DuPage River Salt Creek Workgroup

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DuPage/Salt Creek Special Conditions Report
March 31, 2019

Fullersburg Woods Dam, Fullersburg Woods Forest Preserve

Impoundment at Spring Brook Phase 2, Blackwell Forest Preserve

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Introduction and Participation DuPage/Salt Creek Special Conditions Report March 31, 2019.

This report fulfills certain reporting requirements contained in DuPage River Salt Creek Workgroup's (DRSCW) and Lower DuPage River Watershed Coalition's (LDRWC) NPDES permits. These requirements are as provided in the DRSCW Special Conditions (Attachment 1) and the LDRWC Special Conditions (Attachment 2 – Note: As the LDWRC Special Conditions differ between permit holders, the Special Conditions for Bolingbrook STP#3 is included the Attachment as a representation of the Special Conditions Language).

The Special Conditions are contained in the NPDES permits identified in Table 1 and Table 2. Listed permittees are required to ensure the completion of projects and activities set out in the Special Conditions, while a few other permittees are required to participate only in identified watershed level studies and the chloride reduction program. Table 1 identifies the status of funding for these activities by each permittee in the DRSCW and Table 2 identified the status of funding for these activities by each permittee in the LDRWC.

All listed permittees participate in the DRSCW and/or LDRWC and are working with other watershed members of the DRSCW and LDRWC to determine the most cost effective means to remove dissolved oxygen (DO) and offensive condition impairments in the DRSCW watersheds.

The specific reporting requirements addressed herein include annual reporting on the progress of the projects listed in the Special Conditions, and certain baseline condition reporting for the Chloride Reduction Program. Map 1 and 2 show the locations of the physical projects to be realized under the special conditions.

Special Condition Permit Holder Forum

On November 8, 2018, a Special Conditions Permit Holder Forum for DRSCW and LDRWC Permit Holders was held at the Village of Lombard. Eighteen member agencies and three affiliate members attended. The objective of the meeting was to provide an up on how nutrient regulation in Illinois and discuss current and future DRSCW projects. The meeting agenda is included below.

8:30-8:40	Introductions
8:40-9:00	Update on Current Special Condition Projects (Deanna Doohaluk & Stephen McCracken, The Conservation Foundation)

9:00-9:30	Nutrients – State of Illinois: NSAC recommendations, 3rd party agreements and expansions (Nick Menninga, Downers Grove Sanitary District)
9:30-9:45	Break
9:45-11:00	Discussion on DRSCW Upcoming Permit Negotiations

Table 1. *Participation in the DRSCW Special Condition permit 2018-2019.*

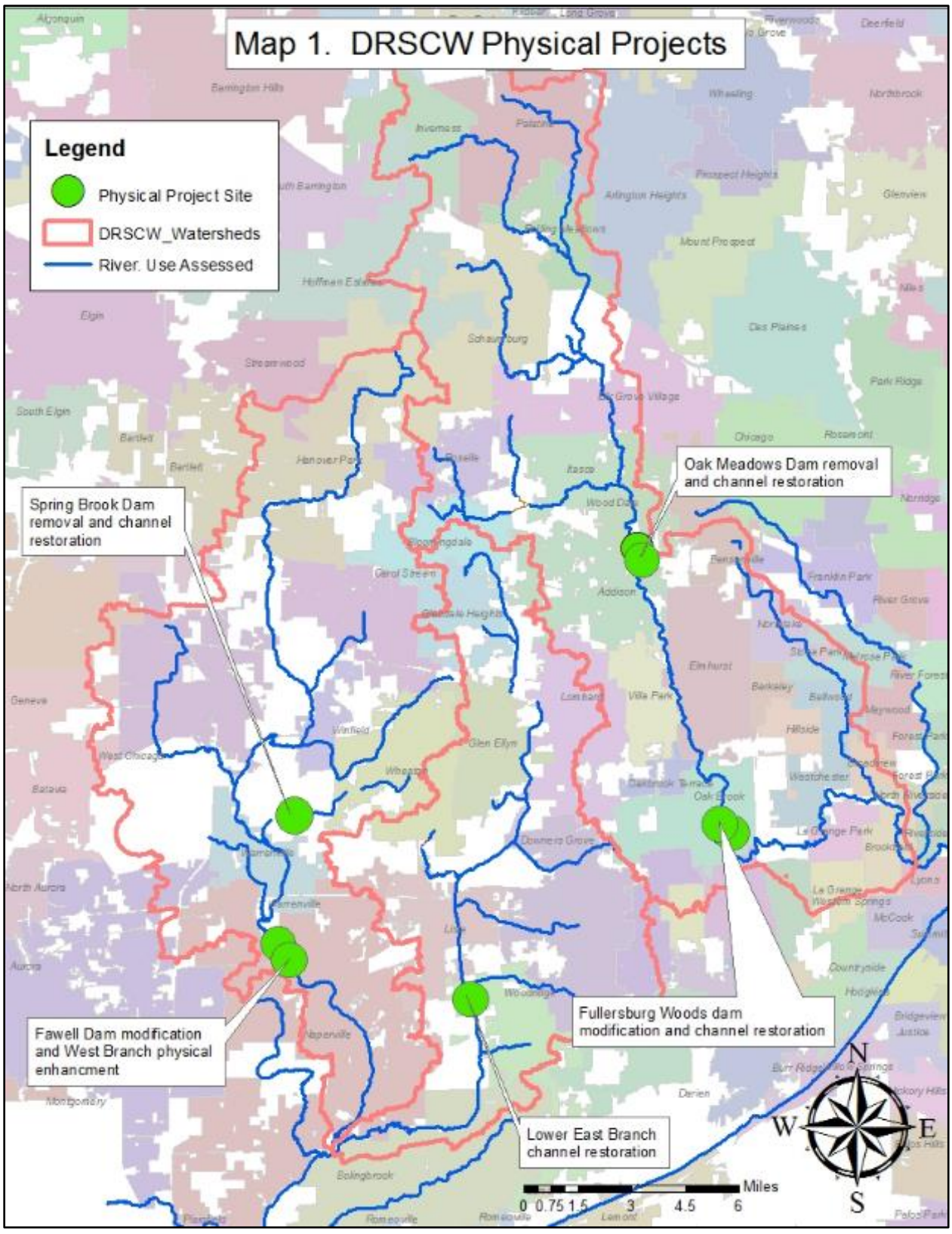
POTW Owner/ Facility Name	NPDES No.	Membership Dues Paid 2018-2019	Assessment Paid For Paragraph 2 Table Project Funding*	Assessment Paid for Chloride Reduction/NIP/QUAL 2k/Trading Program
Addison North STP	IL0033812	YES	YES	YES
Addison South - AJ LaRocca	IL0027367	YES	YES	YES
Bartlett WWTP	IL0027618	YES	YES	YES
Bloomingdale-Reeves WRF	IL0021130	YES	YES	YES
Bolingbrook STP#1	IL0032689	YES	YES	YES
Bolingbrook STP#2	IL0032735	YES	YES	YES
Carol Stream WRC	IL0026352	YES	YES	YES
Downers Grove SD	IL0028380	YES	YES	YES
DuPage County Woodridge	IL0031844	YES	YES	YES
Elmhurst WWTP	IL0028746	YES	YES	YES
Glenbard WW Authority STP	IL0021547	YES	YES	YES
Glendale Heights STP	IL0028967	YES	YES	YES
Hanover Park STP#1	IL0034479	YES	YES	YES
Roselle-Devlin STP	IL0030813	YES	YES	YES
Roselle-J Botterman WWTF	IL0048721	YES	YES	YES
Salt Creek SD	IL0030953	YES	YES	YES
West Chicago STP	IL0023469	YES	YES	YES
Wheaton SD	IL0031739	YES	YES	YES
Wood Dale North STP	IL0020061	YES	YES	YES
Wood Dale South STP	IL0034274	YES	YES	YES
Bensenville South STP	IL0021849	YES	N/A	YES
Itasca STP	IL0079073	YES	N/A	YES

*N/A means that the agency does not have that condition in their permit.

