**Inspection by the Invasive Species Program**

Division of Ecological Resources

Minnesota Department of Natural Resources

**Lake:** Pequaywan Lake **DOW Number**: 69001100 **Date of inspection:** 12 September 2011

**County:** St. Louis **Observer[s]**: Rich Rezanka

**Water temperature (surface): 72** **Weather:** Sunny, air temp 77, STRONG winds West- NW to 30 mph.

**Type of inspection:** Invasive species general inspection in preparation for a PWA installation

**Author of report:** Rezanka **Date of report**: 20 September 2011

**Brief:** ***Biological surveys conducted on Pequaywan Lake indicated no invasive plants or animals present at sampled points during the time of the survey.*** A variety of methods were employed to sample as many biological parameters as possible.

**Photo 1: A view of the island on Pequaywan Lake looking south**

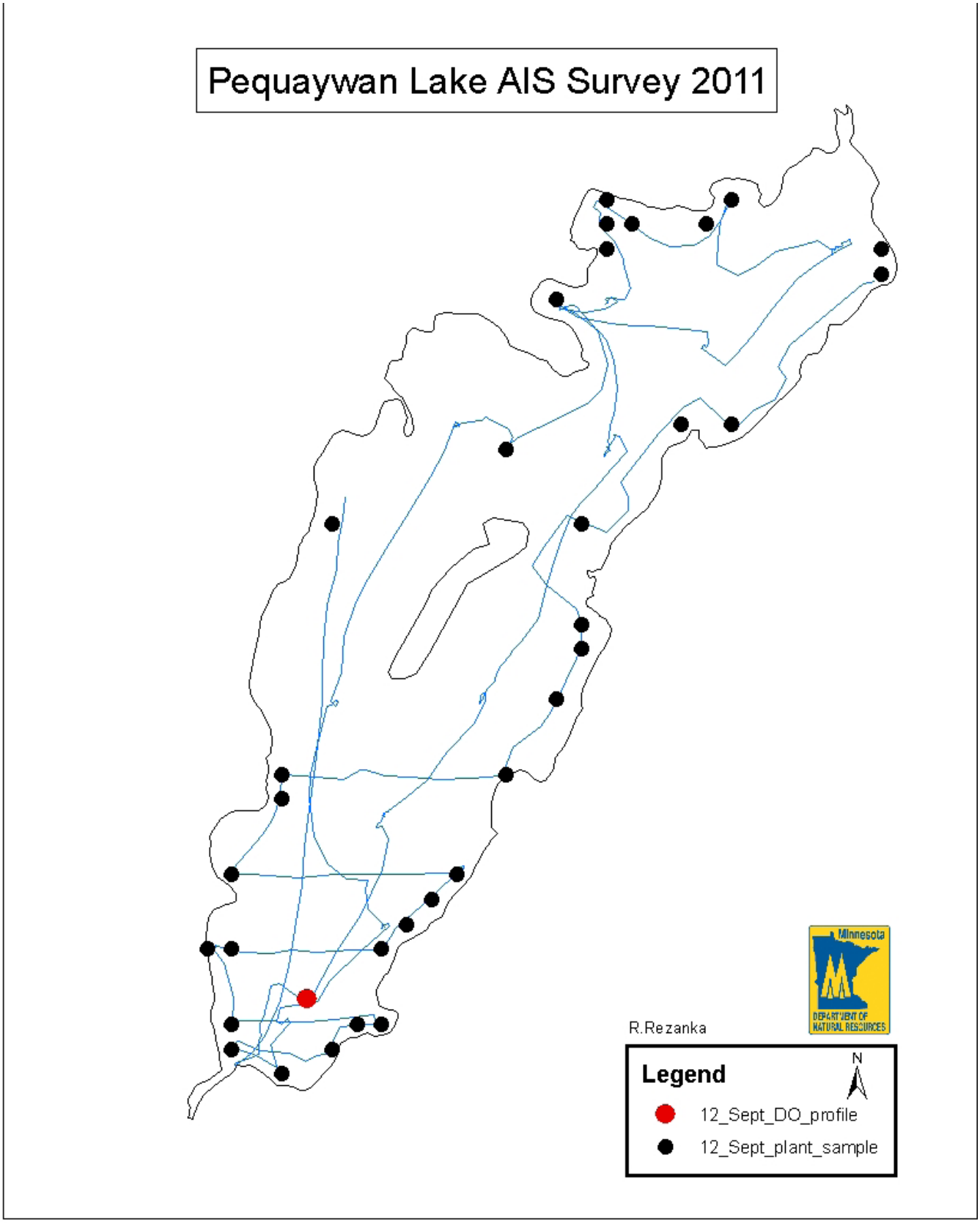


**Figure 1. A map of Pequaywan Lake on which is marked the track of the boat in blue and sampling points in black. The red point indicates the site where the oxygen/temperature profile was taken.**

