2020 Tomahawk Lake Association
Hydraulic Conveyor System
Harvesting Report

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2020 Hydraulic Conveyor Harvesting Report

February 20, 2021

The summer harvesting season of 2020 represents the 12th year anniversary of the operation of the Hydraulic Conveyor System's (HCS) program in the Tomahawk Lake Watershed. Over that 12-year period, the goals for the program have proceeded largely unchanged, building upon the strong operational base established in the initial summer of HCS operation in 2008. Continued refinement of operational protocols has taken place over its years of operation, but the overall goal of the HCS continues to be for the purposes that it was originally designed for; removing new, previously undiscovered points of infestation of EWM. It is by removing these newly discovered infestation sites that the goal of stopping or greatly reducing the spread of EWM before it becomes established may be realized.

In recent harvesting seasons, most notably the 2017 – 19 seasons the HCS has modified it's procedures to devote a greater proportion of its efforts in the removal of EWM from larger high density beds. These changes have been in response to the rapid growth of high density EWM in areas which previously were controlled through the judicious use of chemical herbicides targeted at high density locations. With the continued WDNR and TLA reluctance to apply for and issue permits for the use of chemical herbicides during those seasons(beginning in 2016), the areas of high-density beds of EWM have expanded both spatially and in density. The Tomahawk Lake Association has responded by allocating a greater portion of HCS harvesting efforts in those areas.

In January of 2019, the TLA Board of Directors authorized the construction and operation of a second HCS boat for 2019 and beyond. (This was done without any shared cost grant support from the State of Wisconsin.), In the spring of 2020, the TLA Board of Directors decided to use only one of the two available HCS work boats, due to Covid-19 constraints and budgetary concerns.

Hydraulic Conveyor System Concept & Design:

The original concept of the HCS was developed in the fall of 2008 and was tested in September of that year. The design and construction of the original HCS was done in the spring of 2009 with the design targeting the removal of EWM in areas of new infestation, where the size of the new outbreak is small enough to preclude chemical treatment, and where the diver can remove the entire outbreak before it spreads or becomes established to the point where it adversely affects the native plant and animal community. In addition, the HCS works well in areas where other treatment regimens cannot be used effectively. These areas include areas around and behind docks, areas under boathouses and other structures, and areas where the use of other treatments may adversely affect sensitive areas. A third use for the HCS, although not a use that was anticipated when the concept and design were under development is in locations where chemical treatments have proved ineffective, and where the risk of EWM propagation from fragmentation is high. This includes areas of high EWM density that are susceptible to high boat traffic. An example is in areas in and around restaurant docks and fuel docks.

In subsequent years, the use of the HCS has been expanded to include harvesting in larger, highly dense EWM beds where no other means of control have been available to TLA. While the HCS work boats are highly visible to the public, this use is not efficient and is no doubt cost prohibitive.

Historical Perspective:

Historically, the HCS system has been remarkably consistent in its seasonal harvesting results, with the environmental factors of early season water temperatures and the resulting degree of plant development during the month of June being the determining factors. With the inclusion of larger, more dense beds (2017 season), the seasonal drained weight has increased substantially.

	2015	2016	2017	2018	2019 (2 Boats)
Number of sites	114	102	85	124	128
Seasonal drained weight	24,765	26,653	44,375	41,538	36,457
Approximate area (in sq. ft.)	65,225	84,040	65,522	59,940	78,375
EWM selectivity (bi-catch)	93.19%	94.04%	95.65%	95.11	93.227%

Limiting Factors of Success:

Of the four elements noted above that we have reported on a yearly basis, only *"Seasonal Drained Weight"* gives an accurate measure of the program's progress, as it is an actual representation of what the HCS system accomplished during it's time of seasonal operation. The other two measures of harvesting; "Number of Sites" & Approximate Area (in Square Feet") do not represent any accurate measure of success because they are simply indicators of EWM plant density, and the homogenous nature of the beds harvested. In beds that are more homogenous (higher density of EWM vs. other plant species), relatively more daily drained weight is harvested in less square footage. (More plant weight from a smaller footprint)

As this trend happens, the daily drained weight of harvested EWM would increase even as the harvesting is slowed and the number of EWM plants harvested increases. In the Tomahawk Lake watershed however, the size of the watershed is so great that the emergence of new & dense beds of EWM at new locations seems to overshadow the elimination of high-density older beds. It seems that there are always new & dense beds to harvest.

