



TOWN OF LAKEWOOD - LAKE PROTECTION STUDY

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INTRODUCTION

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The [Town of Lakewood](#) has recently adopted its Comprehensive Master Plan and identified within that plan the importance of protecting the natural resources and specifically the lakes within the town. The Town Board and its Planning Land Use and Zoning Advisory Committee are committed to preserving and protecting the natural resources, and the northwoods character of their community. Specifically, one of the priority goals identified, as part of the larger planning process, is to "Protect Water Aquifers, Streams and Lakes; Protect all Natural Resources." The area's local stream and lake resources are one of the main reasons people are attracted to this area of the state. This smart, responsible approach to local development expressed by representatives of Lakewood provides the initiative necessary to implement effective lake protection measures. This project, made possible by Lake Protection Grant support, will provide the justification necessary to support this initiative and allow the town to consider alternate ordinances and regulations for lake protection.

EXISTING AND HISTORIC LAND USE

The Town of Lakewood covers an area of approximately 72 square miles and contains 14 named lakes, as well as numerous other unnamed lakes, ponds, surface water and wetland resources. According to the Town of Lakewood's Comprehensive Master Plan, the Town has grown by 20% in the last 10 years and is projected to grow by an additional 25% in the next 20 years. Population growth and the resulting development could adversely impact the water resources that are currently one of the Town's greatest assets.

As a "double town" containing 72.38 square miles, Lakewood is twice the size of the normal square town in Wisconsin. The Nicolet National Forest dominates ownership in the eastern half of the town. For planning purposes, land use issues and development is focused in the western portion of the town.

Although development pressures, with all its associated benefits and burdens have increased in recent years, much of Town of Lakewood retains the beautiful, natural character for which it is known. Residential growth is concentrated at the edge of the STH 32 business corridor, around the major lakes, and along and extending from some of the major improved roads. Retail, commercial and service development is focussed along the STH 32 business corridor with a number of lodging and restaurant facilities supporting populations near the larger lakes. Recreational development has increased in recent years with, once again, the area in and around STH 32 experiencing the most growth.

PROJECT OBJECTIVE

The objective of this project is to provide a review and evaluation of the Town of Lakewood's regulations and ordinances relative to their effectiveness in protecting lake resources and make recommendations for improving regulatory language in order to protect the water quality of the lakes in the Town of Lakewood.

CURRENT REGULATIONS

The following is a summary of the zoning that currently affects, and will continue to affect development around the lakes and within the watersheds of the lakes in the Town of Lakewood.

Currently the State of Wisconsin mandates Shoreland/Floodplain Zoning with delegated responsibility going to Oconto County. The following highlights the relevant regulations that effect development and potentially impact surface water quality.

Existing Regulation

- No building or structure within 75 feet of the ordinary high water mark.
- Shoreland Zoning applies to land surrounding a lake, pond or flowage to a distance of 1,000 feet from the Normal High Water Elevation.

- Shoreland Zoning also applies, for a distance of 300 feet, to the Normal High Water Elevation of a river, stream or the landward side of the 100 year floodplain, which ever is greater.

Oconto County has countywide zoning with the Towns' having preliminary review. The following is a summary of general lot requirements in the Town of Lakewood.

Minimum lot size requirements per Zoning District (Local Ordinance):

ZONING DISTRICT LOT SIZE

- R1 Residential 20,000 sq ft
- Ag Forest Residential 2 acres

- Agriculture 10 acres
- Forest 10 acres

BUILD-OUT ANALYSIS

The analysis of the lakes in the Town of Lakewood followed several general assumptions for the buildout scenario. Currently a ring of small lots and homes surrounds most of the larger lakes. As real estate prices rise and prime lake frontage becomes scarcer it is more common to see infill of the lake front properties. Using the Oconto County Taxation records the existing undeveloped lots were highlighted and targeted as future building sites. Applying this scenario to the analysis, the assumption was that shoreline development densities would increase in the future.

Following State, County and local ordinance the remaining open land in the watershed of each lake was developed at a density allowed by the regulatory agencies. This includes shoreland zoning, wetland protection requirements and a lot size minimum of 20,000 square feet. The exception to this rule was in the minimum lot size. The assumption used is that current development, away from the lakes, is occurring on parcels of at least one acre. For this reason the full buildout analysis was conducted assuming parcels would not be smaller than one acre.

