INDIANA SILVER JACKETS
NORTH BRANCH ELKHART RIVER
WEST LAKES TASK TEAM

CHAPTER 4 – Lake Level Establishment, Structures and Data

This chapter provides information on lakes in the North Branch Elkhart River (NBR Elkhart River) watershed/drainage basin related to the establishment of legal lake levels, lake level control structures, Sylvan Lake Dam, and historic data related to lake levels and flooding events.

Lake Level Establishment

Several lakes or lake systems in the watershed of the NBR Elkhart River have court-established lake levels. These levels were established by the county courts following a process provided by State law. The establishment process provides for determination of the "average normal level" through a petition process to the county court.

The process included a report from the Department of Conservation (now Department of Natural Resources) providing data for the establishment. The data included recording daily lake level, typically over a 10-year period, considering testimony from local interests along with other data and testimony needed for the determination of the average normal level. The levels generally are established to protect the lake from being artificially lowered by development activities, such as outlet channel ditching and excavation, and to provide a guidance elevation for the construction of channel grade control works (often known as lake level control structures, outlet works, or in-channel dams).

While state laws providing the process for these establishments were enacted in the 1940s, many lake level establishments occurred in the 1960s. The driving mechanism for the establishments appears to be concerns about low lake levels during the summer recreational season. Droughts in the 1940s, 1950s, and especially 1963 (see Precipitation Section of this report) likely increased the local desire for pursuing the process, leading to the establishment of average normal levels by county courts.

The establishment process typically allows for, and sometimes documents, aspects for the construction of outlet works. These structures, often designed and built under the supervision of the State, were built with the intent of decreasing the impacts of low lake water levels in the summer while not restricting flow for the large flood events such as the regulatory flood event, which is the 1 percent annual chance recurrence level (100-year). These grade control works were never designed to reduce lake levels during larger flooding events. Throughout the state, these in-channel structures have many different forms and designs, and many different designs exist in this watershed. They all provide the same typical function. These structures sometime contain gates or boards that can be opened or removed to provide for additional flow over the structure. Some structures in

the watershed do have minimal operation potential. None of the lakes in this watershed have a seasonally variable or dual level by court establishment.

Structures

In this watershed, the outlet structures for West Lakes, Indian Lakes, and Oliver Lake all have lake level control structures with boards or stop logs that can be removed to provide for lower than normal weir crest elevations. For these structures, lowering of the weir crest by removal of the stop logs during the non-recreational season typically does not result in a lake level lower than the established normal elevation due to natural conditions associated with the outlet channels.

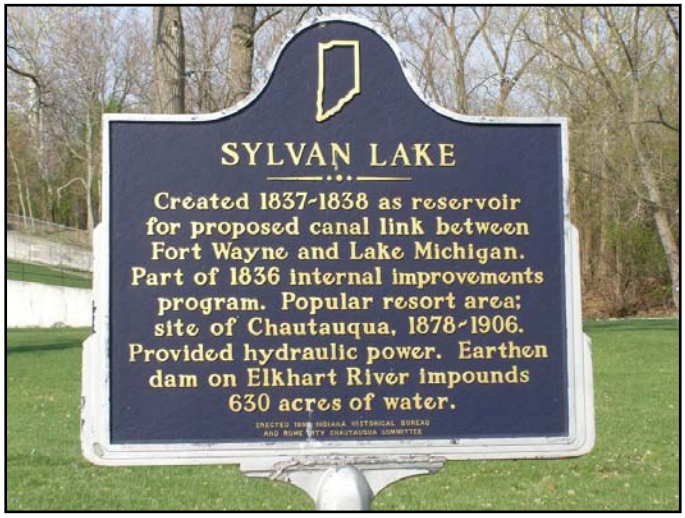
Most high stage flooding occurs during the non-recreational season. Increasing storage within the existing lake systems would require modification to the outlet structures, increasing weir crest elevations, likely construction of embankments, thus impacting lake levels significantly above the court established level, thus requiring modification of the level by the court. The increased flood levels would likely approach the regulatory or 1 percent chance occurrence per year flood level more often. Because of how low so many homes already have been built surrounding the lakes, this concept of increased storage within the existing lakes, would likely be very unpopular for local interests on the lake systems, further complicating court approval of the lake level modification.

The outlet structure for the West Lake Chain (Waldron, Steinbarger, Tamarak, and Jones lakes) is located at the outlet of Waldron Lake, approximately 1,300 feet downstream of Duke's Bridge on County Road 125 West, in Noble County. The structure is approximately 175-feet wide, consisting of steel "H" piles set vertically spaced every five feet with concrete stop logs between the piles. The structure has a concrete base set on a steel sheet piling cutoff wall. Construction of the outlet grade control structure was completed early in 1972 and remains unchanged. The lake level establishment by the Noble County Court provides for operation of the concrete stop logs in the structure (Petition March 1966). The Noble County Court established an average normal level of 885.55 feet (NGVD 1929).

