memo

Project Name |	BCWD Rule Revision Process	**Date** |	08/13/2019
To / Contact info |	BCWD Board of Managers		
Cc / Contact info |	Karen Kill, District Administrator		
From / Contact info |	Camilla Correll, PE; Cecilio Olivier, PE; Ryan Fleming, PE		
Regarding |	Ordinance Comparison and Rate Control Evaluation		

Background

At the July 30th Special Meeting the BCWD Board of Managers approved a scope of services to conduct the following tasks:

1. WD Rules/Local Ordinances Comparison
2. Rate Control Evaluation *which consisted of the following two parts:*
    a. Mapping areas of known erosion, channel instabilities, flooding and capacity issues; and
    b. Comparison of rate control standards on two existing developments in the drainage area to the Diversion Structure.

This memorandum summarizes the findings of these tasks.

WD Rules/Local Ordinances Comparison

EOR performed a comparison of the following rule components for discussion with the member communities on August 14, 2019 (see attachments):

- Development Applicability
- Development Standards
- Redevelopment Applicability
- Redevelopment Standards
- Roadway Applicability
- Roadway Standards
- Wetland Bounce and Inundation
- Pretreatment Requirements
- Maintenance Requirements for Stormwater Management Structures and Facilities
- Buffer Requirements
- Floodplain and Drainage Alterations

It should be noted that the comparison of rules addressing the management of landlocked basins are embedded within the afore mentioned rules.

A draft of the Rules Comparison table was sent to the cities of Stillwater and Oak Park Heights as well as the surrounding watershed management organizations for comment. District Staff anticipates additional changes to be made at the meeting with member communities and will bring the latest draft of the document to the Board Meeting for discussion.

Mapping Exercise

EOR generated a map of recent Long Lake/Diversion Drainage hydrology related stressors which includes areas of potential/temporary flooding, local drainage issues, channel erosion/instabilities (see attachments).

This mapping exercise included the following sources of information:

1. Email correspondence with the cities of Stillwater and Oak Park Heights as well as Washington County to see if they know of any concerns related to temporary flooding (see attached email inquiry), drainage, system capacity and erosion and sediment accumulation. The City of Stillwater noted the same concerns identified previously (e.g. Marylane Drainage, tributary headcut that was repaired in 2018) and the City of Oak Park Heights said there were no concerns. Washington County was also not aware of any issues in the drainage area to Long Lake and the Diversion Structure.
2. City of Stillwater's 2040 Comprehensive Plan and Local Surface Water Management Plans (LSWMPs) as well as the City of Oak Park Heights' Local Surface Water Management Plan. Modeling results contained in the City of Stillwater LSWMP identifies subwatershed where the 100-year HWL of a pond exceeds the nearest approximate building or road elevation.
3. BCWD Drone footage
4. Long Lake Management Plan
5. District project involvement and institutional knowledge

While a number of the stressors identified on this map have been addressed, it illustrates the system-wide change in hydrology that is having impacts (or has the potential to impact) properties and resources. The most significant indicator of these changes are the headcuts along the three tributaries to Brown's Creek. While these instabilities are caused in part by changes in hydrology, they are symptomatic of the overall changes that have been occurring over the last 20+ years (e.g. hydrology, climate, land-use changes, buffer management). Given that the BCWD has had stormwater management rules that mimic pre-development (and pre-settlement), conditions in place since 2000, the Board should consider the implications of relaxing the rate control standard in an already altered system.

Rate Control Evaluation

The objective of the rate control evaluation was to assess how the various rate control standards affect the amount of stormwater management needed for two recently permitted sites located in the drainage area to the Diversion Structure. By selecting previously permitted (and constructed) sites, we could use the design and modeling tools to modify a plan that met the District's requirements and fit within the construction budget of the developer. Both of the sites selected for this evaluation represent the type of development and redevelopment anticipated in the drainage area as articulated in the *MIDS Evaluation – Review of Task 1* memorandum (revised 06/26/2019). As the attached figure demonstrates, approximately half of the area slated for future development/redevelopment falls in these development categories (new development/infill development and redevelopment).

It is important to keep in mind that in no case will the design and sizing of stormwater management facilities be isolated to meeting the rate control standard in the BCWD. Sizing for water quality,

volume control, and freeboard requirements is also required, as was the case for these two developments.

The following two sites were selected for this evaluation:

1. Permit 17-17 Westridge Development

   Westridge is a 4.8-acre single-family residential development located in Stillwater on the south side of Boutwell Road North and 0.9 miles east of Manning Avenue North. This project entails the construction of 14 single-family homes, having 40% impervious coverage. This development is an example of the type of infill development that has been permitted by the District in recent years. The stormwater management facilities designed and constructed to meet the District's rules include two vegetated swales, which route stormwater runoff to two separate infiltration basins (see Figure 1).

   While Westridge was permitted under the 2000 Rules, it should be noted that there were no changes to the new (2018) rules that would have changed what was required for this permit.