Not all issues can be addressed with this study. The focus of the study is based on examining the amount of pollution, caused by development, that enters each lake. Criteria were established in order to develop an accurate model of the pollutant loading effects on the lakes. The following is a list of issues used to focus this study.

Assumptions:

- The computer model was developed assuming full buildout of each watershed. This showed the cumulative impact of development of the lakes.
- According to the recently adopted Comprehensive Master Plan for the Town of Lakewood the population should grow at a rate of 25% over the next 20 years.
- The amount of developable acres in each watershed was calculated, assuming that 25% of the now vacant land would develop over the next 20 years.

With the healthy economy of the past several years both the positives and negatives of this change have been felt on and around the lakes in the area. Due to

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the diversity of the 'problems' associated with the changes not all of them could be addressed in this study. The following is a brief list of issues that when addressed will improve water quality and the overall quality of life as it relates to the lakes in the Town of Lakewood.

Future Issues to Address

- Safety concerns due to boat and personal watercraft - traffic and speed.
- Decreased water quality due to large wakes.
- Shoreline damage due to wake from speedboats and personal watercraft.
- Seasonal traffic congestion especially around boat ramps.
- Noise from large marine engines.
- Fishing pressure / decreased fish populations.

WATER QUALITY IMPLICATIONS

In many cases, the water quality of a lake is a function of the land use within the lake's watershed. The Wisconsin Lake Model Spreadsheet (WLMS) was used to estimate watershed phosphorus loading and resulting in-lake phosphorous concentrations in each of the 14 named lakes. WLMS was applied to each of the 14 lakes to evaluate the existing water quality conditions as well as the water quality impact of a full build-out scenario. Additionally, a pre-settlement land use scenario was modeled to provide an historical perspective on the water quality conditions in these lakes prior to any development.

The Phosphorus prediction module in WLMS allows the user to choose from 10 empirical lake response models for in-lake phosphorus prediction based on the best fit between the model and characteristics of the lake and/or observed in-lake phosphorus data. Rechow's Natural Lake Model (1979) had the best fit based on comparison with available observed in-lake phosphorus concentration data.

Since in-lake phosphorus concentration values are not intuitively understandable, Trophic State Indices (TSI) were calculated using the predicted in-lake concentration values (Carlson, 1977). The TSI is a numeric index based on a scale of 0 to 100 that can be related to in-lake phosphorus concentrations, chlorophyll a, and Secchi disk (SD) transparency. SD transparency is a direct physical measure of water clarity; high SD transparency represents clear water and low SD transparency represents cloudy water. A TSI of 0 is equivalent to a SD transparency of 64 meters while a TSI of 100 is equivalent to 6.4 centimeters.

Lillie and Mason (1983) further related the TSI to a subjective Water Quality Index (WQI) as presented below:

Table 1. Lake Water Quality Index

Water Quality Index	TSI
Excellent	< 34

Very Good	34-44
Good	44-50
Fair	50-54
Poor	54-60
Very Poor	> 60

Caution is recommended here because individuals have different perceptions of what constitutes "good" water quality. For example, a fisherman might place greater value on a weedy, shallow lake with high productivity than on a deep, crystal clear lake with low productivity. Conversely, a water skier might place greater value on the deep, clear lake. In the end, however, the TSI provides a means by which to classify a lake and, in general terms, progression towards the higher end of the scale suggests poorer water quality regardless of an individual's definition of ideal water quality.

The results of this evaluation are presented in Table 2 and 3.

