MAINTAINING THE EDGE

A Quick Guide to Saturated Buffer and Bioreactor Management

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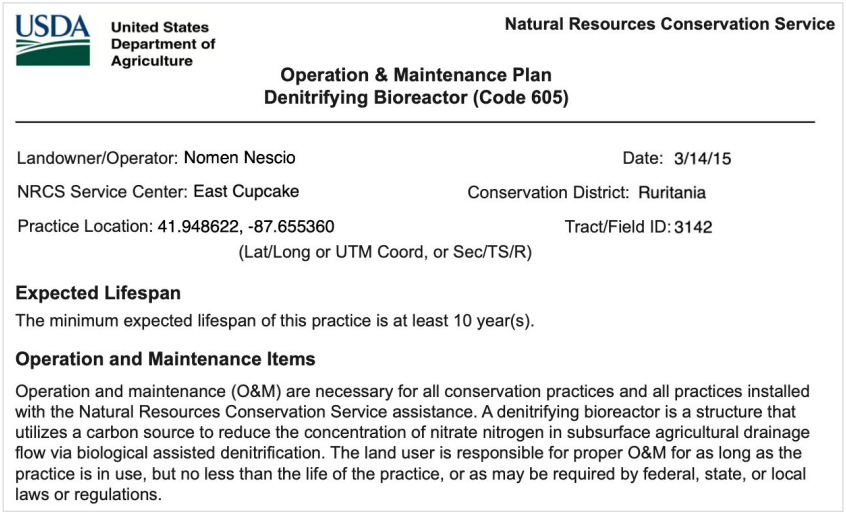
OVERVIEW

This manual is a straightforward guide to keeping your saturated buffer or bioreactor operating as designed to improve water quality. The checklists at the end of each section are a quick reference for all the operations and maintenance tasks you'll need to do throughout the year. Individual sections on managing control structures, seasonal management, saturated buffers, and bioreactors provide more information.

For detailed guidance specific to your individual site, refer to the Operation & Maintenance Plan (or other guidance) that came with your practice.



USDA United States Department of Agriculture

Natural Resources Conservation Service

Operation & Maintenance Plan
Denitrifying Bioreactor (Code 605)

Landowner/Operator: Nomen Nescio Date: 3/14/15

NRCS Service Center: East Cupcake Conservation District: Ruritania

Practice Location: 41.948622, -87.655360 Tract/Field ID: 3142
(Lat/Long or UTM Coord, or Sec/TS/R)

Expected Lifespan

The minimum expected lifespan of this practice is at least 10 year(s).

Operation and Maintenance Items

Operation and maintenance (O&M) are necessary for all conservation practices and all practices installed with the Natural Resources Conservation Service assistance. A denitrifying bioreactor is a structure that utilizes a carbon source to reduce the concentration of nitrate nitrogen in subsurface agricultural drainage flow via biological assisted denitrification. The land user is responsible for proper O&M for as long as the practice is in use, but no less than the life of the practice, or as may be required by federal, state, or local laws or regulations.

Example front page opening of an NRCS Operation & Maintenance Plan for a bioreactor. Plans will vary slightly from state to state.

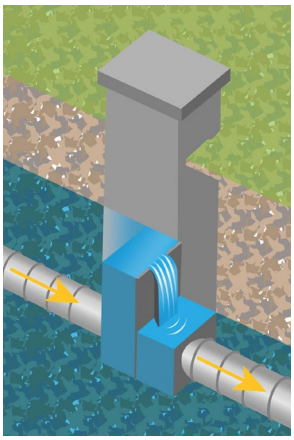
INTRODUCTION

Edge-of-field conservation practices protect water quality by diverting and treating water that comes from agricultural fields through subsurface (tile) drainage before it reaches nearby streams, rivers, or lakes. Saturated buffers and denitrifying bioreactors are effective ways to reduce the amount of nitrogen in tile drainage water. These practices are cost-effective because they perform well and last a long time. Maintenance is relatively easy, and they don't require any changes to in-field management. However, their water quality benefits depend on careful planning, installation, and ongoing management. If maintained properly, these practices will continue to remove nitrogen and improve water quality for years to come.