An aquatic invasive species (AIS) survey was conducted on 12 September 2011 in preparation for the installation of a DNR public water access on Pequaywan Lake in St. Louis County. This survey was not typical of invasive species surveys because it included several types of sampling for a variety of invasive species. Typically an AIS survey is species-specific and is conducted on waters to confirm the presence of a particular species or to delineate the location and abundance of individual species. Because multiple sampling techniques were used the survey took more time than normal to complete. The techniques used in the survey adequately sample and therefore indicate the presence or absence of invasive organism that would normally be detected with these sample methods. Figure 1 shows the locations of each of the sites that were sampled and also indicates the track of the boat throughout the sampling operation.

In addition to biological sampling, measurements of dissolved oxygen and temperature were also taken. These measurements are typically done at or near the deepest portion of the lake basin. Temperature and dissolved oxygen profiles are useful in locating the presence and depth of thermoclines in lakes and the amount of dissolved oxygen present beneath the thermoclines and near the bottom. Profiles are taken by lowering an electronic probe from the water surface to the lake bottom in one foot increments. Readings are displayed on a handheld device connected to the probe. Readings are then recorded. The thermocline in a lake is defined by the greatest change in temperature in the shortest vertical distance in the water column. Knowledge of temperature and oxygen are necessary when planning sampling. Certain invasive invertebrate species seek refuge from predators in deep, oxygen-deficient water during certain times of the day. Sampling in the proper locations ensures that any invasive species present will be sampled. Figure 1 indicates the location where the dissolved oxygen and temperature were measured. Depth at the site was 30 feet.

Pequaywan Lake has no public water access at this time. Access to the lake to conduct the survey was obtained through permission from a private property owner. The boat was launched from the private property in shallow water where the lake bottom was sandy and firm enough to support the weight of the boat and trailer.

Upon launching the boat a preliminary visual survey of the lake indicated Pequaywan Lake has a variable morphometry with many rapid drops and rises. Maximum depth was a little over 40 feet with many deep holes from 25 to 35 feet also present. Shallow areas in the southern basin and along the eastern shore were also noted.

There is much concern over the presence of invertebrate invasive species in lakes in close proximity to Pequaywan Lake. Particular attention was therefore paid to sampling for such organisms during the survey. The larval stage of Zebra Mussels, the veliger, is nearly microscopic and is planktonic. Spiny waterfleas and other similar invasive invertebrates are also planktonic meaning they live in open water and are moved where currents carry them. Sampling such organisms requires the use of a specialty net which is lowered to nearly the bottom and then drawn up through the water column until it reaches the surface. Any material captured by the net is then washed into a specialized “bucket” at the bottom of the net and then transferred to storage containers.

Invasive aquatic plant species have existed in Minnesota lakes for decades. Some species of invasive plants have the potential to cause reduced recreational opportunities and may adversely affect ecological processes in lakes. A standard plant sampling survey was employed to determine whether or not any invasive plants were present in Pequaywan Lake. The plant survey was a condensed version of the point intercept survey which uses ArcMap GIS software to lay out a sampling grid across the lake. Three hundred waypoints were generated by ArcMap to be sampled but due to time constraints significantly fewer of the points were actually visited. Plants typically do not grow deeper than 15 or 20 feet in Minnesota lakes. Much of Pequaywan Lake is far deeper than 20 feet so sampling of plants was concentrated in shallow areas and in areas where invasive plants generally prefer to live.

Sampling was done with a double headed plant rake attached to a length of line. At each sampling site the rake was cast from the boat and allowed to sink to the bottom. As the rake was retrieved it was drawn through whatever plants were growing on the bottom. The contents of the rake were examined for plant species and abundance. The data obtained from these plant samples were recorded.

**Photo 3. Plant sampling rake and attached plants (not from Pequaywan Lake).**

Sampling for invasive plants also provided information on other invasive species. Zebra mussel young-of- the-year have been observed attached to plant stems and leaves in some lakes in Minnesota. Plant sampling on Pequaywan Lake provided another form of inspection for zebra mussels other than the planktonic veliger stage. Since the survey was conducted later in the summer, when veliger abundance typically decreases, plants provided a good surface to inspect for larger young-adult zebra mussels.

