compare two water sources and pick which one is less risky. This tool was designed to help you do just that. The tool will walk you through the various things that add to or decrease risk of a water source fouling produce when it's used on a crop. At the end, you will have a number that you can use to compare how one source stacks up against another. The lower the number, the less risky the water source will be to use on your crop.

No two people will judge a certain risk the same way. That's why if two different people used this tool for the same water source, they will likely get two very different numbers. This tool is best used by one person to compare many water sources.

There is no "correct" risk number, either. The numbers calculated are guides. They do not guarantee that water with a lower risk number will not foul produce. Think of these numbers like a percent chance of something going wrong. The higher the number, the higher the chance of produce being fouled. If the number you generate is not zero, there is a chance of something going wrong.

Directions

On each page, answer each question for the given water source (Green for ground water, blue for still surface water, yellow for running surface water) with the number that best describes the situation for the water source you are evaluating and place it in the white box to the right of the question. Follow the calculations down the row and put the answer in that column's solid colored, numbered box in the bottom rows. Once you have answered all questions, add up all the solid colored numbered boxes in the very bottom row to calculate the score. Shaded boxes should not be written in at all.

Glossary

Direct Discharge– Used when talking about human or animal feces. When feces is put directly on land and not through a septic system or treated.

Likely Water Contact– Used when discussing whether water will contact the harvestable portion of the crop. In situations where drip irrigation is used, water is unlikely to contact tomato fruit with drip under plastic. Water is VERY likely to contact onion bulbs and carrots with drip under plastic.

Vulnerable- Used when talking about water sources and human or animal feces. When a water source is vulnerable, it is easy for the feces to get into the source.

Write answer here

Is the well pumped into a reservoir? **Yes=The water is surface water. Move to the blue section** **No=Continue with the questions**	
How likely is the water to contact the produce? **No way=0.0, Possibly=0.5, Very Likely= 1**	
	X
Is the irrigation water treated for pathogens? If Yes, do you monitor it… **Hourly= 0.0, Daily= 0.1, Once a season=0.25, Not at all=0.5, No treatment used=1**	

If the number in the blue box the arrow is pointing to is zero, stop and draw a line through all the other blue boxes to the left of them. Your calculated risk is zero.

Technical Note: This is the stopgap page that decides if we're dealing with ag water. The number does not appreciably add to the score.

Water does not pool around wellhead because of slope of the ground. **No pooling= 1, Unlikely= 1.25, Pooling possible= 1.5, It pools= 2**	
	X
Extent of soil moisture after recent rainfall **Dry= 0, Wetted soil = 0.5, Saturated soil= 1, Sheet runoff = 2, Concentrated runoff = 3**	
	X
Time since the peak of the most recent rain. **More than five days=0, Four to five days= 2, One to three days=4, A few hours= 5**	
	=
Place the product in this white box.	
Multiply the number in the white box in the last line with the number in the green box that the red arrow is pointing to and put it in this column's green box.	
Technical Note: This calculates the total amount of feces that gets in the water (possible contaminants x transport factors) Irrespective of how (down the pipe or through watershed)	

Ground Water

How many domestic animals (general stocking rate, not number) can be found in the area around the well head?

No or very few animals= 1, Small amounts= 3, Moderate amounts= 5, A whole lot= 10

X

How many animals have access to the area around the wellhead? (Relative amount, not the actual number)

Well inside pump house= 0, Well is fenced= 0.3, Natural barriers or more than 100 yards away= 0.5, No protection = 1

+

How likely are **nearby sewers** to leak?

Not very likely (new systems)= 1, Very likely (Old systems)= 10

+

How likely are **nearby septic systems** to fail?

Not likely (new and/or well-maintained septic systems)= 1, Very likely (Old or failing septic systems)= 10

Put the calculated number here.

Technical Note: This calculates the amount of contaminant that is possible to enter the water both through pipes and the aquifer.

Ground Water

What is the number in the fourth green box from the right at the bottom? (where the arrow is pointing)

X

Backflow prevention devices on pumps and valves are functional

Tested and functional= 0, Appear working= 0.5, Assumed working= 1, No devices = 1

+

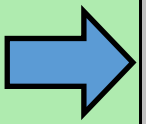
Irrigation lines are separate from piped waste.

No piped waste=0, Separate line=0.5, Probably separated=2, Dual use=5, Unknown=5

X

Does the general water delivery system protect the quality of the water in the system?

Generally protects= 0, I have concerns = 0.5, Known flaws= 1, Don't know = 1



Technical Note: This determines the effect of mitigation factors on poop going down the pipe {[(possible contaminants* transport factors)*backflow]+ separation}*delivery system. Because separation is not mitigated by backflow, it is considered independently.

Ground Water

What kind of well do you have?

Drilled and cased=0, Drilled and not cased=0.3, Sandpoint=0.7, Dug=1

+

What condition is the well in?

Excellent condition/New well=0, Good condition=0.3, Fair condition=0.5, Poor condition/Old well=1

+

What condition is the cap and seal in?

Excellent condition/well-sealed=0, Good condition=0.3, Fair condition=0.7, Poor condition/no cap=1

+

How deep is your well?

More than 200 feet=0.25, 76-200 feet=0.5, 30-75 feet=0.75, Less than 30 feet=1

Place the sum in this green box.

Technical Note: This is the first of two pages that determine the effects of geology and well infrastructure on the level of contamination.

A confining layer above the water bearing layer protects your groundwater source.

Fully confined=0, Partly confined=0.5, Unconfined=1, Unknown=1

+

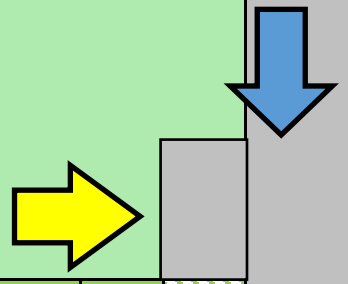
Casing and geology combine to protect well water.

Cased and grouted=0, Partly cased=0.5, Totally uncased=1, Unknown=1

+

Place the number the blue arrow is pointing to in this line's white box.