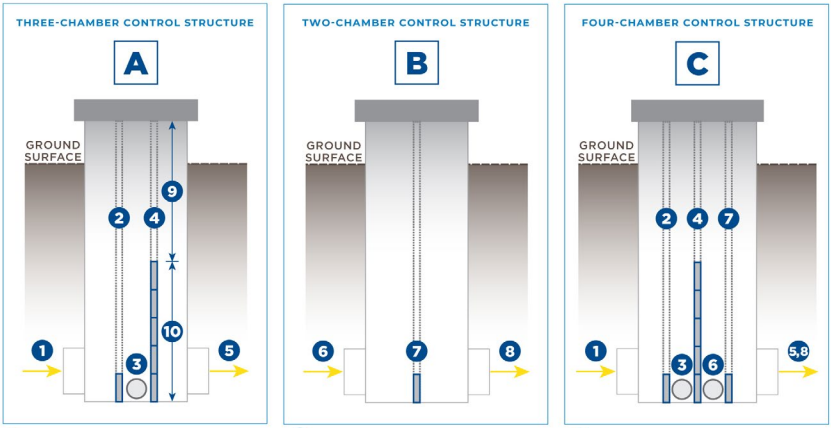
MANAGING CONTROL STRUCTURES

MANAGING WATER CONTROL STRUCTURES

Inline water control structures are a fundamental component of edge-of-field practices like saturated buffers and bioreactors as well as the practice of controlled drainage (or drainage water management. It's important to inspect and manage these structures for proper operation of these practices. Inspection and maintenance tasks are included in the appropriate checklist(s) for your practice(s). Here are some key operational considerations.



Water control structures are used to manage flow in drainage systems. For edge-of-field practices like saturated buffers and bioreactors, the control structures divert water into and control the flow of water through the practice.



1. **Drainage coming from the field.**
2. **Field-side control stoplogs:** To limit sediment entry into the saturated buffer or bioreactor, keep the bottom board installed and temporarily raise the stoplogs when doing work on the field drainage system.
3. **Inlet pipe to the saturated buffer or bioreactor.**
4. **Bypass stoplogs:** Used to set the control elevation for water into the saturated buffer or bioreactor. Anything over this level bypasses directly to the outlet.
5. **Bypass flow to the outlet.**
6. **Outflow from the bioreactor.**
7. **Bioreactor outlet stoplogs:** Used to control the speed of water through the bioreactor.
8. **Flow from the bioreactor to the outlet.**
9. **Distance from the top of the control structure to the top stoplog. One way that stoplog settings may be shown.**
10. **Height of the stoplogs. Another way that stoplog settings may be shown.**

Common control structures commonly for saturated buffers and bioreactors. Saturated buffers typically use three-chamber structures (A), but in some cases, two-chamber structures without the field-side control stoplog tracks (2) are used. For bioreactors with separate inlet and outlet structures, a three-chamber structure (A) is used for the inlet, and a two-chamber structure (B) is used for the outlet. Some bioreactors use a single four-chamber control structure (C) as a combined inlet and outlet structure.

DETERMINING STOPLOG SETTINGS

Stoplogs are the boards that set the water control elevations for your saturated buffer or bioreactor. They are typically available in 5-inch and 7-inch increments, allowing for various combinations to achieve the desired stoplog setting.

A B C D

Stoplogs typically come in 5-inch (A) and 7-inch (B) sizes. A combination of the two sizes is used to get the desired stoplog setting. For example, a stoplog setting of 29 inches (from the bottom of the structure) uses two 7-inch stoplogs and three 5-inch stoplogs (C). A special 7-inch stoplog marked BOTTOM BOARD (D) with a thicker gasket is always used as the first stoplog to seal the bottom. Depending on the structure, stoplogs may have stainless steel (A, B) or plastic lifting hooks (C, D).

The Operation & Maintenance Plan that came with your practice provides the information you need to know the number and height of stoplogs needed. The way the stoplog settings are reported can vary from plan to plan. However, they are usually reported in one or more of the following ways:

- Distance from the top rim of the control structure to the top of the top stoplog
- Height of the stoplogs from the bottom of the control structure
- Number of 7-inch and 5-inch stoplogs needed

When installing or adjusting stoplogs, it's often easier to know how many 7-inch and 5-inch stoplogs you need. However, for spot checking stoplog settings, measuring the distance from the top of the control structure to the stoplogs is usually easier. This manual includes conversion tables (at the end of this section) that convert distance from the top of the structure, height from the bottom of the structure, and the number of stoplogs needed. With one value, you can find the others. Following is an example of how to use them. Another helpful resource is the Control Structure Stoplog Settings online tool from the Iowa Soybean Association at: analytics.iasoybeans.com/cool-apps/StopLogHeight/.

Stop log height (in.)	No. of 7-in. stop logs	No. of 5-in. stop logs	Distance Below the Rim by Structure Height (inches)							
			2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	8 ft.	10 ft.	12 ft.
7	1	0	17	29	41	53	65	89	113	137
12	1	1	12	24	36	48	60	84	108	132
14	2	0	10	22	34	46	58	82	106	130
17	1	2	7	19	31	43	55	79	103	127
19	2	1	5	17	29	41	53	77	101	125
22	1	3	2	14	28	28	50	74	98	122
24	2	2	0	12	24	26	48	72	96	120
26	3	1	-	10	22	24	46	70	94	118
27	1	4	-	9	21	33	45	69	93	117
28	4	0	-	8	20	32	44	68	92	116
29	2	3	-	7	19	31	43	67	91	115

Example of using the stoplog setting conversion tables. For a 6-foot control structure with a stoplog setting of 45 inches below the top rim, the stoplog height is 27 inches above the bottom, requiring one 7-inch stoplog (Bottom Board) and four 5-inch stoplogs.