Table 2. Current Zoning Full Build-out Lake Impact Summary

Lake	Historic TSI	Existing TSI	Full-Build TSI	Full-Build	TP	Increase in	Impact of Current Zoning
				TP Load Increase	Increase (mg/m3)	Developed Area	
Lincoln	44 - good	44 - good	44 - good	0%	0	0%	NONE
Waubee	41 - very good	45 - good	46 - good	18%	2	9%	Minor
Hidden	45 - good	45 - good	47 - good	32%	3	1%	Minor
Pine Ridge	39 - very good	44 - good	46 - good	22%	2	15%	Minor
John	44 - good	44 - good	46 - good	34%	2	5%	Minor
Bear	40 - very good	42 - very good	43 - very good	14%	1	8%	Minor
Chain	40 - very good	45 - good	48 - good	39%	3	26%	Moderate
Wheeler	38 - very good	41 - very good	45 - good	83%	4	58%	Moderate
Munger	42 - very good	47 - good	50 - fair	44%	5	24%	Moderate
Little Bear	46 - good	48 - good	53 - fair	88%	12	29%	Major
Crab	45 - good	45 - good	50 - good	76%	7	16%	Major
Bullfrog	45 - good	46 - good	55 - poor	217%	22	61%	Major
Binder	42 - very good	42 - very good	47 - good	77%	5	22%	Major
Sellin	49 - good	51 - fair	55 - fair	85%	15	17%	Major

The full build-out scenario resulted in TSI increases ranging from 0 to 9, with one lake showing no change (due to being located in the Nicolet National Forest).

Five lakes in the +1 to +2 range, three lakes in the +3 to +4 range, and five lakes with increases of 5 or greater. From a land use and water quality perspective, the above divisions define categories of impact. Therefore, for the purposes of this analysis, potential water quality impacts were divided into the following four categories:

Table 3. Lake Water Quality Impact Category

Impact Category	TSI Increase	Number of Lakes
No Impact	0	1
Minor	1 – 2	5
Moderate	3 – 4	3
Major	5 - 10	5

These categories are only relative to the 14 lakes in this study. Application of this impact classification to lakes outside of this study area would be inappropriate and potentially misleading. A discussion of each impact category is provided in the following paragraphs.

No Impact

Lincoln Lake would not be affected under the full build-out scenario since the entire tributary watershed is located within the Nicolet National Forest where no new development is allowed.

Minor Impact

The following lakes fall into the Minor Impact category:

- Waubee
- Hidden
- Pine Ridge
- John
- Bear

For these lakes, the predicted impact is minimal either as a result of the presence of large areas of public land (e.g., 58% and 85% of the Waubee and Hidden

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Lake watersheds, respectively) that limit the development potential of the watershed, or much of the land area within these lake's watersheds has already been developed. The water quality impact associated with development in Pine Ridge, John and Bear lakes' watersheds have already been realized. Table 2 shows that the majority of development impacts has already been realized. Within this category, future development effects will be minimal.

The full build-out scenario produced predicted phosphorus load increases ranging from 14 to 34 percent and resulting in-lake phosphorus concentrations increased by 1 to 3 milligrams per cubic meter (mg/m³). Increases of this magnitude are not likely to result in any noticeable adverse water quality impacts.

Moderate Impact

The following lakes fall into the Moderate Impact Category:

- Chain
- Wheeler
- Munger

As the name of the category infers the impact of development on these lakes would be moderate. There will be noticeable effects on the water quality in these lakes, however it will not be severe. Changes in the water quality to this level will affect some of the more sensitive vegetation and animal life.

The full build-out scenario produced predicted phosphorus load increases ranging from 39 to 83 percent and resulting in-lake phosphorus concentrations increased by 3 to 5 milligrams per cubic meter (mg/m³).

Major

The following lakes fall into the Major Impact Category:

- Little Bear
- Crab
- Bullfrog
- Binder
- Sellin

The full build-out scenario produced phosphorus load increases ranging from 76 to 217 percent and resulting in-lake phosphorus concentration increase ranging from 5 to 22 mg/m³. For each of these lakes, the full build-out scenario resulted in a substantial reapportionment of the phosphorus load across the various land use types in the lake's watersheds. In most cases, forested land, with relatively low phosphorus loading potential was replaced by low-density residential development, with considerably higher phosphorus loading potential.

Bullfrog Lake exhibited the most dramatic water quality change resulting from full build-out of its watershed. A 217 percent increase in phosphorus loading was predicted resulting from a substantial increase in developed land area. The predicted WQI for the current land use condition falls in the "good" category. Under the full build-out scenario the TSI increases by nine and the water quality index drops to the "poor" category. A TSI increase of nine units nearly represents a doubling in the in lake algae biomass (Carlson, 1983). Full build-out under the current zoning would likely drive significant, negative water quality changes with increased algal biomass and increased incidence of low dissolved oxygen. Similar, but slightly less pronounced affects, would be likely in the remaining four lakes in the major impact category.