Divide the sum by 6 and place it in the green box where the yellow arrow is pointing. ÷

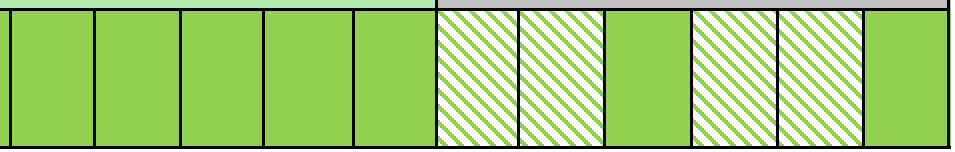


Technical Note: This is the second of two pages that determine the effects of geology and well infrastructure on the level of contamination. The result should be between 0 and 1. This determines how much the landscape deposition contributes to the fecal load.

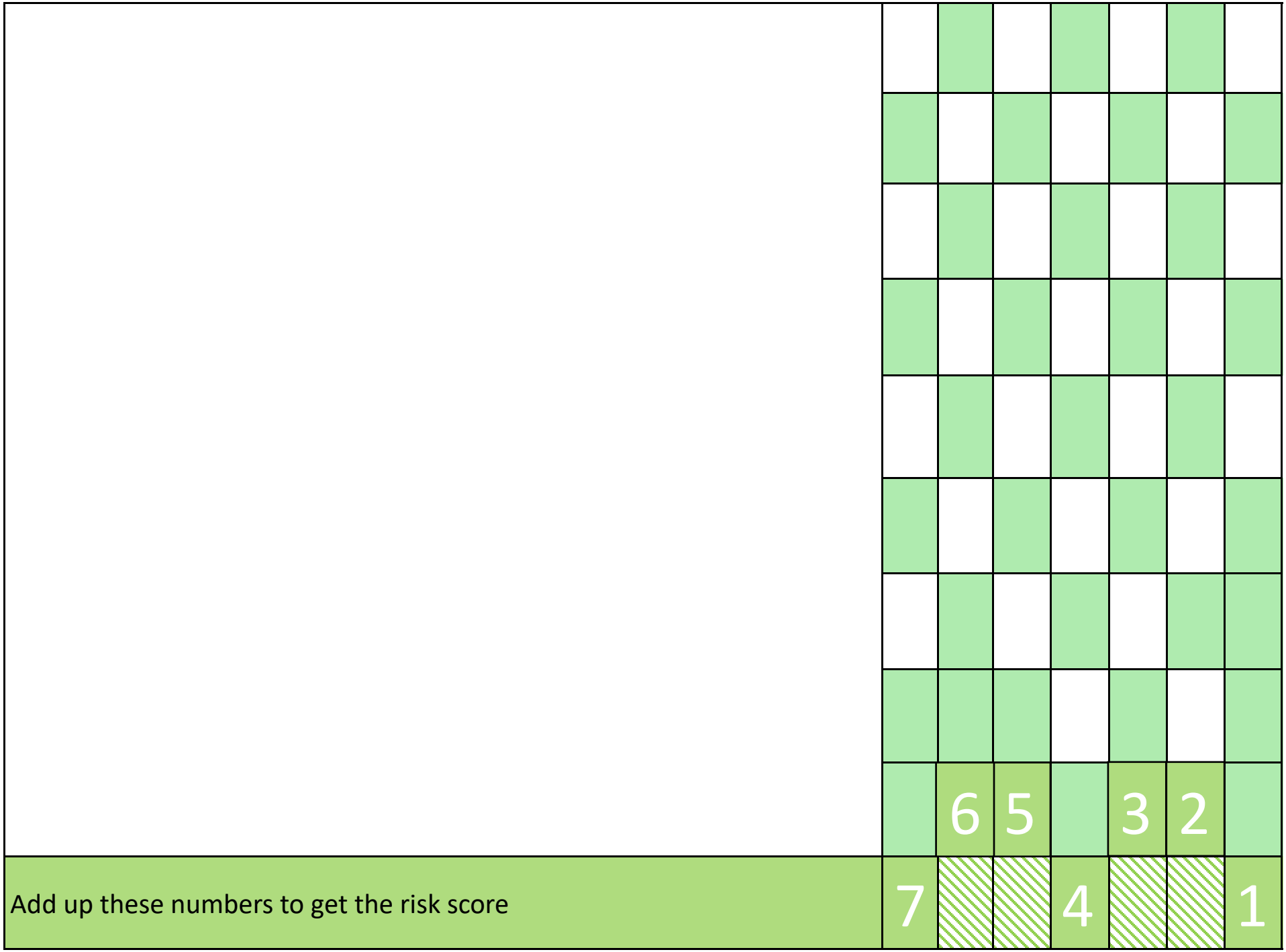
Ground Water

Place the number from the green box that the blue arrow is pointing into this row's white box.	
X	
Place the number from the green box in the third box from right into this row's white box.	
+	
A generic *E. coli* test on the well came back positive. **No=0, Yes=100, Never tested=50**	
+	
A fecal coliform test on the well came back positive. **No=0, Yes=100, Never tested=50**	

Technical Note: This actually calculates the effects of geology and well infrastructure on the level of contamination from the landscape. E. coli and coliform results are added as a fail safe. Positive results or not sampling negatively impact score.



Ground Water



Ground Water

Write answer here

How likely is the water to contact the produce? **No way=0.0, Possibly=0.5, Very Likely= 1**	
	X
Is the irrigation water treated for pathogens? If Yes, do you monitor it… **Hourly= 0.0, Daily= 0.1, Once a season=0.25, Not at all=0.5, No treatment used=1**	

If the number in the blue box the arrow is pointing to is zero, stop and draw a line through all the other blue boxes to the left of them. Your calculated risk is zero.

Technical Note: This is the stopgap page that decides if we're dealing with ag water. The number does not appreciably add to the score.											

Amount of manure piles or applied manure on land that slopes to the source.

Not much= 1, Small amounts= 3, Moderate amounts= 5, A whole lot= 10

How much manure handling in the area that drains to the pond takes place?

None or rarely= 1, Small amounts= 3, Moderate amounts= 5, A whole lot= 10

X

Domesticated animal waste (pits, pens and piles) is fully captured or otherwise controlled.

No pits, pens or piles= 0; Fully controlled= 0.25, Partly controlled= 0.5, Poorly controlled=0.75 Uncontrolled= 1

Put the calculated number here.