MANAGING STOPLOGS

Proper handling and storage of stop logs

Keep the stoplogs clean to prevent dirt and grime buildup in the tracks, which will shorten the gasket life. Use a container to hold the stoplogs and keep them off the ground and out of sunlight. Store them in a labeled container in the shop or another easily accessible place so that they are available when needed.

Installing stop logs correctly

When installing stop logs, make sure the lifting hooks point toward the downstream or outlet side of the structure. This sets the gasket on the downstream side, so water pressure helps create a tight seal. First, use the stoplog tool (or handle) to install the bottom board (marked with a sticker) which has a larger gasket. This seals the bottom and reduces leaks. Then, stack stoplogs on top of each other using the tool to make sure they are stacked together tightly. Aligning the stop logs firmly against one side of the track also helps minimize seepage.

Stoplog tool (handle) used for removing and inserting stoplogs from control structures. The "hook" portion is used with the lifting hooks on the stoplogs to pull up the stoplogs, while the "notch" portion is placed over the top of the stoplogs to push them down into the structure and make sure they are seated firmly.

STOPLOG SETTING CONVERSION TABLES

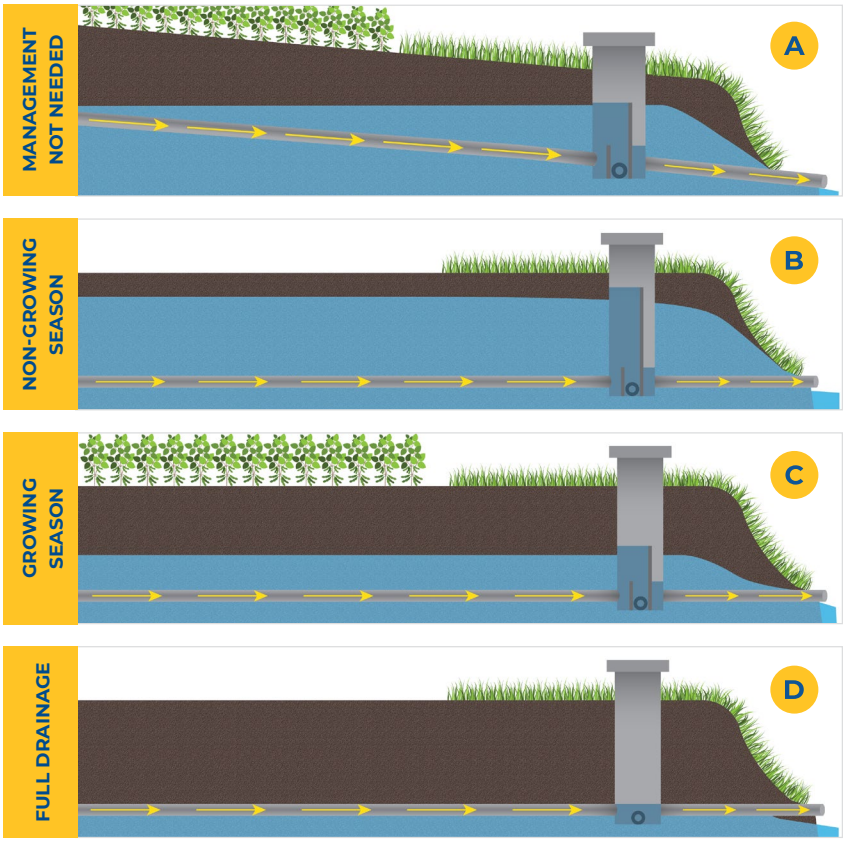
Stop log height (in.)	No. of 7-in. stop logs	No. of 5-in. stop logs	Distance Below the Rim by Structure Height (feet and inches)					
			3 ft.	4 ft.	5 ft.	6 ft.	8 ft.	10 ft.
7	1	0	2' 5"	3' 5"	4' 5"	5' 5"	7' 5"	9' 5"
12	1	1	2' 0"	3' 0"	4' 0"	5' 0"	7' 0"	9' 5"
14	2	0	1' 10"	2' 10"	3' 10"	4' 10"	6' 10"	8' 10"
17	1	2	1' 7"	2' 7"	3' 7"	4' 7"	6' 7"	8' 7"
19	2	1	1' 5"	2' 5"	3' 5"	4' 5"	6' 5"	8' 5"
22	1	3	1' 2"	2' 2"	3' 2"	4' 2"	6' 2"	8' 2"
24	2	2	1' 0"	2' 0"	3' 0"	4' 0"	6' 0"	8' 0"
26	3	1	10"	1' 10"	2' 10"	3' 10"	5' 10"	7' 10"
27	1	4	9"	1' 9"	2' 9"	3' 9"	5' 9"	7' 9"
28	4	0	8"	1' 8"	2' 8"	3' 8"	5' 8"	7' 8"
29	2	3	7"	1' 7"	2' 7"	3' 7"	5' 7"	7' 7"
31	3	2	5"	1' 5"	2' 5"	3' 5"	5' 5"	7' 5"
32	1	5	4"	1' 4"	2' 4"	3' 4"	5' 4"	7' 4"
33	4	1	3"	1' 3"	2' 3"	3' 3"	5' 3"	7' 3"
34	2	4	2"	1' 2"	2' 2"	3' 2"	5' 2"	7' 2"
35	5	0	1"	1' 1"	2' 1"	3' 1"	5' 1"	7' 1"
36	3	3	0"	1' 0"	2' 0"	3' 0"	5' 0"	7' 0"
37	1	6	-	11"	1' 11"	2' 11"	4' 11"	6' 11"
38	4	2	-	10"	1' 10"	2' 10"	4' 10"	6' 10"
39	2	5	-	9"	1' 9"	2' 9"	4' 9"	6' 9"
40	5	1	-	8"	1' 8"	2' 8"	4' 8"	6' 8"
41	3	4	-	7"	1' 7"	2' 7"	4' 7"	6' 7"
42	6	0	-	6"	1' 6"	2' 6"	4' 6"	6' 6"
43	4	3	-	5"	1' 5"	2' 5"	4' 5"	6' 5"
44	2	6	-	4"	1' 4"	2' 4"	4' 4"	6' 4"
45	5	2	-	3"	1' 3"	2' 3"	4' 3"	6' 3"
46	3	5	-	2"	1' 2"	2' 2"	4' 2"	6' 2"
47	6	1	-	1"	1' 1"	2' 1"	4' 1"	6' 1"
48	4	4	-	0"	1' 0"	2' 0"	4' 0"	6' 0"
49	7	0	-	-	11"	1' 11"	3' 11"	5' 11"
50	5	3	-	-	10"	1' 10"	3' 10"	5' 10"
51	3	6	-	-	9"	1' 9"	3' 9"	5' 9"
52	6	2	-	-	8"	1' 8"	3' 8"	5' 8"
53	4	5	-	-	7"	1' 7"	3' 7"	5' 7"
54	7	1	-	-	6"	1' 6"	3' 6"	5' 6"
55	5	4	-	-	5"	1' 5"	3' 5"	5' 5"
56	8	0	-	-	4"	1' 4"	3' 4"	5' 4"
57	6	3	-	-	2"	1' 3"	3' 3"	5' 3"
58	4	6	-	-	2"	1' 2"	3' 2"	5' 2"
59	7	2	-	-	1"	1' 1"	3' 1"	5' 1"
60	5	5	-	-	0"	1' 0"	3' 0"	5' 0"
61	8	1	-	-	-	11"	2' 11"	4' 11"