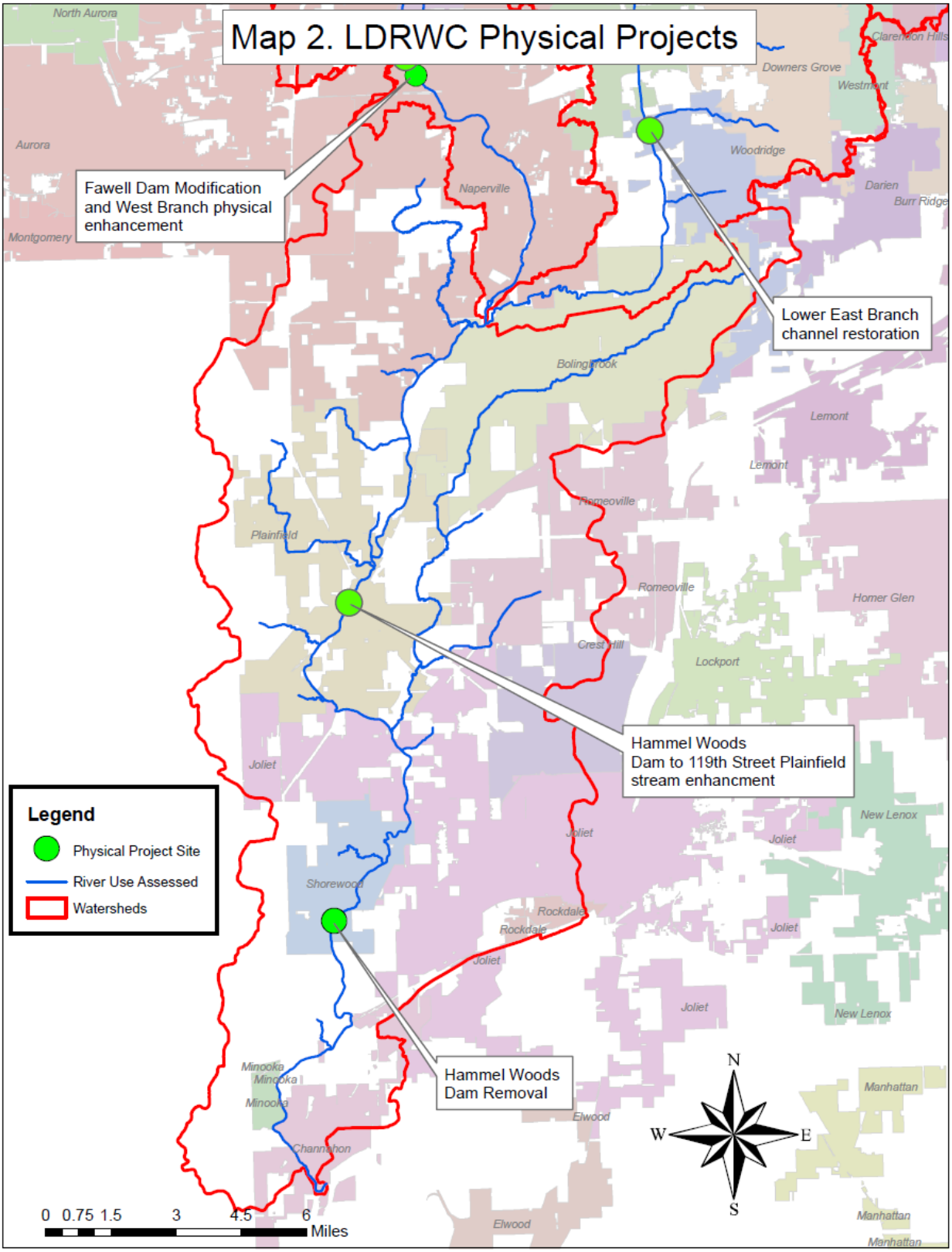
Table 2. *Participation in the LDRWC Special Condition Permit 2018-2019.*

POTW Owner/ Facility Name	NPDES No.	Membership Dues Paid 2018-2019	Assessment Paid For Paragraph 2 Table Project Funding*	Assessment Paid for Chloride Reduction/NIP/QUAL 2k/Trading Program
Naperville Springbrook WRC	IL0034061	YES	Permit issued on 12/14/2019 and payment is pending.	Permit issued on 12/14/2019 and payment is pending.
Bolingbrook STP#3	IL0069744	YES	NO	NO
Plainfield STP	IL0074373	YES	N/A	YES
Joliet Aux Sable Plant	IL0076414	YES	N/A	YES
Crest Hill West STP	IL0021121	YES	N/A	YES
Minooka STP	IL0055913	YES	N/A	YES

*N/A means that the agency does not have that condition in their permit.



Map 1. *Map of DRSCW physical projects set out in the Special Condition.*



Map 2. *Map of the LDRWC physical projects set out in the Special Condition*

1.0 Physical Projects

The Special Condition Paragraph 2 identifies stream restoration and dam modification projects that must be completed by the DRSCW and/or LDWRC. The current DRSCW Five-Year Financial Plan and the LDRWC Five-Year Financial Plan identifies project expenses and funds allocated for each of the physical project. Map 1 shows the DRSCW physical projects covered in this section and Map 2 shows the LDRWC physical projects covered in this section.

1.1 Oak Meadows Dam Removal and Stream Restoration

- Special Condition Completion Date – December 31, 2016 (dam removal), December 31, 2017 (stream restoration)
- Project Status – Dam removal and stream restoration complete. In impact monitoring phase.

Summary of Results – Post project survey results: mean QHEI increased from 57.25 to 69.3 in 2017 to 70 in 2018. Mean mIBI increased from 23.6 (based on 2013 data) to 33.2 in 2017 to 34.9 in 2018. Five (5) new, high-value species were found present at the project location in 2018 with a total of seven (7) new species overall.

1.1.1. Site Description and Project Design

The 2016 Annual Report provided a site description and the design plan.

1.1.2. Project Implementation

The 2017 Annual Report detailed the project implementation.

1.1.3. Project Impact Evaluation

As construction is complete, the project is in its impact evaluation phase. The short and long-term objectives for the project were:

Short Term

- **Improve Qualitative Habitat Evaluation Index (QHEI).** QHEI was surveyed at four sites within the project footprint.

- **Fish Passage** - Measured by removal of the dam. No improvement in fish IBI or presence of new species is predicted because of the project. Fish biodiversity is constrained by a downstream barrier, Fullersburg Woods dam.

Long Term

- **a) Increase macroinvertebrate Index of Biological Integrity scores (mIBI)** and **b) increase the presence of specific high value taxa** in the 1.3-mile stretch of Salt Creek main stem contained in the project footprint. The potential post project high value taxa list was compiled from taxa lists from two Salt Creek sites with a performing macro-invertebrate community. Fourteen (14) rheobiotic and hard or coarse substrate associated taxa were identified at the sites listed in Table 3. All 14 taxa were found at one or both of the high mIBI sites (lower part of the Salt Creek basin), but only six (6) were collected inside the project footprint.