2. Permit 18-11 Ridgecrest

   Ridgecrest is a 2.3-acre commercial redevelopment located in Oak Park Heights at the intersection of Norrell Avenue North and 60th Street North. The site, which was previously occupied by the Fraternal Order of Eagles (Stillwater Eagles #94), was redeveloped into a two retail building commercial development having 65% impervious coverage. Ridgecrest is an example of the type of redevelopment that has been permitted by the District in recent years. The stormwater management facilities designed and constructed to meet the District's rules include an underground stormwater retention vault, rain garden/tree trench basins, sump manholes, and storm sewer infrastructure (see Figure 2).

Definition of Terms

The following definitions contain the land-use and hydrological criteria consistent with application of the BCWD Rules:

Pre-Settlement Conditions: The natural vegetation and soil permeability conditions existing before European settlement. The curve number assignments for pre-settlement conditions as provided in the BCWD Rules and shown in Table 1.

Pre-Development Conditions: The land-use and soil permeability conditions before any development occurred. This has been considered to be open space, good condition as defined in the Minnesota Hydrology Guide and shown in Table 1.

Existing Conditions: The land-use and permeability conditions immediately preceding the proposed development (Note that Existing Conditions is not specifically included in the BCWD Rule Definitions). Open space (under existing conditions) hs been considered to be open space, poor condition as defined in the Minnesota Hydrology Guide and shown in Table 1.

Table 1. Comparison of NRCS Runoff Curve Number Values

Scenario	NRCS Runoff Curve Number			
	A Soil	B Soil	C Soil	D Soil
Pre-Settlement	30	57	70	77
Pre-Development	39	61	74	80
Existing (Impervious CN = 98)	49	69	79	84

Westridge Development Results

EOR used the HydroCAD models provided with the permit submittal to reconfigure the stormwater management facilities (infiltration basins) and show how their size and footprint would change depending upon the rate control requirement. It should be noted that in the case of this development, the existing condition approximates the predevelopment condition (i.e. the site is considered open space in good condition).

Table 2 illustrates the peak runoff rates under pre-settlement and pre-development standards for the 24-hour events required in the Rules (2-year, 10-year and 100-year). Table 2 also shows the percentage of increase in peak runoff rates between the pre-settlement and pre-development standard.

For the 2-year event, results indicate a 74% increase in peak runoff rate if the pre-development standard is applied. For the 10-year and 100-year events, the peak runoff rate increases are 34% and 15% respectively.

Table 2. Westridge comparison of peak runoff rates and percent increase for rate control standards

Rate Scenario	Peak Runoff Rate [cfs]					
	2-year		10-year		100-year	
Pre-Settlement	0.53	100%	3.08	100%	13.24	100%
Pre-Development	0.92	174%	4.13	134%	15.29	115%
Existing	NA (Existing = Pre-Development)					

Table 3 illustrates the required change in footprint and volume of the management facilities to meet the pre-settlement and pre-development standards. For the 100-year event (the event that represents the larger footprint), the facilities designed to meet pre-development peak runoff standards have a 12% smaller footprint than the facilities designed to meet pre-settlement standards. Under the pre-settlement standard, 5.3% of the site needs to be dedicated to meet all BCWD rules (runoff volume reduction, water quality and rate control). If the peak rate standard is changed to a pre-development standard, then the required footprint would be reduced to 4.7%. This difference represents 0.6% of the total developable area (i.e. and additional 0.6% of the total

developable area could have been used for development purposes instead of having to dedicate it to stormwater management).

Table 3. Westridge comparison of BMP size and percentage of total site area for rate control standards

Rate Scenario	100-year, 24-hour Size Difference			
	Square Feet	Cubic Feet	Capacity	Site Area
Pre-Settlement	10,710	36,252	100%	5.3%
Pre-Development	9,433	32,480	88%	4.7%
Existing	NA (Existing = Pre-Development)			

In summary, these are the main findings for the analysis and our assessment of the findings:

- The difference between pre-settlement and pre-development peak runoff rates targets is significant. Applying a pre-development peak rate standard would result in a 74% increase in peak over the pre-settlement standard for a 2-year event. For the 10-year and 100-year events, the increase is 34% and 15% respectively. It is important to point out that natural streams are typically shaped by the 1.5 to 2-year storm event.
- Going from a pre-settlement to a pre-development peak runoff rate standard, will reduce the stormwater facility footprint by 12%. This equates to a 0.6% increase in developable area.
- Although a 12% difference in the stormwater management facility footprint is minimal, it is important to keep in mind that a thoughtful design can always minimize the stormwater management footprint and maximize developable land. For instance, the additional detention needed to meet the pre-settlement rate standard could be provided by installing a series of check dams in the vegetated swales running the length of the development or alternative outlet structures could be designed to optimize the discharge at various stages in the pond storage.
- Because this analysis is a relative comparison (in percentages) between standards, results for the Westridge Development would be similar and can be extrapolated to other similar types of developments regardless of size, physical characteristics or soil types.