Stop log height (in.)	No. of 7-in. stop logs	No. of 5-in. stop logs	Distance Below the Rim by Structure Height (inches)					
			3 ft.	4 ft.	5 ft.	6 ft.	8 ft.	10 ft.
7	1	0	29	41	53	65	89	113
12	1	1	24	36	48	60	84	108
14	2	0	22	34	46	58	82	106
17	1	2	19	31	43	55	79	103
19	2	1	17	29	41	53	77	101
22	1	3	14	26	38	50	74	98
24	2	2	12	24	36	48	72	96
26	3	1	10	22	34	46	70	94
27	1	4	9	21	33	45	69	93
28	4	0	8	20	32	44	68	92
29	2	3	7	19	31	43	67	91
31	3	2	5	17	29	41	65	89
32	1	5	4	16	28	40	64	88
33	4	1	3	15	27	39	63	87
34	2	4	2	14	26	38	62	86
35	5	0	1	13	25	37	61	85
36	3	3	0	12	24	36	60	84
37	1	6	-	11	23	35	59	83
38	4	2	-	10	22	34	58	82
39	2	5	-	9	21	33	57	81
40	5	1	-	8	20	32	56	80
41	3	4	-	7	19	31	55	79
42	6	0	-	6	18	30	54	78
43	4	3	-	5	17	29	53	77
44	2	6	-	4	16	28	52	76
45	5	2	-	3	15	27	51	75
46	3	5	-	2	14	26	50	74
47	6	1	-	1	13	25	49	73
48	4	4	-	0	12	24	48	72
49	7	0	-	-	11	23	47	71
50	5	3	-	-	10	22	46	70
51	3	6	-	-	9	21	45	69
52	6	2	-	-	8	20	44	68
53	4	5	-	-	7	19	43	67
54	7	1	-	-	6	18	42	66
55	5	4	-	-	5	17	41	65
56	8	0	-	-	4	16	40	64
57	6	3	-	-	2	15	39	63
58	4	6	-	-	2	14	38	62
59	7	2	-	-	1	13	37	61
60	5	5	-	-	0	12	36	60
61	8	1	-	-	-	11	35	59

SEASONAL MANAGEMENT

SEASONAL MANAGEMENT

If your saturated buffer or bioreactor is lower in elevation than the adjacent cropped field by a few feet or more, the stoplog settings in the control structure won't affect field drainage. In these cases, you can consider the stoplog settings as "set-it-and-forget-it", since they generally won't need to be changed. However, on flatter sites, the stoplog settings can negatively impact drainage during certain times of the year, requiring multiple adjustments per year. The Operation & Maintenance Plan for your saturated buffer or bioreactor should indicate any seasonal management and the appropriate stoplog settings for each season. This section provides general guidance for seasonal management of control structures where needed.