In 2018 the critical factors which limited the success of the harvesting program were growth in the spatial size of EWM beds and most impactful, the increased plant density within those beds!

2020 Harvesting Results:

The following results were obtained during the 2020 harvesting season:

Number of sites:	77 sites (1 boat)
Seasonal drained weight:	26,082#
Approximate Area Removed	22,550 sq. ft.
EWM selectivity (bi-catch):	97.0 %

Discussion:

The 2020 harvesting season was the first year in several that the HCS program returned to it's original design goals. Following several years of working at removing EWM from large, dense beds of EWM, the HCS team was asked to return to the targeted areas described in the "Concept & Design" section of this report.

In 2020, TLA utilized only one Hydraulic Conveyor System (HCS) boat to harvest Eurasian Water Milfoil (EWM) in the Tomahawk Lake Watershed. There were a number of factors that effected the harvest results:

- Covid 19 concerns and protocols required a small amount of new training which pushed back the actual start of harvesting a few days.
- The launching and tuning of the new smaller HCS was not completed until Mid-June.
- Weather conditions (wind & electrical storms) forced our dive teams to get off of the water early or to not go out onto the watershed in several days.

The effects of these factors were to limit the initial efficiency of the harvesting effort early on, however once adjustments were made to the system, the harvesting work continued at a relatively high level. In addition, the focus of the Hydraulic Conveyor System effort was realigned somewhat, to place greater priority on the original goals for which the HCS was designed. Because of the rapid expansion of the size and density within the EWM beds highlighted in the 2019 End of Year P.I. Survey, the decision was made to place greater emphasis on those areas where heavy dense EWM interfaced with near shore/on-shore docks, boat houses, and areas in and around public access points. These areas typically contain a more mixed plant community rather than the heavy EWM monocultures harvested in recent years.

The results for 2020 are noted below:

Number of Sites:

The number of sites that are harvested over the course of the typical HCS harvesting season varies greatly due in part to a number of factors which are beyond the control of the harvesting team. These factors include but are not limited to:

- Weather conditions including high wind, electrical storm activity, and extremely cold temperatures.
- Mechanical failures of equipment
- Changes in diver seasonal start and stop dates (students)

In 2020, the number of sites harvested were affected adversely by a high number of windy days which led to adjustments to daily harvesting plans and locations. Equipment failures played a relatively minor role with mechanical failure down time about average.
EWM plant density within harvested beds was higher than in previous years which slowed the harvesting rate, and reduced the total number of

beds which were harvested. In all 77 sites were harvested with one boat in 2020, up from 64/boat average in 2019.

Seasonal Drained — Seasonal drained weight was lower on a per boat basis than in recent previous harvesting seasons for the adverse reasons noted above and the realignment to smaller, more mixed sites associated with shore side structures. (docks, boat houses & public area structured).

Typically, fluctuations in total seasonal drained weight tend to be a product of the number of harvested sites, as well as EWM site density and in particular, site homogeneity.

Approximate Area: — *"*Approximate Area" Searched has no relevancy in understanding the nature of the annual harvest, because the plant density within the harvested sites has no "baseline" value. There can be no comparatively valid conclusions drawn between a 100 square foot area with 10 EWM plant clusters of 10 stems per cluster, and a 100 square foot highly dense bed with 50 stems per square foot. However, we do keep records of estimated surface area of locations where harvesting took place. In 2020, the estimated surface area (foot print) where EWM was removed was 22,550 Sq. Ft.

Bi-Catch: — Bi-Catch sampling provides a snapshot in time of diver efficiency in 1. plant identification and 2. ability to selectively harvest only the target species (EWM.) Over time, Bi-catch % of the target species should increase as diver skills in these areas develop. In 2020, the HCS team recorded a bi-catch average of 97 % of harvested plant material as Eurasian Water Milfoil (Target species).

