Supplementary Information (SI): Influence of Tritium Exposure Route on Vegetation Types at the Savannah River Site

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Detailed Plant Descriptions for the Maint Text (MT) Methods Section:

There were many types of plants that were sampled as part of this study. A description of the wetland plants (*Typha, Juncus, Sparganium* and *Nymphaea*) is provided in Niering (1979)[1] and descriptions of other non-wetland plants are also provided as noted below.

One of the plant samples consisted of *Typha latifolia* (commonly known as cattail, bulrush or reed although bulrush and reed are names for other plant species), which is native to the northern hemisphere. This plant prefers to live on the edges of freshwater water bodies, has long sword-like leaves on a stiff stalk, is 90 to 270 cm in height and forms a meshed rooting system near the sediment surface.

Juncus (soft rush) is a common marsh plant that grows in clump, has soft grass-like stems, is 45 to 120 cm tall and has small green-brown flowers that grow close to the top and on one side of the stem.

American burreed or *Sparganium americanum* is a flowering aquatic plant that has grass-like stalks with wide leaves (5 to 11 cm) that grow to 90 cm. It is a partially emerged plant that roots in the underwater sediment and it produces green ball-like flowers from its stalks.

Pond lily (*Nymphaea*) is another aquatic plant with 10 to 30 cm diameter floating leaves and white flowers. It can be found along the shore of ponds or in deeper slow-moving water. The flat leaves are sponge-like and the stems have channels to move oxygen to the underwater rhizomes which rest on the muck above the sediment bottom.

A cedar tree of unknown species was sampled. Cedar trees are sometimes observed in wetlands.[2] They typically have scale-like aromatic leaves that are blue-green in color. Mature trees can reach up to 30 m in height.

Wax myrtle or Southern bayberry (*Myrica cerifera* L.) is a small tree that grows to 9 meters (m) and is often found in sandy soils of swamps, bogs and pineland forests.[2,3] It has reverse lance-shaped leaves, light gray smooth bark, an aromatic smell, produces small 3 mm drupes (berry-like fruit) and has tiny white flowers that grow up to 19 mm wide.

Spanish moss (*Tillandsia usneoides*) is a bromeliad epiphyte that lives on other tree branches. It consists of a mass of wavy grey stems that can be several m in length. It is found throughout the Southern U.S.[3]

Another plant that was sampled was *Bacopa caroliniana* (commonly known as blue water-hyssop).[4] This creeping perennial prefers moist edges and can be found submerged in shallow waters of slow-moving water bodies. It is a common plant in the eastern U.S. that has blueish purple flowers and the leaves are lemon scented when crushed.

Cyperus (often called a sedge) is a common plant that is found in the southeastern U.S. and in many cases it can be invasive. One of the plants that we obtained in the field was the yellow nutgrass (*Cyperus esculentus* L.). It has spiked grass-like blades, reaches up to 70 cm in height and has small spiked golden-brown florets. It will inhabit parking lots, lawns, gardens and fields.[4] The other *Cyperus* that we found was the dwarf papyrus *(Cyperus haspan*), which prefers moist

habitats. We refer to this plant as “papyrus”. It can be invasive and is common in the southeastern U.S. It grows up to 0.6 m tall.[5]