Technical Note: This is one of several pages that calculates the amount of contaminant that is possible to enter the water through surface flow and subsurface flow. [(Confined amount + storage)x control]

Still Water

1. Amount of scat observed or likely on land that slopes to the source. **Not much= 1, Small amounts= 3, Moderate amounts= 5, A whole lot= 10**	
X	
2. How much of the area wildlife are aquatic? (Waterfowl, beavers, etc.) **None= 0, A few= 2, Some= 3, All= 4**	
3. What is the general animal stocking rate on land that slopes to the pond? **None= 1, Far below capacity= 3, Below capacity= 5, Over capacity= 10**	
X	
4. Feces from free range and grazing animals on the landscape can get into the pond. **Full separation=0, Large buffer=2, Medium Buffer=3, Grazing to the bank=5**	

Product of Lines 1 and 2		+ **Product of Lines 3 and 4**		=	
				Put the sum in the blue box	

Technical Note: This page calculates both the direct deposit fecal amount and the surface flow. (Total Wildlife x Direct deposit) + (Grazing x buffer)= wildlife and adjacent animal contribution.

1. Place the number from the blue box in the last column into the white box in this line and on line 3.

X

2. The water is protected by constructed or natural exclusion (ie. Fencing, steep banks) or deterrents.

All possible tactics= 0, More than one tactic= 1, One tactic= 2, No tactics= 4

3. Place the number from the blue box in the last column into the white box in this line

X

4. What is the slope of the land right around the pond.

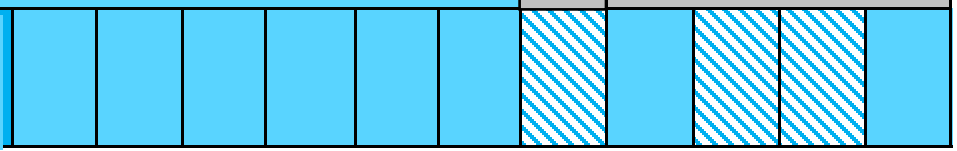
Bermed pond= 0, Land slopes away= 1, Gradual slope= 2, Steep slope= 4

Product of Lines 1 and 2 + **Product of Lines 3 and 4** = **Put the sum in this blue box**

Technical Note: This page calculates the effect of mitigations on surface flow. (Wild and Domestic x exclusion)+ (Wild and Domestic x slope)= Direct contribution.

How many people live **on farm**? (Relative amount, not the actual number) **None= 0, A few= 2, Many= 3, A whole lot=4**	
	+
How many people live **in the watershed**? (Relative amount, not the actual number) **None= 0, A few= 2, Many= 3, A whole lot=4**	
	X
Amount humans use the water source for recreation (Boating, swimming, etc.) **No way= 0, Unlikely=1, Some= 2, A lot=4**	
	+
Place the number from the second blue box from the right in the white box in this line	

Technical Note: This page calculates the direct deposition of feces by people in the area. [wildlife and adjacent animal contribution + (Human pressure x Likelihood)]



Still Water

Place the number from the second blue box from the right in the white box in this line

+

How many people live **on farm**? (Relative amount. You've answered this before.)

None= 0, A few= 2, Many= 3, A whole lot=4

+

How many people live **in the watershed**? (Relative amount. You've answered this before.)

None= 0, A few= 2, Many= 3, A whole lot=4

X

Sewer systems are well constructed and sized appropriately. Consider age of systems

No sewers= 1, Low likelihood of leaks= 1, Leaks possible=3, Known leaks=5, Don't know=5

Technical Note: This is the first of three pages that calculate the subsurface infiltration of feces by wildlife and people in the area. [wildlife and adjacent animal contribution + (Human pressure x potential sewer additions)]

Still Water

Place the number from the sixth blue box from the right (where the arrow is pointing) in the white box in this line.	
	X
Septic systems are properly sized, constructed and maintained to prevent sewage from entering the pond	
No septic systems=1, Recently serviced=1, Suspected failure= 3, Visible sewage=5, Unknown=5	X
Vault or pit toilets, straight pipes or other human waste are close enough to get into the pond.	
No vaults or pits=1, Far away=1, Pretty far= 3, Close=5	

Technical Note: This is the second of three pages that calculate the subsurface infiltration of feces by wildlife and people in the area. [wildlife and adjacent animal contribution + (Human pressure x potential sewer x Septic x Pit toilet)]							

Still Water

Place the number from the seventh blue box from the right in the white box in this line.	
	X
Water does not enter the pond because of slope of the ground. **No entry= 1, Unlikely= 1.25, Entry possible= 1.5, It flows in= 2**	
	X
Extent of soil moisture after recent rainfall **Dry= 0, Wetted soil = 0.5, Saturated soil= 1, Sheet runoff = 2, Concentrated runoff=3**	
	X
Time since the peak of the most recent rain. **More than five days=0, Four to five days= 2, One to three days=4, A few hours= 5**	
Technical Note: This is the third of three pages that calculate the actual subsurface infiltration of feces by wild-life and people in the area. [wildlife and adjacent animal contribution + (Human pressure x sewer x Septic x Pit)] x mobilization=actual subsurface and/or surface deposits	

Still Water

1. Place the number from the eighth blue box from the right (where the arrow is pointing) in the white box in this line.	
X	
2. Subsurface flow is prevented with a liner or other barrier. **Liner=0, loose sediment=0.5, Sand & gravel=1, High water table=1**	
3. Place the number from the eighth blue box from the right (where the arrow is pointing) in the white box in this line.	
X	
4. What is the slope of the land right around the pond. **Bermed pond= 0, Land slopes away= 1, Gradual slope= 2, Steep slope= 4**	
↘	

Product of Lines 1 and 2		+	**Product of Lines 3 and 4**	=	**Put the sum in this column's blue box**

Technical Note: This calculates the actual subsurface and surface contribution of feces by wildlife and people in the area. (Total potential deposition x subsurface mitigation) + (Total potential deposition x surface mitigation)= Actual subsurface and surface deposition from nondirect sources.