Ridgecrest Development Results

EOR used the HydroCAD models provided with the permit submittal to reconfigure the stormwater management facility (underground stormwater treatment gallery) and show how the size and footprint would change depending upon the rate control requirement. Because the site was previously occupied by a building and parking lot, the existing (pre-project) conditions were simulated in addition to pre-settlement and pre-development conditions.

Table 4 illustrates the peak runoff rates for the 24-hour events required in the Rules (2-year, 10-year and 100-year). Table 4 also shows the percentage of increase in peak runoff rates from the pre-settlement standard.

For the 2-year event, results indicate a 44% increase in peak runoff rate if the pre-development standard is applied. Also, if the pre-development standard is applied for the 10-year and 100-year events, the peak runoff rate increases are 23% and 12% respectively. When an existing conditions standard is applied, peak runoff rates are 210%, 99%, and 44% higher than the pre-settlement rates.

Table 4. Ridgecrest comparison of peak runoff rates and percent increase for rate control standards

Rate Scenario	Peak Runoff Rate [cfs]					
	2-year		10-year		100-year	
Pre-Settlement	1.24	100%	3.46	100%	8.79	100%
Pre-Development	1.79	144%	4.27	123%	9.83	112%
Existing	3.84	310%	6.90	199%	12.66	144%

Table 5 illustrates the required change in footprint and volume of the underground stormwater treatment gallery to meet pre-settlement, pre-development, and existing conditions standards. For the 100-year event (the event that represent the largest footprint), the facility designed to meet pre-development and existing condition peak runoff standards has a 22% and 29% smaller size than the facility designed to meet pre-settlement standards. The size of the underground facility to meet the current rules (runoff volume reduction, water quality and pre-settlement rate control) represents 7.5% of the total site area. If the peak rate standard were revised to a pre-development or existing conditions standard, the required footprint would be reduced to 5.9% or 5.3% of the total site area respectively. This difference represents 1.6% or 2.2% of the site.

Table 5. Ridgecrest comparison of BMP size and percentage of site area for the range of rate control standards

Rate Scenario	100-year, 24-hour Size Difference			
	Square Feet	Cubic Feet	Capacity	Site Area
Pre-Settlement*	6,075	7,815	100%	7.5%
Pre-Development	4,769	6,134	78%	5.9%
Existing	4,312	5,546	71%	5.3%

*Note: Designed footprint for underground stormwater treatment gallery was 6,533 square feet, or 108% of the volume required to meet the pre-settlement rate control standard.

In the case of underground treatment facilities, volume capacity is often more critical than square footage due to the facility not occupying developable land area and the ability to adjust the depth of the facility to accommodate other site constraints.

In summary, these are the main findings for the analysis and our assessment of the findings:

- The difference between pre-settlement and pre-development peak runoff rates targets is significant. Applying a pre-development peak rate standard would result in a 44% increase in peak over the pre-settlement standard for a 2-year event. For the 10-year and 100-year events, the increase is 23% and 12% respectively. More significant is the difference between pre-settlement and existing conditions standard where the resulting peak discharge rates are 44% to 210% more.
- Going from a pre-settlement to a pre-development or existing conditions peak runoff rate standard, will reduce the underground facility size by 22% or 29%. This equates to a reduction of 1.6% or 2.2% of the total site area.

- The size of an underground facility does not affect developable land, but it does affect cost. A 22% to 29% reduction in size will not necessarily equate to the same percent in construction cost savings as several of the construction items do not scale proportionally such as:
    - Mobilization – the same equipment would be needed to construct the facility
    - Chamber delivery – the owner would pay the same delivery fee for full or partial truckloads.
    - Unit prices – Price per unit normally increases for lower quantities. This is especially true on premium items such as the impermeable liner for the stormwater facility.
- Because this analysis is a relative comparison (in percentages) between standards, results for the Ridgecrest commercial development would be similar and can be extrapolated to other developments regardless of size, physical characteristics or soil types.

BCWD 2019 Rule Revisions: Comparison of "all other standards" for discussion with communities in the drainage area to Long Lake + Diversion Structure. August 2019