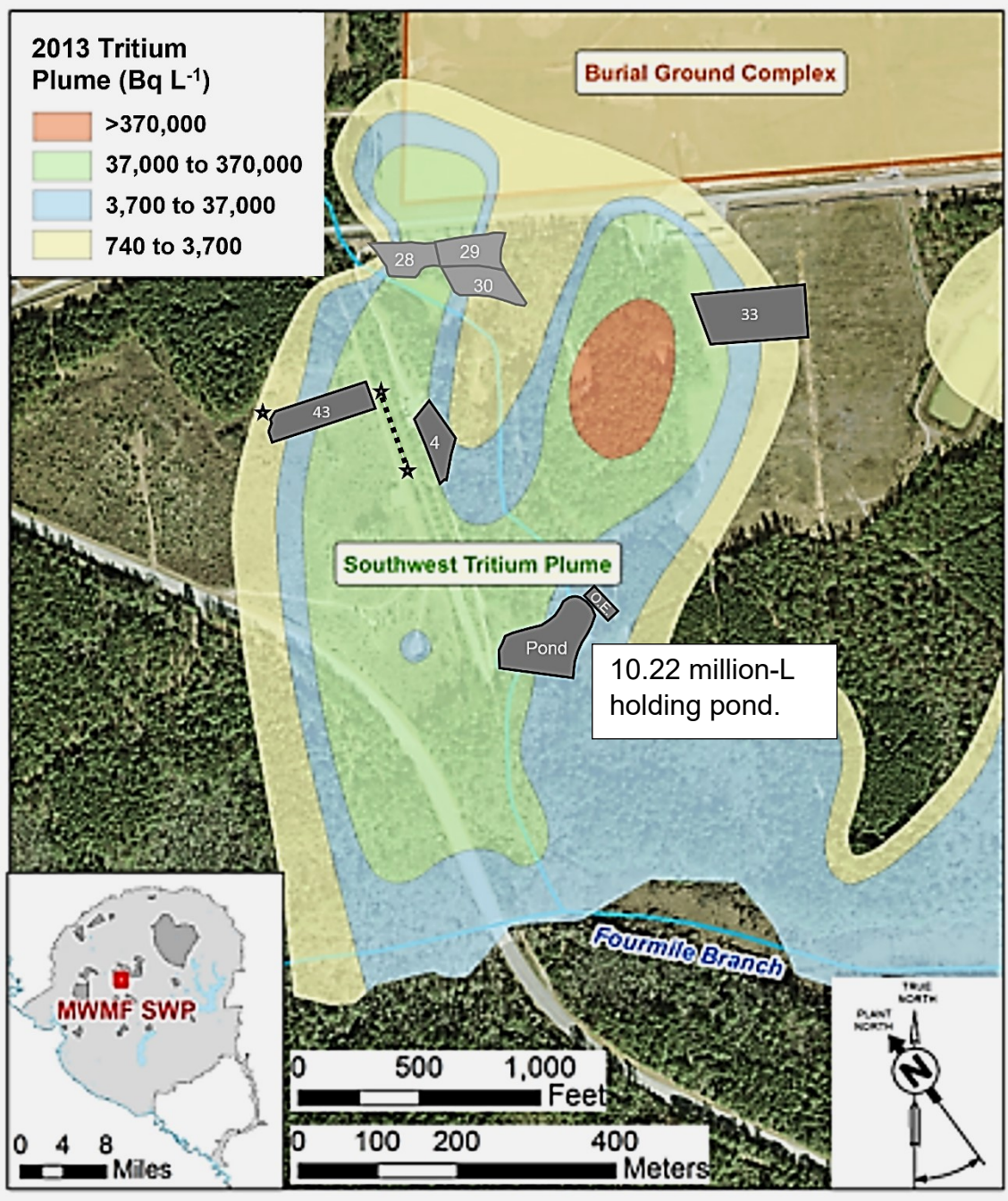
Wild millet (*Echinochloa*) is also known as barnyard grass. It prefers to grow in moist disturbed areas and has blades that produce an inflorescence that somewhat resembles rice or wheat. It can reach a height of nearly 60 to 120 cm. It has a fibrous root system that can reach up to 46 cm deep.[6]

Juniperus virginiana L. or red cedar is a common coniferous shrub that grows in the southeastern U.S. and can reach heights of 15 m. It has whorls of small needle-like leaves, with yellow and blue flowers and blueish-black fruit.