This represents a relatively high %. The bi-catch result is a testament to our divers' ability to quickly recognize EWM while underwater and segregate EWM stems from the other native plant stems. This process obviously slows the harvesting process down. Both of our 2020 divers have worked for TLA in the past, and experience is a great advantage in performing the harvesting task. In other words, the more that you do it the better you get at it!

Conclusion:

Since the beginning in 2017, the only means TLA has utilized to remove EWM from the lakebed has been by the use of the Hydraulic Conveyor System, (and any shoreline owner initiatives of hand pulling EWM plants). Future monitoring efforts by TLA will need to determine how TLA utilizes the HCS in future years. It should be remembered that the Hydraulic Conveyor System was developed to control smaller areas of new infestation. As established EWM infestations continue to grow in both spatial size and plant density, the HCS has become less effective in its ability to "keep up" with the demands of larger and larger areas of EWM infestation. It is for this

reason that TLA chose to add additional harvesting capacity by way of a second HCS boat in 2019. Unfortunately, 2020 budgetary restraints did not allow for the operation of TLA's second HCS Boat. The truth is however that the HCS is not effective in removing large amounts of EWM from heavy dense EWM beds. It is much more effective when used for the purposes it was designed for.

The Tomahawk Lake Association believes that the HCS contribution to the 2020 EWM control effort had little effect in the overall control of EWM in the Tomahawk Lake Watershed. Tomahawk Lake's large size, coupled with its many bays, it's diversity of the character of it's lakebed, and the high degree of public usage of the resource all have had a negative effect on the control and reduction of the EWM infestations in our lake. The HCS program was never designed to remove large amounts of EWM from the lake bed. It was designed to limit and reduce the growth of new areas of EWM in previously un-infested sites, and to control EWM in and about docks, boat houses and sensitive areas. In a sense, 2020 represents a return to it's original purpose.

Historically, the Hydraulic Conveyor System has been one element in a two-tiered treatment regime in our effort to control and reduce the effects of Aquatic Invasive Species in our watershed. The original two-tiered regime called for the judicious use of aquatic herbicides to remove / control larger areas of established heavy dense EWM, followed by the season long use of the Hydraulic Conveyor System to remove and/or reduce EWM in new areas of infestation, around shore side structures, public use structures and in sensitive areas. In 2016 the use of herbicides was discontinued. While the use of aquatic herbicides to control EWM is constantly being debated, there is little debate that it has been effective in removing large areas of heavy dense EWM in many lakes.

In 2021, TLA is committed to utilizing Mechanical Harvesting (Mowing) to remove heavy dense EWM foliage from the surface in many out of control areas in the watershed. While mowing may remove plant material from the surface of the lake for a short period of time, it will not remove the plant beds.

In 2021, TLA will again operate one HCS work boat to control EWM infestations in and around docks, boat houses and public use structures (ramps, swim areas, restaurants etc.) While the HCS will have little to no effect on the approximately 129 acres of EWM targeted for mowing, it is hoped that it will have a positive effect on the useability of the shoreline areas where it operates.

