

Little Falls Dam

Drawdown Strategy & Sediment Management Report

May 2015, as amended June 12, 2015

Drawdown Plan Addendum added August 5, 2015

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Project Description

The Little Falls Dam is owned and operated by the Wisconsin Department of Natural Resources (Department). The dam and majority of the impoundment reside within Willow River State Park located in Hudson, WI. As it exists today from left to right, looking downstream, the dam includes a 117 ft. concrete arch buttress section, a 22 ft. wide by 12 ft. tall tainter gate, 43 ft. wide powerhouse, three 12 ft. wide by 9 ft. tall tainter gates, a gated 3 ft. diameter low water draw (sluice gate), and a 72 ft. concrete overflow spillway. The inverts of the 22 ft. by 12 ft. and three 12 ft. by 9 ft. tainter gates are 728.6 ft. and 731.56 ft., respectively. The upstream invert of the low water draw culvert is 716.6 ft., NAVD88.

Timing of Drawdown* (addendum added August 5th, 2015, page 7)

The drawdown of the Little Falls Impoundment will begin on June 15, 2015 unless excessive river flows or dangerous weather conditions prohibit safe effective operation of the dam. The duration of the drawdown is unknown, however the impoundment will remain drawn down until all actions to repair or reconstruct the dam are completed and in compliance.

Drawdown Strategy

As currently proposed, to limit sediment transport and reduce hydrostatic pressure on the Little Falls dam, a staged drawdown will be implemented. The drawdown will be dependent on site conditions and subject to fluidity throughout the duration of the process.

The City of Hudson has agreed to cooperate with the Department to possibly drawdown Lake Mallalieu in order for the sediment load in said lake to be minimized by the Little Falls Dam drawdown. To effectuate this, the Department may issue a verbal and written Order to the City to begin a staged drawdown in conjunction with the Little Falls Dam Drawdown. It is anticipated that said drawdown may begin sometime after July 1, 2015. The rate of drawdown will be 6 inches per day, to a maximum drawdown of two feet. There are significant environmental concerns with a Lake Mallalieu drawdown in excess of two feet at this time. The Little Falls Dam drawdown may start earlier than the Lake Mallalieu drawdown due the unlikely discharge of excessive sediment from the impoundment during the first week of the process. Department personnel will closely monitor the process and will make adjustments including but not limited to the halting of the Little Falls dam drawdown in order to control excessive sediment discharge.

Initially the Little Falls Dam 22 ft. by 12 ft. tainter gate as well as its sluice gate will be operated simultaneously to lower the impoundment the recommended 6 inches per 24 hours. This rate of drawdown may need to be increased or decreased depending on the type and consistency of the exposed sediment. Close monitoring during drawdown will be required to insure the rate of drawdown is based on actual conditions at the site. The sluice gate will be operated periodically to assure that it remains functional. The sluice gate has a maximum measured discharge of 150 cfs at 21.8 ft. of head when the gate is opened at least 32 inches. Opening of the sluice gate will be based on observed site conditions beginning with 1-2 inches initially. Failure to operate the sluice gate concurrent with the tainter gate may result in consolidation and compaction of the sediment in and around the inlet of this structure that could prohibit successful operation of this gate in the latter stages of the drawdown. The sluice gate will then be gradually opened further should the water clarity noticeably improve in order to provide a defined channel upstream of the gate while the sediment in front of the rest of the dam remain in place. Once the water level elevation in the impoundment reaches the sill elevation of the 22 ft. by 12 ft. tainter gate, the hydrostatic pressure on the dam will be significantly reduced. The sluice gate will remain open even after this elevation is obtained and sediment is removed immediately upstream of the dam gate.

As part of the staged drawdown the water level will be maintained at this elevation as much as possible to allow for finer sediment particles to settle and to allow for the sediment in the upper elevations of the pool to dewater and vegetate. The water level may fluctuate depending on potential storm events that may occur. During this time, the situation will be evaluated to determine the feasibility of installing grade control structures, shaped banks, check dams or other measures that can be installed in an effort to reduce sediment transport.

While the water level is maintained near the sill elevation of the 22 ft. by 12 ft. tainter gate, a dredging operation will be evaluated to determine feasibility to remove as much sediment as possible near the upstream face of the dam. The dredging mechanism will be dependent on the availability and accessibility of the equipment owned and operated by local contractors.

The final stage of the complete drawdown will be dependent on the feasibility of completing a dredge or observed site conditions. All operable gates will be fully opened for the remainder of the drawdown. The normal flow of the original channel will be routed through the sluice gate.