Many saturated buffers and bioreactors don't need seasonal management (A), so their stoplog settings generally don't need to be changed. For those that do, adjust the stoplog settings throughout the year with the highest settings during the non-growing season (B), intermediate settings during the growing season (C), and full drainage around planting and harvest (D).

NON-GROWING SEASON

After harvest, set stoplogs at their highest level as per your Operation & Maintenance Plan to direct as much water as possible to the saturated buffer or bioreactor for treatment. If cover crops are used, consult your local conservation district or NRCS office about adjusting stoplog settings, if needed, to encourage cover crop growth.

SPRING

Lower the stoplogs two weeks before spring field operations to drain the system and create good conditions for planting. This generally means removing all stoplogs but check your Operation & Management Plan for specific details.

Lower the water level slowly from the control structure to avoid high-velocity flow that can damage the tile line. An easy way to do this is to pull each stoplog up 2 inches at a time, leaving a 2-inch gap at the bottom. Then, slowly remove the stoplogs.

Two weeks after planting, add stoplogs to match the growing season setting.

GROWING SEASON

The growing season stoplog settings balance water flow to the saturated buffer or bioreactor with field drainage. Since the drainage system isn't fully open, you may need to lower the stoplogs following heavy rains or very wet periods in the growing season to prevent crop damage. As conditions improve, remember to return the stoplogs to their growing season setting.

FALL

If there is water in the control structure in the fall, lower the stoplogs about two weeks before harvest to drain the field to be ready for harvest equipment. If drainage isn't occurring and there is no water in the control structure, the stoplogs can be left at the growing season setting. Then, as soon as possible after harvest, raise the stoplogs to the nongrowing season setting.

SEASONAL MANAGEMENT CHECKLIST

Additional operations items for saturated buffers and bioreactors that require seasonal management. If your saturated buffer or bioreactor doesn't require seasonal management, just use the respective checklist for your practice. Specific settings and details for your saturated buffer or bioreactor are in the Operation & Maintenance Plan that came with your practice design.

AFTER HARVEST

- ☐ **Raise stoplogs:** As soon as practical after harvest, add the necessary stoplogs to bring the stoplog height up the nongrowing (or fallow) season setting.

TWO WEEKS PRIOR TO SPRING FIELD OPERATIONS

- ☐ **Lower stoplogs:** Remove stoplogs to bring the stoplog height to the full drainage (or open) setting to prepare the field for planting. Usually, this means removing all stoplogs but check your Operation & Maintenance Plan.

TWO WEEKS AFTER PLANTING

- ☐ **Raise stoplogs:** Add the necessary stoplogs to bring the stoplog height up the growing (or crop) season setting.

AS NEEDED FOR WET CONDITIONS IN THE GROWING SEASON

- ☐ **Monitor conditions during the growing season.** For very wet conditions where excess water is a concern, manage the stoplogs to prevent crop damage.
- ☐ **Lower stoplogs:** Remove stoplogs to bring the stoplog height to the full drainage or open setting.
- ☐ **Raise stoplogs:** As soon as conditions improve, add the necessary stoplogs to bring the stoplog height back up to the growing (or crop) season setting.

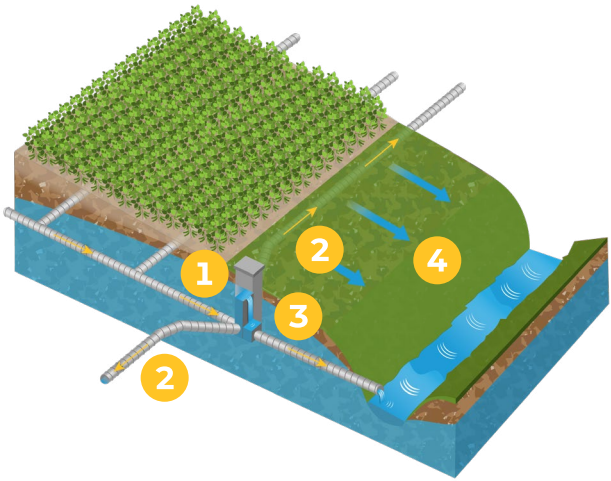
TWO WEEKS PRIOR TO HARVEST

- ☐ **Lower stoplogs if needed:** If there is water in the control structure in the fall, lower the stoplogs to the full drainage (or open) setting to prepare the field for harvest equipment. If there is no water in the control structure and drainage isn't occurring, leave the stoplogs at the growing season setting.