Waldron, West Lakes, Outlet Control Structure,
Summer 2005, Low Flow Conditions, Stop Logs In Place

The outlet structure for the Indian Lakes Chain (Wrestler, Witmer, Dallas, Hackenburg, and Messick lakes) is located in the North Branch of the Elkhart River in the outlet from Messick Lake approximately 2,900 feet west of County Road 75 West in LaGrange County. The structure is much the same design as the structure for West Lake Chain with "H" piles and stop logs for a length of approximately 85 feet. The average normal level established by the LaGrange County Court for Indian Lakes is 897.36 feet (NGVD 1929).

The outlet works for Sylvan Lake are unique for this watershed. Sylvan Lake as is known today was created in the mid 1800s by the construction of a large embankment dam. The largest section of the embankment dam is approximately 2,000 feet in length lying adjacent to and under Indiana 9, just north of Rome City.



The outlet for Sylvan Lake is located in a section of embankment southwest of the largest section of the embankment. The outlet works (Figure 4-1, see next page) can easily be seen from Indiana 9. The outlet works consists of four components, each with a design capacity for discharge. The low fixed weir, where normal flows discharge, has an elevation of 915.97 feet and a width of 30 feet. The upper fixed weir has a crest height of 917.46 feet and a width of 25 feet. Both of these structures are fixed concrete weirs with no operable component.

Together these two structures can pass more than 740 cubic feet per second (cfs) of flow at a lake level elevation of 919.0 feet, or just less than three feet above the normal water level.