Drawdown Timeline

Initial Stage

1. June 15, 2015
 - a. The 22 ft. by 12 ft. tainter shall be gradually opened, limiting the rate to the recommended 6 inches per 24 hours unless conditions dictate otherwise.

- b. After the tainter gate has been opened the sluice gate shall be opened 1-2 inches until water clarity increases in an attempt to stabilize (form) a channel upstream of the gate, lessen the degree of sediment consolidation and insure the gate remains operable.
 - c. The Lake Mallalieu drawdown may commence at the point where doing so would be optimal for sediment transport. The anticipated date is on or after July 1; and the drawdown cannot occur until adequate notice has been provided to the community. The Lake Mallalieu drawdown will be closely monitored.
 - d. Seeding efforts to take place, if feasible, during this time.
2. Beginning of July or Middle of July, 2015
- a. Depending on river flow, condition of the dam and upon the presence of sediment in front of the sluice gate once the water elevation reaches the sill of the 22 ft. by 12 ft. tainter gate, all of the remaining tainter gates and the sluice gate (only if a channel has been created and sediment is cleared from in front of this gate) shall be opened to their fullest extent possible and shall remain open to allow for fines to dry out in front of the rest of the dam.
 - b. Seeding efforts to take place, if applicable, during this time.
 - c. Situation will be evaluated to determine feasibility of installing grade control structures, shaped banks, check dams or other measures that can be installed in an effort to reduce sediment transport
 - d. It may be possible to refill Lake Mallalieu at this time and again at a rate not to exceed 6 inches per 24 hours.

Final Stage

- 1. Time dependent on site conditions or completion of the dredge.
 - a. All gates shall be fully opened at this stage to accomplish a full drawdown
 - b. When the lake bed is accessible, grade control structures and other measures, if applicable, shall be put in place to reduce erosion of the bottom sediments.

Sediment Management Plan

The goal of the Sediment Management Plan, implemented by the Department, is to reduce the amount of downstream sediment transport. This report highlights all efforts that will be taken by the Department to minimize sediment transport.

Preparation and Initial Considerations

The Little Falls dam is the fourth of a series of five dams on the Willow River starting from New Richmond, WI and ending in Hudson, WI. Today, of the original five dams, only the first (New

Richmond Mills Dam), fourth, (Little Falls Dam) and the fifth (Lower Power Dam in Hudson) exist. The second (Willow Falls) and third (Mounds Plant) dams were removed in 1992 and 1997 respectively. As a result of the dam removals, sediment accumulation from the watershed was moved downstream to the Little Falls impoundment. Although the exact amount is unknown, the sediment accumulation on the upper delta of the Little Falls impoundment was taken into account in preparation for the Sediment Management Plan. Typically, when an impoundment is drawn down, head cutting of the sediment/lake bed starts to occur at the upper delta of the impoundment. Installing a series of check dams, grade control structures, and other measures may help reduce coarse sediment mobilization downstream during the time when the channel begins to reestablish.

In December of 2014, Department staff performed an approximate sediment depth examination from a series of probed transects extending 1000 feet from the upstream face of the dam. A gross estimate of the volume of the space between the diffuse top of the sediment layer and the firm bottom lake bed was made. The relative proportions of high water content to actual soil material were not determined within the scope of the data collection. Due to variability in the sediment layer an accurate determination of the volume of material is not possible. As a subset of the available sediment in the lake, it is difficult to predict exactly how much of the sediment will mobilize downstream, as the channel and the bed material reach equilibrium at a lower water level. Containment of sediment realized by channel migration is extremely difficult if not impossible to predict and achieve.

Additional considerations include the critical habitat areas and Lake Mallalieu, located downstream of the Little Falls Dam. The Department's goal is to minimize the impact of the critical habitat and Lake Mallalieu as much as possible. Understanding that Lake Mallalieu recently adopted a Lake Management Plan, the Department sampled the sediment from the Little Falls Impoundment, which identifies what types of contaminants, if any, could potentially transport downstream. Ideally, by completing a staged drawdown, implementing check dams/grade control structures, and other measures, the goal is to maintain as much sediment as feasible in the impoundment to avoid any sediment deposition that may impact critical habitat and Lake Mallalieu downstream.

As part of the staged drawdown, the Department is investigating feasibility to perform a dredging operation near the upstream face of the dam to remove as much sediment as possible before the final drawdown stage begins. The investigation will include how the sediment will be removed, which will require discussion with local contractors, where the sediment will be deposited, budget, and other variables. Local farmers have expressed interest for the material to be spread on their fields, which will be taken into account during the feasibility investigation.