LAKE IMPACT

In no case, did full build-out of a watershed, in accordance with the current zoning ordinances, improve water quality in the studied lakes. The effect of increased phosphorus concentrations, however, is dependent upon the sensitivity of the lake to phosphorus. A method of evaluating phosphorus sensitivity has been developed by the WDNR incorporating the lake's morphology, hydrologic characteristics, and TSI values to produce a relative classification of the lake's susceptibility to additional phosphorus inputs. Following the WDNR procedures, all of the 14 study lakes are considered to be sensitivity Class IA; potentially the most sensitive to increased phosphorus loading. As a result, any increase in phosphorus loading will result in water quality degradation in these lakes, regardless of the impact category in which they have been placed herein.

This evaluation considered only those impacts that would be directly attributable to phosphorus loading. However, there are a number of other factors that should be considered when evaluating the impact of the current zoning ordinances on the Town's lakes. For example, increased development means an increase in population and a corresponding increase in recreational activity on the lakes. The effects of recreational boating have been well documented and include:

- Disturbances to wildlife
- Disturbances to fish
- Direct and indirect impacts to aquatic vegetation
- Release of contaminants from the operation of outboard motors
- Re-suspension of bottom sediments and nutrients
- Shoreline erosion

Further, additional development adjacent to the lakes may also potentially alter the "up north" character of the area with aesthetic impacts, increased noise, increased traffic, etc.

ALTERNATE ZONING

Analysis of the effect of development on the Towns lakes was based on the current zoning ordinance. This analysis demonstrated that all of the Town's lakes water quality is degraded by phosphorus loading brought on by increased development. Therefore, reducing phosphorus loads is one of the primary objectives of this alternative zoning scenario.

It has also been demonstrated that some of the Town's lakes are less susceptible to impacts than others. Some of the lakes in the minor impact category are relatively immune to the impacts of development because a large percentage of their watersheds are in public ownership. Others in the minor impact category have already been developed to nearly their maximum potential. Although future impacts to these lakes are not likely as a result of increased phosphorus loading, impacts resulting from an increased population and increased recreational activities are still a real threat. Some of these potential impacts are more of a threat to the "quality of life" currently enjoyed in the Town than to the chemical and biological integrity of the lakes. The second objective of this alternative zoning scenario is to minimize these potential secondary impacts to the extent possible.

The goal of promoting sustained water quality is the basis of recommending zoning changes. As mentioned earlier in the report many of the lakes have already been negatively affected by development. Protecting water quality is the quantifiable goal while protecting the aesthetic integrity of the natural areas is also of utmost importance. By providing alternate zoning options development can occur without causing great harm to the lakes.

Oconto County has countywide zoning with the Town of Lakewood initial review. The following is a summary of alternate zoning options that will minimize the impacts of development to the town's lakes. Listed first is the existing regulation followed by the recommended change.

Existing Regulation

No building or structure within 75 feet of the ordinary high water mark.

Recommended Change

Increase minimum to **100 feet** for any building or man-made structure.

Existing Regulation

Shoreland Zoning applies to land surrounding a lake, pond or flowage to a distance of 1,000 feet from the Normal High Water Elevation.

Recommended Change

Add language to **include the watershed** or 1,000 feet of lake, pond or flowage which ever is greater.

Existing Regulation

1. R1 Residential – 20,000 sq ft.

(This lot density currently applies to any land whether inside or outside the Lakewood Sanitary District.)

2. Ag. Forest Residential – 2 acres.

3. Forest - 10 acres

Recommended Change

1. R1 Residential – **5 acres minimum.**

(This recommended change is to apply only to land outside of the Lakewood Sanitary District.)