Monkey grass (*Liriope*, sometimes called spiker grass) is a common Asian ornamental in South Carolina that can be found in the wild.[7] It is a hardy, evergreen invasive plant that is used for a ground cover. It has leaves that are leather-like and have up to 11 veins, purple-blue flowers and it produces purplish black berries in the fall months and has a tufted base.[7]

Location	Latitude (°N, DD)	Longitude (°W, DD)
Aiken County	33.53799	-81.73873
Tinker Creek	33.37017	-81.52820
MWMF	33.27601	-81.66831
R Canal	33.28042	-81.57696
Par Pond	33.30539	-81.51607

SI Table 1. Global Position System (GPS) Information for MT Figure 1.



SI Fig. 1. A map of the MWMF adapted from SRNS (2014)[8] that shows the location and concentration of the T groundwater plume from prior work and the sampling areas of interest in this paper including: Plots 4, 33 and 43, Plot 43 ditch (dashed black line), Plot 43 road, the MWMF pond and the Old Evaporator. The groundwater T plume has moved very little in direction of magnitude due to the successful use of remediation and phyto-irrigation for the last 20+ years at the MWMF.[9,10]

SI Table 2. Total T combustion pyrolyser settings for sample analysis.

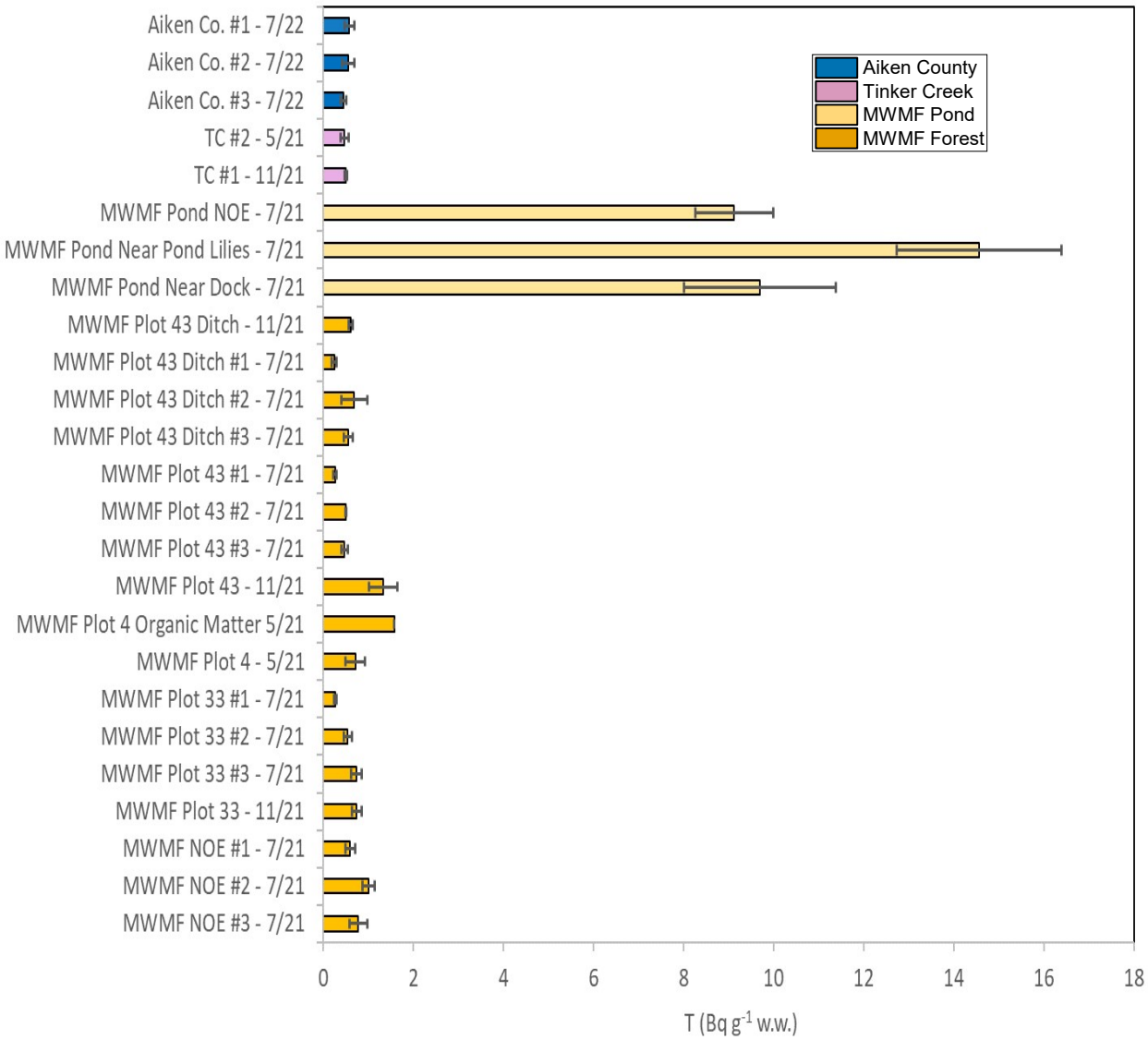
ZONE 1			
Ramp Rate (^{o}C min.$^{-1}$)	**Target Temperature (^{o}C)**	**Dwell Time (min)**	**Purge Gas**
3	200	20	Air
3	300	20	Air
3	500	90	Oxygen
ZONE 2			
Ramp to 500^{o}C when Zone 1 is at 500^{o}C			
ZONE 3			
Remain at 600^{o}C for until completion			