SATURATED BUFFERS

SATURATED BUFFERS

Saturated buffers divert water from the drainage system into a strip of perennial vegetation, typically grasses, between the crop field and the drainage outlet. A water control structure directs drainage flow into a perforated distribution pipe in the buffer zone. A bypass feature prevents negative impacts to drainage in the field. The distribution pipe allows water to seep back to the stream or ditch. As water moves through the soil and plant roots, microbes convert nitrate to harmless nitrogen gas through denitrification, and plants absorb some nitrate for growth. Saturated buffers are cost-effective, require minimal maintenance, and if there is a buffer already, don't require taking additional land from crop production.



A typical saturated buffer design where a water control structure (1) intercepts field drainage, diverts water into a perforated distribution pipe (2) running along the buffer. A bypass feature (3) prevents any field drainage issues. Water seeps through the buffer soil (4), where microbes convert nitrate in the water to harmless nitrogen gas.

MANAGING SATURATED BUFFERS

Managing a saturated buffer requires some minor operations and maintenance to keep it working well to remove nitrogen from tile drainage water. Refer to the Operation & Maintenance Plan for your saturated buffer for specific management activities. General tips for managing saturated buffers are included in the saturated buffer checklist, and the seasonal management checklist applies to buffers that also need seasonal management.

SATURATED BUFFER CHECKLIST

For saturated buffers that require seasonal management, also refer to the seasonal management checklist. Specific settings and details for your saturated buffer are in the Operation & Maintenance Plan that came with your saturated buffer design.

ANYTIME

Inspect control structure

- ☐ **Check for visible damage:** Repair or replace components as needed.
- ☐ **Check that water can flow freely:** Look for sediment or debris in the structure that could impact flow. Clean out if needed.
- ☐ **Check that stoplog settings are correct:** Measure from the top of the control structure to the top stoplog and compare to the settings in the Operation & Maintenance Plan.
- ☐ **Secure the lid:** Clip or lock the lid when finished to prevent tampering and keep animals out.
- ☐ **Control structure marking:** Make sure control structure is clearly marked to prevent damage from equipment.

Inspect saturated buffer and outlet

- ☐ **Erosion/settling:** Check for erosion or settling around the control structure, along buried pipes, and the outlet. Fill in eroded or settled areas as needed.
- ☐ **Debris:** Remove any debris that has accumulated on or around the control structure.
- ☐ **Buffer vegetation:** Make sure there is good growth of desirable vegetation in the buffer (reseeding, fertilizing, and mowing as needed). Meet contract terms for buffers in CRP.
- ☐ **Woody vegetation:** Look for trees or woody vegetation encroaching around the control structure and distribution line and control as needed.
- ☐ **Rodents:** Look for evidence of rodent damage or activity and control as needed.
- ☐ **Check drainage outlet:** Check that outlet can flow freely and make sure rodent guard is in place and operational. Fix or replace rodent guard as needed.

SPRING (DRAINAGE SEASON) AND AFTER MAJOR STORM EVENTS

In addition to the Anytime items, do the following in the spring or after major storm events:

- ☐ **Check water flow:** When the field is draining, make sure that water is flowing freely, especially if bypass flow is occurring. Remove any obstructions impeding flow.
- ☐ **Excess water:** If excess water is a concern after heavy rain or snowmelt, temporarily lower the stoplog height to speed drainage. Replace the stoplogs as soon as possible to redirect water to the saturated buffer.

FALL (OR AFTER DRAINAGE HAS STOPPED)

In addition to the Anytime items, do the following in the fall:

- ☐ **Inspect stoplogs:** Pull out and inspect stoplogs and gaskets. Replace or repair as needed.
- ☐ **Clean stoplogs and tracks:** Clean dirt or debris from the stoplogs and tracks to protect gaskets and minimize seepage.
- ☐ **Lubricate gaskets:** Use lithium grease to lubricate gaskets to minimize seepage and ensure stoplogs can move smoothly.
- ☐ **Reinstall stoplogs:** Start with bottom stoplog (marked “Bottom Board”). Make sure lifting hooks point downstream and stack stoplogs tightly using the stoplog tool to press them firmly together.
- ☐ **Replace tool, close and latch lid:** Put the stoplog tool back in the control structure, and close and clip or lock the lid.