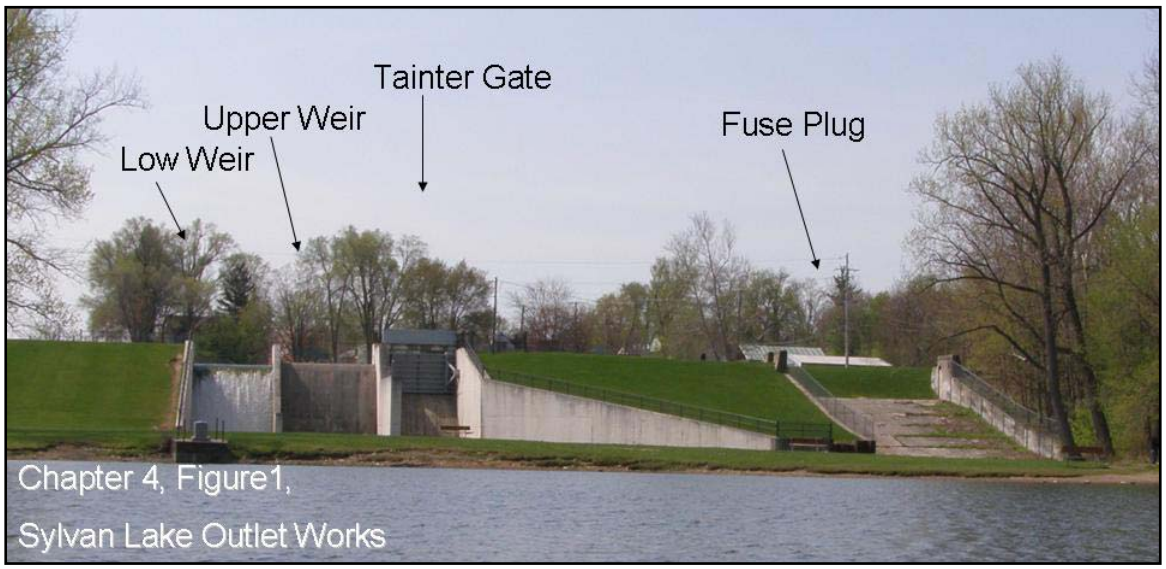


Figure 4-1

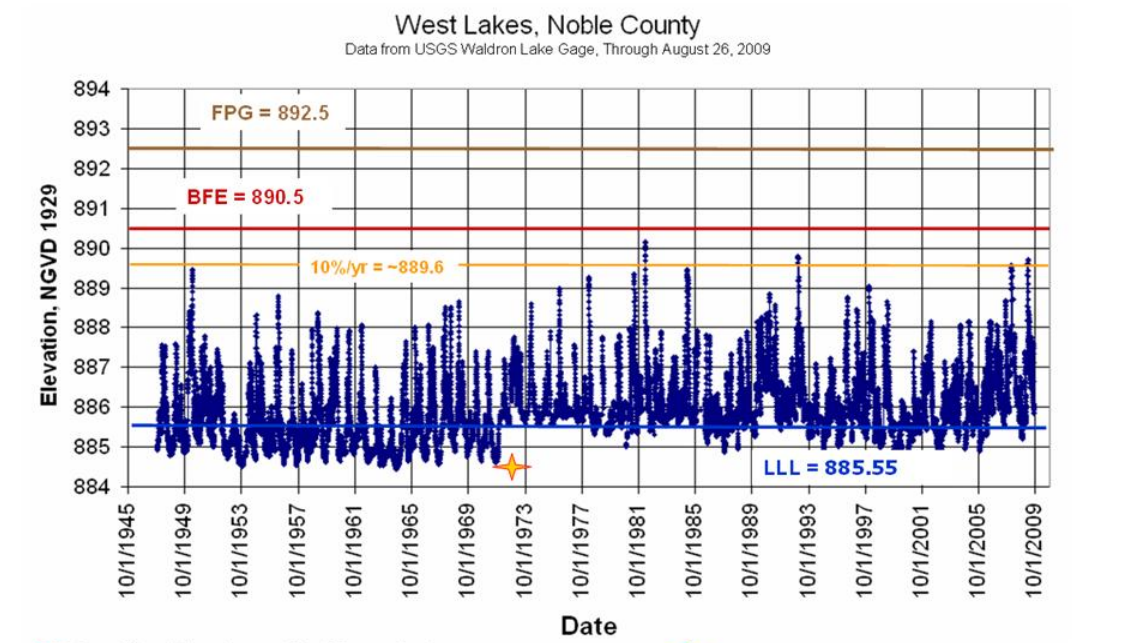
Two additional structures are placed in the dam to prevent overtopping and failure of the embankment during extreme events. The tainter gate can be operated under defined emergency conditions to discharge an additional flow of over 3,000 cfs at just above elevation 919 feet, which can increase to over 6,000 cfs before a fuse plug is activated. Activation of the fuse plug would occur only under extreme emergency lake level conditions. The fuse plug system can discharge much higher flows, but without any control once activated. Conditions leading to operation of the tainter gate and fuse plug are defined in the Emergency Action Plan (EAP) for Sylvan Lake. The discharge curve for this structure can be seen in Appendix E.

The Noble County Court established the average normal level for Sylvan Lake at 916.2 feet (NGVD 1929). The maximum pool of record in the last approximately 60 years occurred in March 2009 at 918.14 feet. The 1 percent chance per year recurrence (100-year) level for Sylvan Lake is 917.55 feet based on the Flood Insurance Study, FIS.

A discussion of each lake level outlet structure found in the watershed is beyond the scope of this report. Additional lakes in the North Branch of the Elkhart River watershed that have court-established average normal levels and outlet control works are: Oliver, Adams, Blackman, Cree, Bixler, and Little Long lakes.

Data

Lake data for West Lakes is available for a long term record through USGS gage records for Waldron Lake. The USGS gage is located at the public access site near Dukes Bridge. Several interesting features can be easily seen in the long term record for this gage, Figure 4-2 (see next page). The most obvious feature is related to the date of construction of the outlet works for the lake system. This construction, in the winter of 1971-1972, created a step in the low stage records upstream of the weir. It also resulted in a change of the average stage.



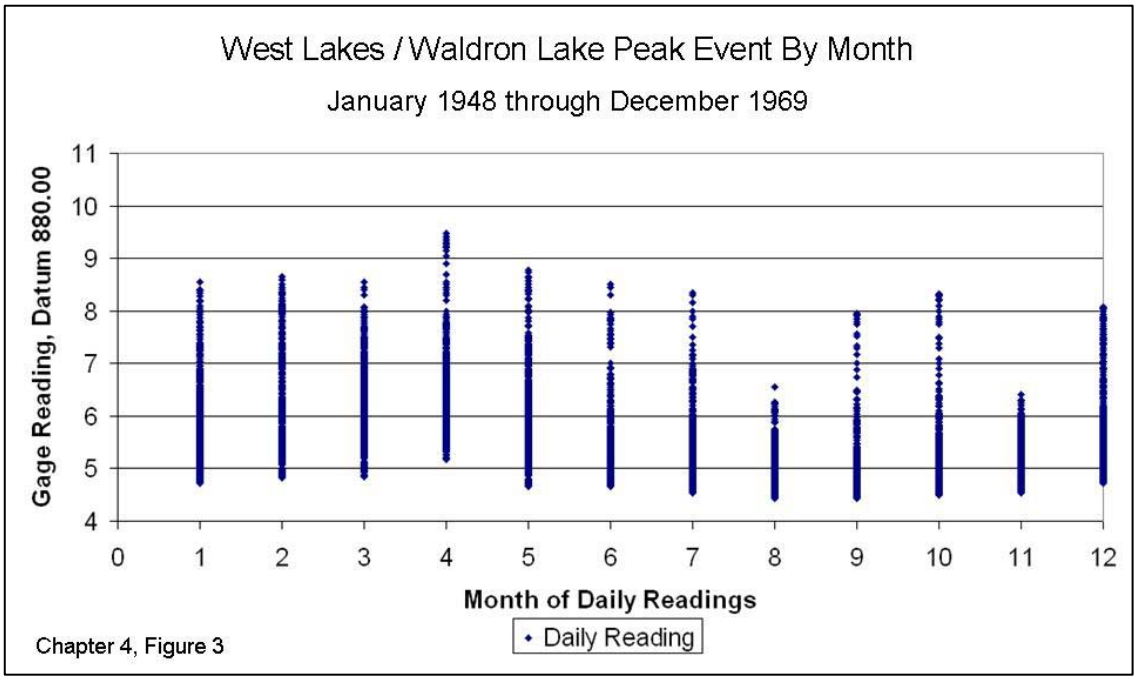
Chapter 4, Figure 2

Prior to construction, the county court followed the recorded data to determine the average normal level of 885.55 feet (NGVD1929). As can be seen on the graph in Figure 4-2, this average included the uncontrolled seasonal low levels, including the 1963 drought. It also resulted in a change of the average stage.