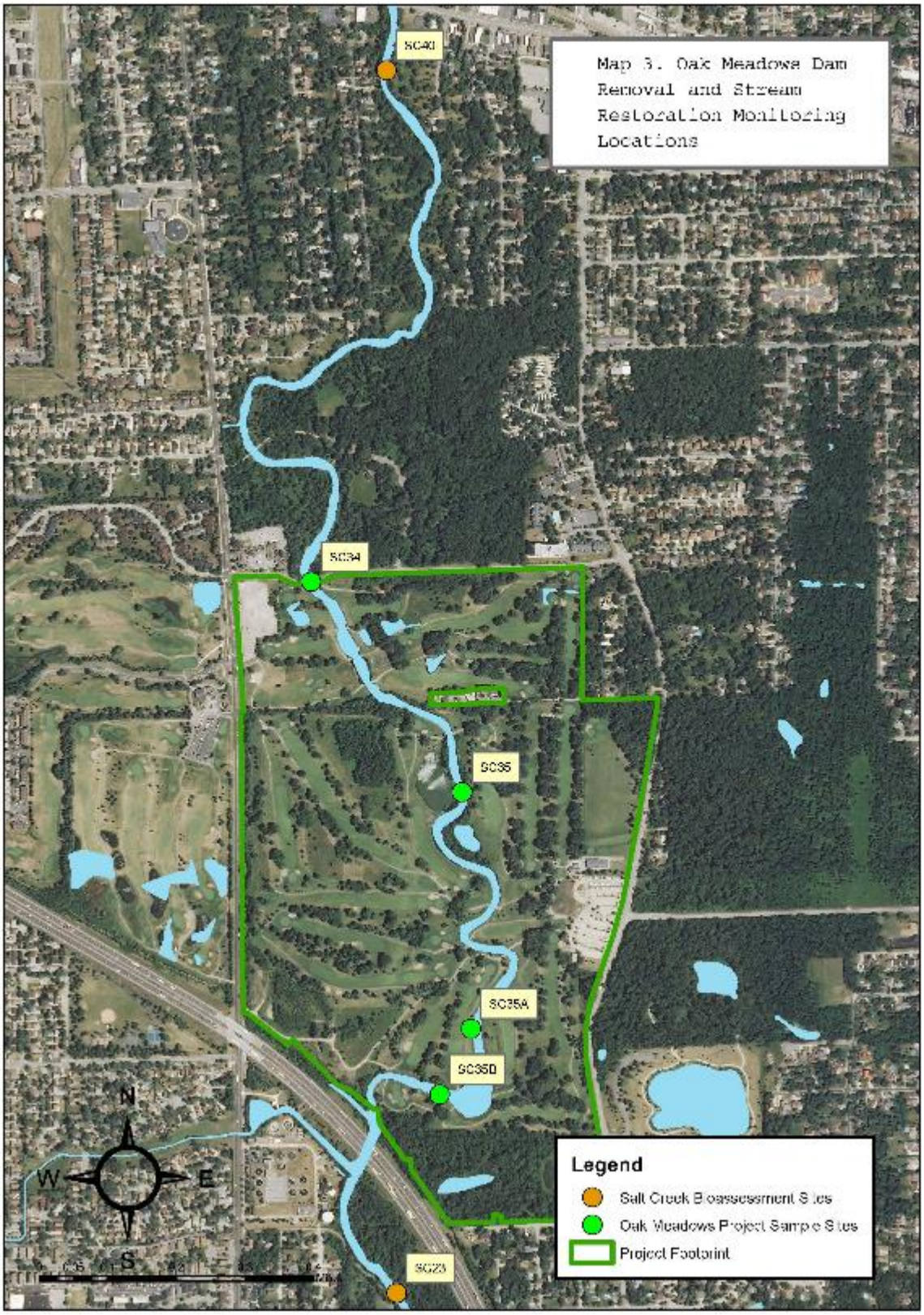
- **Improve dissolved oxygen (DO) scores** directly upstream of the Oak Meadows dam. The DRSCW recorded continuous DO data at the site 2009-2013. Data collection will resume in June 2017. Diel variation and daily and monthly average and minimums will be compared in the pre and post project data sets.

2018 Project Monitoring

Five sites were monitored post project: one outside and north of the project footprint and 4 inside the footprint (see Table 3 and Map 3). Of the four inside the project footprint, two are part of the DRSCW's regular Salt Creek basin assessment program (SC34 & SC35); SC35A was added in 2014 (mIBI in 2014 and for mIBI/ QHEI in 2017); and a fourth site was added in 2017 (SC35B QHEI and mIBI). No monitoring at the site was conducted in 2015 or 2016 as construction was on going. The site north of the project footprint (SC40) is included as a form of control. Post-project monitoring will continue in 2019 and will be part of the whole basin assessment scheduled for 2021.

Table 3. *Physical Habitat and Biological Monitoring locations at Oak Meadows.*
Sites in the project footprint are highlighted in green, sites outside the footprint are in white. Sites SC35A and SC35B were created to increase the resolution of data generated by the project. Note the correction from the SC35A over the 2017 report: QHEI was not collected at the site but was collected at SC35B.

Site Data		Parameters Collected				
Site ID	**River Mile**	**2010**	**2013**	**2014**	**2017**	**2018**
SC40	24.5	mIBI, QHEI	mIBI, QHEI		mIBI, QHEI	mIBI, QHEI
SC34	23.5	mIBI, QHEI	mIBI, QHEI	mIBI, QHEI	mIBI, QHEI	mIBI, QHEI
SC35	23	mIBI, QHEI	mIBI, QHEI	mIBI, QHEI	mIBI, QHEI	mIBI, QHEI
SC35B	22.8				mIBI, QHEI	mIBI, QHEI
SC35A	22.7			mIBI	mIBI	mIBI, QHEI
SC23	22.5	mIBI, QHEI	mIBI, QHEI			



Map 3. *Oak Meadows Project footprint showing monitoring in footprint (green) and outside (orange).*

Results - Physical Habitat/QHEI

Figure 1 shows QHEI scores at the project location relative to other main stem sites surveyed as part of the regular basin wide assessment surveys conducted in 2007, 2010 and 2013. Data limited to the project footprint was collected in 2014, 2017 and 2018 and is shown in Figures 2 & 3. Oak Meadows forms one of four QHEI "sags". Table 4 summarizes the data shown in Figure 2.

Post project QHEI increased at all sites with improvements in substrate, riparian, pool and riffle scores. Mean QHEI at the project location has increased to 70. All QHEI scores were within the "good" range (>60 QHEI points).

Figure 1. *Salt Creek main stem basin QHEI assessment results for 2007, 2010 and 2013.*
Dips in QHEI are associated with three principle dams on the river. The blue arrow and red ellipse mark the project location.

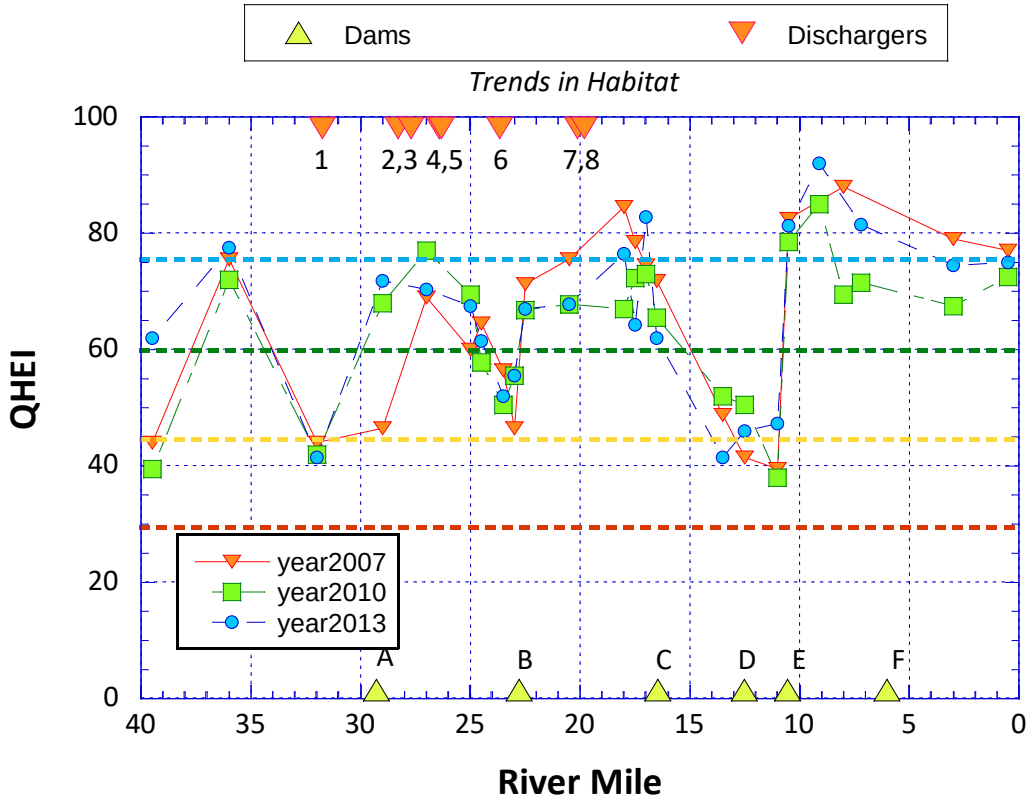


Figure 2. QHEI scores pre- (2010, 2013, and 2014) and post-project (2017 and 2018) at Oak Meadows. Sites SC34, SC35, SC35B and SC35A are all inside the project footprint (area highlighted in green).

