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Donna Macalle-Holly  
Lake Hopatcong Foundation  
37 Nolan's Point Park Road  
Lake Hopatcong, NJ 07849

Dear Ms. Macalle-Holly,

Please find the results of our inventory of boat docks on Lake Hopatcong attached. I am happy to share that Maxwell Dolphin and Daniel Ratyniak successfully completed their coursework in Advanced Geographic Information Systems. I found their report interesting, and I hope that you find it useful to your work.

Sincerely,

Lisa Jordan

Director, Spatial Data Center  
Drew University

## **A Summary of Docks on Lake Hopatcong**

Maxwell Dolphin and Daniel Ratyniak

Drew University

Prepared for the Lake Hopatcong Foundation and the New Jersey State Park Service at Hopatcong State Park,  
toward completion of coursework in Advanced Geographic Information Systems

17 December 2014

## Introduction

Lake Hopatcong is the largest freshwater lake in New Jersey at 9 miles in length, with 38 miles of shoreline and 2,658 acres of water cover (NJDEP 2011). Sitting on the border between Morris County and Sussex County, it encompasses four municipalities: the Borough of Hopatcong, the Borough of Mount Arlington, Jefferson Township, and Roxbury Township (NJDEP 2011) (Figure 1). In the 1750s, the Musconetcong River was dammed, creating Lake Hopatcong (NJDEP 2011). Lake Hopatcong is utilized for a variety of recreational activities, including boating and fishing. The New Jersey Department of Environmental Protection (NJDEP) set a maximum dock length of 50 feet for new or replaced docks in 1991, grandfathering in those exceeding the maximum length (N.J.A.C. 7:2). Recently, the NJDEP Division of Parks and Forestry teamed up with the Lake Hopatcong Foundation (LHF) to review the regulations around dock construction and repairs.