Irrigation lines are separate from piped waste lines.	
No piped waste=0, Separate line=0.5, Probably separate=2, Dual Use=5, Un-known=5	+
Does the general water delivery system protect the quality of the water in the system?	
Generally protects= 0, I have concerns = 0.5, Known flaws= 1, Don't know = 1	X
Backflow prevention devices on pumps and valves are functional	
Tested and functional= 0, Appear working= 0.5, Assumed working= 1, No devices = 1	
Technical Note: This calculates the impact of contamination that could result from the pipe. (Shared system + adequacy of the delivery system) x mitigation.	

A generic *E. coli* test on the pond came back positive.

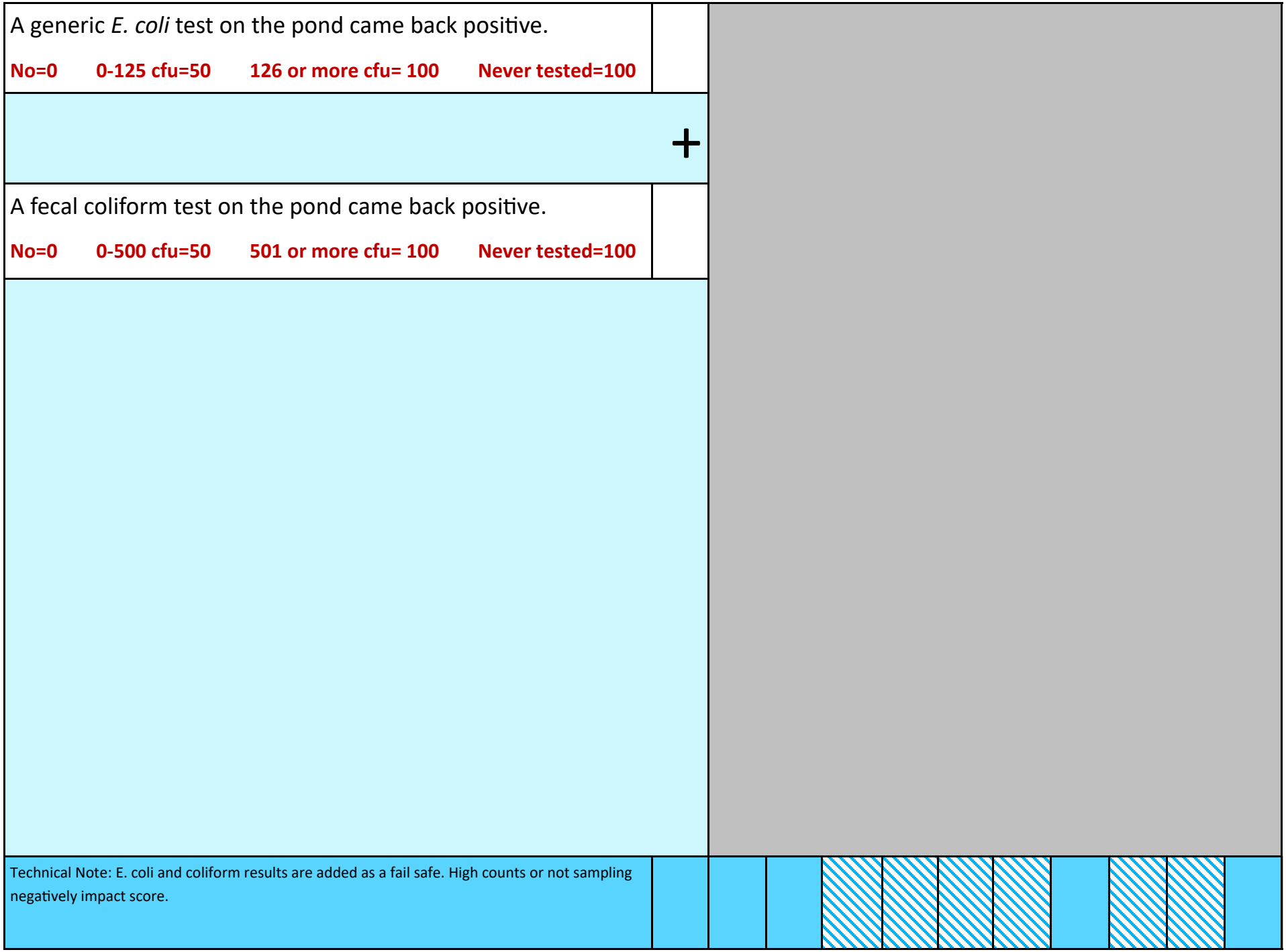
No=0 0-125 cfu=50 126 or more cfu= 100 Never tested=100