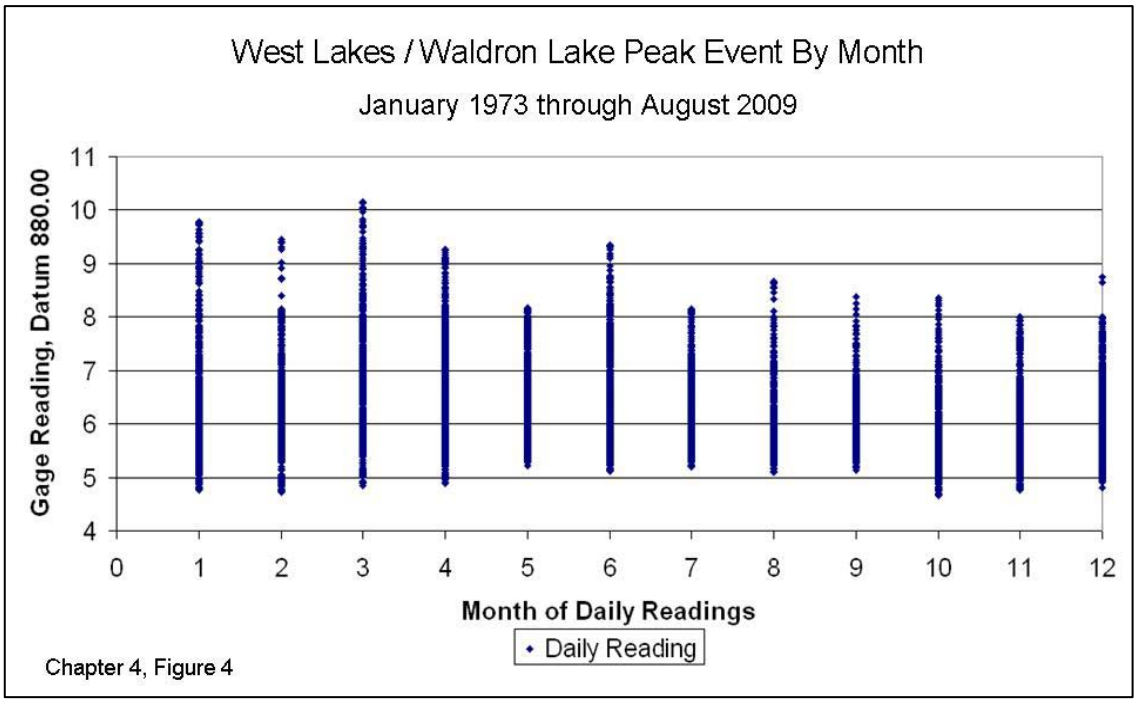
Following construction of the outlet works, the seasonal low levels decreased significantly, improving recreational use of the lake. Daily stage records for each month over the period prior to and post construction of the outlet works (Figures 4-3 and 4-4, see next page) show that the high stage events both before and after construction occur during the non recreational season. More significantly, the magnitude of low stage events during the recreational season were reduced following construction of the outlet works (Figure 4-4).

The records also show that prior to construction of the outlet works the average lake level was on a slightly decreasing trend (Figure 4-5, see Page 7 of this chapter). The trend following construction (Figure 4-6), although over 0.6 feet higher, shows neither an increase nor a decrease over the almost 30-year-record when the most recent, above normal years, are included. However, the decreasing trend persisted when the period 2006 through 2009 are excluded from the data set.

During the period 1973 to 2009 several high stage events occurred, including the top four stages in the long term record, with one each in 2008 and 2009. The data presented on the graph (Figure 4-6) show above normal stage periods in the early 1980s, 1991 through