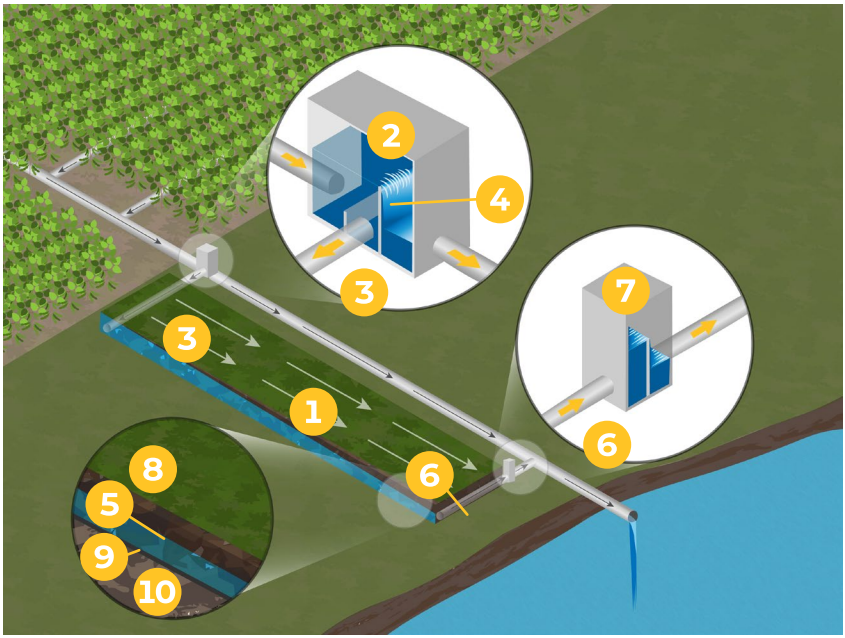
OTHER CONSIDERATIONS

- ☐ **Stoplog storage:** Store stoplogs properly (keep off ground, out of sunlight, and store in a labeled, accessible container).
- ☐ **Monitor field drainage system:** Look for signs of blowouts or other damage to the drainage system and keep any surface inlets clean and protected to keep sediment and trash from getting into the saturated buffer. Make repairs as needed.
- ☐ **When doing field drainage work:** Add stoplogs to the field-side tracks (upstream of the distribution pipe) to prevent sediment from entering the distribution line. Remove any sediment from the control structure before removing the added stoplogs.
- ☐ **Controlled burning:** If used, make sure control structure and drainage outlet are protected.

BIOREACTORS

BIOREACTORS

Denitrifying woodchip bioreactors use an excavated trench filled with woodchips as food for bacteria that convert nitrate in the water to harmless nitrogen gas. This is a natural process called denitrification. A water control structure diverts drainage water into the bioreactor, bypassing excess water to prevent field drainage issues. The treated water, with reduced nitrate, exits the bioreactor and is released to the outlet ditch or stream. Bioreactors require minimal maintenance, but unlike saturated buffers that rely on soil carbon, the woodchips in the bioreactor will eventually break down. So, woodchips will need to be replaced approximately every ten years. Bioreactors are cost-effective, have a small footprint, and don't impact crop production.



A typical bioreactor design consists of an excavated trench filled with woodchips (1). A water control structure (2) intercepts field drainage and diverts water into the bioreactor through an inlet manifold (3). A bypass feature (4) prevents any field drainage issues. Water flows through the woodchips (5), where microbes convert nitrate in the water to harmless nitrogen gas. An outlet manifold (6) collects the water and returns it to the drainage main or a new outlet. An outlet control structure (7) controls water flow through the bioreactor. Bioreactors may be open, with woodchips filled to the surface, or have a shallow soil cap (8) and typically have a plastic liner (9) to prevent water flow into or out of the bioreactor from the surrounding soil (10).

BIOREACTOR MANAGEMENT

To maintain a bioreactor for effective nitrogen removal from tile drainage water, regular operations and maintenance are necessary. Refer to the Operation & Maintenance Plan for your bioreactor for specific details. The bioreactor checklist provides general tips, while the seasonal management checklist applies to bioreactors requiring seasonal management. Additional seasonal checks are discussed below.

Check water flow and drainage

Spring

Check for flow coming from the bioreactor in the outlet control structure in the spring when the field drains. If the field tiles are flowing but bioreactor flow is slow or nonexistent, more investigation may be needed for plugged woodchips, especially for older bioreactors (over five years old). Consistently low bioreactor flow when tiles are flowing heavily suggests restricted flow, and it may be time to replace (recharge) the woodchips. Consult your local conservation district or NRCS office for concerns about bioreactor flow.

Fall

In late summer or fall, when drainage has stopped, double-check that the bioreactor has drained and isn't holding water. If the inflow structure is dry, there shouldn't be any water flowing from the outlet. Stagnant water can lead to sulfur reduction and other unwanted effects. If you consistently smell a rotten egg smell (a sign of sulfur reduction) near the outlet, reduce the number of stoplogs in the outlet structure to speed water flow through the woodchips. If the outlet control structure lacks a drawdown plate (a bottom board with a notch to allow full drainage), pull the outlet stoplogs to drain the bioreactor and replace them once the bioreactor has drained.

Newer bioreactors typically have a drawdown plate (A) in the outlet control structure. The notch on the bottom allows the bioreactor to fully drain after inflow stops to preventing stagnant water effects. For outlet control structures with a standard bottom board (B), pull stoplogs from the outlet structure in the fall to drain the bioreactor replacing them when finished.