+

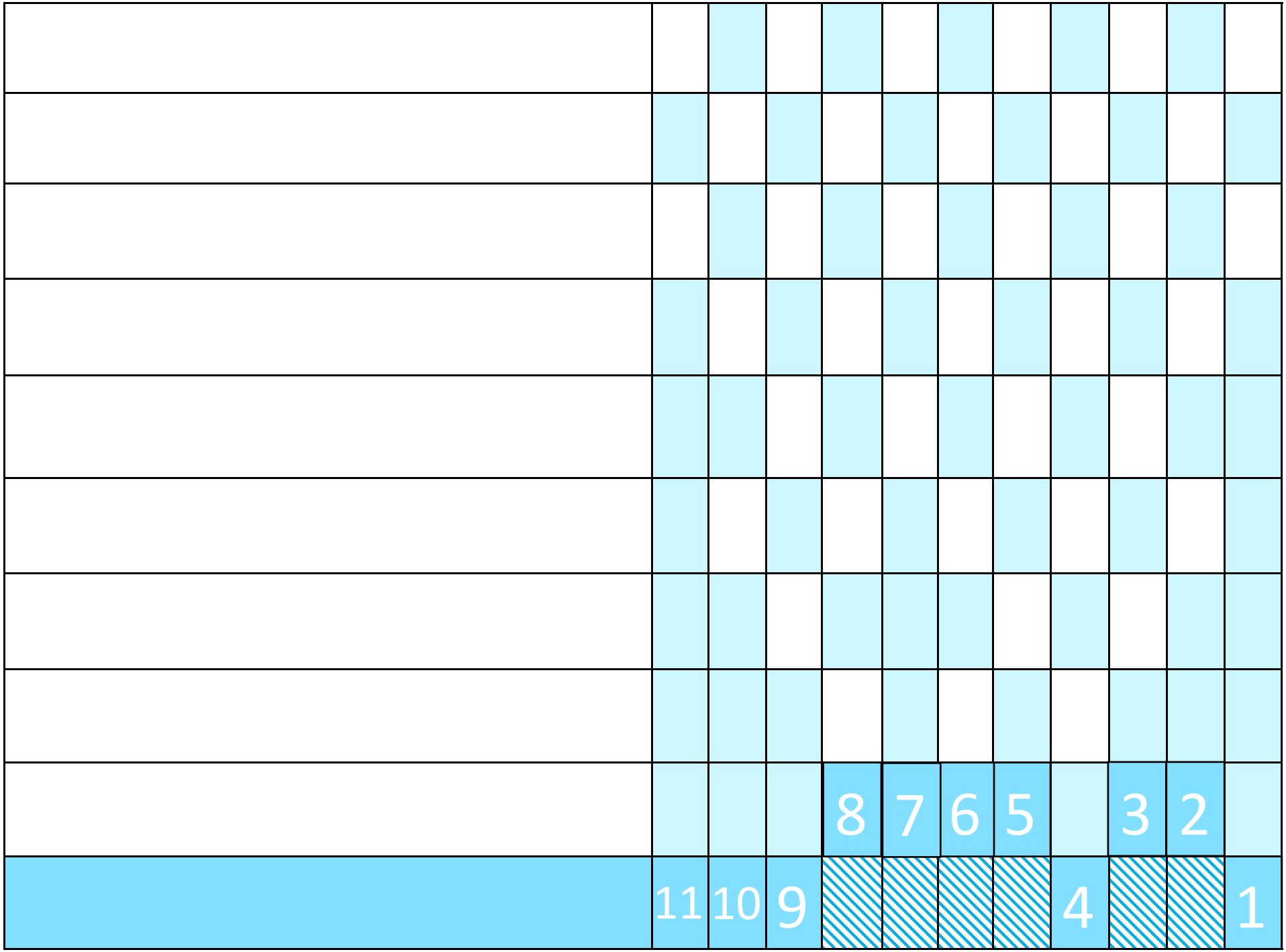
A fecal coliform test on the pond came back positive.

No=0 0-500 cfu=50 501 or more cfu= 100 Never tested=100

Technical Note: E. coli and coliform results are added as a fail safe. High counts or not sampling negatively impact score.



Still Water



Still Water

Write answer here

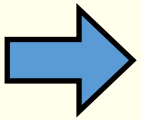
How likely is the water to contact the produce? **No way=0.0, Possibly=0.5, Very Likely= 1**	
	X
Is the irrigation water treated for pathogens? If Yes, do you monitor it… **Hourly= 0.0, Daily= 0.1, Once a season=0.25, Not at all=0.5, No treatment used=1**	

If the number in the yellow box the arrow is pointing to is zero, stop and draw a line through all the other yellow boxes to the left of them. Your calculated risk is zero.

Technical Note: This is the stopgap page that decides if we're dealing with ag water. The number does not appreciably add to the score.											

Amount of manure piles or applied manure on land that slopes to the source. **Not much= 1, Small amounts= 3, Moderate amounts= 5, A whole lot= 10**	
How much manure handling in the watershed that drains to the source takes place? **None or rarely= 1, Small amounts= 3, Moderate amounts= 5, A whole lot= 10**	
	X
Domesticated animal waste (pits, pens and piles) is fully captured or otherwise controlled. **No pits, pens or piles= 0; Fully controlled= 0.25, Partly controlled= 0.5, Poorly controlled=0.75 Uncontrolled= 1**	

Put the calculated number here.



Technical Note: This is one of several pages that calculates the amount of contaminant that is possible to enter the water through surface flow and subsurface flow. [(Confined amount + storage)x control]

1. Amount of scat observed or likely on land that slopes to the source. **Not much= 1, Small amounts= 3, Moderate amounts= 5, A whole lot= 10**	
	X
2. How much of the area wildlife are aquatic? (Waterfowl, beavers, etc.) **None= 0, A few= 2, Some= 3, All= 4**	
3. What is the general animal stocking rate on land in the watershed? **None= 1, Far below capacity= 3, Below capacity= 5, Over capacity= 10**	
	X
4. Feces from free range and grazing animals on the landscape can get into the water source. **Full separation=0, Large buffer=2, Medium Buffer=3, Grazing to the bank=5**	

Product of Lines 1 and 2		+ **Product of Lines 3 and 4**		= **Put the sum in the yellow box**	

Technical Note: This page calculates both the direct deposit fecal amount and the surface flow. (Total Wildlife x Direct deposit) + (Grazing x buffer)= wildlife and adjacent animal contribution.

1. Place the number from the yellow box in the last column into the white box in this line and on line 3.	
X	
2. The water is protected by constructed or natural exclusion (ie. Fencing, steep banks) or deterrents. **All possible tactics= 0, More than one tactic= 1, One tactic= 2, No tactics= 4**	
3. Place the number from the yellow box in the last column into the white box in this line	
X	
4. What is the slope of the land right around the source. **Bermed banks= 0, Land slopes away= 1, Gradual slope= 2, Steep slope= 4**	

Product of Lines 1 and 2		+ **Product of Lines 3 and 4**		=	**Put the sum in this yellow box**

Technical Note: This page calculates the effect of mitigations on surface flow. (Wild and Domestic x exclusion)+ (Wild and Domestic x slope)= Direct contribution.