Chapter 4, Figure 3

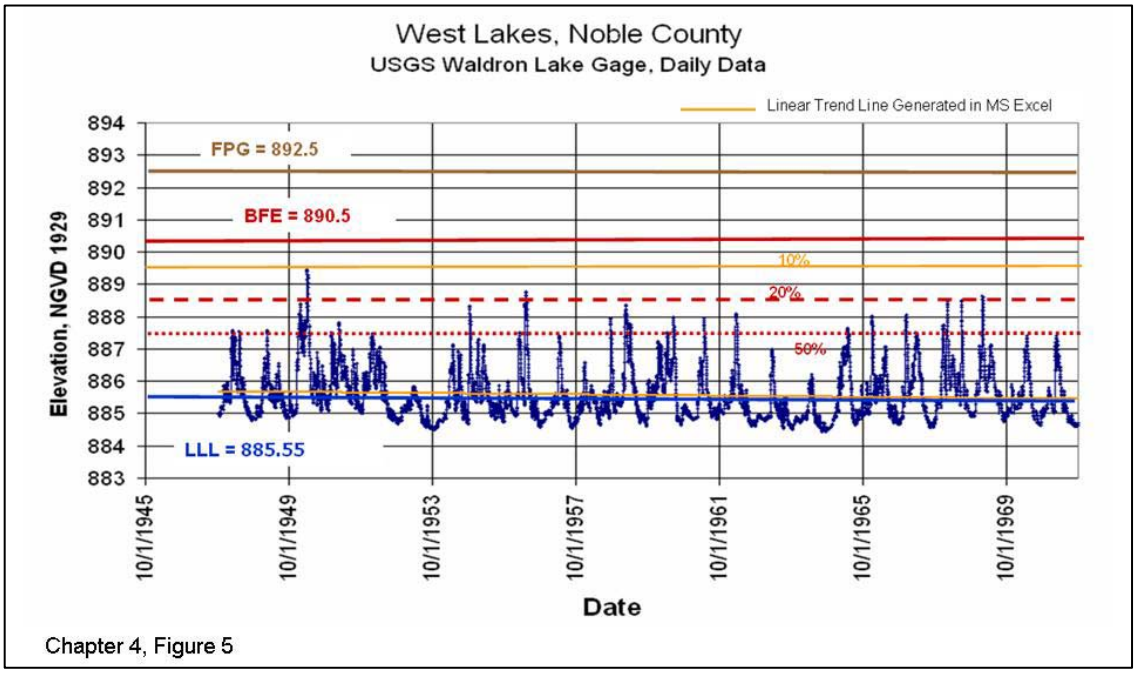


Chapter 4, Figure 4

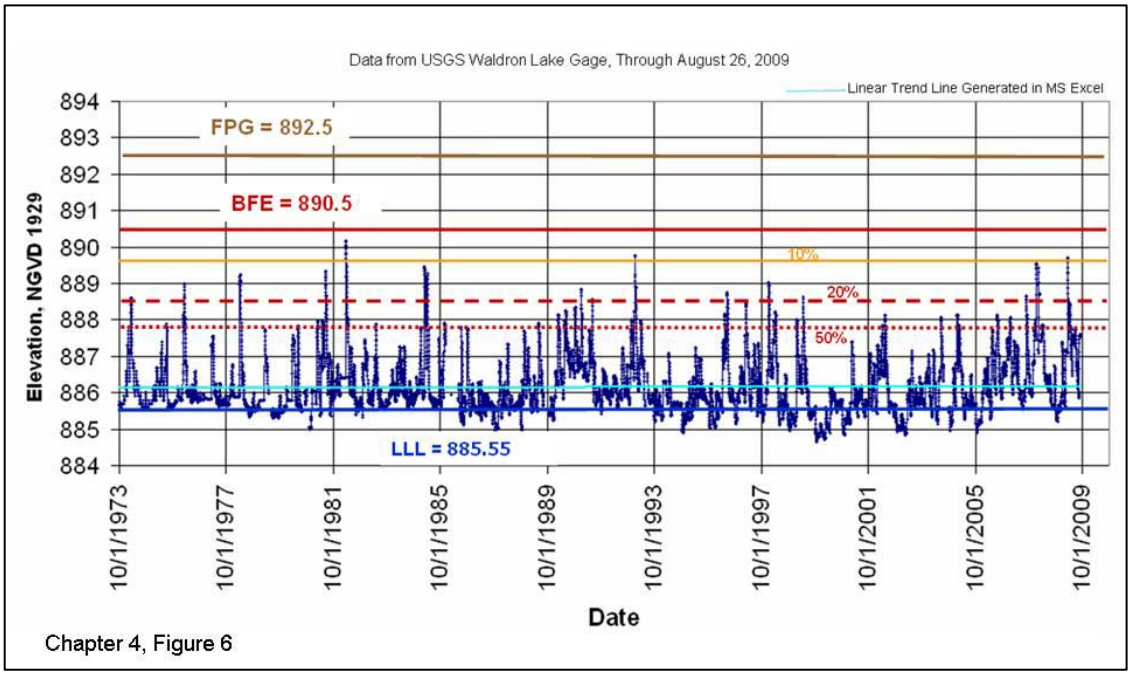
1993, and 2006 through 2009 (present). Precipitation data, in this report, can be used to better understand the recorded stages as compared to the long term precipitation records.

Stage data for Indian Lakes and Sylvan Lake can be found in Figures 4-7 through 4-11. This data can be related to the West Lakes data (Waldron Lake data) showing similar patterns, while unique for each system and event.