BIOREACTOR CHECKLIST

For bioreactors that require seasonal management, also refer to the seasonal management checklist. Specific settings and details for your bioreactor are in the Operation & Maintenance Plan that came with your bioreactor design.

ANYTIME

Inspect control structures

- ☐ **Check for visible damage:** Repair or replace components as needed.
- ☐ **Check that water can flow freely:** Look for sediment or debris in the structure that could impact flow. Clean out if needed.
- ☐ **Check that stoplog settings are correct:** Measure from the top of the control structure to the top stoplog and compare to the settings in the Operation & Maintenance Plan.
- ☐ **Secure the lid:** Clip or lock the lid when finished to prevent tampering and keep animals out.
- ☐ **Control structure and bioreactor marking:** Make sure control structure and the corners of the bioreactor are clearly marked to prevent damage from equipment.

Inspect bioreactor and outlet

- ☐ **Erosion/settling:** Check for erosion or settling around the control structure, along buried pipes, and the outlet. Fill in eroded or settled areas as needed.
- ☐ **Bioreactor subsidence:** Monitor the bioreactor for sinking, or subsidence, as woodchips break down. If water collects on top of the bioreactor, add more woodchips (open top) or soil (soil cap) to prevent ponding. Contact your conservation district or NRCS office for help if you're having trouble with subsidence.
- ☐ **Debris:** Remove any debris that has accumulated on or around the control structure.
- ☐ **Woody vegetation:** Look for encroachment of trees or woody vegetation around the control structure and bioreactor and control as needed.
- ☐ **Rodents:** Look for evidence of rodent damage or activity and control as needed.
- ☐ **Check drainage outlet:** Check that outlet can flow freely and make sure rodent guard is in place and operational. Fix or replace rodent guard as needed.

SPRING (DRAINAGE SEASON) AND AFTER MAJOR STORM EVENTS

In addition to the Anytime items, do the following in the spring or after major storm events:

- ☐ **Check water flow:** When the field is draining, make sure that water is flowing freely, especially if bypass flow is occurring. Remove any obstructions impeding flow.
- ☐ **Excess water:** If excess water is a concern after heavy rain or snowmelt, temporarily lower the stoplog height to speed drainage. Replace the stoplogs as soon as possible to redirect water to the saturated buffer.
- ☐ **Check flow through bioreactor:** Make sure water is flowing out of the bioreactor.

FALL (OR AFTER DRAINAGE HAS STOPPED)

In addition to the Anytime items, do the following in the fall:

- ☐ **Bioreactor drainage:** After field drainage has stopped, check that the bioreactor has drained and isn't holding water. If the inflow structure is dry, there shouldn't be any water flowing from the outlet. Pull the outlet stoplog(s), if needed, to drain the bioreactor and replace them once the bioreactor has drained.
- ☐ **Inspect stoplogs:** Pull out and inspect stoplogs and gaskets. Replace or repair as needed.
- ☐ **Clean stoplogs and tracks:** Clean dirt or debris from the stoplogs and tracks to protect gaskets and minimize seepage.
- ☐ **Lubricate gaskets:** Use lithium grease to lubricate gaskets to minimize seepage and ensure stoplogs can move smoothly.
- ☐ **Reinstall stoplogs:** Start with bottom stoplog (marked "Bottom Board"). Make sure lifting hooks point downstream. Align firmly against one side of the tracks. Make sure stoplogs are stacked tightly using the stoplog tool to press them firmly together.
- ☐ **Replace tool, close and latch lid:** Put the stoplog tool back in the control structure, and close and clip or lock the lid so the structure is ready for next time.

OTHER CONSIDERATIONS

- ☐ **Stoplog storage:** Store stoplogs properly (keep off ground, out of sunlight, and store in a labeled, accessible container).
- ☐ **Monitor field drainage system:** Look for signs of blowouts or other damage to the drainage system and keep any surface inlets clean and protected to keep sediment and trash from getting into the bioreactor. Make repairs as needed.
- ☐ **When doing field drainage work:** Add stoplogs to the field-side tracks (upstream of the bioreactor inlet pipe) to prevent sediment from entering the bioreactor. Remove any sediment from the control structure before removing the added stoplogs.
- ☐ **Controlled burning:** If used, make sure control structures and drainage outlet are protected.
- ☐ **Grazing:** Fence off the bioreactor if the area will be grazed to keep livestock out.

ADDITIONAL RESOURCES AND INFORMATION

For more information and links to videos and other resources for saturated buffer and bioreactor management, visit:

- The Practice Management page at the Conservation Drainage Network website: conservationdrainage.net/resources/conservation-drainage/practice-management/.
- The Soil and Water Conservation Society's Conservation Media Library: swcs.org/resources/conservation-media-library.

For a more comprehensive source of information on conservation drainage practices including saturated buffers and bioreactors, visit the Conservation Drainage Network Resource Library: conservationdrainage.net/resource-library/.

For additional questions, reach out to your local conservation district or NRCS office or your Cooperative Extension Service.

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