SI Table 3. HTO speciation pyrolyser settings for sample analysis.

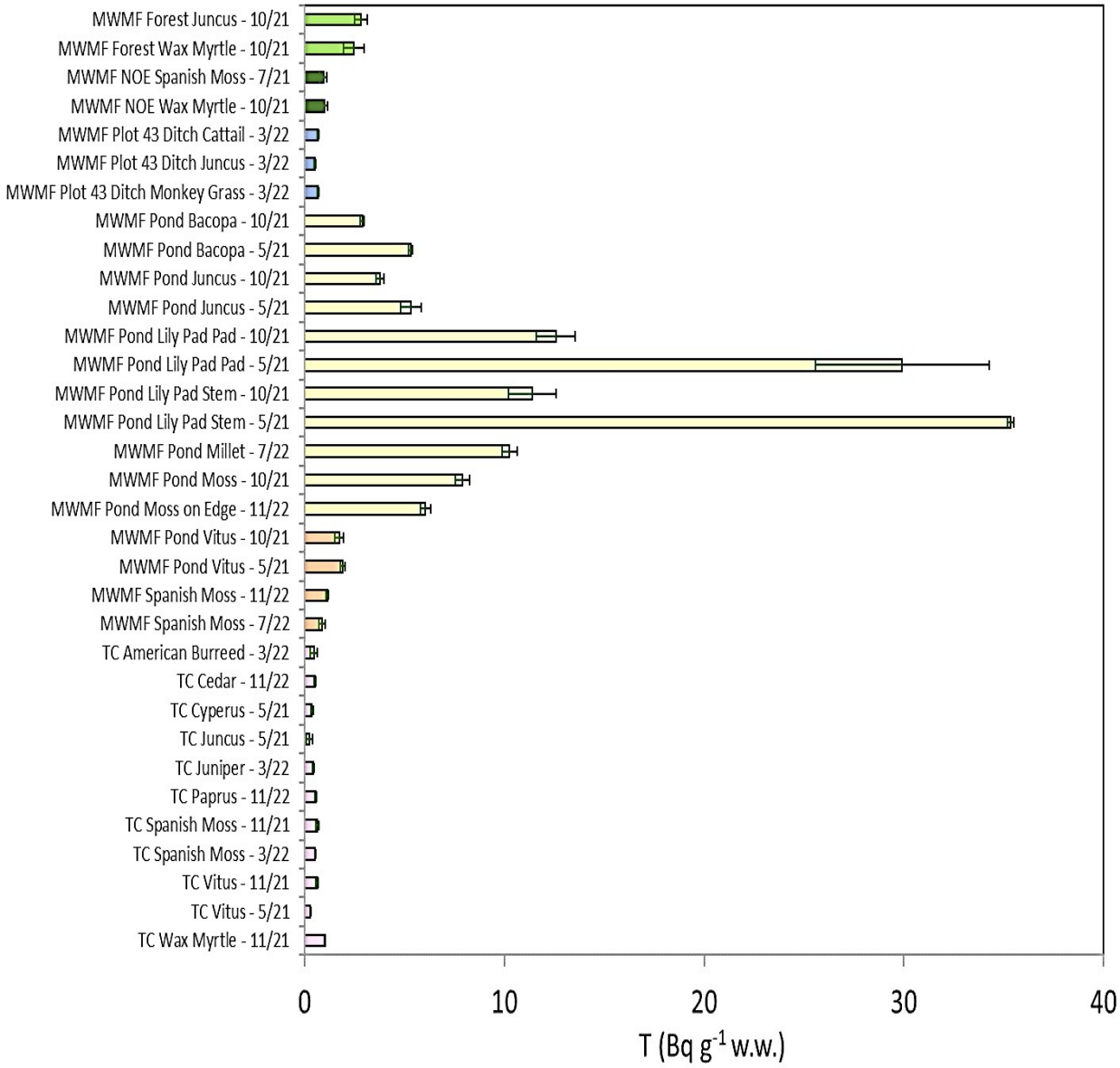
ZONE 1			
Ramp Rate (^{o}C min.$^{-1}$)	**Target Temperature (^{o}C)**	**Dwell Time (min)**	**Purge Gas**
2.5	150	30	Air
ZONE 2			
No set temperature – intermediate zone between 150^{o}C and 600^{o}C			
ZONE 3			
Remain at 600^{o}C for entire run duration			