Large adult zebra mussels are best observed attached to hard surfaces underwater. Surveys to locate zebra mussel adults can be done by wading in shallow water and randomly picking hard objects from the water and observing the objects for attached zebra mussels. Dock posts, irrigation hoses, bricks, and boat lift stanchions all provide good attachment points for zebra mussels so inspection of these objects is useful in determining the presence of zebra mussels. A number of random inspections for adult zebra mussels were conducted during the survey. The boat was secured in shallow water and an inspection of rocks and hard objects was carried out for several hundred feet in either direction of the boat. Boat lifts and docks were also inspected in this manner.

**Results**

Dissolved oxygen and temperature on Pequaywan Lake were normal for similar lakes in late summer. Figure 3 indicates oxygen levels around 8 mg/l on the surface and decreasing predictable to near 0 near the bottom. Conditions such as these present difficult living conditions beneath the thermocline for many organisms.

**Figure 2. Dissolved oxygen profile from site 18 taken on Pequaywan Lake 12, September 2011.**

| DO (mg/l) | Depth (ft.) |
|---|---|
| 5.3 | 15 |
| 4.1 | 16 |
| 2.94 | 17 |
| 2.41 | 18 |
| 1.6 | 19 |
| 0.8 | 20 |
| 0.09 | 21 |
| 0.01 | 22 |
| 0 | 23 |
| 0 | 24 |
| 0 | 25 |
| 0 | 26 |
| 0 | 27 |
| 0 | 28 |
| 0 | 29 |
| 0 | 30 |

| DO (mg/l) | Depth (ft.) |
|---|---|
| 8.2 | surface |
| 8.2 | 1 |
| 8.4 | 2 |
| 8.1 | 3 |
| 7.9 | 4 |
| 7.5 | 5 |
| 7.29 | 6 |
| 7.2 | 7 |
| 6.7 | 8 |
| 6.6 | 9 |
| 6.6 | 10 |
| 6.5 | 11 |
| 5.5 | 12 |
| 5.7 | 13 |
| 5.4 | 14 |

Samples from each of the plankton tows were sent to MN DNR in St. Paul for analysis by specialist with the necessary equipment and knowledge to identify zooplankton species. The results of the analysis indicated there were no invertebrate aquatic invasive species present. A number of common zooplankton were identified, counted and their recorded in a database. Results of the plankton work are included in the graphics below.