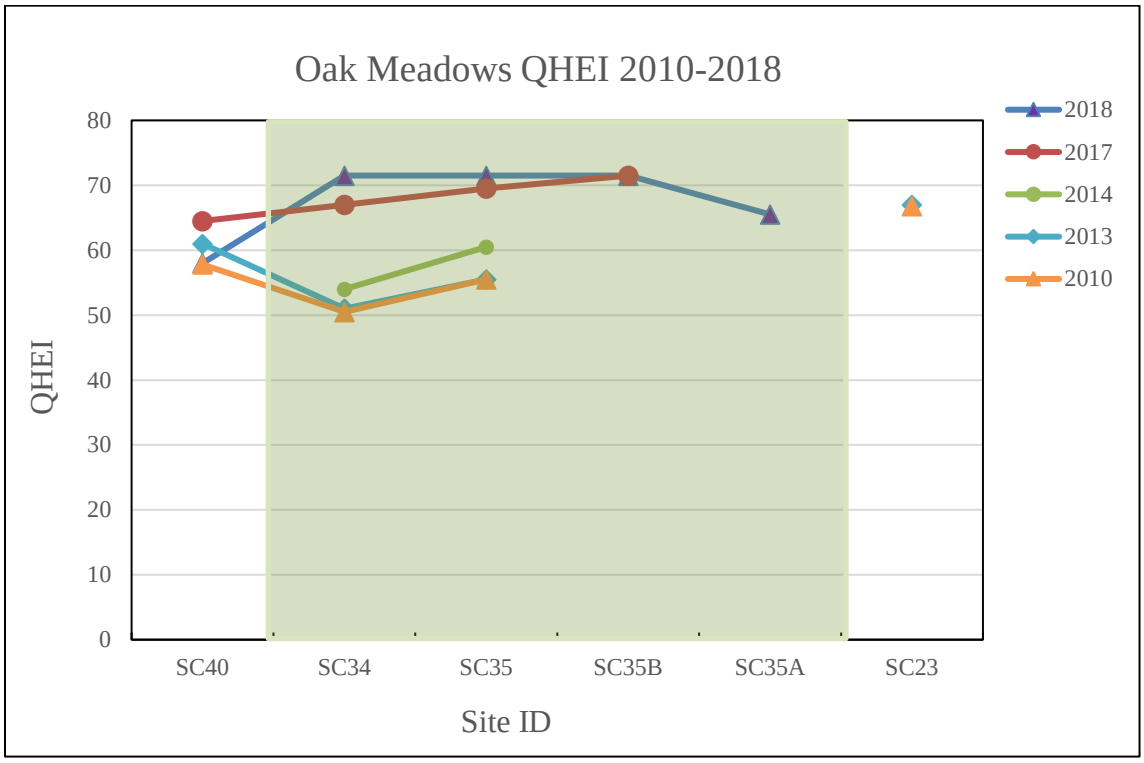


Table 4. *QHEI Results for 2010-2018 at Oak Meadows.*

Site Description		QHEI					
Site ID	**River Mile**	**2010**	**2013**	**2014**	**2016**	**2017**	**2018**
SC40	24.5	57.8	61		55.5	64.5	58
SC34	23.5	50.5	51	54		67	71.5
SC35	23	55.5	55.5	60.5		69.5	71.5
SC35B	22.8					71.5	71.5
SC35A	22.7						65.5
SC23	22.5	66.8	67		56		

*2017 and 2018 are the post project condition. The Key is below in table 5.

Table 5. *Color code to QHEI scores depicted in Table 4.*

Legend: QHEI
Excellent
Good
Fair
Poor

Results – Macroinvertebrates (mIBI)

Post-project, both mIBI and individual species taxa biodiversity were monitored at the site. As Table 5 shows, the 2018 post-project mean mIBI was 34.9 compared to a pre-project mean score of 23.6. The project's objective is to increase the mean mIBI to 35. Notably two sites achieved a score of 38.5 in 2018.

Figure 3 represents the data graphically. Two sites (RM 24.5 SC40 and RM 22.5 SC23) from outside the project footprint are included for reference (see Map 3).

Table 6. *MIBI results from 2010-2018 for the project footprint at Oak Meadows.*

mIBI (Target 41)						
Site ID	**River Mile**	**2018**	**2017**	**2016**	**2014**	**2013**
SC40	24.5	34.4*	32*	7.4*	-	35.1*
SC34	23.5	38.5^{ns}	36*	-	20.2*	23.2*
SC35	23	28.9*	29.7*	-	15.5*	24.1*
SC35B	22.8	33.8*	33.1*	-	-	-
SC35A	22.7	38.4^{ns}	33.9*	-	12.1*	-
SC23	22.5	-	-	21.2*	-	28*

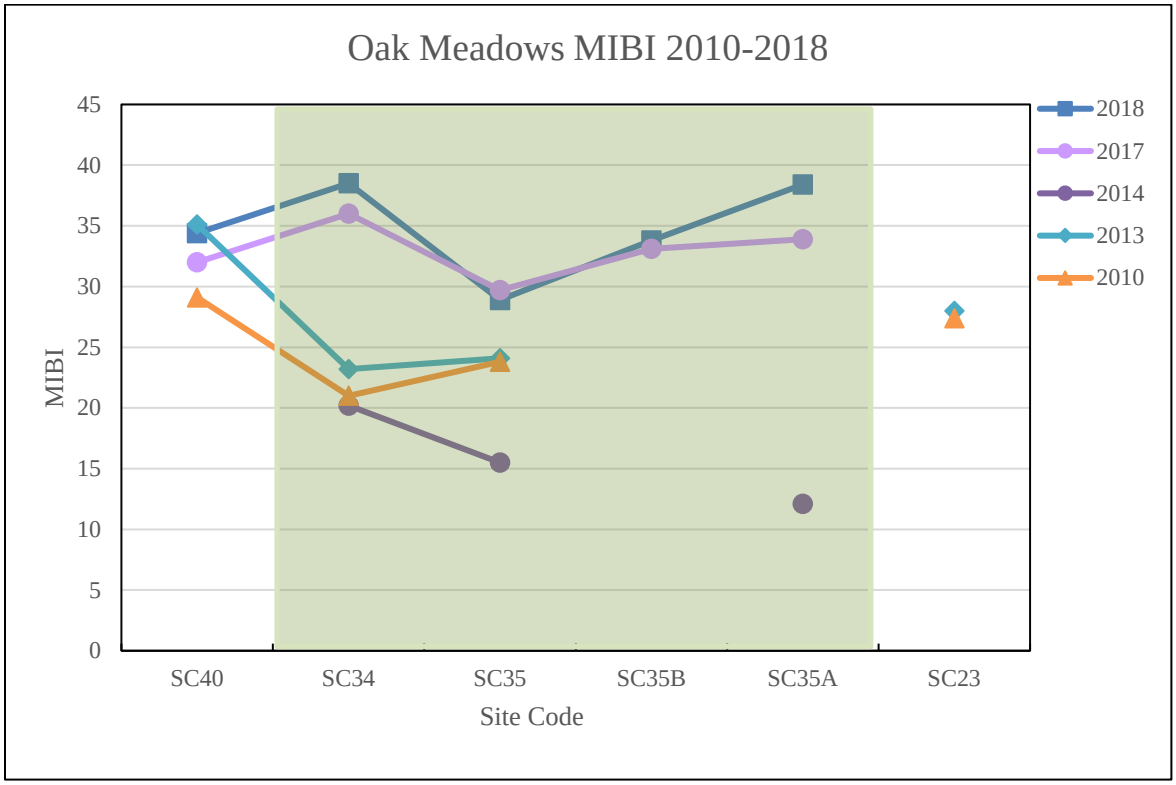
*2017 and 2018 are the post project condition.

Table 7. *Color code to mIBI scores depicted in Table 6.*

Legend: Biological Indicators	
Green	Good
Yellow	Fair
Red	Poor
*	Significant departure from biocriterion
NS	Nonsignificant departure from biocriterion

T

Figure 3. *mIBI results for 2010-2017. 2017 and 2018 are post-project at Oak Meadows.*
Sites SC34, SC35, SC35B and SC35A are all inside the project footprint (area highlighted in green).