2. Ag. Forest Residential – **5 acres.**

3. Forest - 10 acres

Existing Regulation

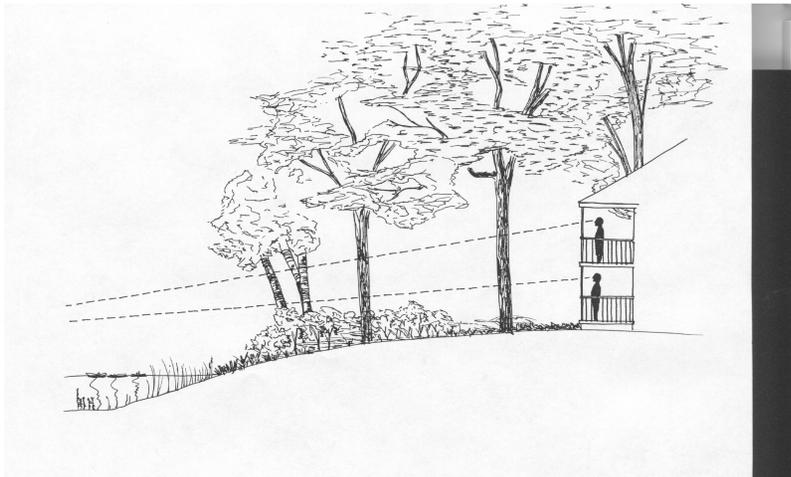
Alterations of Surface Vegetation

1. In a strip of land 35 feet wide inland from the ordinary high water mark currently allows 30 feet in any 100 feet of frontage may be clear-cut.
2. In shoreland areas located more that 35 feet inland may be cut with consideration for water quality, natural beauty, sound forestry and soil conservation practices. This does not include dead or diseased trees or vegetation.

Recommended Change

Alterations of Surface/Shoreline Vegetation

1. No cutting.



2. Within the recommended 100 foot building or structure setback regulation no cutting should be permitted. Shrubs and ground cover should be left in place. If barren they should be restored. The overstory of trees is to be maintained. Trees are allowed to be pruned in order to maintain sight lines between the ground cover and canopy trees. (The illustration above is an example of how ground vegetation and a full tree canopy can be maintained while still allowing a view of the lake.)

Other Recommendations

1. No major filling or grading within the area between the ordinary high water line and the recommended 100-foot setback line.
2. Encourage the removal of lawns and the restoration of native vegetation within the 100-foot riparian buffer. (This is especially important for the existing small lake lots.)
3. All lots should be covered with natural vegetation as much as possible. For new construction, tree cutting should be minimized to the construction site and a small clearing around the building envelope. (The more trees and natural cover left within a watershed the better the resulting water quality within the lake.)

These changes will allow development within the watersheds of the lakes in the Town of Lakewood without causing serious pollutant loading impacts. It will also assist in aesthetic protections by limiting the number of new structures and provide additional screening between structures and natural shoreline views.

These recommended changes would not affect existing lots that are smaller than 5 acres. Increased building setback lines would not be enforced on existing structures, nor would it make them non-conforming. **New zoning language would relate to new development only.** Existing structures could be limited to allow additions only if behind the 100-foot setback line.

WATER QUALITY IMPLICATIONS

The quality of the water within the named lakes within the Town of Lakewood were quantified within a series of parameters. By measuring the water quality of a lake within the Nicolet National Forest a base line for historic water quality could be established. The Wisconsin Department of Natural Resources, local organizations as well as field verifications established the measurements for determining the existing water quality. As discussed earlier population projections, average household density, and existing ordinances and regulations were used to establish the full buildout analysis.

Computer modeling allowed testing of zoning requirements and development densities that would not severely diminish water quality. The following Table 4 and Graph 1 illustrate these findings and the effects of development based on current zoning as well as an alternate model based on the recommendations discussed above.