BCWD	VBWD	MSCWMO	CMSCWD	City of Stillwater	City of Oak Park Heights	MPCA SW Construction Permit
DEVELOPMENT APPLICABILITY						
- **Subdivision of 4+ lots**, - Creating impervious surface that, aggregated with existing impervious surface on the site equals **10,000+ square feet** (5,000 sq ft within the surface water contributing area of a groundwater-dependent natural resource)	- Land disturbance **1+ acre** - Create **6,000+ square feet** of new and/or fully reconstructed impervious - **All subdivisions**	*No permitting program* *Policies to be adopted by LGU's* - Creates or fully reconstructs **6,000+ square feet impervious** or **500+ square feet** impervious in the St. Croix Riverway - Disturbances of 100+ cubic yards or 10,000+ square feet of land - **Subdivision 4+ lots** - Projects requiring a **variance** from the local % impervious zoning requirements - Any project with grading within 40-feet of the bluff line	- **Residential subdivision 4+ lots**; - Create impervious **>1 acre or 5% of a site** (whichever is less); - Land disturbance of **5,000+ square feet** creating impervious surface within 1,000 feet of a tributary to a groundwater-dependent natural resource or public water - Projects requiring a **variance** from the applicable shoreland or St. Croix Riverway ordinance for structure setback and % impervious	Every applicant for subdivision or a permit to allow land-disturbing activities	All new subdivisions, planned unit developments, plats, and other developments of real property	
DEVELOPMENT STANDARDS						
RATE **Pre-settlement 2, 10, 100 year** 24-hour precipitation events for all discharge points VOLUME **Pre-settlement 2 year event** for all discharge points Curve Numbers for Pre-Settlement: Hydrologic Soil Group A – 30 B – 57 C – 70 D – 77 WATER QUALITY No increase in annual phosphorus loading, as compared with the **pre-development** LANDLOCKED BASIN No increase from pre-settlement volume for the **5-year event** for all discharge points	RATE Shall not exceed the **existing** peak rate of runoff for **2, 10, 100 year** 24-hour precipitation events and **100-year 10-day snowmelt event** for all discharge points during all phases of development VOLUME **1.1 inches** retained from impervious - Infiltration practices drawdown within 48 hours - Sites within Valley Creek, Lake Edith, Kelle's Coulee, and Swede Hill Creek watersheds – drawdown within 24 hours WATER QUALITY Achieved through volume control LANDLOCKED BASIN N/A	RATE No increase in [**existing**] peak flow rate at **2, 10, and 100 year** for 24-hour rainfall events Curve Numbers – assume predevelopment in "good hydrologic condition", Curve Numbers for cropland by Hydrologic Soil Group shall be: A- 56 B- 70 C- 79 D- 83 VOLUME **1.1 inches** retained from impervious - Infiltration practices drawdown within 48 hours - Maximum water depth of above ground practices with vegetation is 1.5 feet Flexible treatment options for sites with restrictions WATER QUALITY Achieved through volume control LANDLOCKED BASIN Landlocked watersheds: no increase in predevelopment volume for **10-year event**	RATE **Pre-development 2, 10, 100 year** 24-hour precipitation events for all discharge points VOLUME **Pre-development 2-year event** Curve Numbers for Pre-Development [similar to pre-settlement]: Hydrologic Soil Group A – 30 B – 58 C – 71 D – 78 WATER QUALITY Achieved through 2-year event volume control LANDLOCKED BASIN No increase in predevelopment volume for **10-year event**	RATE No increase from **existing** storm peak discharge rates for the **2, 10, and 100 year** events VOLUME **1.1 inches** retained from impervious - Flexible treatment options for sites with restrictions WATER QUALITY Achieved through volume control LANDLOCKED BASIN N/A	RATE No increase from **existing** peak runoff rates for the **2, 10, and 100 year** rainfall events VOLUME **1.1 inches** retained from impervious - Flexible treatment options for sites with restrictions WATER QUALITY Achieved through volume control LANDLOCKED BASIN N/A	

BCWD	VBWD	MSCWMO	CMSCWD	City of Stillwater	City of Oak Park Heights	MPCA SW Construction Permit
REDEVELOPMENT APPLICABILITY						
Same as development except: - If disturbing >50% of existing impervious surface, then criteria apply to all impervious and disturbed areas - If disturbing <50% of existing impervious, criteria apply only to reconstructed and net additional impervious and all disturbed areas	Same as development	Same as development	Same as development except: - If disturbing >50% of existing impervious and results in net increase in impervious – then rule applies to all impervious on site - If disturbing <50% of existing impervious – applies only to the new and reconstructed impervious	Same as development	Same as development	
REDEVELOPMENT STANDARDS						
RATE Same as development VOLUME Same as development WATER QUALITY Same as development	RATE Same as development VOLUME Same as development WATER QUALITY Same as development	RATE Same as development VOLUME Same as development WATER QUALITY Same as development	RATE Same as development VOLUME Same as development WATER QUALITY Same as development	RATE Same as development VOLUME **1.1 inches** retained from new and/or fully reconstructed impervious WATER QUALITY Same as development	RATE Same as development VOLUME **1.1 inches** retained from new and/or fully reconstructed impervious WATER QUALITY Same as development	

ROADWAY APPLICABILITY

BCWD	VBWD	MSCWMO	CMSCWD	City of Stillwater	City of Oak Park Heights	MPCA SW Construction Permit
Linear projects that create **1+ acres** of new and/or reconstructed impervious surfaces (5,000 square feet if in surface water contributing area to groundwater dependent natural resource) Larger of the following is required: - 100% of required volume from the net additional impervious or - 50% of the required volume from all new and reconstructed surfaces	Linear projects that creates **6,000+ square feet** of new or reconstructed impervious	Same as development	- Creating impervious surface **>1 acre** - Only net additional impervious surface will be considered.	Linear projects that create **1+ acres** of new and/or reconstructed impervious surfaces	Linear projects that create **1+ acres** of new and/or reconstructed impervious surfaces	

