Background

At the April 23rd CLFLWD Board meeting, EOR was authorized to perform a hydrological and water quality assessment of the main watershed contributing to Shields Lake. The main objective of this analysis was to evaluate the system’s hydrology to determine the water quality benefit of enlarging the two storage ponds at Heath/209th Street in the context of reducing phosphorus loads to Shields Lake.

Modeling Construction

The drainage area west of Shields Lake to the Heath/209th Street pond (approximately 705 acres), was modeled using PCSWMM (runoff quantity) and PondNet (runoff quality).

PCSWMM incorporated all key structures, crossings and storage features in the watershed (see Figure 1). The watershed contains significant storage and wetlands that contribute to the reduction of annual runoff reaching Shields Lake. The main control structures and wetlands modeled are:

- The crossing at Harrow Avenue North west of the golf course. This crossing is an obstructed/collapsed pipe with no visible outlet to the golf course (see Figure 2). All runoff is kept on the west side of Harrow Avenue.
- The large semi-landlocked, open water wetland located east of Harrow Avenue North.
- The control structure at Holstad Trail North that reduces low and high flows via a 3-stage outlet as shown in Figures 3 and 4. Due to the staged control and very flat topography upstream, this structure provides significant storage and evapotranspiration for small to medium size storm events.

To check for potential residential flooding, a more detailed hydraulic analysis was performed at the driveway crossing culverts (36” CMPs) along Heath Street North (see example in Figure 5).

PCSWMM was also run for 9-years of rainfall data to determine the range and average hydraulic loads (ac. ft./year) reaching the Heath/209th Street pond and Shields Lake.

Water quality at the wetland south of Heath Street North and north of Holstad Trail (see Figure 7) and at the Heath/209th pond (see Figure 8) were also modeled using PondNet.

PondNet hydrologic input parameters were checked against the results of the PCSWMM’s 9-year runs and adjusted accordingly.
**Figure 2.** Obstructed crossing under Harrow Ave N west of the golf course.

**Figure 3.** 3-stage outlet control structure at Holstad Trail North.
Figure 4. 3-stage outlet control structure at Holstad Trail North.

Figure 5. Driveway Culvert along Heath Street.

Figure 6. Recently replaced culvert under Harrow Ave N near 210th St N.
Figure 7. Wetland south of Heath Street North and north of Holstad Trail.

Figure 8. Heath/209th Street pond.
Modeling Results

Water Quantity
The following are the key findings regarding the hydrological/hydraulic system:

- There are a number of storage wetlands and road crossings controls in the watershed. This, in combination with a fairly flat topography, generates a significant amount of retention/detention that translates into lower than average hydraulic load into Shields Lake (about 60-100 ac. ft./year versus the 200-250 ac. ft./year that could be expected from similar size, partially farmed watersheds).
- The existing upstream retention/detention also helps the Heath/209th Street development, where the existing 36” CMPs driveway culverts have available capacity that exceeds the 50-year, 24-hour storm event. It is important to recognize that to keep this level of protection, the current hydraulic/hydrological conditions need to be maintained as development occurs upstream.

Water Quality
The following are the key findings regarding runoff quality:

- The low hydraulic load to Shields Lake combined with potentially lower phosphorous concentrations due to wetlands and other controls, result in lower than normal P annual loads. Pending complete monitoring results and assessment, the model indicates that the annual loads from the 705 acres are in the 60-80 lbs/year range.
- The pond at Heath Street North and 209th Street North is about 1/3 acre and receives all upstream drainage. The pond’s capacity is currently maximized since the average depth is about 5 feet (with a maximum depth of about 8 feet). Given the limited area available for additional excavation/expansion (see Figure 8) and the high hydraulic load, the pond could not be excavated/enlarged to a level that would make a difference in P removal.
- The wetland south of Heath Street North and north of Holstad Trail could be excavated or enlarged by restricting its current outlet. The PondNet models show that this wetland currently works at an 18% efficiency, removing about 5 lbs/year of phosphorus. Again, due to its high hydraulic load, enlarging the wetland to provide double the wet volume capacity will only result in an additional 2 lbs/year of phosphorous removal.

Recommendations

- Due to the marginal water quality benefit of enlarging and/or deepening the Heath/209th Street pond, this action is not recommended at this point.
- The additional P removal associated with enlarging the wetland is also very minimal (about 2 lbs./year when the capacity is doubled). Enlarging the wetland is not recommended from a cost/benefit perspective, but the possibility of modifying the outlet (e.g. by incorporating a simple 2-stage retention structure) to enlarge the water depth and footprint could be considered.
• The storage already available in the watershed could be maximized by modifying key crossings. This would entail a more detailed modeling of the crossings to verify that the peak flow capacity for bigger storms is not compromised.