Changes in individual taxa is measured in two ways, 1) tracking a subset of key taxa and 2) tracking overall numbers at and throughout the site.

Tracking of individual taxa is done is two ways. First, certain key high value taxa judged likely candidates at the site based on their presence in the basin were tracked. The potential post-project high value taxa list includes fourteen seventeen (17) taxa although two of the seventeen (*Ceratopsyche* morosa group and *Thienemanniella xena*) were not found during the reporting period. Seven (7) of these high value taxa were previously recorded as present at the site and ten (10) were not. Post-project, in 2017 and 2018 eight (8) of the high value taxa not found in previous surveys were recorded (Table 8), but in 2018 one of the two taxa noted as absent post project returned (the Mayfly *Stenacron sp).* Only one high value taxa (the dance fly larvae, *Hemerodrimia sp*) was found pre-project but not found during post-project sampling.

In terms of total species, 8 new high value species have been found post project at the site, part of the 33 total new species that have either appeared at the site. If additional taxa that have of extended their range within the site (that is captured at a monitoring site where they had not previously been found by surveys) are included, the number of high value taxa increased to 13 among 63 taxa with range expansions (Attachment 3).

Table 8. *High value species pre- and post-project at Oak Meadows.*

Taxa code	Taxa	2010-2014			2017b				2018b			
		SC34	SC35	SC35A	SC34	SC35	SC35B	SC35A	SC34	SC35	SC35B	SC35A
Mayflies												
11130	*Baetis intercalaris*		x		x	x	x	x	x		x	x
13400	*Stenacron sp*	x								x**		
Caddisflies												
52200	*Cheumatopsyche sp*	x	x		x	x	x	x	x	x	x	x
52431	*Ceratopsyche morosa group*											
52521	*Hydropsyche bidens or H. orris*								x			
52570	*Hydropsyche simulans*				x	x	x	x	x			x
53800	*Hydroptilla sp (also Hydroptilidae)*	x					x		x		x	x
59410	*Nectopsyche diarina*				x	x				x	x	
Beetles												
69400	*Stenelmis sp*				x		x	x	x	x	x	x
Diptera/flies												
74100	*Simulium sp*	x			x		x	x	x		x	x
80440	*Cricotopus (C.) trifascia*										x	x
81825	*Rheocricotopus (Psilocricotopus) robacki*						x					
82141	*Thienemanniella xena*											
83820	*Microtendipes caelum*							x				
84450	*Polypedilum (Uresipedilum) flavum*	x	x	x	x	x	x	x	x	x	x	x
85625	*Rheotanytarsus sp*				x		x	x	x		x	
87540	*Hemerodromia*		x									

** Heptageneiidae; Family includes Stenacron

Taxa Added to List: Justification

Nectopsyche diarina - Unlike other Nectopsyche species which are often associated with lentic habitats, *N. diarina* is specifically associated with swift streams (Glover and Floyd 2004).

Cricotopus (C.) trifascia group and **Microtendipes "caelum" (sensu Simpson & Bode, 1980)** are listed as rheobiotic (current dependent) (Simpson and Bode 1980).

Hemerodromia sp - listed as Rheophilic and associated with depositional substrates in: https://www.mvs.usace.army.mil/Portals/54/docs/navigation/SEIS/Library/Other_Documents/Nav_Study_Cumulative_Effects_Vol%202_Ecological_Assessment.pdf Also Numerous reports associating larvae with flowing waters and predatory on blackflies which are flow dependent and associated with riffles and swift runs: https://www.waterbugkey.vcsu.edu/php/genusdetail.php?idnum=7&g=Hemerodromia&ls=larvae&f=Empididae

Taxa Removed From List: Justification

Stenochironomus sp - A wood miner dipteran (Chironomidae) associated with both lotic and lentic habitats. The midge was originally included because it is typically associated with deposits of stable woody debris (a positive habitat indicator) but it is not particularly indicative of lotic conditions.

Results – Fish (fIBI)

The 2018 post-project monitoring included fish surveys at all four project sites. As predicted, no change in fIBI scores was recorded. Fish populations are constrained by downstream barriers (see Fullersburg Woods project).

Results - Dissolved Oxygen

Dissolved oxygen (DO) was recorded at SCOM directly upstream of the Oak Meadows dam in the project footprint. Hourly data was gathered via a luminescent dissolved oxygen data logger during the months of June, July and August.

DO is a function of a number of other environmental variables including sunlight, wet weather, water temperature, sediment oxygen demand, BOD, reaeration rates, nutrients, algae and macrophyte biomass. Impacts of these variables vary in time and are themselves interdependent. Improvements in DO are measured here by looking at mean DO during the period, number of sample points under 5 mg/l and 3.5 mg/l as a percentage of total datums, and mean and median DIEL.

Table 9. *Dissolved Oxygen collected upstream of the dam at Oak Meadows.*
Scores have been coded green, orange, and yellow in descending order of their ranking for the top three positive scores in the date set for each category respectively.

DO Parameters Oak Meadows 2010-2018	2018	2017	2014	2013	2010	2009
# of data points for Jun/Jul/Aug	1567.0	1457.0	1171.0	1675.0	2190.0	2088.0
Whole Period - Mean Temp (°C)	23.7	23.5	21.9	23.8	24.8	22.2
Jun - Mean Temp	21.3	23.3	22.5	22.9	23.4	21.7
Jul - Mean Temp	24.4	24.3	23.1	24.6	25.5	22.1
Aug - Mean Temp	24.5	23.2	24.6	23.5	25.4	22.8
Whole Period - Mean LDO (mg/L)	5.7	6.1	4.3	5.0	6.3	6.8
Jun - Mean LDO	5.2	6.2	5.6	5.5	6.6	6.6
Jul - Mean LDO	6.6	5.8	2.5	5.3	6.2	6.9
Aug - Mean LDO	5.3	6.2	3.5	4.6	6.1	6.9
Whole Period - # of times < 5mg/L	442	211	670	866	352	163
Whole Period - # of times < 3.5mg/L	78	20	365	144	9	1
Whole Period - # of times < 1mg/L	22	3	18	0	0	0
Whole Period - # of times < 5mg/L as percentage of total # of samples	28.2%	14.0%	57.0%	52.0%	16.0%	8.0%
Whole Period - # of times < 3.5mg/L as percentage of total samples	5.0%	1.4%	31.2%	8.6%	0.4%	0.0%
Mean DIEL Swing Whole Period mg/l	3.14	2.91	3.36	2.78	3.40	3.50
Median DIEL Swing Whole Period mg/l	3.11	2.71	3.06	2.52	3.41	3.45

2009 continues to have the highest mean DO concentration metrics. However, these scores are coupled with the highest mean/median DIEL values suggesting that the high mean DO concentrations seen in 2009 & 2010 were driven by higher algae activity. Lower values in 2017 & 2018 were associated with wet weather (two in each year). Such influences were not observed in the pre project data set but are unlikely to be a function of the project but rather of flow variability.

1.2 Fawell Dam Modification

- Special Condition Listed Completion Date – December 2018, Extended to December 2021
- Status – Returned to design and permitting phase. The design team will have a recommendation on the fish passage alternative by early May 2019.

The objective of the project is raise the fish index of biological integrity scores (fIBI) above its current average 18.5 for the three mainstem survey sites immediately upstream of the dam. To accomplish this, the original design approach focused on modifying the dam's primary spillway, which consists of three box culverts. In June 2018 the Dams owner revealed that following several repairs to the dams structure they could no longer support direct structural modifications of the culvert system.

The project team, including the dams owner has been reviewing an alternative plan to establish fish passage at the dam which eliminates any proposed modifications to the existing Fawell Dam structure. The new design approach is focused on the installation of an inflatable low head weir structure and associated fish ladder downstream of the exiting Fawell Dam structure. This system will create a tailwater condition on the Fawell Dam's primary spillway that will result in hydraulic conditions favorable to fish passage. When the low head dam is in operation (inflated), the fish ladder will prevent the low head dam from being a barrier to fish passage.