ROADWAY STANDARDS

BCWD	VBWD	MSCWMO	CMSCWD	City of Stillwater	City of Oak Park Heights	MPCA SW Construction Permit
RATE Same as development VOLUME Same as development WATER QUALITY Same as development	RATE Same as development VOLUME The **greater of**: -Retain **0.55 inches** from all new and reconstructed impervious -Retain **1.1 inches** from the net increase in impervious WATER QUALITY Achieved through volume control	RATE Same as development VOLUME The **greater of**: -Retain **0.55 inches** from all new and reconstructed impervious -Retain **1.1 inches** from the net increase in impervious WATER QUALITY Achieved through volume control	RATE Same as development VOLUME Same as development WATER QUALITY Same as development	RATE Same as development VOLUME The **greater of**: -Retain **0.55 inches** from all new and reconstructed impervious -Retain **1.1 inches** from the net increase in impervious WATER QUALITY Achieved through volume control	RATE Same as development VOLUME The **greater of**: -Retain **0.55 inches** from all new and reconstructed impervious -Retain **1.1 inches** from the net increase in impervious WATER QUALITY Achieved through volume control	

WETLAND BOUNCE AND INUNDATION REQUIREMENTS

Mgmt. Class	**Bounce**	**Inund. 2-yr**	**Inund. 10-yr**
Preserve	Pre-dev	Existing	Existing
Manage 1	Pre-dev + 0.5 ft	Exist. + 1 day	Exist. + 2 days
Manage 2	Pre-dev + 1.0 ft	Exist. + 2 days	Exist. + 7 days
Manage 3 or Lake	No limit	Exist. + 7 days	Exist. + 14 days

Mgmt. Class	**Bounce**	**Inund. 2-yr**	**Inund. 10-yr**
Preserve	Existing	Existing	Existing
Manage 1	Existing + 0.5 ft	Exist. + 1 day	Exist. + 7 days
Manage 2	Existing + 2.0 ft	Exist. + 5 days	Exist. + 14 days

Match inflow runoff volume from the 2-year 24-hour event.
- Manage 2 wetlands, allow +/- 25% change.
- Manage 1 and Preserve wetlands, allow +/- 10% change

Susceptibility Class	**Bounce**	**Inundation 1- and 2-yr**
Highly	Existing	Existing
Moderately or Slightly	Existing + 0.5-1.0 ft	Existing + 1-2 days
Least	No limit	Existing + 7 days

Suscept. Class	**Bounce**	**Inund. 2-yr**	**Inund. ≥10-yr**
Highly	Existing	Existing	Existing
Moderately	Existing + 0.5 ft	Exist. + 1 day	Exist. + 7 days
Slightly	Existing + 1.0 ft	Exist. + 2 days	Exist. + 14 days
Least	No limit	Exist. + 7 days	Exist. + 21 days