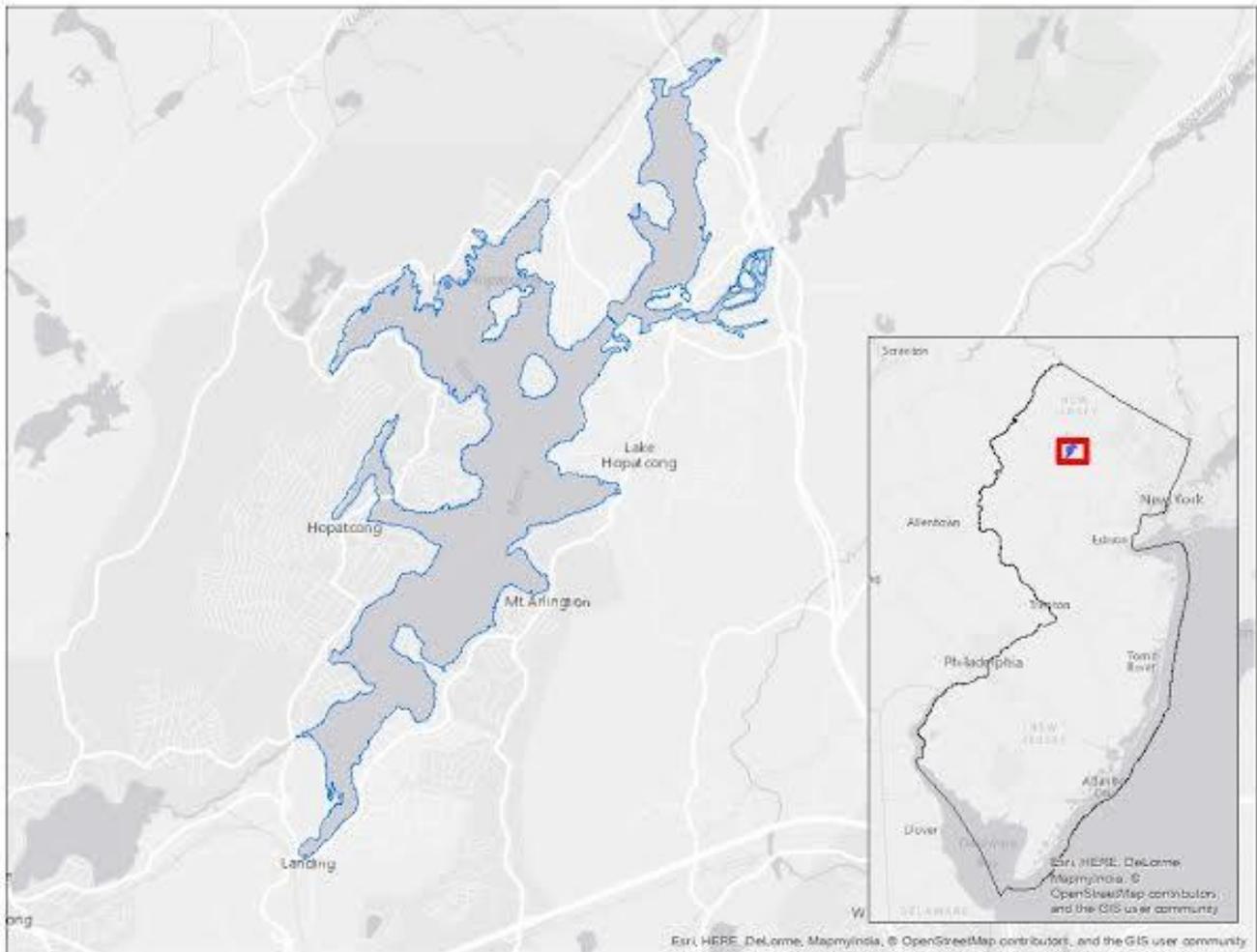


Figure 1. Lake Hopatcong reference map

## **Community Partners**

The Lake Hopatcong Foundation engages in a variety of activities, including invasive species removal and education, while also assisting the NJDEP Division of Parks and Forestry in dock regulation and permit applications. With the NJDEP Division of Parks and Forestry we worked with Dan Bello, an Environmental Specialist with Lake Hopatcong State Park. With Lake Hopatcong Foundation we worked with Donna Macalle-Holly. We met with our community partners on November 21, 2014 at the Lake Hopatcong Foundation location in Hopatcong to present our finished product.

## **Data & Methods**

Data used in the creation of the Lake Hopatcong visual representation included vector data. Vector data is a representation of the world using points, lines, and polygons. Vector models are useful for storing data that has discrete boundaries, such as country borders, land parcels, and streets (UN 2004). Initially, boundary data for the lake and the coastline were obtained from the NJDEP Bureau of Geographic Information Systems. In addition, the hydrographic and watershed data was also obtained from the same source. Morris and Sussex parcel data was obtained from the New Jersey Geographic Information Network (NJGIN, NAD83). Likewise, the orthographic tiles surrounding Lake Hopatcong were downloaded via NJGIN (New Jersey 2012 - 2013 High Resolution Orthophotography, NAD83 NJ State Plane Feet, MrSID Tiles).

In addition to the data downloads, we used the process of digitization to determine the individual lengths of the docks. Digitizing lines involves creating a line feature that consists of a node (start and end) and a series of vertices, which indicate a change of direction along that line. Straight features require fewer vertices; curved/complex features require more vertices. To begin digitization, a shapefile is needed. We created a shapefile based on the same coordinate systems as the NJDEP aerial tiles. Next, we navigated to the Editor tool in ArcGIS to begin creating features on our map. We selected our shapefile, and began generating lines to estimate the maximum length of each dock on Lake Hopatcong (an example with the tile codes and boundaries is shown in Figure 2).

# Lake Hopatcong

Daniel Ratyniak  
Final Digitized Lake



## Legend

- G4D3
- Ortho\_index\_07\_rev09v4
- SussexParcelData
- MorrisParcelData\_20ft

Figure 2. Examples of digitization

With the assistance of the students of the Advanced GIS course and the Introduction to GIS course, all docks were digitized with relative ease. However, the Introduction to GIS course used a different baseline aerial imagery than we initially used. Because of this, when their digitization was overlaid on our map, much of the digitization did not match our docks. Due to this, a painstakingly repetitive process of reviewing submitted work was necessary to ensure accuracy.