The dam is a flood control structure operated by DuPage County Stormwater Management and must be fully functional as such post project.

1.2.1. Site Description

The 2017 Annual Report provided a site description.

1.2.2. Design Characteristics

Successful fish passage depends on variables such as water velocity, depth, distance between resting positions for the fish, and each fish's ability to swim against the current. The initial design focused on lowering two of the dam's box culverts in order to achieve the desired water velocity

and depth conditions at the dam. The current design will evaluate the possibility of constructing an inflatable low head dam and fish ramp system downstream of the Fawell Dam structure that will achieve the same desired water velocity and depth conditions at the dam through the creation of a tailwater condition while also allowing fish passage through the new low head system.

To ensure fish passage, the project seeks to mimic as closely as possible the depth, velocity and distance requirements encountered by the target fishes in an unmodified system during their spawning or migration periods (March – August). An optimal design would allow fish passage for all flows between the 10% and 95% exceedance levels during this migratory period. The flow duration analysis indicated that these target flows are between 42 and 397 cfs.

A literature review of appropriate target average velocity throughout the stream cross section suggested a target for northern pike and walleye of approximately 123 cm/s (4 ft/s), and an appropriate target average velocity for smallmouth bass, and white suckers of approximately 148 cm/s (4.9 ft/s). Smaller fishes tend to be weaker swimmers; most will be able to take advantage of the lower velocities in the boundary layers adjacent to rocks that can be used as resting places behind and between rocks in natural stream. The exception is the black stripe top minnow, which may not be able to use the boundary layer near the stream bottom as it is a surface swimmer.

The project aims to have a minimum of 8 inches in the deepest water at any cross section. The team is currently reviewing if the revised plan can meet these requirements.

1.2.3. Permitting Requirements

Similar to the original design, the revised design approach will require a stormwater management certification demonstrating compliance with the DuPage County Countywide Stormwater Ordinance. The modification will likely require a new Dam Permit from the Illinois Department of Natural Resources – Office of Water Resources (IDNR-OWR). It is anticipated that a separate Floodway Construction permit will not be required by IDNR-OWR but will be reviewed as part of the County permitting process. Since Fawell Dam is a flood control facility with historical concerns regarding flooding upstream and downstream of the dam, the proposed design and permitting processes will focus on demonstrating that the proposed downstream improvements will not adversely impact flooding conditions.

In addition to the floodway/floodplain regulatory requirements, the proposed improvements will also need to comply with both the DuPage County and US Army Corps of Engineers (USACE) requirements associated with wetlands, Waters of the U.S., buffers, and sediment and erosion control. It is anticipated that the proposed improvements qualify for USACE Regional Permit (RP)

5, Wetland and Stream Restoration and Enhancement, which also typically requires submittal of a Stormwater Pollution Prevention Plan (SWPPP) to Kane-DuPage Soil & Water Conservation District as part of the permitting process.

1.2.4. Design Progress Report

Modeling

As discussed in previous reports, the hydraulic modeling associated with modifications to and/or near Fawell Dam is very complex. The primary model being used, FEQ, uses a utility program called FEQUTL to create all the files necessary to describe various hydraulic structures within an FEQ model. As Fawell Dam is a very specific structure both in shape and operation methodology, a specific utility program was coded in order to model the hydraulics through the dam that incorporate the operation rules for the gates.

Although the revised design approach will no longer directly impact the Fawell Dam structure, the proposed inflatable low head dam will have a hydraulic impact on the functionality of Fawell Dam and will need to be evaluated. SWM has done some initial modeling of the proposed conceptual low head dam system that suggests the system can be constructed without adversely impacting the flood control functionality of Fawell Dam.

Similar to original design concept, the project team will coordinate with IDNR-OWR regarding the change in the proposed design and the impact to the modeling methodology and the initial modeling results.

The basis of the revised project is to remove the physical barrier created by the dam and to reduce velocities through the culverts to a favorable level for fish passage. Whereas the original design attempted to achieve this via physical modifications to the primary spillway of Fawell Dam, the current design focuses on a downstream inflatable low head dam and fish ladder system that will create a tailwater condition that effectively reduces velocities through the Fawell Dam culverts.

However, since Fawell Dam functions as a flood control structure along the West Branch DuPage River, any modifications that would impact the hydraulic functionality of the dam must not result in increases in flood elevations up or downstream of the dam. Similar to the previous evaluation, the inflatable low head dam and fish ladder system must be evaluated to confirm it meets the applicable regulatory requirements.

As part of the initial design evaluation, the project team previously met with both DuPage County (regulatory department) and the local representative from the USACE to discuss wetland/ waters

permitting associated. Although not confirmed at this time, it is anticipated that the new proposed improvements will likely qualify for a USACE Regional Permit (similar to the original design). Similarly, additional discussions regarding indirect wetland impacts with the County regulatory staff will be necessary.

Structural and Geotechnical Design Considerations

As described above, the original design approach focused on modifying the dam's primary spillway, which consists of three box culverts. However, as the original design progressed, it became clear that the dam owner (DuPage County Stormwater) will not authorize the proposed structural modifications to the dam.

As such, the current design approach eliminates any proposed modifications to the existing Fawell Dam structure. The new design approach is focused on the installation of an inflatable low head dam structure and associated fish ladder downstream of the existing Fawell Dam structure. The proposed inflatable low head dam system would utilize a rubber bladder system that is operated with a controlled source of compressed air and a means for controlled venting of air from the bladders. The bladder system would be installed between two structural wall systems that would be designed to tie into the surrounding topography at the appropriate elevations.

The final details still need to be worked out but an initial evaluation indicated the inflatable low head dam system will need to be approximately 4 to 6 feet high. The fish ramp system will also need to be structurally independent of the inflatable bladder system. The project will also likely include some type of structure to house the controls for inflating and deflating the bladder system.

Channel Management

An adaptive management plan for the upstream channel post modification was prepared for the original design and was previously under review by SWM (dam owner and operator) and the FPDDC (property owner). Since the new proposed design will no longer lower the dam's culverts, the upstream river reach will likely not change much with respect to channel geomorphology. As such, the previously proposed upstream channel restoration improvements will likely be scaled back significantly and/or focused on the disturbed downstream reach.

1.2.5. Impact Evaluation

Post project, both fIBI and fish taxa will be sampled upstream of the site and compared to historical data. Additional instream monitoring for fish movement through the system is being evaluated based on the new concept.

1.3 Spring Brook Restoration and Dam Removal (Spring Brook Phase 2)

- Special Condition Listed Completion Date – December 2019
- Status – in the design and permitting phase. Permits have been submitted. Construction is due to start in early 2019.

The original objective of the project is to raise QHEI above its current 64 score, raise fIBI above its current score of 21.5 and to raise mIBI above its current score of 30.1. These scores were all based on historic sampling at site WB10. Table 10 gives an updated and expanded baseline for fIBI, mIBI and QHEI based on expanded sampling in 2018.

The Forest Preserve District of DuPage County (FPDDC) is managing the project. A consortium of agencies including the FPDDC, the Illinois State Toll Highway Authority and the DRSCW is funding the project's construction, permitting, and long-term monitoring.

1.3.1. Site Description

The Phase 2 Project is located in unincorporated DuPage County in Blackwell Forest Preserve. The project footprint limits are entirely on FPDDC property. The project runs along Spring Brook #1. The downstream limit is approximately 400' downstream of the existing unnamed pedestrian bridge, which runs south from Mack Road and east of Williams Road. The upstream limit is Winfield Road. The project is immediately downstream of the Spring Brook #1 Stream and Wetland Restoration Project (Phase 1) constructed in 2015.

1.3.2. Design Characteristics

The 2017 Annual Report provided details on the Project's design characteristics in sections titled Existing Conditions and Proposed Conditions.

1.3.3. Permitting Requirements

The below listed permits are required for the Spring Brook Phase 2 Project. Status as of March 27, 2019 is included.