N/A

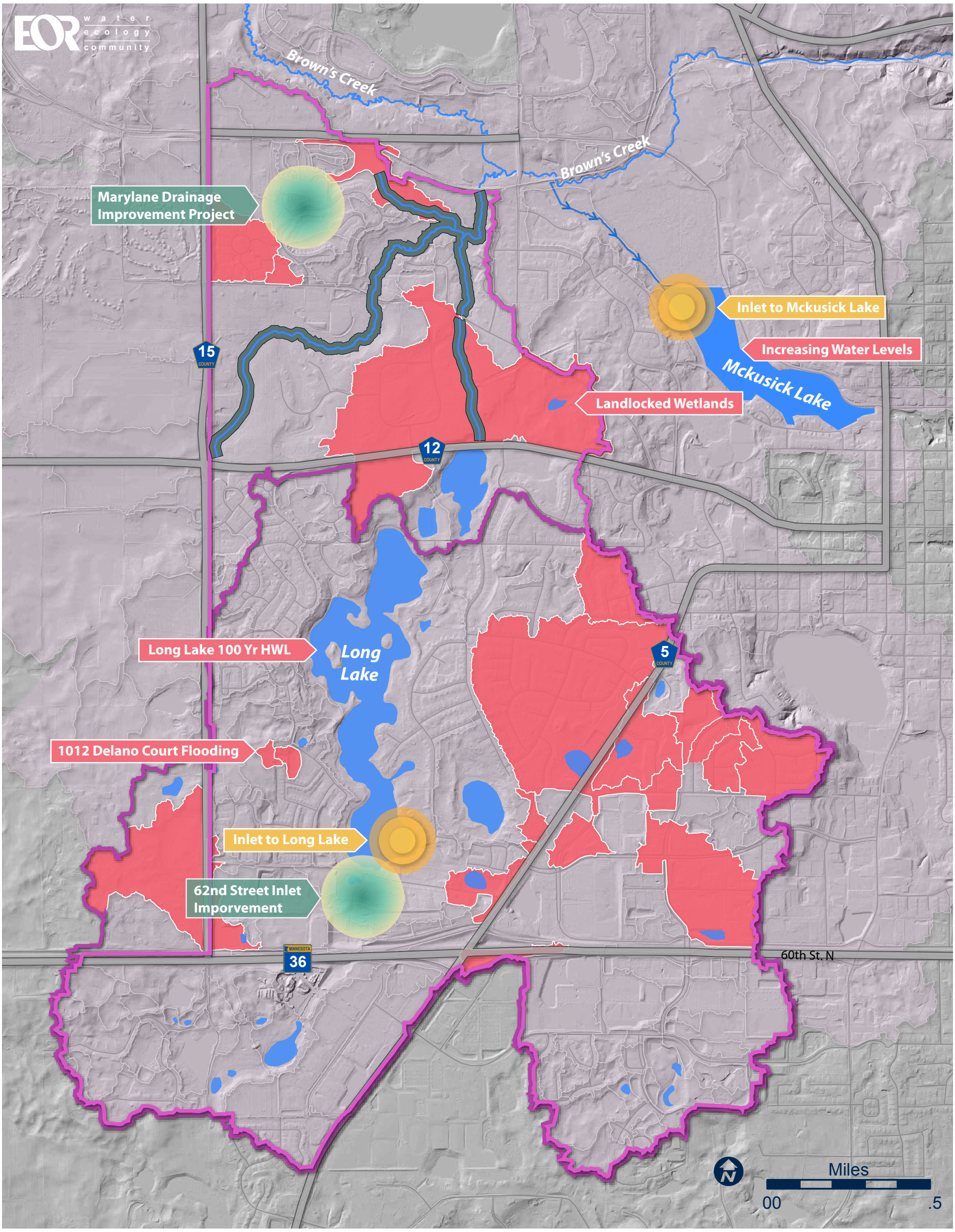
N/A

PRETREATMENT REQUIREMENTS

BCWD	VBWD	MSCWMO	CMSCWD	City of Stillwater	City of Oak Park Heights	MPCA SW Construction Permit
- Surface flows to infiltration facilities must be pretreated for long-term removal of at least 50	- Infiltration facility with tributary area of ≤2 acres and <0.7 acres of impervious: **at least 50%** of	- Surface flows to infiltration facilities must be pretreated for long-term removal of at least 50	- Surface flows to infiltration facilities must be pretreated for long-term removal of at least 50	N/A	N/A	

BCWD	VBWD	MSCWMO	CMSCWD	City of Stillwater	City of Oak Park Heights	MPCA SW Construction Permit
percent of sediment loads - In the event an infiltration facility is constructed in the vicinity downstream of a potential Hot Spot, a skimmer must be installed to facilitate cleanup	inflow volume from impervious surfaces must be pretreated - Infiltration facility with tributary area of >2 acres or >0.7 acres of impervious: **100%** of inflow volume from impervious surfaces must be pretreated. Pre-treatment must **remove at least 25% of sediment load**	percent of sediment loads - In the event an infiltration facility is constructed in the vicinity downstream of a potential Hot Spot, a skimmer must be installed to facilitate cleanup	percent of sediment loads - In the event an infiltration facility is constructed in the vicinity downstream of a potential Hot Spot, a skimmer must be installed to facilitate cleanup			
MAINTENANCE REQUIREMENTS FOR STORMWATER MANAGEMENT STRUCTURES AND FACILITIES						
- Designed for maintenance access - Properly maintained in perpetuity to assure that they continue to function as designed - Provide a maintenance, inspection and, if required, monitoring plan that identifies and protects the design, capacity and functionality of onsite and offsite stormwater management facilities; provides specifications, methods and a schedule for the inspection and maintenance in perpetuity of the facility, with documentation retained onsite and available to the District on reasonable notice; and contains at a minimum the requirements in the District's standard maintenance declaration	- A maintenance agreement is required, including exhibit showing the facility meets the minimum maintenance standards for stormwater quality treatment facilities - Adequate access must be provided to all stormwater management facilities for inspection, maintenance, and landscaping upkeep	- A maintenance agreement is required - Easement for maintenance access to stormwater management facilities is required	- Designed for maintenance access - Properly maintained in perpetuity to assure that they continue to function as designed - Memorialize maintenance responsibility	All stormwater management facilities must be designed to: - Minimize the need of maintenance - Provide access for maintenance purposes - Be structurally sound All stormwater management facilities must have a plan of operation and maintenance that ensures continued effective removal of pollutants carried in stormwater runoff. The director of public works, or designated representative, must inspect all stormwater management facilities during construction, during the first year of operation and at least once every five years thereafter. The inspection records will be kept on file at the public works department for a period of six years. It is the responsibility of the applicant to obtain any easements or property interests to allow needed access to the stormwater management facilities for inspection and maintenance purposes.	N/A	
BUFFER REQUIREMENTS						
<u>Wetland</u> Preserve – 100 feet Manage 1 – 75 feet Manage 2 – 50 feet Manage 3 – 25 feet GD* – 100 feet <u>Stream/Tributary</u> Streamside zone – 25 feet (50 GD*) Middle zone – 50 feet (100 GD*) Outer zone – from middle zone to structure setback line <u>Lake</u> Lake – 75 feet (100 GD*) <u>Buffer Extensions</u> - Upland edge of mapped natural communities	<u>Wetlands</u> Preserve – 100 feet Manage 1 – 75 feet Manage 2 – 50 feet *Measured from the delineated wetland edge or DNR OHW, whichever is higher.* <u>Stream</u> Valley Creek – 100 feet Raleigh Creek & All Intermittent Streams – 50 ft av., 25 ft min *Measured from edge of water for Valley Creek and from the centerline for all other streams.* <u>Lakes</u> Lake – 35 feet	<u>Wetlands</u> Preserve – 60 feet Maintain – 30 feet Manage – No buffer required *All buildings must be set back at least 20' from the buffer <u>Bluffs and Steep Slopes</u> - Construction is prohibited on slopes greater than 12% - Construction is prohibited within 40' of the top of bluff lines	<u>Wetland</u> Manage 1 – 100 feet Manage 2 – 75 feet Manage 3 – 50 feet Manage 4 – 25 feet GD* – 100 feet <u>St. Croix River</u> Streamside zone – 25 feet from Bluff Line or OHWL Middle zone – 50 feet Outer zone – from middle zone to structure setback set by LSCNSR Management Rules <u>Streams, Creeks & Tributaries</u> Streamside zone – 25 feet (50 GD*) Middle zone – 50 feet (100 GD*) Outer zone – from middle zone to	16.5 foot buffer around all wetlands Regulate the use of fertilizers and pesticides within the buffer define as Fifty (50) foot wide strip of land, measured at a right angle to the shoreline or the OHWL adjacent to every lake, pond, wetland, creek, river or standing water surface (Included in the definitions of Chapter 35. Stormwater Drainage)	Wetland buffer width dependent on wetland size: 0-3 acres – 15 feet >3 acres – 25 feet DNR protected water – 35 feet (incl. wetlands, lakes, and streams)	