Table 4. Alternate Zoning - Full Build-out Lake Impact

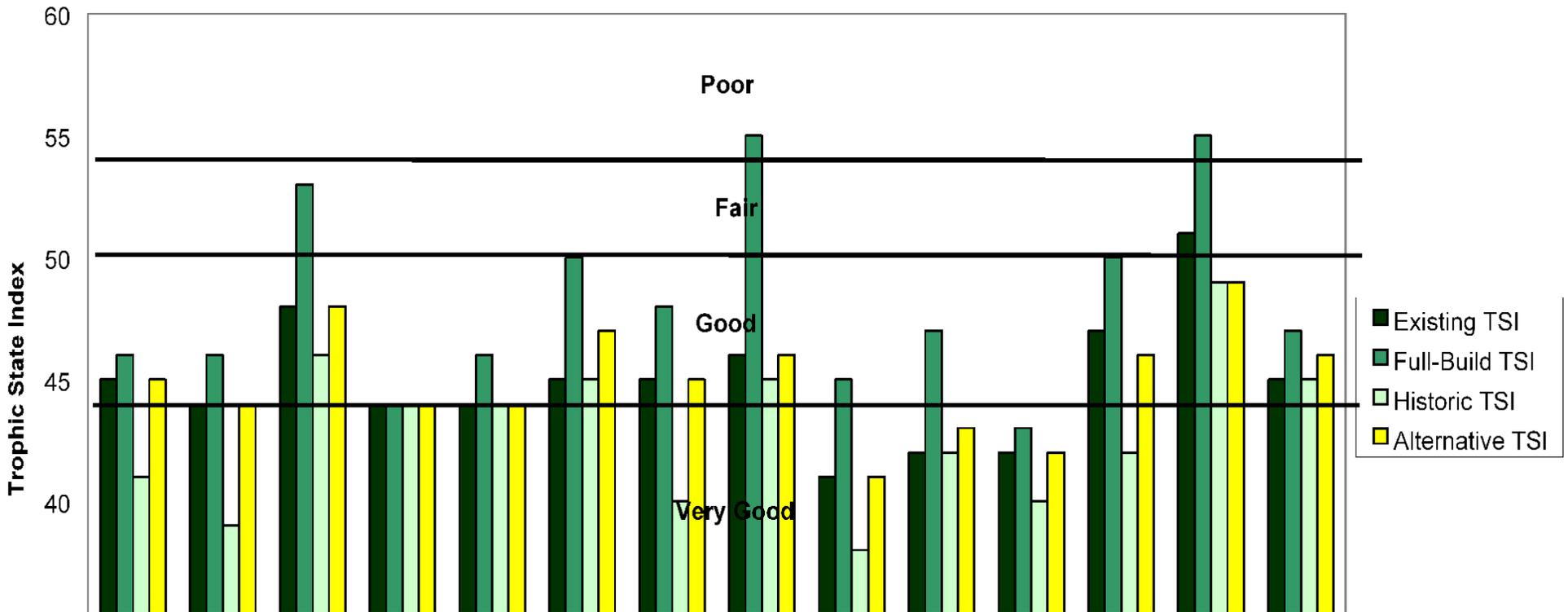
Lake	Historic TSI	Existing TSI	Full-Build TSI	Alternate Zoning Relative Impact	Current Zoning Impact
Lincoln	44 - good	44 - good	44 - good	NONE	NONE
Waubee	41 - very good	45 - good	45 - good	~NONE	<i>Minor</i>
Hidden	45 - good	45 - good	46 - good	Minor	<i>Minor</i>
Pine Ridge	39 - very good	44 - good	45 - good	Minor	<i>Minor</i>
John	44 - good	44 - good	45 - good	Minor	<i>Minor</i>
Bear	40 - very good	42 - very good	43 - very good	Minor	<i>Minor</i>
Chain	40 - very good	45 - good	46 - good	Minor	<i>Moderate</i>