Table #1 - 2020 HCS Harvesting Site Data

SiteID	Latitude	Longitude	Depth	Est. SqFt_Removed	Date_	Comment
1	45.845167	-89.689667	6.5	200	2020-06-03	
2	45.817167	-89.692	3.5	0	2020-06-04	
3	45.817167	-89.692167	3.5	400	2020-06-05	
4	45.825833	-89.65	15	200	2020-06-05	
5	45.831333	-89.684833	4.5	200	2020-06-08	Dock Bay
6	45.843	-89.680333	6	800	2020-06-09	Kemp
7	45.831333	-89.684833	4	0	2020-06-10	Boat issues
8	45.820833	-89.620833	6	0	2020-06-11	Area 6 resort shore stations
9	45.842833	-89.680167	9	300	2020-06-13	Kemp
10	45.826333	-89.652833	15.5	800	2020-06-16	North side of Windy Point
11	45.813667	-89.611	4.5	1400	2020-06-17	Run away raft fetch
12	45.826333	-89.6525	10	600	2020-06-18	N side of Windy Point
13	45.8355	-89.688833	18.5	0	2020-06-19	Josh Corner
14	45.835333	-89.688667	6	400	2020-06-22	Josh Corner
15	45.826167	-89.652667	6.5	200	2020-06-22	N Windy Point
16	45.842333	-89.681667	3.5	0	2020-06-23	Kemp swin dock w/Plaque
17	45.8315	-89.684667	5	100	2020-06-23	Our Dock
18	45.842667	-89.676	4.5	600	2020-06-24	Back pocket Kemp/Jetski Dock
19	45.8425	-89.677833	4	200	2020-06-24	Across from Kemp Station
20	45.826167	-89.6525	4.5	400	2020-06-25	N Windy Point
21	45.826167	-89.652667	11	200	2020-06-28	N Windy Point
22	45.842833	-89.6785	15	600	2020-06-30	Kemp
23	45.826167	-89.6525	15	300	2020-07-01	N Windy Pt
24	45.844333	-89.689833	4	200	2020-07-02	Left of Lakeside
25	45.831333	-89.684667	4.5	0	2020-07-02	Our Dock
26	45.843	-89.680667	11	300	2020-07-03	Kemp by Torys Raft
27	45.826167	-89.6525	10	400	2020-07-06	N Windy Pt
28	45.816333	-89.692167	4.5	400	2020-07-07	Ann's
29	45.826167	-89.6525	10	200	2020-07-07	
30	45.807833	-89.639667	10	0	2020-07-08	Sunflower Bay Guy
31	45.8315	-89.684833	5	0	2020-07-08	Our Dock
53	45.812667	-89.681667	7	500	2020-07-12	Frosts
32	0	0	0	0	2020-07-13	Wrights
33	45.816	-89.691667	10	0	2020-07-13	Noah's
34	45.826333	-89.651667	4.5	0	2020-07-14	N Windy Pt /Rainy Day
35	45.826167	-89.6525	8.5	200	2020-07-15	N Windy Pt
36	45.8135	-89.6755	9.5	300	2020-07-16	Sylvan Corner
SiteID	Latitude	Longitude	Depth	Est. SqFt_Removed	Date_	Comment