BCWD	VBWD	MSCWMO	CMSCWD	City of Stillwater	City of Oak Park Heights	MPCA SW Construction Permit
- Top of steep slope - Upland edge of 100-year floodplain *GD = Groundwater-dependent natural resource	*Measured from the OHW.* <u>Stormwater Ponds</u> Stormwater Pond – 10 feet		structure setback line <u>Lake</u> Natural Environ. Lake – 75 feet Recreational Dev. Lake – 50 feet GD* – 100 feet <u>Buffer Extensions</u> - Upland edge of mapped natural communities - Top of steep slope - Upland edge of 100-year floodplain - Along drainageways conveying flow through buffer and extending outside buffer *GD = Groundwater-dependent natural resource			
FLOODPLAIN AND DRAINAGE ALTERATIONS						
- Replace flood volume of floodplain filling between the ordinary water level and the 100-year flood elevation - Lowest floor must be: o 2 ft above 100-yr HWL or 1ft above natural overflow of waterbody o 2 ft above 100-yr HWL of any open stormwater conveyance o 2 ft above 100-yr HWL or 1ft above emergency overflow of a constructed basin - <u>Landlocked basins</u>: Lowest floor elevation must be at least 3 feet above the 100-yr HWL as listed above within a landlocked basin Alteration will not have an unreasonable impact on an upstream or downstream landowner and will not adversely affect flood risk, basin or channel stability, groundwater hydrology, stream baseflow, water quality or aquatic or riparian habitat	Lowest floor elevation is 2 feet above the 100-year flood elevation Floodplain Alterations will: - Not unreasonably impact another community (e.g. outletting of landlocked ponds and modifying lake outlet elevations) - Not unnecessarily impact the waters of the VBWD	Lowest floor elevation must be 2 feet above the 100-year flood elevation <u>Landlocked basins</u>: lowest floor elevation must be 2 feet above the natural overflow of the landlocked basin	- Replace flood volume of floodplain filling between the ordinary water level and the 100-year flood elevation - Lowest floor must be 2 ft above 100-yr HWL or 1ft above emergency overflow - <u>Landlocked basins</u>: Lowest floor elevation must be at least 3 feet above the 100-yr HWL, unless the building is 1 foot above the basin overflow Alteration will not have an unreasonable impact on an upstream or downstream landowner and will not adversely affect flood risk, basin or channel stability, groundwater hydrology, stream baseflow, water quality or aquatic or riparian habitat	<u>For Lakes</u> Lowest floor elevation at least 3 feet above the highest known water level or 3 feet above the OHWL, whichever is higher <u>For Rivers and Streams</u> Lowest floor at least 3 feet above the flood of record, the OHWL, or the flood stage determined by technical evaluation, whichever is highest	Lowest floor elevation is one (1) foot above the water surface profile associated with the 100-year flood, plus any increases in flood heights attributable to encroachments on the floodplain.	