Data in Figure 4-7 (see page 8 of this chapter) show the long-term period of lake levels recorded for Sylvan Lake. Several times over the history of the lake, the level has been

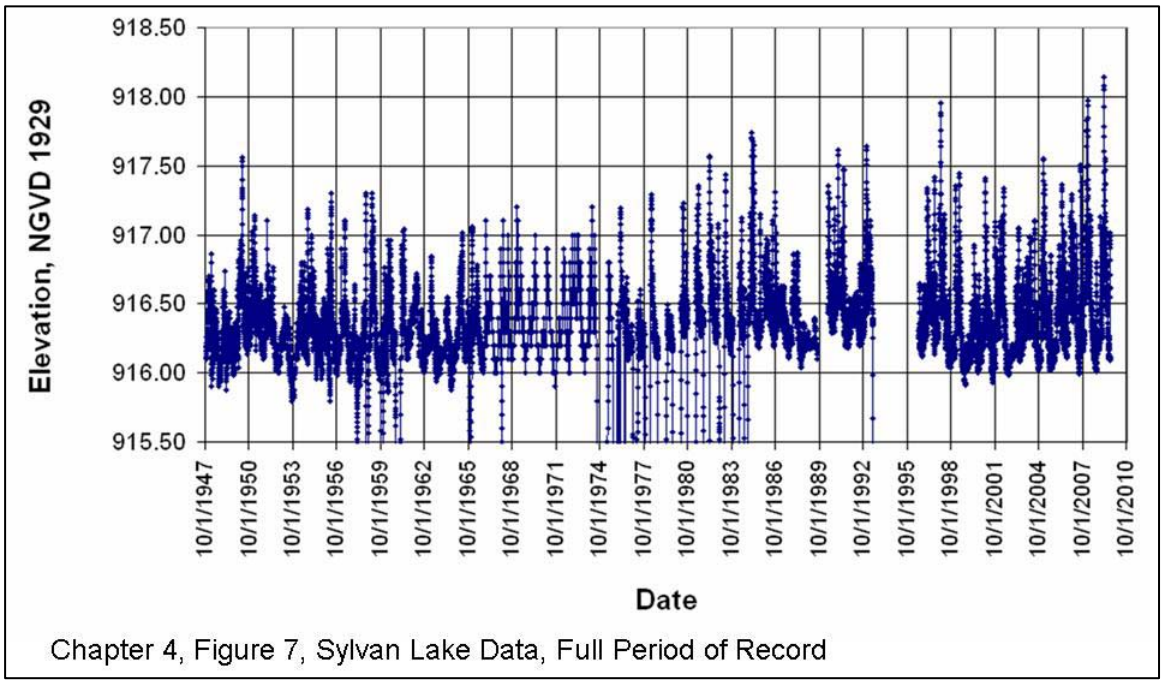


Chapter 4, Figure 5

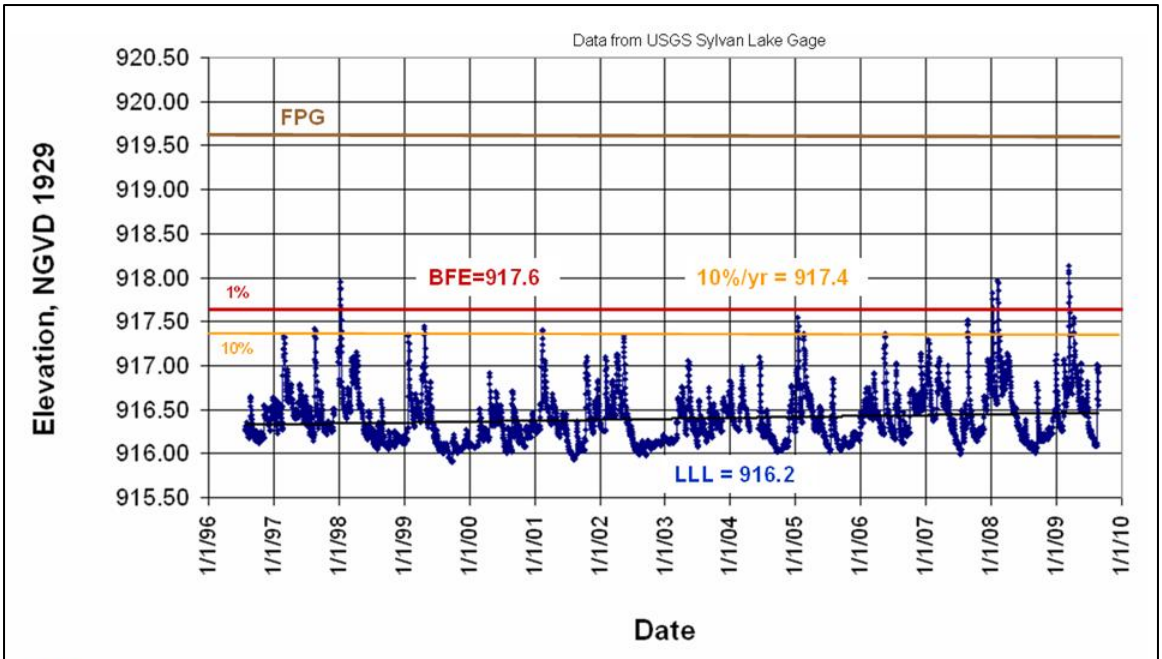


Chapter 4, Figure 6

lowered several feet by operation of boards used as gates for the lake. These operations resulted in the level of the lake dropping below the 915.5 elevation seen on the graph in Figure 4-7. These operations were done gradually. The most recent period of low water level operation, in the early 1980s was targeted to improve the quality of fish in the lake. That operation did not produce the needed results and another operation was conducted to improve the fish quality in 1983. From 1993 through early 1996, the lake was held six feet below normal level while improvements were made to the dam and the existing outlet works were constructed.