After ensuring all docks were digitized, we were then able to differentiate the docks based on length. We edited the attributes table for each dock to include a field called "length," which measured the length in feet for each dock. In creating

thematic maps of the docks, we created three different dock length thresholds, highlighted in green, yellow, and red respectively.

The thresholds were: docks less than 50 feet; docks between 50 feet and 60 feet; and docks greater than 60 feet.

## Results

In all total, we digitized 2,183 individual docks. Because our aerial imagery was from 2012-2013, there is the possibility that additional docks were constructed during 2014. According to our data, the majority of docks (1,706 individual docks) fell in the first threshold of dock length less than 50 feet. For the second threshold, dock length between 50 feet and 60 feet, our data indicates 201 individual docks. For the third threshold, dock length greater than 60 feet, our data shows 276 individual docks (Table 1). Our final map can be seen in Figure 3. For a summary of the boat dock inventory, lakeside parcels, and regional differences, see tables 1, 2, and 3.

Table 1. Summary of Dock Lengths

Dock Classification:	Number	Percent
All Docks	2,183	100%
Docks less than 50 ft.	1,706	78%
Docks between 50 and 60 ft.	201	9%
Docks more than 60 ft.	276	13%

In addition to individual dock length we also divided the data into dock length by parcel, with a total of 2,056 parcels. For this section we had four thresholds: parcels with dock length less than 50 feet; parcels with dock length between 50 feet and 60 feet; parcels with dock length greater than 60 feet; and parcels with no docks. For the first threshold, parcels with dock length less than 50 feet, the data shows 845 parcels. For the second threshold, parcels with dock length between 50 feet and 60 feet, our data shows 132 parcels. For the third threshold, parcels with dock length greater than 60 feet, the data shows 159 parcels. For the fourth threshold, parcels with no docks, we had 920 parcels (Table 2). In addition to the summary of docks by lakeside parcel property type we also did a summary of docks by municipality. Hopatcong Borough had 921 of the 2,183 docks. Jefferson Township had 871 of the 2,183 docks. Mount Arlington Borough had 234 of the 2,183 docks. Roxbury Township had 157 of the 2,183 docks (Table 3).

Table 2. Summary of Lakeside Parcels by Dock Length

Parcel Characteristics:	Number
All Lakeside Parcels:	2,056
Parcels with docks less than 50 ft.	845
Parcels with docks between 50 and 60 ft.	132
Parcels with docks more than 60 ft.	159
Parcels with no docks	920

Table 3. Summary of Docks by Borough or Township

Borough or Township	Total
Hopatcong Borough	921
Jefferson Township	871
Mount Arlington Borough	234
Roxbury Township	157
All Boroughs and Townships	2,183