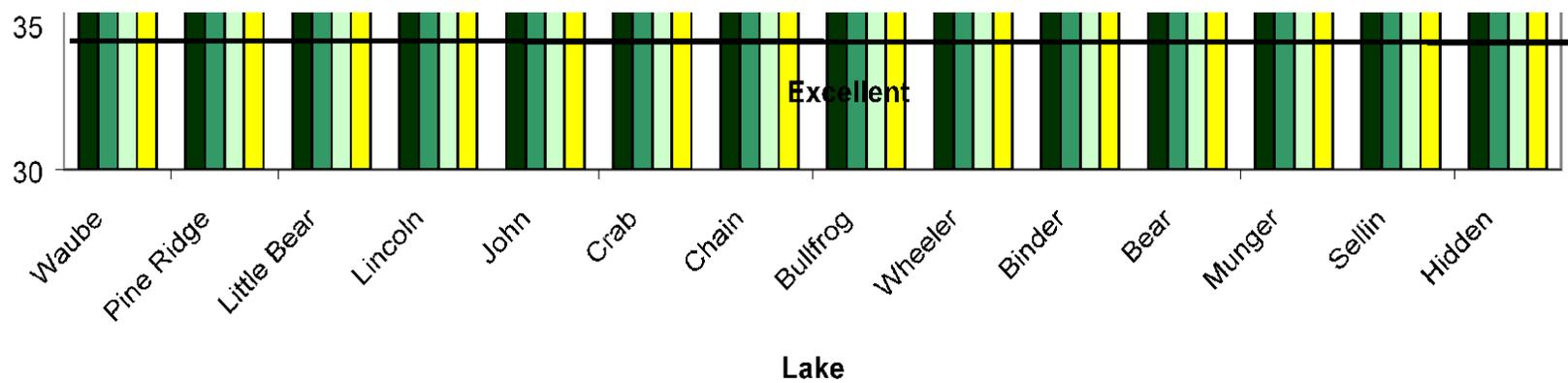
Wheeler	38 - very good	41 - very good	43 - good	Minor	<i>Moderate</i>
Munger	42 - very good	47 - good	49 - fair	Minor	<i>Moderate</i>
Little Bear	46 - good	48 - good	50 - fair	minor	<i>Major</i>
Crab	45 - good	45 - good	48 - good	Moderate	<i>Major</i>
Bullfrog	45 - good	46 - good	50 - poor	Moderate	<i>Major</i>
Binder	42 - very good	42 - very good	45 - good	Moderate	<i>Major</i>
Sellin	49 - good	51 - fair	54 - fair	Moderate	<i>Major</i>

*Implementing alternate zoning should keep all lakes out of the Major Impact category.

Graph 1. Trophic State Index

Town of Lakewood Lakes Carlson TSI Values





As can be seen in Table 5 the lake water quality has the potential to be protected if proper steps are taken. In comparison to Table 3 the future impact of development can be minimized. Under current regulations, there would be only one lake that, after development, would have no significant impact. With improved ordinances there could be two lakes in this category. Under the heading of 'Minor Impacts' there would be eight lakes as opposed to only five. Moderate pollutant influences would be seen in 4 lakes instead of 3. These results are most important when comparing the results of the last category, that being 'Major Impacts'. Under current regulatory language there will be 5 lakes severely contaminated by phosphorus runoff from development, as opposed to the alternate ordinance language where no lakes will be influenced to this extent. These charts summarize the importance of, and need to improve the current language regulating development in the watersheds in the Town of Lakewood.

Table 5. Lake Water Quality Impact Category

Impact Category	TSI Increase	Number of Lakes
No Impact	0	2
Minor	1 - 2	8
Moderate	3 - 4	4
Major	5 - 10	0

AESTHETIC IMPACTS

Aesthetics are not quantifiable, as the water quality is, however there is a conceptual standard, which can be applied. Residents and tourist alike identify with concept of 'Up North.' The look and feel of an area is often described as having a 'Northwoods' look. The concept behind this is to feel alone with nature and not be disturbed by man-made nuisances such as shoreline structures, noise, traffic or other deterrents related to a heavily populated area.

Aesthetic impacts follow the same intuitive logic as the science behind water quality protection section of this report. The environmental quality of an area as well as the water quality of a lake will hold a high standard as long as the development pressure is minimal. This directly relates to the recommendations mentioned earlier. By reducing the density around a lake, increasing the setbacks of all structures and maintaining a natural buffer around the lakes the water quality will be maintained. As can be seen on the attached illustration the same standards will improve the aesthetics of the lakes as development pressure continues in the town. This illustration represents the recommendations mentioned earlier and shows how they can also improve or maintain the natural beauty of the lakeshore. Lower density, greater lakeshore setbacks and more natural vegetation will improve the aesthetics as much as the water quality.

CONCLUSION

Each of the recommendations mentioned in this report can be implemented incrementally. As these improvements to the ordinance language take effect the closer the town will be to preserving the water quality of its lakes. This study and these recommendations should be considered a starting point. As was mentioned in the report this study only investigated the impacts of phosphorus loading due to development. This is one tool that can be used to improve and protect the area lakes. While new construction and redevelopment is a sign of healthy economic times it does negatively affect the water quality of the lakes if done improperly. Care should be taken with all development. The lakes are a strong factor in the Lakewood economy. If they are seriously degraded by development they will lose their environmental significance, natural aesthetic beauty as well as their economic worth.

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Town of Lakewood Lakes Carlson TSI Values