SI Table 4. NE-OBT speciation pyrolyser settings for sample analysis.

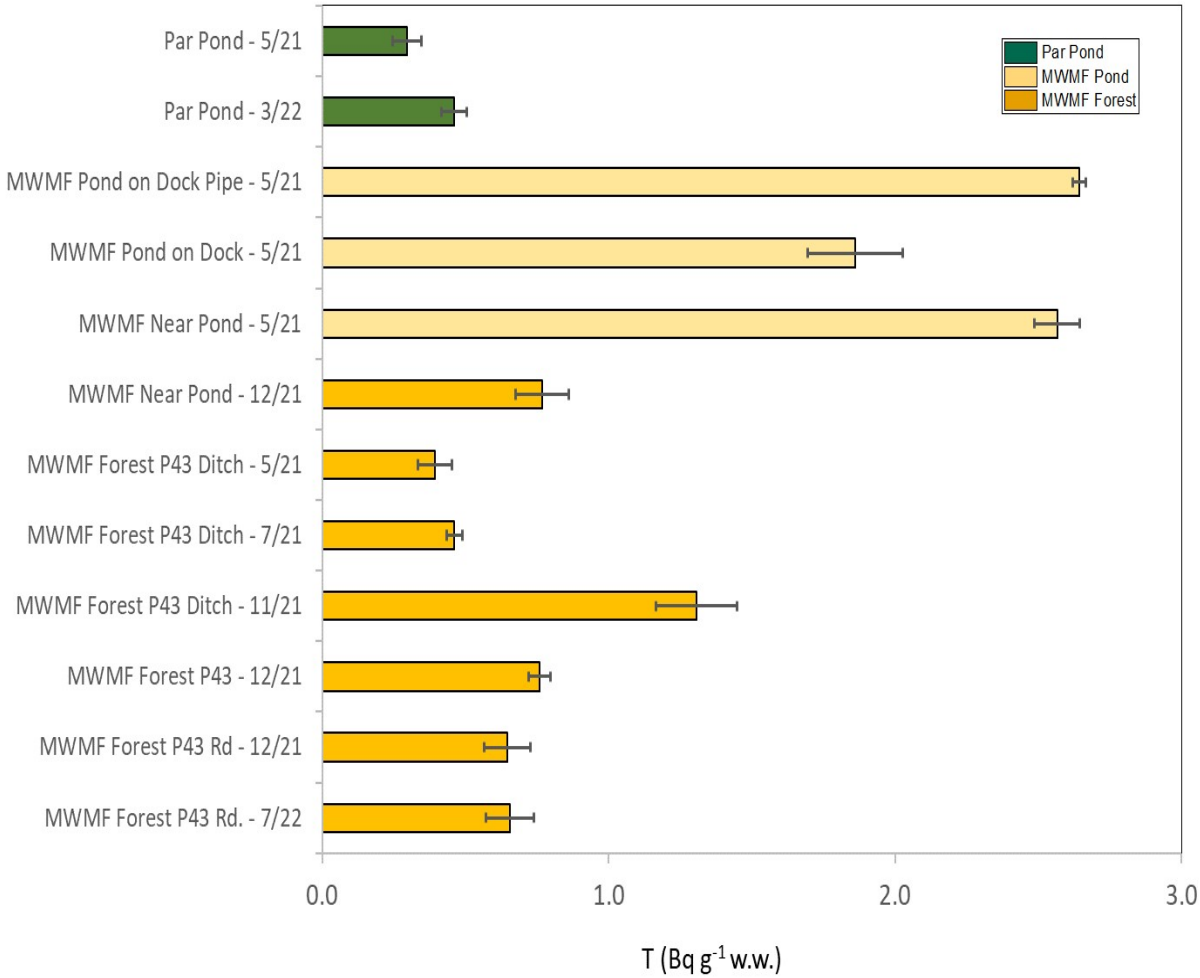
ZONE 1			
Ramp Rate (^{o}C min.$^{-1}$)	**Target Temperature (^{o}C)**	**Dwell Time (min)**	**Purge Gas**
5	600	60	Oxygen
ZONE 2			
Ramp to 500^{o}C when Zone 1 is at 600^{o}C			
ZONE 3			
Remain at 600^{o}C for run duration			



SI Fig. 2. Measurement data for T from the total combustion of MWMF forest organic matter, forest soil, and pond sediment samples.



SI Fig. 3. Measurement data for total T from the total combustion of plant samples.



SI Fig. 4. Measurement data for T from the total combustion of lichen samples. P43: Plot 43. All of the lichens from the pond dock were crustose lichens of unknown species. All remaining lichens were *Cladina rangiferina*, which is a fruticose lichen (also known as reindeer lichen) that is common to the area.

SI Table 5. July 2021 MWMF pond sediment data for total T and T-based on speciation measurements of HTO, NE-OBT and E-OBT.

July 2021 MWMF Pond Sampling	Total T from Combustion		Total T from Speciation		OBT:HTO	NE-OBT:E-OBT
	Bq T g^{-1} (w.w.)	±SD	Bq T g^{-1} (w.w.)	±SD		
Sediment near Pond Lilies	14.6	1.8	8.8	1.2	0.08	2.6
Sediment near Old Evaporator	9.1	0.9	7.5	0.7	0.10	3.7
Sediment near Dock	9.7	1.7	7.3	0.6	0.09	5.4

SI Table 6. Plant data for total T and T-based on speciation measurements of HTO, NE-OBT and E-OBT.