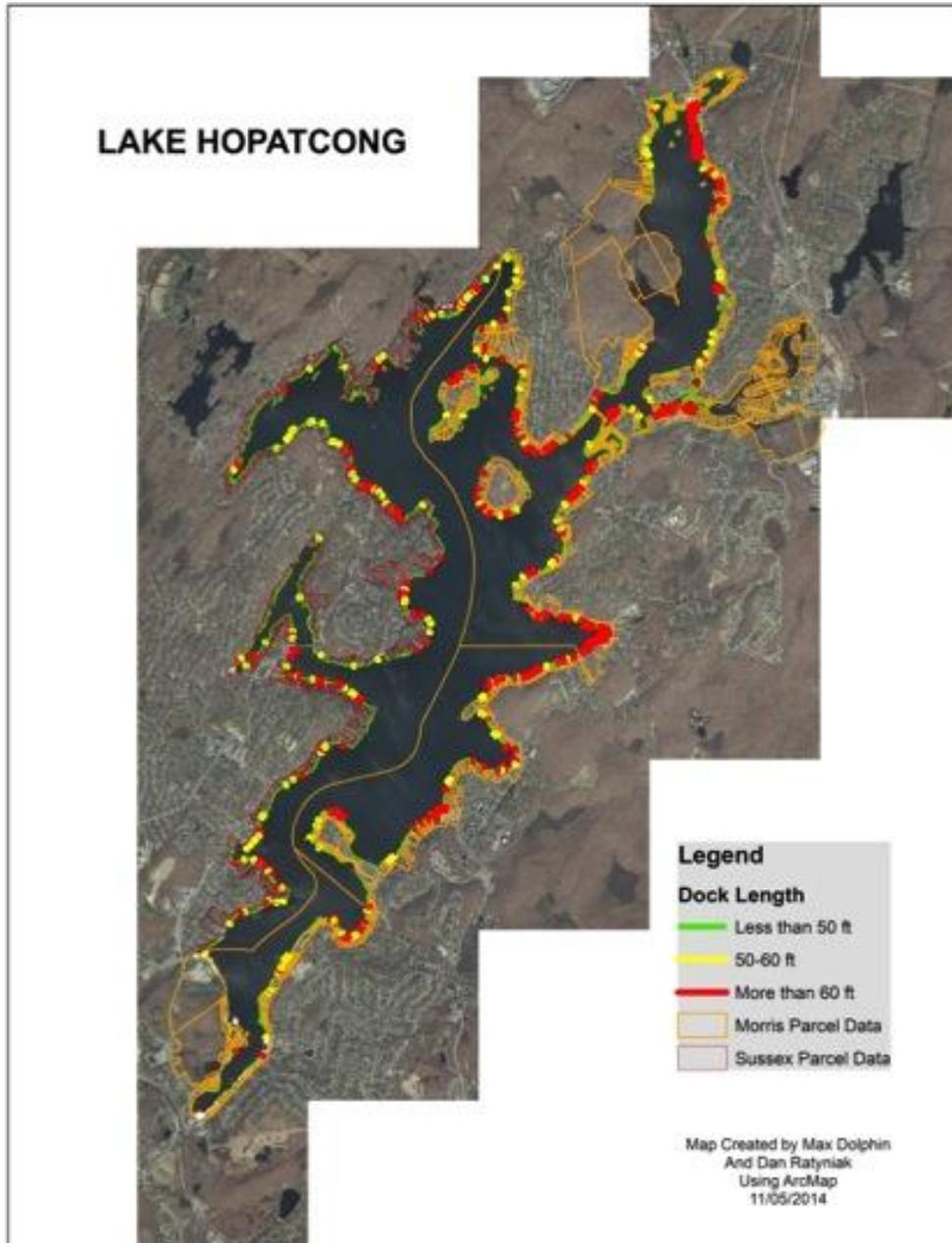


Figure 3. Summary of Docks on Lake Hopatcong. Docks in green are <50 ft., docks in yellow are between 50 ft. and 60 ft., and docks in red are > 60ft.

## Discussion

In the fall of 2014, LHF and NJDEP Division of Parks and Forestry called upon the Drew University Spatial Data Center to create baseline spatial information highlighting existing docks surrounding Lake Hopatcong. The goal was to identify docks by length. A 1991 statute (N.J.A.C. 7:2) required new docks to not exceed a length of 50 feet. Existing docks with a length greater than 50 feet would only be allowed repairs, while any replacement or new construction must fall into the threshold of 50 feet or less. This is why the visual baseline of dock length is important; when an application for a building permit for either repair, replacement, or to build new comes into the Department, a baseline is crucial for location and length of what is already existing.

Every 5 years Lake Hopatcong is drawn down about 5 feet, the last one occurring in the winter of 2013-2014. The reason for this is so property owners can access areas that are usually underwater in order to build or make repairs to seawalls, bulkheads, boathouses, and docks. Our dock survey will be helpful in locating docks that exceed 50 feet in length. During the next draw down, if these property owners wish to replace their docks, the NJDEP Division of Parks and Forestry will be better able to enforce building regulations.