Chapter 4, Figure 7, Sylvan Lake Data, Full Period of Record



BFE, Base Flood Elevation, AKA **1%, 100 year flood, or Regulatory Flood: This** is the elevation of the flood that has a 1% chance of occurrence each year.

FPG: Flood Protection Grade. Defined as an elevation 2 feet above the elevation of the 1% chance per year flood event, BFE. This is the elevation used for construction of the bottom floor of a residential structure.

Trend line placed by MS Excel. Tend line shows an increasing trend over the shown period.

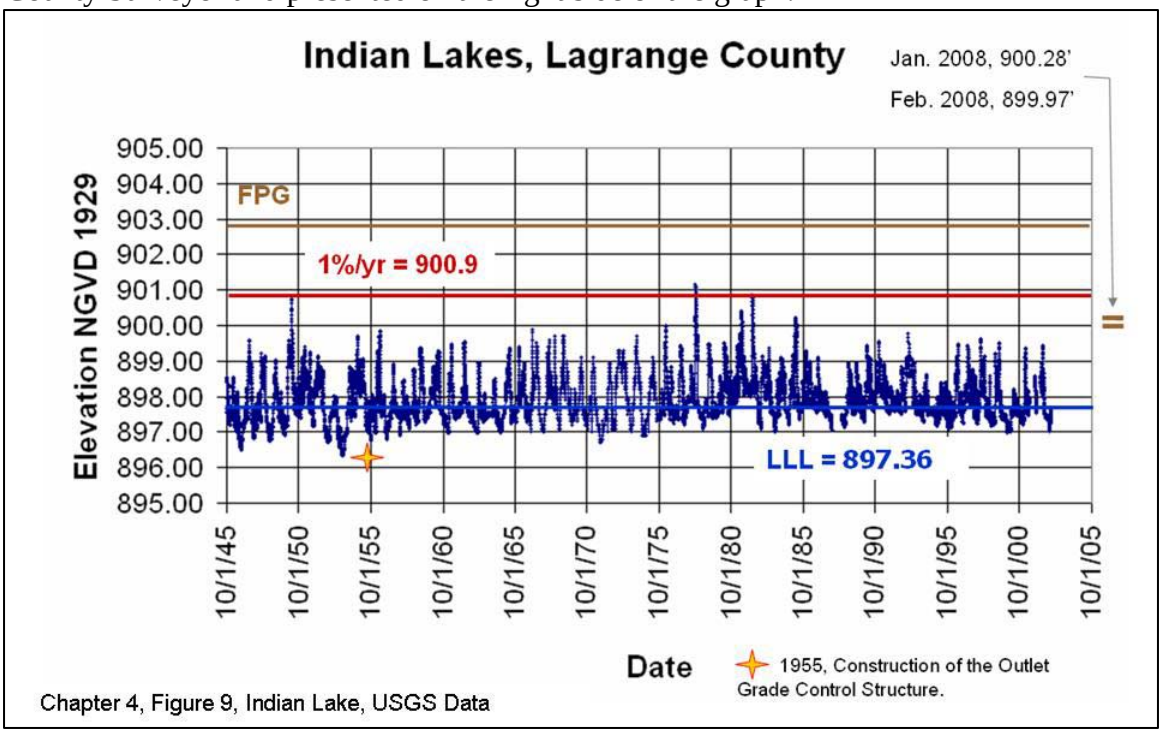
Daily lake level data from the USGS Waldron Lake gage located at the public access site.

Chapter 4, Figure 8, Sylvan Lake Data

The present outlet works have been in operation since the spring of 1996. As described earlier, the only operable section of the present spillway is a large tainter gate. Since going into operation, the tainter gate has been dry tested several times by placing a bulkhead (a large heavy blocking wall section) in the lake upstream of the gate and

opening the gate. The tainter gate has not been opened to discharge water from the lake or as a lake level control device. Therefore, the lake level data record is a record of the function of the fixed crest weirs. The outlet works were designed to function much like the previous outlet works under normal conditions, up to the 1 percent chance per year recurrence event. Data for the most recent period of record for Sylvan Lake can be seen in Figure 4-8. The data does indicate an increasing lake level trend over the period.