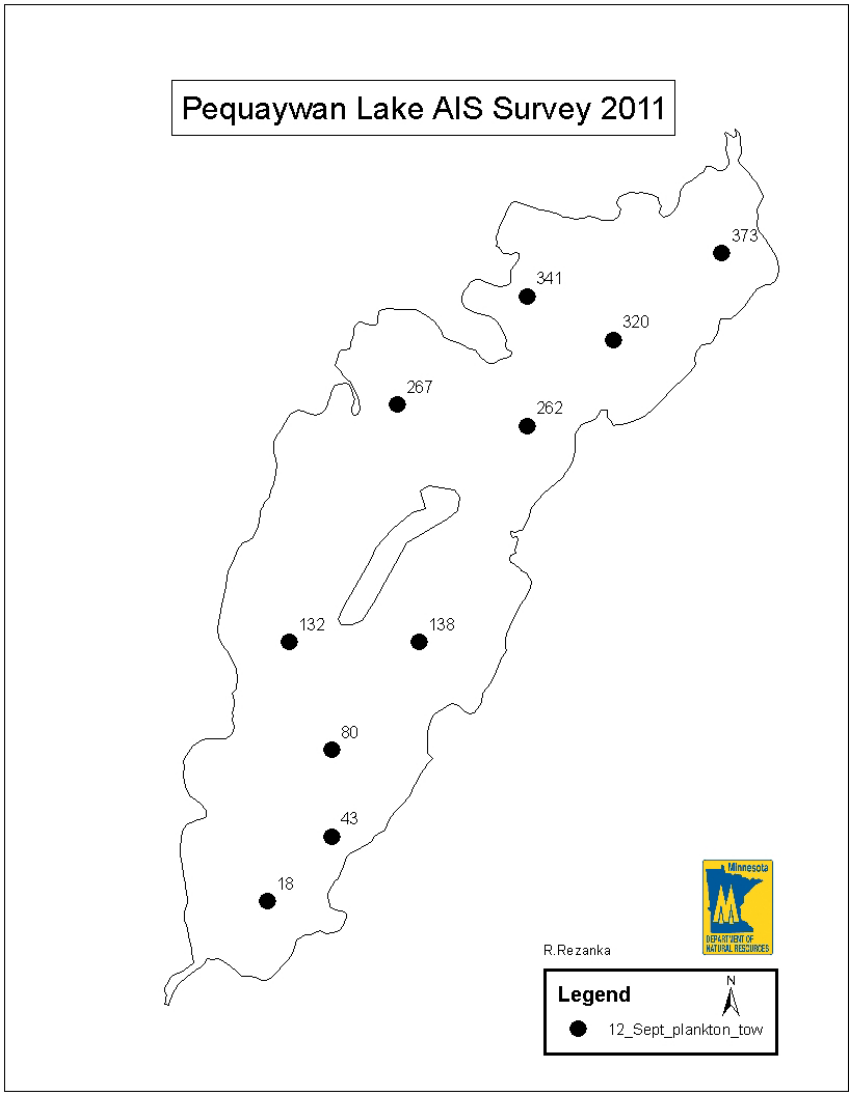


**Figure 3. Sampling sites where plankton nets were used to sample the water column.**

| Site | depth | net depth |
|---|---|---|
| 18 | 30 | 20 |
| 43 | 28 | 20 |
| 80 | 27 | 20 |
| 132 | 29 | 20 |
| 138 | 34 | 30 |
| 262 | 30 | 20 |
| 267 | 19 | 15 |
| 320 | 29 | 20 |
| 341 | 20 | 15 |
| 373 | 17 | 12 |