- U.S. Army Corps of Engineers Regional Permit – LRC-2015-00319: Permit obtained 1/11/2019'
- Illinois Department of Natural Resources Floodway Construction Permit—Delegated to DuPage County on 12/17/2018;
- DuPage County Stormwater/Building Permit – Pending;
- DuPage County Highway Access Permit – Pending;
- Winfield Township Highway Access Permit – Pending;

- Illinois Environmental Protection Agency NPDES Permit for Construction (NOI) – Pending;
- Illinois Historic Preservation Agency Section 106 clearance—Clearance received 3/15/2019; and
- U.S. Fish & Wildlife Service Section 7 Consultation – "Not likely to adversely affect" concurrence received 6/12/2018.

1.3.4 Design Progress Report

The impounding structure will be removed and the channel realigned into the adjacent floodplain in order to increase sinuosity and mimic more natural geomorphology. The proposed stream length will increase from 4,400 LF to approximately 5,515 LF due to the additional sinuosity. The proposed channel will have varying bank slopes ranging from 2.5:1 to 20:1. The design bank full condition is 120 cfs. The design bank full condition will increase the frequency of overbank flooding and reconnecting the floodplain, within the project site to facilitate desired habitats in the floodplain. There will be 1.58 acres of US ACOE/ DuPage County jurisdictional wetland impacts.

The wetland impacts are attributable to the excavation and fill placement for the restored stream channel meander and to replace a service road and pedestrian bridge. The project will create 18.60 acres of wetland. There are 15.488 acres of the impoundment area that will be converted to wetland within the dam removal zone of the project. A large-scale plan of the post project condition is included in Attachment 4.

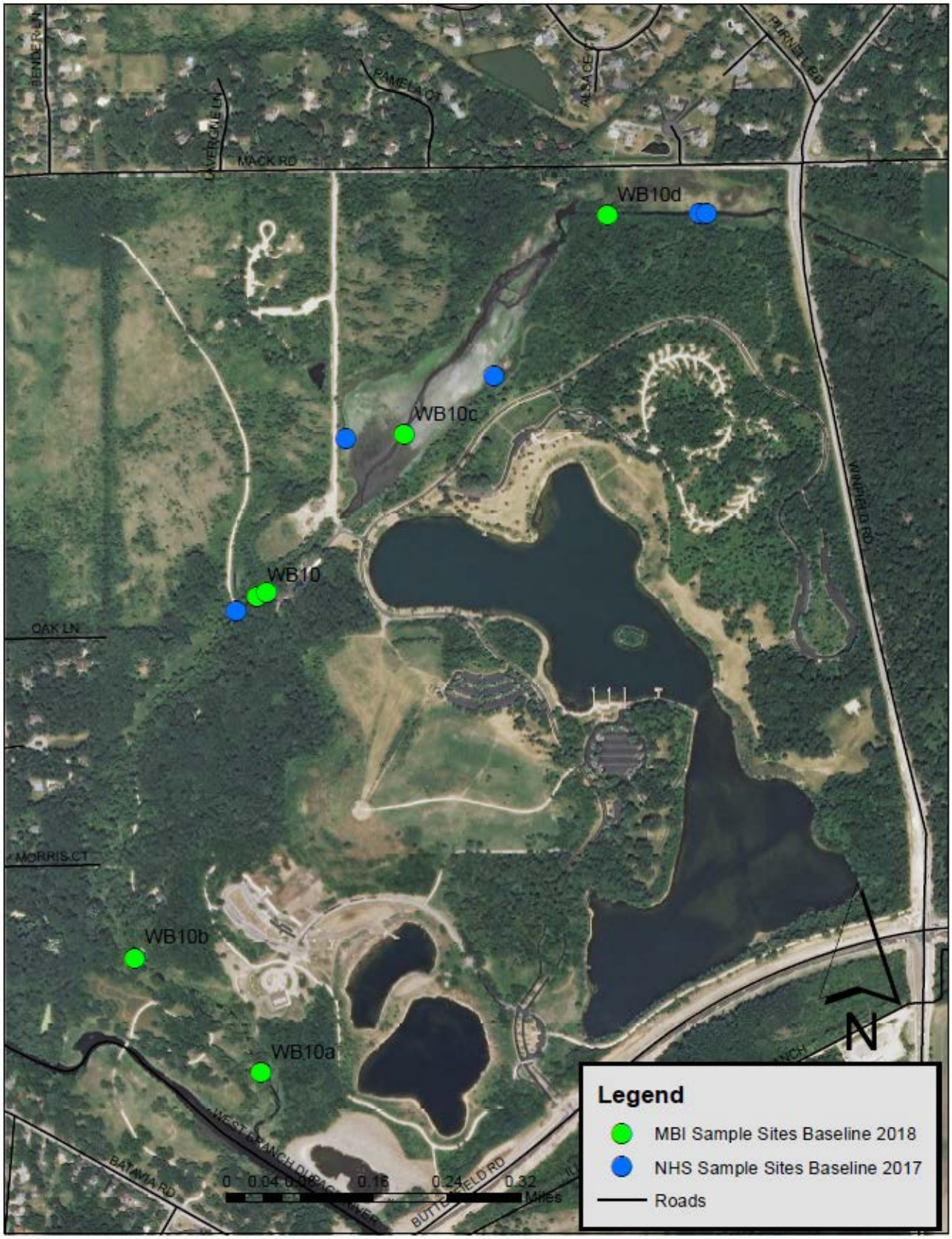
1.3.5. Impact Evaluation

Baseline data for the Spring Brook Phase 2 Project was collected in two surveys:

- Natural History Survey - fIBI, mIBI and mussel data was collected at 5 locations in 2017 (Natural History Survey, 2018); and
- DRSCW - QHEI, fIBI and mIBI was collected at 5 sites in 2018.

Map 4 depicts the locations of the samples collected by Natural History Survey and the DRSCW. Table 10 included the results of the survey collected by the DRSCW. Figure 4 depicts the pre-project (2018) mIBI scores and Figure 5 depicts the pre-project (2018) fIBI scores at Spring Brook Phase 2 collected by the DRSCW.

Post-project fIBI, mIBI and QHEI will be monitored and compared to historical survey data.



Map 4. *DRSCW and NHS Sampling Locations at Spring Brook Phase 2.*

Table 10. *fIBI, mIBI, and QHEI baseline data collected in 2018 for Spring Brook Phase 2.*

Site ID	River Mile	Drainage Area (sq mi)	fIBI	mIBI	QHEI	Attainment Status
Spring Brook 2018						
WB10D	1.42	6.0	15*	29.5*	54.0	Non-Poor
WB10C	1.12	6.3	11*	29.1*	34.0	Non-Poor
WB10	0.75	6.8	25*	42.8	69.5	Partial
WB10B	0.30	6.9	18*	51.6	54.0	Non-Poor
WB10A	0.10	7.0	28*	56.0	62.5	Partial

Table 11. *Color code to IBI and QHEI scores depicted in Table 10.*

Legend: Biological Indicators	
Green	Good
Yellow	Fair
Red	Poor
*	Significant departure from biocriterion
NS	Nonsignificant departure from biocriterion