How many people live **on farm**? (Relative amount, not the actual number) **None= 0, A few= 2, Many= 3, A whole lot=4**	
+	
How many people live **in the watershed**? (Relative amount, not the actual number) **None= 0, A few= 2, Many= 3, A whole lot=4**	
X	
Amount humans use the water source for recreation (Boating, swimming, etc.) **No way= 0, Unlikely=1, Some= 2, A lot=4**	
+	
Place the number from the second yellow box from the right in the white box in this line	
Technical Note: This page calculates the direct deposition of feces by people in the area. [wildlife and adjacent animal contribution + (Human pressure x Likelihood)]	

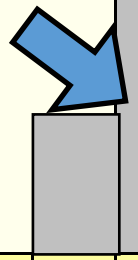
Still Water

Place the number from the second yellow box from the right in the white box in this line	
+	
How many people live **on farm**? (Relative amount. You've answered this before.) **None= 0, A few= 2, Many= 3, A whole lot=4**	
+	
How many people live **in the watershed**? (Relative amount. You've answered this before.) **None= 0, A few= 2, Many= 3, A whole lot=4**	
X	
Sewer systems are well constructed and sized appropriately. Consider age of systems **No sewers= 1, Low likelihood of leaks= 1, Leaks possible=3, Known leaks=5, Don't know=5**	

Technical Note: This is the first of three pages that calculate the subsurface infiltration of feces by wildlife and people in the area. [wildlife and adjacent animal contribution + (Human pressure x potential sewer additions)]

Still Water

Place the number from the sixth yellow box from the right (where the arrow is pointing) in the white box in this line.	
X	
Septic systems are properly sized, constructed and maintained to prevent sewage from entering the water source.	
No septic systems=1, Recently serviced=1, Suspected failure= 3, Visible sewage=5, Unknown=5	
X	
Vault or pit toilets, straight pipes or other human waste are close enough to get into the water source.	
No vaults or pits=1, Far away=1, Pretty far= 3, Close=5	
Technical Note: This is the second of three pages that calculate the subsurface infiltration of feces by wildlife and people in the area. [wildlife and adjacent animal contribution + (Human pressure x potential sewer x Septic x Pit toilet)]	



Still Water

Place the number from the seventh yellow box from the right in the white box in this line.	
	X
Water does not enter the water source because of slope of the ground. **No entry= 1, Unlikely= 1.25, Entry possible= 1.5, It flows in= 2**	
	X
Extent of soil moisture after recent rainfall **Dry= 0, Wetted soil = 0.5, Saturated soil= 1, Sheet runoff = 2, Concentrated runoff=3**	
	X
Time since the peak of the most recent rain. **More than five days=0, Four to five days= 2, One to three days=4, A few hours= 5**	
Technical Note: This is the third of three pages that calculate the actual subsurface infiltration of feces by wild-life and people in the area. [wildlife and adjacent animal contribution + (Human pressure x sewer x Septic x Pit)] x mobilization=actual subsurface and/or surface deposits	

Still Water

1. Place the number from the eighth yellow box from the right (where the arrow is pointing) in the white box in this line.	
X	
2. Subsurface flow is prevented with a liner or other barrier. **Liner=0, loose sediment=0.5, Sand & gravel=1, High water table=1**	
3. Place the number from the eighth yellow box from the right (where the arrow is pointing) in the white box in this line.	
X	
4. What is the slope of the land right around the water source. **Bermed banks= 0, Land slopes away= 1, Gradual slope= 2, Steep slope= 4**	
↘	

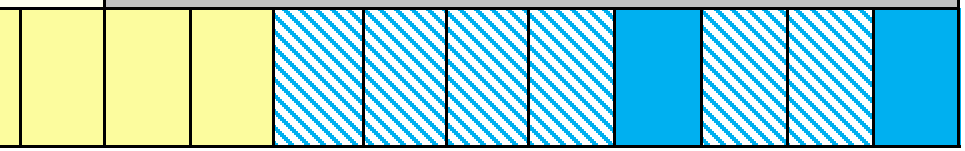
Product of Lines 1 and 2		+	**Product of Lines 3 and 4**	=	**Put the sum in this column's yellow box**

Technical Note: This calculates the actual subsurface and surface contribution of feces by wildlife and people in the area. (Total potential deposition x subsurface mitigation) + (Total potential deposition x surface mitigation)= Actual subsurface and surface deposition from nondirect sources.									