**Table 1. Zooplankton species, densities and size from Pequaywan Lake on 12 September 2011.**

| sample_id | grp | species | density * | biomass** | percent comp (number) | percent comp (weight) | mean weight ($\mu$g) | mean length (mm) | count |
|---|---|---|---|---|---|---|---|---|---|
| 341 | Copepods | nauplii | 6.766 | 1.291 | 10.138 | 0.506 | 0.191 | 0.197 | 22 |
| 341 | Copepods | copepodites | 5.843 | 4.145 | 8.756 | 1.624 | 0.709 | 0.327 | 19 |
| 341 | Copepods | calanoids | 10.457 | 52.995 | 15.668 | 20.770 | 5.068 | 0.887 | 34 |
| 341 | Copepods | cyclopoids | 26.449 | 13.768 | 39.631 | 5.396 | 0.521 | 0.397 | 86 |
| 341 | Cladocerans | Daphnia galeata mendotae | 15.992 | 170.369 | 23.963 | 66.774 | 10.653 | 1.224 | 52 |
| 341 | Cladocerans | Chydorus sphaericus | 0.923 | 0.666 | 1.382 | 0.261 | 0.721 | 0.222 | 3 |
| 341 | Cladocerans | Leptodora kindti | 0.308 | 11.911 | 0.461 | 4.668 | 38.730 | 5.556 | 1 |
| | | | | | | | | | |
| 373 | Copepods | nauplii | 35.330 | 6.607 | 43.626 | 9.626 | 0.187 | 0.194 | 154 |
| 373 | Copepods | copepodites | 7.571 | 6.163 | 9.348 | 8.980 | 0.814 | 0.354 | 33 |
| 373 | Copepods | calanoids | 6.194 | 19.687 | 7.649 | 28.683 | 3.178 | 0.696 | 27 |
| 373 | Copepods | cyclopoids | 27.530 | 13.235 | 33.994 | 19.283 | 0.481 | 0.383 | 120 |
| 373 | Cladocerans | Daphnia galeata mendotae | 3.671 | 21.954 | 4.533 | 31.985 | 5.981 | 0.854 | 16 |
| 373 | Cladocerans | Chydorus sphaericus | 0.459 | 0.424 | 0.567 | 0.618 | 0.925 | 0.251 | 2 |
| 373 | Cladocerans | Diaphanosoma birgei | 0.229 | 0.566 | 0.283 | 0.824 | 2.466 | 0.502 | 1 |
| | | | | | | | | | |
| 267 | Copepods | nauplii | 22.451 | 4.381 | 33.953 | 3.044 | 0.195 | 0.199 | 73 |
| 267 | Copepods | copepodites | 7.996 | 6.003 | 12.093 | 4.171 | 0.751 | 0.338 | 26 |
| 267 | Copepods | calanoids | 9.534 | 55.148 | 14.419 | 38.318 | 5.784 | 0.945 | 31 |
| 267 | Copepods | cyclopoids | 18.145 | 14.141 | 27.442 | 9.826 | 0.779 | 0.442 | 59 |
| 267 | Cladocerans | Daphnia galeata mendotae | 6.766 | 62.917 | 10.233 | 43.716 | 9.299 | 1.122 | 22 |
| 267 | Cladocerans | Chydorus sphaericus | 0.923 | 0.578 | 1.395 | 0.402 | 0.627 | 0.204 | 3 |
| 267 | Cladocerans | Diaphanosoma birgei | 0.308 | 0.753 | 0.465 | 0.524 | 2.450 | 0.499 | 1 |
| | | | | | | | | | |
| 80 | Copepods | nauplii | 7.190 | 1.338 | 14.623 | 0.840 | 0.186 | 0.193 | 31 |
| 80 | Copepods | copepodites | 2.319 | 2.165 | 4.717 | 1.360 | 0.933 | 0.380 | 10 |
| 80 | Copepods | calanoids | 4.406 | 23.183 | 8.962 | 14.563 | 5.261 | 0.902 | 19 |
| 80 | Copepods | cyclopoids | 25.743 | 21.455 | 52.358 | 13.477 | 0.833 | 0.450 | 111 |
| 80 | Cladocerans | Daphnia galeata mendotae | 9.045 | 109.647 | 18.396 | 68.875 | 12.123 | 1.319 | 39 |
| 80 | Cladocerans | Diaphanosoma birgei | 0.464 | 1.408 | 0.943 | 0.884 | 3.034 | 0.612 | 2 |
| | | | | | | | | | |
| 43 | Copepods | nauplii | 12.292 | 2.001 | 29.609 | 2.697 | 0.163 | 0.179 | 53 |
| 43 | Copepods | copepodites | 4.870 | 2.700 | 11.732 | 3.640 | 0.554 | 0.282 | 21 |
| 43 | Copepods | calanoids | 2.319 | 13.778 | 5.587 | 18.576 | 5.941 | 0.947 | 10 |
| 43 | Copepods | cyclopoids | 19.249 | 20.515 | 46.369 | 27.658 | 1.066 | 0.462 | 83 |
| 43 | Cladocerans | Daphnia galeata mendotae | 2.783 | 35.180 | 6.704 | 47.429 | 12.641 | 1.371 | 12 |
| | | | | | | | | | |