37	45.842833	-89.6785	10	200	2020-07-16	Kemp
38	45.822667	-89.689833	13.5	200	2020-07-17	Next to Furguson's
39	45.826	-89.652167	4.5	200	2020-07-17	N Windy Pt Spooky Log Square
40	45.826167	-89.6525	7.5	150	2020-07-20	N Windy Pt
41	45.822667	-89.689667	12	400	2020-07-20	Furguson
42	45.842833	-89.674333	4	500	2020-07-22	Back Kemp Corner
43	45.8425	-89.675	13	300	2020-07-22	2 over
44	45.842833	-89.674333	4	200	2020-07-23	Back Kemp Corner
45	45.842667	-89.678167	5	400	2020-07-23	Kemp Giant Green Shorestations
46	45.825667	-89.650333	11.5	300	2020-07-28	S Windy Pt
47	45.835	-89.6885	6	300	2020-07-29	Raft by Rickers (?)
48	45.8245	-89.6145	16.5	300	2020-07-29	Next to Judy
49	45.824667	-89.615	20	300	2020-07-31	Next to Judy
50	45.824667	-89.615	18	400	2020-08-04	Next to Judy
51	45.831333	-89.685	5	200	2020-08-04	Our Dock
52	45.826167	-89.652667	16	300	2020-08-07	N Windy
54	45.824833	-89.615	13	400	2020-08-13	Next to Judy
55	45.812167	-89.611333	4	500	2020-08-14	Bruce's
56	45.816	-89.6075	10	250	2020-08-14	Sawmill Patch
57	45.824833	-89.615167	6.5	400	2020-08-15	Next to Judy
58	45.842	-89.677	18	400	2020-08-17	Kemp Peninsula
59	45.824833	-89.615	7	200	2020-08-17	2 down from Judy
60	45.816	-89.6075	5.5	500	2020-08-18	Sawmill Patch
61	45.842667	-89.674333	14	200	2020-08-18	Back Kemp Corner
62	45.824667	-89.614833	9	300	2020-08-19	Wakeboard Boat
63	45.826333	-89.652833	12	300	2020-08-20	N Windy Pt
64	45.817167	-89.691	20	200	2020-08-21	front of Wrights
65	45.8225	-89.6935	4.5	150	2020-08-24	Lasier
66	45.824667	-89.615	13	250	2020-08-24	Wakeboard Boat
67	45.8225	-89.6935	3	250	2020-08-25	Lasier
68	45.835	-89.688667	4.5	400	2020-08-25	Next to Rikkers
69	45.824667	-89.614833	20.5	250	2020-08-27	Wakeboard Boat
70	45.808	-89.639833	14	250	2020-09-01	Sunflower Corner
71	45.842667	-89.674333	8	300	2020-09-02	Back Kemp Corner
72	45.8225	-89.6935	8	400	2020-09-02	Lasier
73	45.822667	-89.689833	12	200	2020-09-04	Furguson
74	45.808167	-89.639833	11	250	2020-09-16	Sunflower Corner
75	45.808167	-89.639833	11	400	2020-09-16	
76	45.826333	-89.652833	16	350	2020-09-22	Windy Point
77	45.826333	-89.652833	13	400	2020-09-23	Windy Point