Sediment Sampling & Probing

In an effort to identify a potential volume of the sediment layer within the immediate vicinity of the dam, the Department probed a series of transects extending approximately 1000 feet of the upstream face of the dam. This area was selected due to the assumption of greater sediment depth residing in the previously open stream channel that would move when the water is lowered and the dam removed. Due to variability of solids content in the material and the unknown path of channel migration as it is re-established as well as the inherent limitations in sampling, the information is to be used as a scale reference rather than a basis for a defined quantity for the Sediment Management Plan. It is difficult to predict, from the depth and location of the sediment identified, what volume will actually mobilize.

An additional result from the probed and surveyed transects was the depths of sediment in various locations within 1000 feet of the dam. The maximum depth of sediment observed was located in the original channel, at a depth of approximately 9 feet. Average sediment depth outside of the channel was estimated to be 3 feet. Knowing the maximum depth of sediment is located in the original channel, it is fair to assume the sediment located in the channel will have higher transport potential.

A sediment sample from the lake bed of the Little Falls Impoundment was performed and routed to the lab for analysis. The results indicated that pollutant levels are well below that expected to adversely affect aquatic life. Phosphorus levels was well below average for Western Wisconsin flowages and significantly lower than sediment associated with stormwater going into Lake Mallalieu.

Sediment Stabilization Efforts

When the water level reaches the lowest elevation with all gates open, as part of the initial drawdown stage, seeding efforts as well as natural vegetation may be begin to establish. Having the vegetation cover on the lake bed will help reduce sediment transport for future storm events. Seeding efforts will be based on accessibility of the exposed lake bed.

Initially, due to the high water content of the sediment and lake bed there is little if any capacity to support the weight of heavy equipment to install grade control structures and check dams. Installation will depend on the time it takes to dewater and locate a stable route to access the original channel. The dimensions of the structures are difficult to determine until some idea of what the original channel cross section appears to be. Anticipated material to be used would be a 3 – 12 inch dolomite base with shot rock fines to fill interstitial voids. The number of grade control structures and check dams will be determined under observation of conditions as the river channel emerges. It is assumed that the pools created by the grade control structures and check

dams will capture the coarse sediment, however may have difficulty reducing the finer particle transport. The structures will remain in place until the anticipated drawdown is completed and will remain if deemed suitable for fish habitat per approval by the DNR.

Downstream measures may include installation of turbidity and silt curtains and check dams, if physically and economically feasible. The goal would be to capture as much sediment as possible from transporting downstream, if feasible, assuming that some sediment transport is inevitable. Regular maintenance, especially following periods of high flows would be necessary. The turbidity and silt curtains may remain in place for the duration of the drawdown.

Little Falls Dam Drawdown Plan Addendum

August 5, 2015

Background

Since the drawdown of the Little Falls Dam impoundment began on June 15, 2015 St. Croix County has experienced numerous rain events, some even reaching up to seven inches in less than 24 hours. The response of the partial impoundment has been to re-suspend settled sediment and relocate newly established channels, adding to the overall volume of the sediment transport in the system. Operation of the Little Falls Dam, during the drawdown, was amended accordingly to reduce the amount of sediment transport and pass the additional volume of water resulting from the rain events. In order to avoid the impoundment fluctuation and increased sediment transport, a breach of the Little Falls Dam is proposed to complete and maintain a full drawdown. The breach will be the most effective mechanism to dewater and stabilize the sediment in the impoundment. The objective is to complete the breach in a timely manner to address public safety concerns and take advantage of the growing season.

Objective

Plans and specifications, signed and stamped by a professional engineer, for the breach are required to be submitted to Dam Safety staff for review and approval. The goal is to breach a section of the dam that is both economically and structurally feasible. The width of the breach must be designed to pass enough flow as to limit refilling of the impoundment during rain events. The breach cannot jeopardize the structural integrity of the sections of the dam that are to remain after the demolition is complete. The expected extent of the drawdown is the elevation of the sill of the apron below the fixed crest portion of the dam or lower elevation. Practical standards to minimize sediment transport during the breach should be implemented, understanding that an initial sediment discharge is inevitable.

Timeline

August 17, 2015 – Plans and Specifications submitted to Dam Safety Staff
September 1, 2015 – Breach to begin to optimize growing season
October 1, 2015 – Full drawdown complete