| sample_id | grp | species | density * | biomass** | percent comp (number) | percent comp (weight) | mean weight ($\mu$g) | mean length (mm) | count |
|---|---|---|---|---|---|---|---|---|---|
| 18 | Copepods | nauplii | 16.002 | 2.607 | 34.158 | 3.504 | 0.163 | 0.179 | 69 |
| 18 | Copepods | copepodites | 1.623 | 1.129 | 3.465 | 1.517 | 0.695 | 0.323 | 7 |
| 18 | Copepods | calanoids | 1.623 | 6.352 | 3.465 | 8.536 | 3.913 | 0.746 | 7 |
| 18 | Copepods | cyclopoids | 24.120 | 19.866 | 51.485 | 26.697 | 0.824 | 0.445 | 104 |
| 18 | Cladocerans | Daphnia galeata mendotae | 2.319 | 27.273 | 4.950 | 36.652 | 11.760 | 1.320 | 10 |
| 18 | Cladocerans | Daphnia pulicaria | 1.160 | 17.186 | 2.475 | 23.095 | 14.820 | 1.231 | 5 |
| | | | | | | | | | |
| 320 | Copepods | nauplii | 7.190 | 1.412 | 10.473 | 0.641 | 0.196 | 0.199 | 31 |
| 320 | Copepods | copepodites | 3.943 | 3.595 | 5.743 | 1.631 | 0.912 | 0.371 | 17 |
| 320 | Copepods | calanoids | 13.219 | 67.828 | 19.257 | 30.777 | 5.131 | 0.889 | 57 |
| 320 | Copepods | cyclopoids | 34.324 | 28.994 | 50.000 | 13.156 | 0.845 | 0.438 | 148 |
| 320 | Cladocerans | Daphnia galeata mendotae | 8.813 | 103.224 | 12.838 | 46.838 | 11.713 | 1.307 | 38 |
| 320 | Cladocerans | Daphnia pulicaria | 0.232 | 11.291 | 0.338 | 5.123 | 48.683 | 2.009 | 1 |
| 320 | Cladocerans | Diaphanosoma birgei | 0.928 | 4.043 | 1.351 | 1.835 | 4.358 | 0.865 | 4 |
| | | | | | | | | | |
| 132 | Copepods | nauplii | 7.421 | 1.335 | 14.884 | 0.699 | 0.180 | 0.188 | 32 |
| 132 | Copepods | copepodites | 2.087 | 1.568 | 4.186 | 0.821 | 0.751 | 0.341 | 9 |
| 132 | Copepods | calanoids | 2.783 | 13.447 | 5.581 | 7.038 | 4.832 | 0.854 | 12 |
| 132 | Copepods | cyclopoids | 25.047 | 30.187 | 50.233 | 15.799 | 1.205 | 0.488 | 108 |
| 132 | Cladocerans | Daphnia galeata mendotae | 9.973 | 120.903 | 20.000 | 63.277 | 12.124 | 1.325 | 43 |
| 132 | Cladocerans | Daphnia pulicaria | 1.392 | 22.749 | 2.791 | 11.906 | 16.348 | 1.262 | 6 |
| 132 | Cladocerans | Chydorus sphaericus | 1.160 | 0.879 | 2.326 | 0.460 | 0.758 | 0.227 | 5 |
| | | | | | | | | | |
| 262 | Copepods | nauplii | 6.262 | 1.040 | 9.747 | 0.317 | 0.166 | 0.181 | 27 |
| 262 | Copepods | copepodites | 3.247 | 3.172 | 5.054 | 0.968 | 0.977 | 0.395 | 14 |
| 262 | Copepods | calanoids | 6.726 | 34.775 | 10.469 | 10.614 | 5.170 | 0.904 | 29 |
| 262 | Copepods | cyclopoids | 26.671 | 27.061 | 41.516 | 8.260 | 1.015 | 0.449 | 115 |
| 262 | Cladocerans | Daphnia galeata mendotae | 20.177 | 258.342 | 31.408 | 78.853 | 12.804 | 1.383 | 87 |
| 262 | Cladocerans | Daphnia pulicaria | 0.232 | 0.915 | 0.361 | 0.279 | 3.946 | 0.787 | 1 |
| 262 | Cladocerans | Chydorus sphaericus | 0.464 | 0.529 | 0.722 | 0.161 | 1.140 | 0.281 | 2 |
| 262 | Cladocerans | Diaphanosoma birgei | 0.464 | 1.793 | 0.722 | 0.547 | 3.865 | 0.771 | 2 |
| | | | | | | | | | |
| 138 | Copepods | nauplii | 7.773 | 1.649 | 19.608 | 1.016 | 0.212 | 0.209 | 50 |
| 138 | Copepods | copepodites | 2.643 | 2.027 | 6.667 | 1.249 | 0.767 | 0.345 | 17 |
| 138 | Copepods | calanoids | 5.597 | 29.065 | 14.118 | 17.913 | 5.193 | 0.902 | 36 |
| 138 | Copepods | cyclopoids | 13.525 | 13.654 | 34.118 | 8.415 | 1.010 | 0.450 | 87 |
| 138 | Cladocerans | Daphnia galeata mendotae | 9.794 | 115.723 | 24.706 | 71.318 | 11.816 | 1.304 | 63 |
| 138 | Cladocerans | Chydorus sphaericus | 0.311 | 0.144 | 0.784 | 0.089 | 0.463 | 0.178 | 2 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *** No./liter** | | | | | | | | | |
| ****(µg/liter)** | | | | | | | | | |

Aquatic plants found during the survey were common plants native to northern Minnesota. Common Bladderwort (*Utricularia vulgaris*) occurred throughout the lake but was abundant in the shallows of the north end. Water Celery (*Vallisneria americana*) was also found basin wide and often occurred in large patches. Robbins Pondweed (*Potamogeton robbinsii*), White stem Pondweed (*Potamogeton praelongus*), Sago Pondweed (*Stuckenia pectinata*), Water Marigold (*Megalondonta beckii*), and Northern watermilfoil (*Myriophyllum exalbescens*), were all common plants found within the Pequaywan Lake basin.

## Conclusion

**Based on this survey there is no evidence to indicate the presence of aquatic species in Pequaywan Lake**.