Table #1 - 2020 HCS Site Data

Table 2: 2020 HCS Bi-catch Calculations

Daily							
% EWM							
98							
98							
98							
96							
99							
98							
97							
98							
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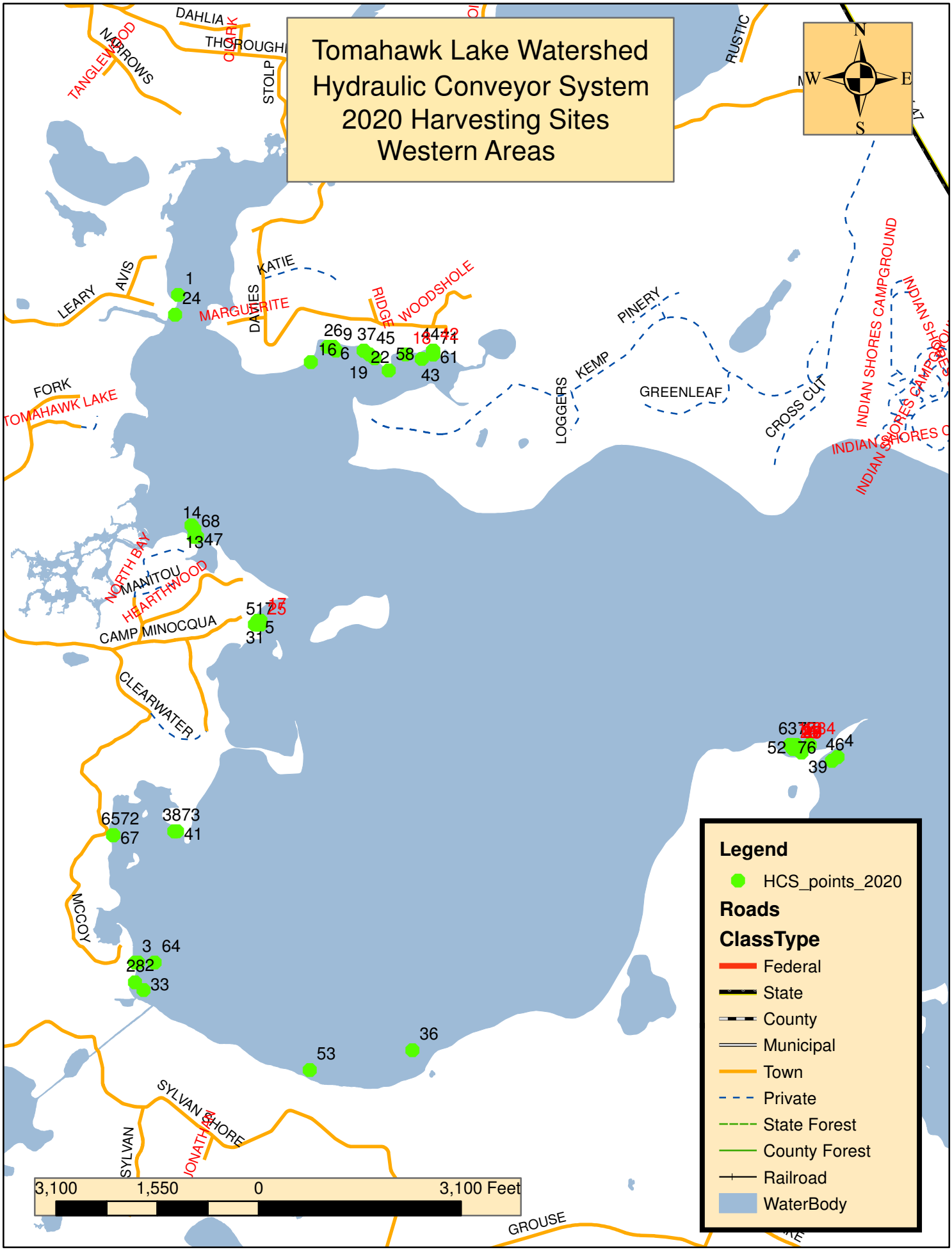
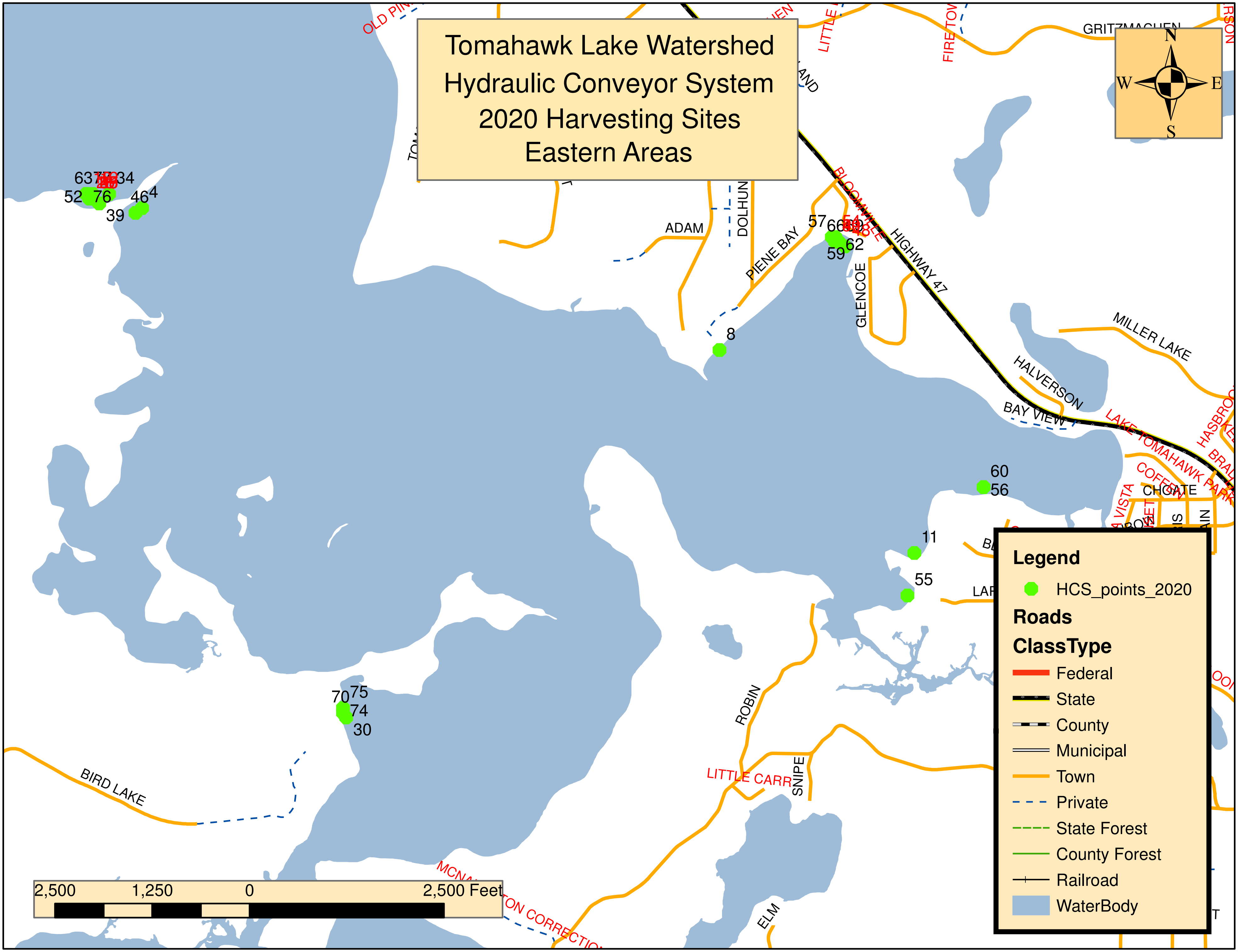
96							
96							
98							
97							
96							
98							
98							
97							
4462							
46	Harvesting Days						
97.0000	Bi-catch Average						