Some discussion of boat dock management can be found in the scientific and social science literature. A National Oceanic and Atmospheric Administration (NOAA) conference highlighted two case studies of coastal docks in Maine and South Carolina (Kelly & Bliven 2003). The case studies discussed the aesthetical impact of small coastal docks and piers. While they concluded that docks increase property value, they also decrease the visuals of an area, impacting its scenic value (Kelly & Bliven 2003). Additionally, a number of studies on the effects of docks on aquatic ecosystems have been conducted, but most of the literature focuses on estuarine ecosystems. What they have found is that setting pilings have an immediate impact on aquatic vegetation in the direct path of the piling (Bliven 2005). Likewise, depending on the manner of installation, additional vegetation in the surrounding area can be negatively affected (Bliven 2005). Furthermore, docks and piers create shade that may negatively impacts submerged aquatic vegetation (SAV) (Bliven 2005). The limited light can restrict growth rates, kill plants, and also change the vegetation density and type of vegetation (Bliven 2005). The change in vegetation density can impact sediment, causing "resuspension" and increasing turbidity (Bliven 2005). Furthermore, the pilings associated with docks can change the flow of the water, with evidence showing both an increase in current surrounding the piling, resulting in erosion, or a decrease in current, resulting in increased sedimentation (Bliven 2005). Likewise, the loss of SAV impacts macroinvertebrates and vertebrates through habitat loss (Bliven 2005).

While these conclusions were based on estuarine ecosystems, additional studies on lake ecosystems have been conducted. A study on the effects of small docks on light availability in two lakes in Florida had very similar findings to the estuarine studies.

Shade cover from small docks and piers have an adverse effect on SAV as well as its composition (Campbell & Baird 2009). The reduction in light means a reduction in vegetation density, regardless of composition (Campbell & Baird 2009). The reduction of vegetation density results in loss of habitat and food, as well as a variety of ecosystem services (Campbell & Baird 2009). SAV protects shorelines by minimizing wave impact, and also stabilizes sediment and reduces turbidity (Campbell & Baird 2009). Since turbidity is known to reduce available light, stable densities of SAV protect themselves. However, this study suggested that the closer the dock was to the water the less light that was available (Campbell & Baird 2009), which reduces the density of SAV, which then increases turbidity, further reducing the available light and thus reducing the density of SAV, creating a positive feedback loop.

Besides dock height, an additional study suggested there were further factors influencing shading (Garrison et al 2005). Dock width, as well as the direction the dock was facing, had an impact on the shade cover (Garrison et al 2005). The wider the dock was, the more shade it casted and the less SAV that grew in the shadow (Garrison et al 2005). Furthermore, if the dock faced east or west, it casted a larger shadow than if the dock faced north or south (Garrison 2005).

Another factor to consider is the chemicals used to treat the wood used for docks and piers. Until 2004, the pressure-treated lumber used in dock construction was treated with chromium, copper, and arsenic, forming chromated copper arsenate (CCA) treated lumber (Bliven 2005). In 2004, CCA treated lumber was no longer used in freshwater ecosystems (Bliven 2005). Regardless, CCA treated lumber leaches rapidly within the first few days it comes in contact with water (Bliven 2004). The chemicals will settle in sediment and bioaccumulate in bivalves and other bottoms dwellers, subsequently biomagnifying up the food chain (Bliven 2005). Also, seasonal maintenance can expose aquatic ecosystem to an additional source of chemicals that likewise settles in the sediments and biomagnifies up the food chain (Bliven 2005). Besides biomagnification, exposure to these chemicals can cause a loss in species richness (Bliven 2005).

Due to the environmental and aesthetic impacts that docks can have on aquatic ecosystems it is important to regulate them. Considering the literature, perhaps instead of focusing on dock length the NJDEP and LHF might consider regulations of dock width and height to reduce shading and minimize environmental impact.

## Conclusion

The 1991 statute (N.J.A.C. 7:2) required that new or replaced docks not exceed a length of 50 feet. In the fall of 2014, the NJDEP Division of Parks and Forestry and the Lake Hopatcong Foundation requested the Drew University Spatial Data Center's aid in creating a baseline visual representation of the boat docks surrounding Lake Hopatcong. The objective of the visual representation was to assist the NJDEP and LHF in applying regulations. By knowing how many docks exceeded the 50-foot limit, and their locations, the NJDEP and LHF can have an easier time enforcing regulations regarding replacing old docks and building new docks.