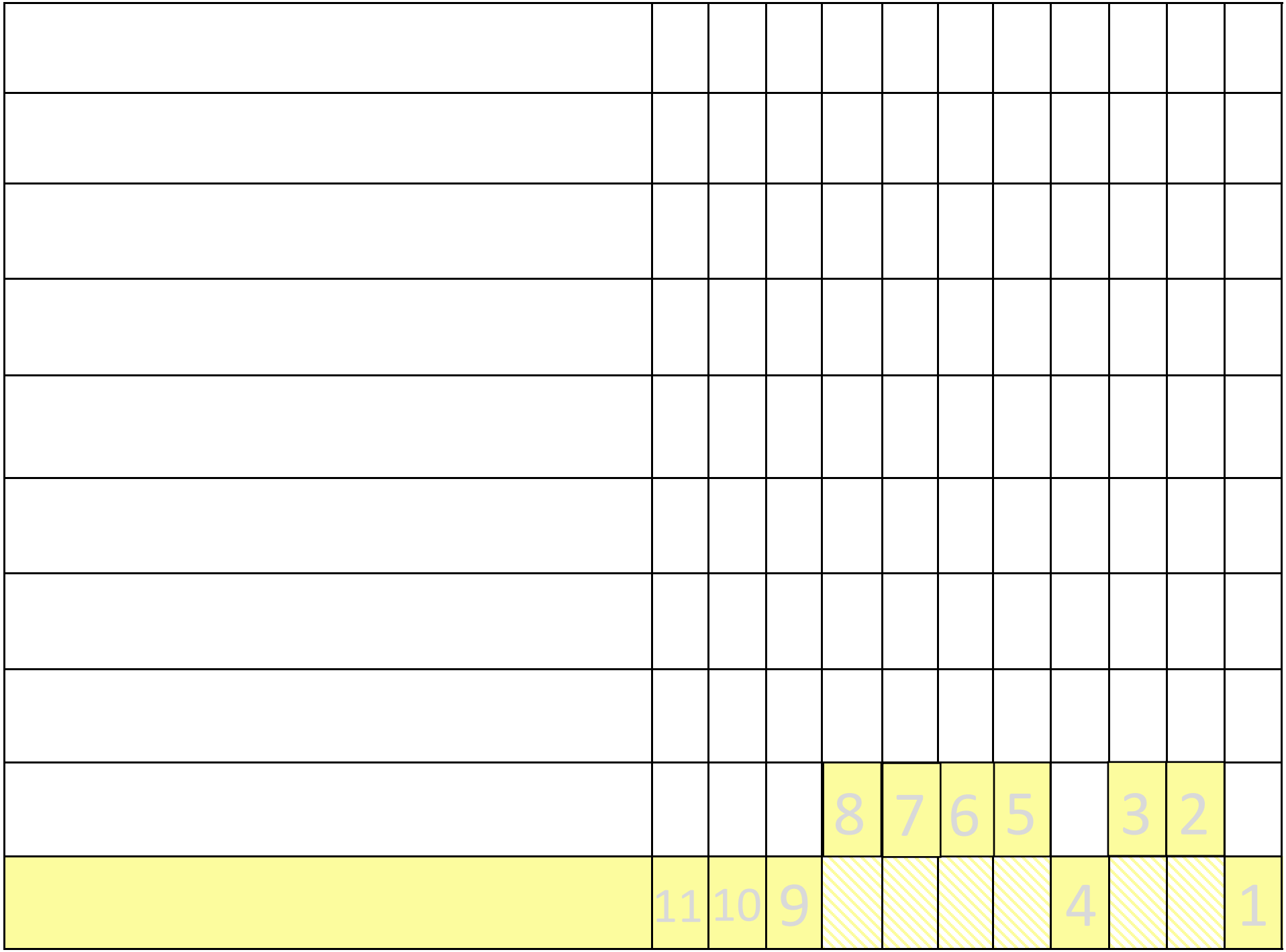
Still Water

Irrigation lines are separate from piped waste lines.		
No piped waste=0, Separate line=0.5, Probably separate=2, Dual Use=5, Un-known=5	+	
Does the general water delivery system protect the quality of the water in the system?		
Generally protects= 0, I have concerns = 0.5, Known flaws= 1, Don't know = 1	X	
Backflow prevention devices on pumps and valves are functional		
Tested and functional= 0, Appear working= 0.5, Assumed working= 1, No devices = 1		
Technical Note: This calculates the impact of contamination that could result from the pipe. (Shared system + adequacy of the delivery system) x mitigation.		

A generic *E. coli* test on the pond came back positive. **No=0 0-125 cfu=50 126 or more cfu= 100 Never tested=100**		
+		
A fecal coliform test on the pond came back positive. **No=0 0-500 cfu=50 501 or more cfu= 100 Never tested=100**		
Technical Note: E. coli and coliform results are added as a fail safe. High counts or not sampling negatively impact score.		



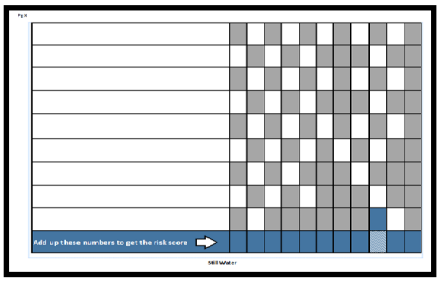
Still Water

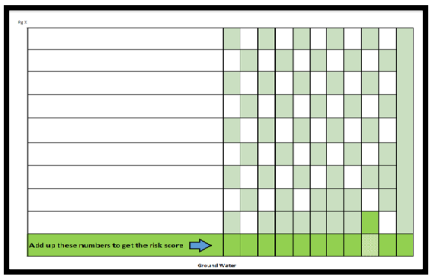


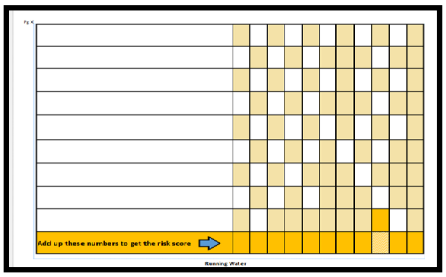
Still Water

Water Risk Tool Assembly Guide

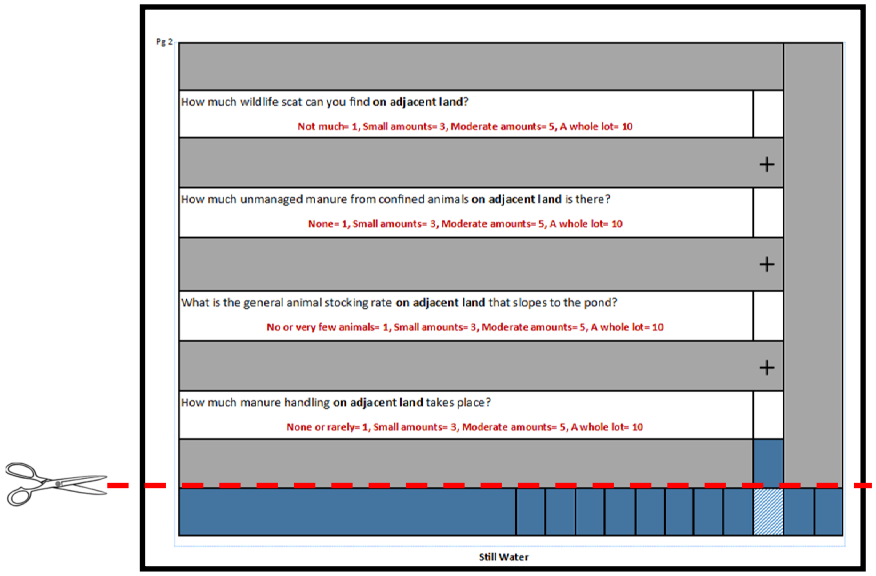
1. Begin by removing and setting aside the pages that look like the ones below. These are the tally sheets. If you can, have these three pages laminated for easy reuse.