Table 3: 2020 Hydraulic Conveyor Waste Site Deliveries

The Tomahawk Lake Association has been granted access to the Town Of Minocqua Herbacious Waste Site for the disposal of harvested EWM. The site is located on Gun Club Road in the Town of Minocqua.

Deposit Date	Drained Weight
6/29/2020	2,482
7/15/2020	3,903
8/5/2020	4,038
8/21/2020	4,198
9/4/2020	3,971
9/18/2020	3,172
10/1/2020	4,320
Total Drained Weight	26,084


Tomahawk Lake Watershed
Hydraulic Conveyor System
2020 Harvesting Sites
Western Areas
N
W
E
S
DAHLIA
THOROUGHF
TANGLEWOOD
NARROWS
CLARK
STOLP
RUSTIC
KATIE
AVIS
LEARY
DAVIES
MARGUERITE
RIDGE
WOODSHOLE
PINERY
INDIAN SHORES CAMPGROUND
INDIAN SHORES
FORK
TOMAHAWK LAKE
KEMP
LOGGERS
GREENLEAF
CROSS CUT
NORTH BAY
MANITOU
HEARTHWOOD
CAMP MINOCQUA
CLEARWATER
MCCOY
SYLVAN SHORE
SYLVAN
GROUSE
1 24
269 37 45 16 6 22 58 61 19 43
14 68 13 47
51 5 31
52 76 46 4 39
6572 67
3873 41
3 64 282 33
53
36
3,100 1,550 0 3,100 Feet
Legend
HCS_points_2020
Roads
ClassType
Federal
State
County
Municipal
Town
Private
State Forest
County Forest
Railroad
WaterBody


Tomahawk Lake Watershed
Hydraulic Conveyor System
2020 Harvesting Sites
Eastern Areas
N
W
E
S
Legend
HCS_points_2020
Roads
ClassType
Federal
State
County
Municipal
Town
Private
State Forest
County Forest
Railroad
WaterBody
2,500
1,250
0
2,500 Feet
HIGHWAY 47
BLOOMVILLE
GLENCOE
PIENE BAY
ADAM
DOLHUN
MILLER LAKE
HALVERSON
BAY VIEW
LAKE TOMAHAWK PARK
CHOATE
BIRD LAKE
ROBIN
SNIPE
ELM
LITTLE CARR
OLD PIN
8
11
55
60
56
57
59
62
39
52
76
70
75
74
30