With our baseline visual representation, the NJDEP and LHF can begin to reconsider existing regulations, and possibly make changes to make the regulations more effective regarding accessibility as well as minimizing environmental and aesthetic impacts.

## References

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**Appendix.**

## Additional Summary Tables Based on Parcel Characteristics

## Summary of Lakeside Parcels:

Parcel Characteristics:	Number	Percent
Total Lakeside Parcels	2,056	100%
No Assessment Data	156	7.6%
Residential (4 families or less)	1,674	81.4%
Vacant Land	105	5.1%
Farm Land	4	0.2%
Commercial	55	2.7%
Apartment/Cooperative	4	0.2%
Exempt Public	46	2.2%
Exempt Charitable	3	0.1%
Exempt Miscellaneous	9	0.4%

## Summary of Docks by Lakeside Parcel Property Type:

Parcel Property Type of Dock	Number	< 50 ft.	50-60 ft.	> 60 ft.
No Assessment Data	131	99	14	18
Residential (4 families or less)	1,702	1,360	170	172
Vacant Land	73	63	5	5
Farm Land	2	2	0	0
Commercial	174	99	6	69
Apartment/Cooperative	54	51	1	2
Exempt Public	34	30	1	3
Exempt Charitable	3	0	0	0
Exempt Miscellaneous	13	2	4	7

## Summary of Lakeside Parcel Major Property Types by Dock Length (not all types listed):

Property Type of Parcel		< 50 ft.	50-60 ft.	> 60 ft.
No Assessment Data	92	58	15	19
Residential (4 families or less)	964	755	109	100
Commercial	38	5	3	30
Apartment/Cooperative	5	1	3	1

**Webmaps for this project may be publically accessed from the following sites:**

Google Map of Lake Hopatcong Parcels with Boat Docks:

[https://www.google.com/fusiontables/embedviz?q=select+col2%3E%3E1+from+16PfobGEDPxlAD5z9D8-FjRZ-BOUtlmxnXL3\\_PuRK&viz=MAP&h=false&lat=40.95246967779459&lng=-74.6302045915375&t=3&z=14&l=col2%3E%3E1&y=2&tmplt=2&hml=KML](https://www.google.com/fusiontables/embedviz?q=select+col2%3E%3E1+from+16PfobGEDPxlAD5z9D8-FjRZ-BOUtlmxnXL3_PuRK&viz=MAP&h=false&lat=40.95246967779459&lng=-74.6302045915375&t=3&z=14&l=col2%3E%3E1&y=2&tmplt=2&hml=KML)

Google Fusion (map + data tables) of Lake Hopatcong Parcels with Boat Docks:

[https://www.google.com/fusiontables/DataSource?docid=16PfobGEDPxlAD5z9D8-FjRZ-BOUtlmxnXL3\\_PuRK#rows:id=1](https://www.google.com/fusiontables/DataSource?docid=16PfobGEDPxlAD5z9D8-FjRZ-BOUtlmxnXL3_PuRK#rows:id=1)

Google Map of Inventory of Boat Docks:

<https://www.google.com/fusiontables/embedviz?q=select+col2%3E%3E0+from+1tf5jOYgwO6mQTM172I6aSArHfGAqZ9dsqJXHDXpk&viz=MAP&h=false&lat=40.950400207425545&lng=-74.62489169833373&t=3&z=15&l=col2%3E%3E0&y=2&tmplt=2&hml=KML>

Google Fusion (map + data tables) of Boat Dock Inventory:

<https://www.google.com/fusiontables/DataSource?docid=1tf5jOYgwO6mQTM172I6aSArHfGAqZ9dsqJXHDXpk#map:id=3>

(Click file > download, to obtain .csv, which is an Excel formatted spreadsheet of all boat docks.)