Plant Sample Description*	Total T from combustion		Total T from speciation		OBT:HTO	NE-OBT: E-OBT**
	Bq T g^{-1} (w.w.)	±SD	Bq T g^{-1} (w.w.)	±SD		
MWMF Pond *Vitus* - 5/21	1.9	0.1	2.5	0.6	0.4	3.7
MWMF Pond *Bacopa* - 5/21	5.3	0.1	4.8	1.1	0.4	3.7
MWMF Pond Millet - 7/22	10.3	0.4	10.5	1.1	0.2	3.5
MWMF Pond Lily Pad - 5/21	29.9	4.4	11.6	1.7	0.3	2.7
MWMF Pond Lily Pad - 10/21	12.6	1.0	7.6	1.2	0.2	NA
MWMF Pond Lily Stem - 10/21	11.4	1.2	10.7	0.7	0.1	4.5
MWMF Pond Moss Near Lilies - 10/21	7.9	0.4	7.6	1.2	0.1	3.7
MWMF Plot 43 Ditch *Juncus* - 3/22	0.5	0.0	1.2	0.6	1.1	6.5
MWMF Plot 43 Ditch Cattail - 3/22	0.7	0.0	1.5	0.8	1.1	33.6
MWMF Plot 43 Ditch Monkey Grass - 3/22	0.7	0.0	1.4	0.7	1.1	16
MWMF Forest *Juncus* - 10/21	2.8	0.3	3.8	0.8	0.4	3.6
MWMF Forest Wax Myrtle - 10/21	2.5	0.5	3.7	1.0	0.5	3.5
MWMF Forest Spanish Moss - 7/22	0.9	0.2	1.5	0.6	1.2	2.8
MWMF NOE Spanish Moss - 7/21	0.9	0.2	1.4	0.7	1.5	3.0
MWMF NOE Wax Myrtle - 10/21	1.0	0.2	2.0	0.7	0.8	4.4
TC *Juncus* - 5/21	0.2	0.2	1.0	0.4	1.3	3.5
TC *Vitus* - 5/21	0.3	0.0	1.0	0.4	1.2	2.8
TC *Cyperus* - 5/21	0.4	0.1	1.1	0.4	1.2	3.3
TC Wax Myrtle - 11/21	1.0	0.0	1.3	0.7	1.7	5.1
TC American Burreed - 3/22	0.5	0.2	1.0	0.4	1.2	3.2

*NOE: Near Old Evaporator; **NA: Not applicable: the E-OBT levels were below detection.

SI Literature Cited:

[1] W. A. Niering, National Audubon Society Field Guide to North American Wildflowers, 1979, Alfred A. Knopf, 15th edition, New York.

[2] W. A. Niering, National Audubon Society Field Guides: Wetlands, 1988, Alfred A. Knopf, third edition, New York.

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[4] W. H. Duncan and M. B. Duncan, Wildflowers of the Eastern United States, University of Georgia Press, Athens, GA, 30602.

[5] "*Cyperus haspan* Linn. in Flora of North America @ efloras.org" eFlora. Missouri Botanical Garden, St. Louis, MO & Harvard University Herbaria, Cambridge, MA., 2003. Web. Accessed February 2018.

[6] W. E. Pittman Jr. and J. W. Sweeney, State-of-theart of phosphatic clay dewatering technology and disposal techniques (in two parts), U.S. Dept. of Int. Bureau of Mines and Florida Inst. Phosphate Research. 1983, Publ.# 02-017-021.

[7] C. Grey-Wilson and P. Cribb, Guide to the Flowers of Western China, Kew Publishing, Richmond, Surrey, TW9 3AB, UK, 2011.

[8] Savannah River Nuclear Solutions (SRNS), *Mixed Waste Management Facility Groundwater Remediation Fact Sheet*, 2014, SRNS, Aiken, SC 29808.

[9] SRNS, *Savannah River Site Environmental Report 2022*. SRNS-RP-2023-00273, Aiken, SC 29808.

[10] SRNS, *Annual Corrective Action Report for the F-Area Hazardous Waste Management Facility, the H-Area Hazardous Waste Management Facility, and the Mixed Waste Management Facility,* Savannah River Site, Vol. 1, April 2021, SRNS-RP-2021-00513, Aiken, SC 29808.