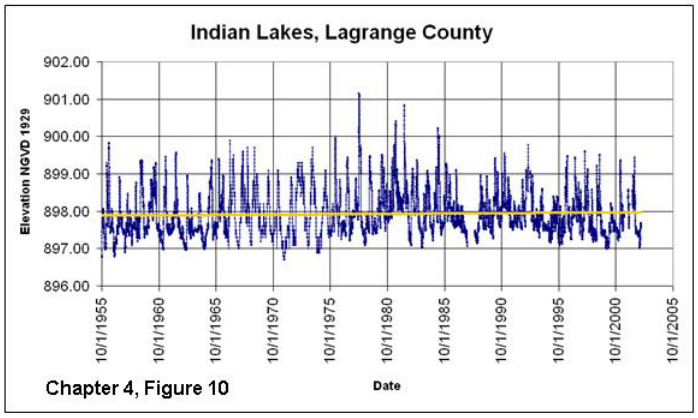
Lake level for the Indian Lakes Chain can be seen in Figure 4-9. Funding for the USGS gage for this system was discontinued in 2002. Therefore the data record is lost for the more recent events, except for the 2008 flood crest data supplied by the LaGrange County Surveyor and presented on the right side of the graph.

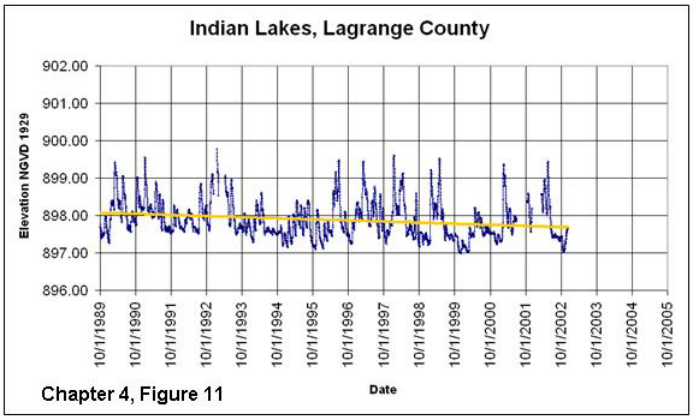


Chapter 4, Figure 9, Indian Lake, USGS Data

Data presented on Figure 4-9 show a relatively stable long term record with some notable features. Visual comparison of a 10-year period either side of 1955 would suggest that variability in lake level does not appear to have changed significantly as a function of the outlet works. A significant high stage occurred in 1950 and in the late 1970s. The early 1980s appears to be a time of higher than normal lake levels as was the case throughout much of northern Indiana due to higher precipitation. The late 1980s provided a contrasting period of low lake levels associated with a dryer than normal period throughout much of Indiana. The overall trend for lake level data is slightly increasing for the period, but more significantly the lake level trends above the average normal level by approximately one half of a foot.

The graph in Figure 4-10 shows the data after construction of the outlet works. This data indicates a very slight increasing trend toward an average level of approximately 897.9 feet. However, the late 1990s were generally a period of low lake levels. The data graphed in Figure 4-11 show the trend following the dry period in the late 1980s through the end of the record in 2002. Data from the other lakes, Sylvan and Waldron, indicate the period from 2006 to present was unusually wet, similar to the early 1980s. It is likely that the decreasing trend seen in the graph would be negated with a full record of the data through 2009.





Indian Lakes Chain shares many characteristics with West Lakes Chain. The outlet works and receiving stream conditions are very similar. Like West Lakes, Indian Lakes has also trended high on average for most of the record. The impact of the control structure on the low level periods at Indian Lakes is not as evident as for West Lakes. However, unlike West Lake Chain, both Indian Lakes Chain and Sylvan Lake have experienced high stage events that have met and exceeded the level for 1 percent chance annual occurrence (100-year flood level).

Chapter 4, Key Points

1. Lake level outlet works for public freshwater lakes with court established lake levels function to assist in preventing or decreasing the impacts of low lake levels associated with drought or drought like periods that frequently occur during the peak recreational season.

2. The outlet works typically are designed not to be restrictive and not to add flood storage. They typically are designed not to add additional flood depth on top of the naturally occurring lake flooding levels.

3. If operative boards or gates exist within a typical lake level outlet structure, their operation shortly before a substantial flooding event is unlikely to provide much if any reduction in flood levels. These structures are often already under water from downstream flooding, during larger flood events.

4. Lake levels are a function of a combination of natural factors that have been described in the Physical Settings Chapter of this report. The most obvious, and likely the most variable, natural feature that impacts lake level is precipitation.

5. The lake level data that exists for this watershed is best represented by the data presented in this section. Only partial data exist for some other lakes. However, the data on these three systems does indicate that relative to the 1 percent annual chance flood event (100-year flood) for each system, the West Lakes Chain may be experiencing the least flooding.

6. The data show lake levels at or above flood protection grade have not been recorded on any of these three lake gages over the period of record.

7. As a side note: Additional lake level, stream flow, and precipitation data could be considered for this watershed to be used for future improved flow modeling (Chapter 6). Partnerships with the U.S. Geological Survey, Hoosier River Watch, Indiana Department of Natural Resources, and Indiana University SPEA Volunteer Monitoring could provide assistance in collection, personnel training, or storage of data. A watershed steering group could search for the programs or equipment to assist local lake associations and groups to properly collect quality data and provide for useful storage of those data sources.