Potential/Temporary Flooding

Long Lake	*100 Year high water level above LFE*
Armory Wetland	*Landlocked wetland on neighboring property*
Mckusick Lake	*Upward trend in water levels over the last 10 years*
Subwatersheds	*Potential flooding (0.5' – 4.68') identified in modeling results provided in Local Surface Water Management Plan*

Local Drainage Isues

Marylane Drainage	*Flooding outside of drainage easement*
62nd St. Improvement	*Pipe replacement beneath 62th street to address flooding threatening driveway access*

Channel Erosion/ Instabilities

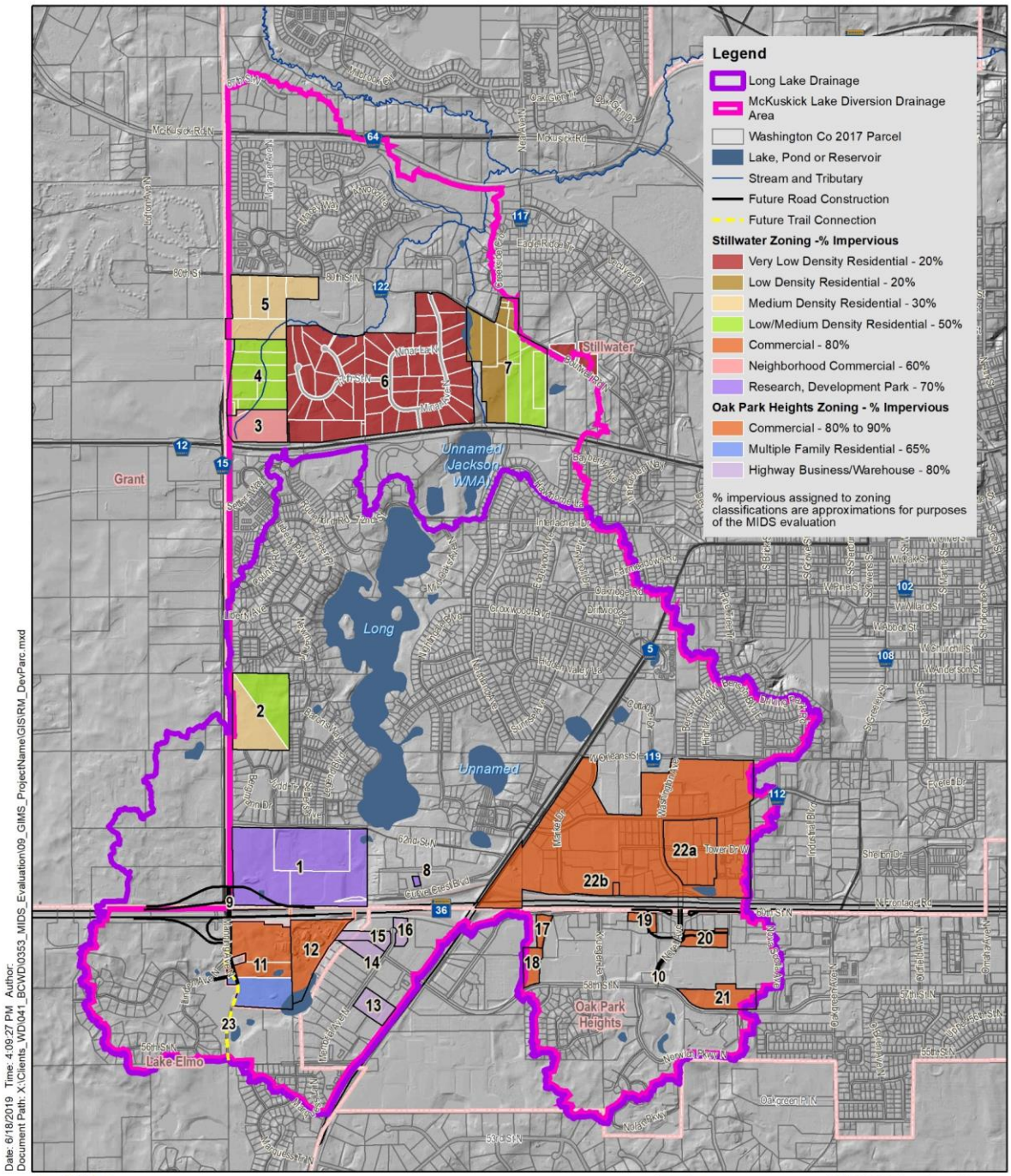
Head cuts along all three Tributaries	*Pipe Instability on Boutwell Road following spring melt*

Erosion and/or Sediment Accumulation

Lake Inlet Sediment Deltas	*Sediment Identified in Long Lake and surveyed in Mckusick Lake*

Recent Long Lake/Diversion Drainage Hydrology Related Stressors

Brown's Creek Watershed District *08/15/2019*



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EOR water ecology community

MIDS Evaluation - Future Development Assessment

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