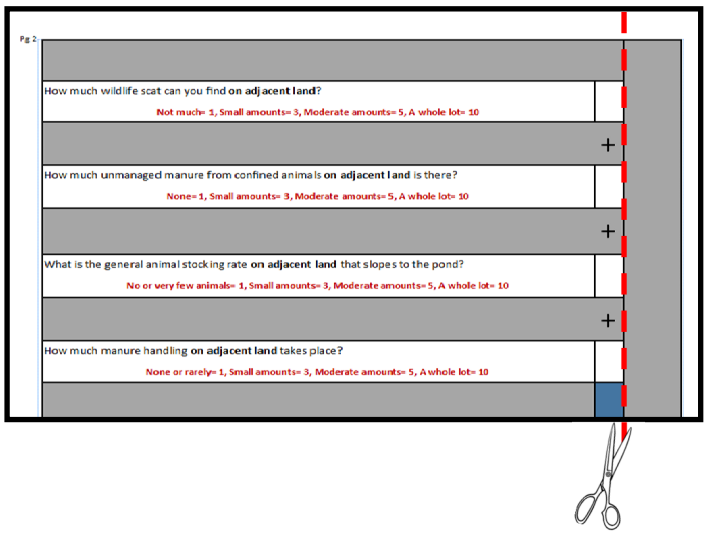


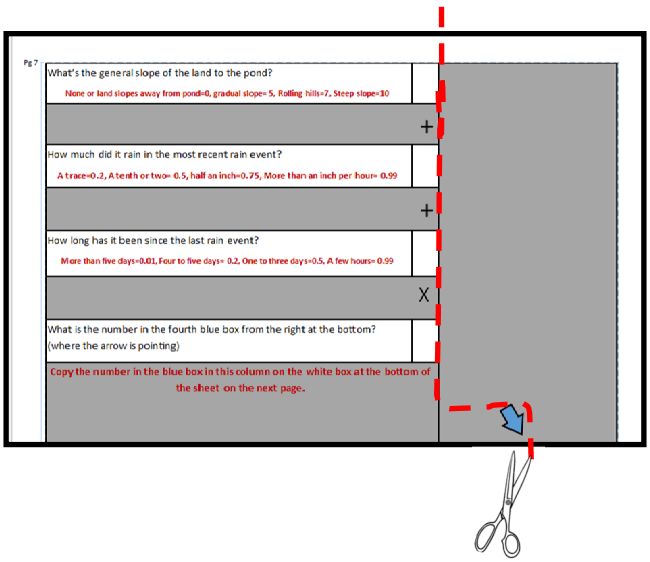


2. Cut the bottom colored row off the rest of the pages.

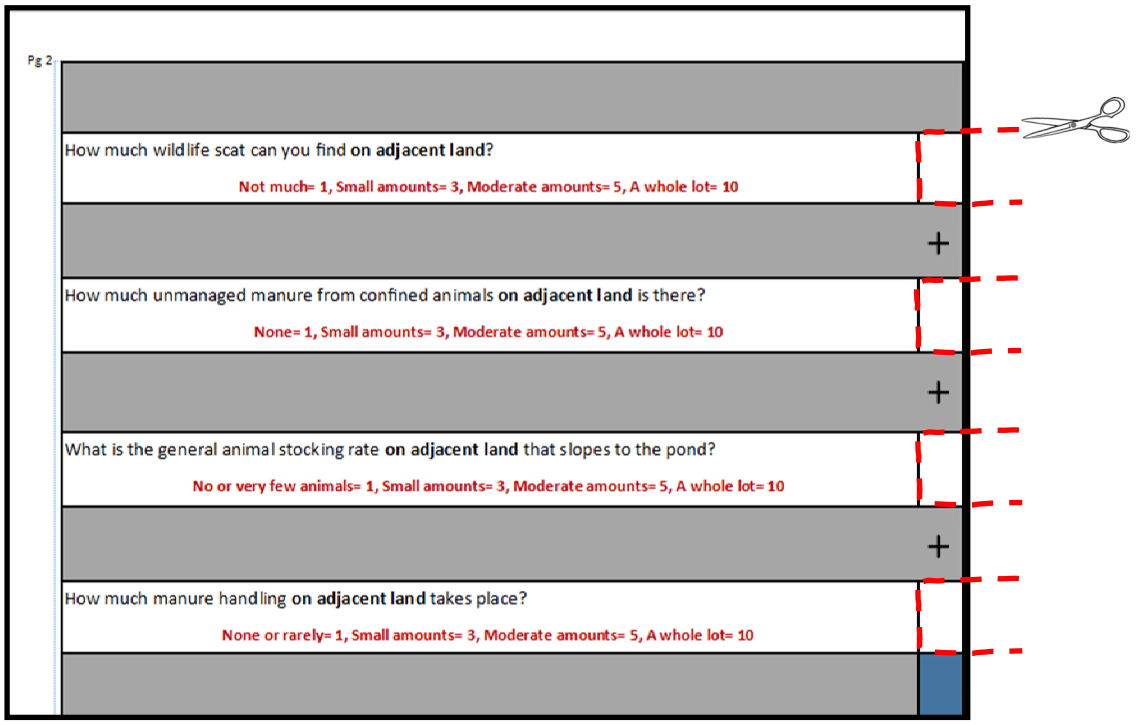


3. Cut the shaded box to the right of each sheet off. In situations where there are arrows in the grey boxes, cut around the arrow.

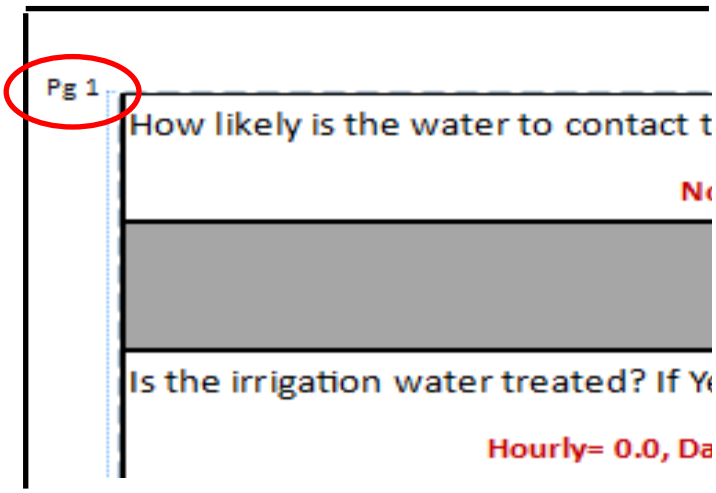




4. Cut out each individual little white box to the right of each white line. Do this for every page except the tally sheets.



5. Assemble the cut out pages by the number in the upper left hand corner (1-7 for ground water, 1-11 for still and flowing water). You should only see page 1 when they are stacked.



6. Put the corresponding tally sheet behind each stack (Match up the colors). IMPORTANT STEP: Align all pages on the left hand side and the top. Double check that the little white areas cut out at the end of each white line align with corresponding white boxes on the tally sheet, then staple along the left edge.