Table 12. *Color code to QHEI scores depicted in Table 10.*

Legend: QHEI	
	Excellent
	Good
	Fair
	Poor

Figure 4. *Pre-project (2018) mIBI scores at Spring Brook Phase 2*

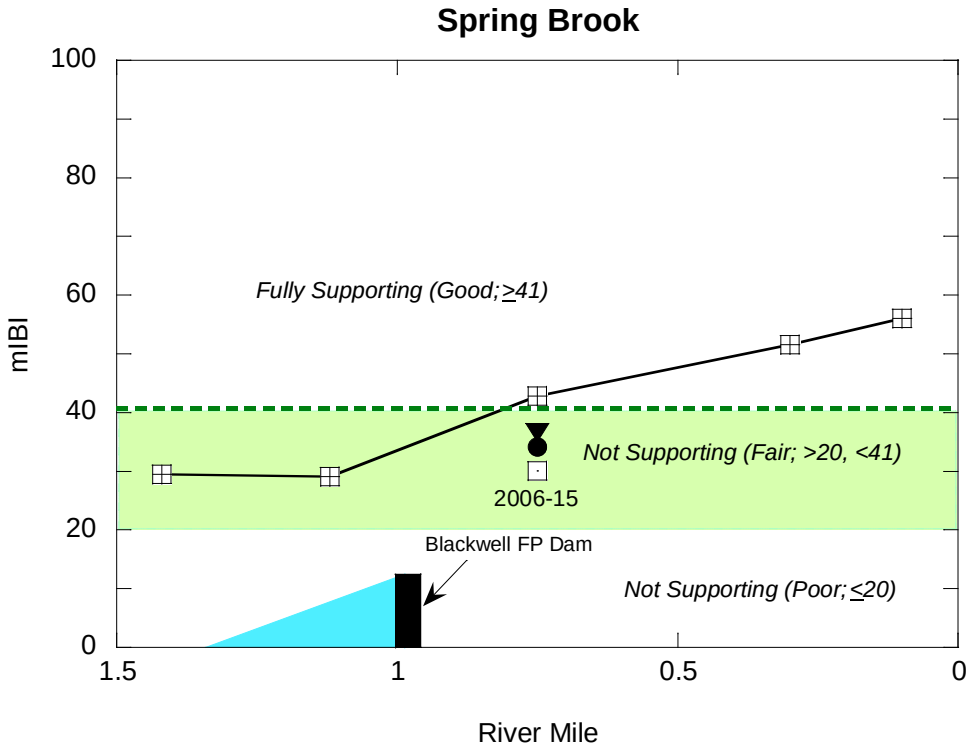
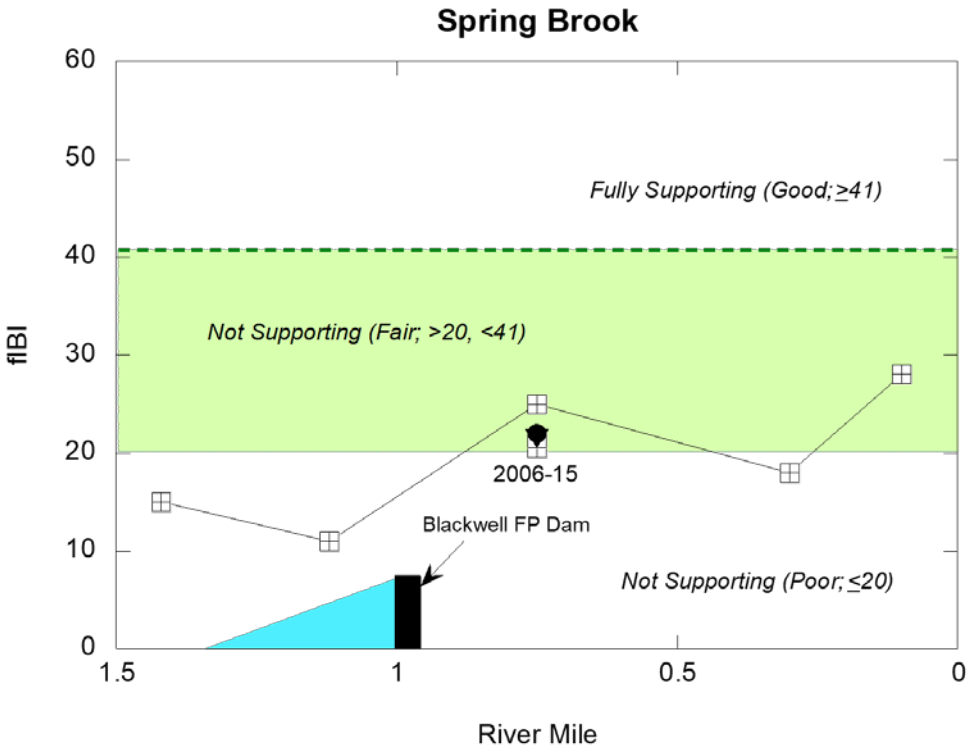


Figure 5. *Pre-project (2018) fIBI scores at Spring Brook Phase 2.*



1.4 Fullersburg Woods Dam Modification Concept Plan Development

- Special Condition Listed Completion Date – December 2016
- Status – Complete (December 2016)

In December 2016, the DRSCW submitted the Fullersburg Woods Dam Modification Concept Plan to the IEPA. The 2017 Annual Report included details on the findings of the Fullersburg Woods Dam Modification Concept Plan.

1.5 Fullersburg Woods Dam Modification and Stream Restoration

- Special Condition Listed Completion Date – December 2021
- Status – Outreach and Education Campaign (started 2017). Design/Construction (Not started yet)

The project is on the Salt Creek mainstem; its objectives are to raise QHEI above its current score of 39.5, raise fIBI above its current score of 19.0, raise mIBI above its current score of 17 for approximately 1.5 river miles and to improve dissolved oxygen in the impoundment, as compared to the 2007-2018 data set. The DRSCW will be collaborating with FPDDC and DuPage County Stormwater Management on this project. DRSCW has budgeted $4,975,000 for this project.

1.5.1 Site Description

Fullersburg Woods Dam (also known as the Graue Mill or Graue Dam) is located on Salt Creek adjacent to Graue Mill in the Fullersburg Woods Forest Preserve in the Village of Oak Brook. The dam is owned by the Forest Preserve District of DuPage County (FPDDC).

In 1934, the Civilian Conservation Corps built the concrete dam that exists at the site today. The dam has a crest length of 132 ft. (40.3 m) and stands 6.2 ft. (1.9 m) high. The purpose of its construction was to generate power. A side stream millrace is also present, which houses the wheel at Graue Mill. While flow is no longer used to power the machinery that grinds grain, it is important to historical nature of the site that water remain flowing in the raceway post-project.

In 1991, the Forest Preserve District retained Harza Engineering Company to design a dewatering gate, which was built on the north side of the dam, to allow periodic drawdown for maintenance and inspection. The impoundment created by the dam spans 16 acres and is approximately 3,900 linear feet in length.

The Forest Preserve District of DuPage County has extensive accounting of the current structure of the dam, which is summarized below from a 1991 Maintenance Plan (HDR 2009):

- Concrete Spillway: The concrete wall is 3’ thick supported by a 23’ wide concrete footing. A 9’ sheet pile wall is installed 9.5’ upstream of the concrete footing. The walls key into the earthen abutments on both sides. A 10’ long concrete stilling basin prevents erosion on the downstream side of the dam
- Earthen Abutments: both abutments are built on a 19’ thick layer of hard clay overlain by 10’ of dense sand, 3’ of hard clay, and finally 6’ of topsoil on the North abutment, or 5’ of topsoil over 2 feet of dense silt on the South. Tests for seepage conducted by Harza were negative for both abutments.
- Millrace Channel and Sluice Gate: the Mill Race is 10’ wide by 210’ long and houses the 18’ wheel used at Graue Mill. Water control is provided by a sluice gate. Little if any capacity for dewatering exists in this channel. Dewatering Slide Gates: Three 7’w x 4’h stainless steel slide gates comprise the dewatering portion of the dam. The gates are housed in a reinforced concrete structure located on the North side of the dam.

The State of Illinois has found that Salt Creek does not meet state water quality standards for dissolved oxygen (DO) or state thresholds for fish and aquatic insect biodiversity (Illinois EPA 2018). Monitoring and modeling of Salt Creek DO levels found that the lowest levels were in the impoundment upstream of the Fullersburg Woods dam (HDR 2009). Four biological surveys showed a large decrease in fish biodiversity upstream of the dam (MBI 2008, 2012, 2015, draft 2018).

Due to the significant ecological declines associated with the Fullersburg Woods dam, the DRSCW is proposing to modify the dam in order to eliminate the impoundment and create fish passage. This option is the most effective at increasing DO levels, allowing fish passage and improving aquatic habitat. Dam modification options being consider but not limited to include a removal, modification, modification with cascade maintained, and modification with additional enhancements.

1.5.2 Research and Public Outreach

Modification of the Fullersburg Woods (Graue Mill) dam will likely encounter significant public opposition. The concept plan prepared in 2016 included a framework for reaching out to stakeholders, listening to their concerns and soliciting feedback so that the final design proposal can incorporate features based on their input. In 2018, the DRSCW replaced its original outreach coordinator with Aileron Communications and updated the research and public outreach work plan. Below includes each task and work completed in 2018/2019.

Task 1: Project Kickoff

The research and public outreach campaign kicked off in November 2018.

Task 2: Survey Development

Aileron Communications developed an eight (8)-question survey for the project. A copy of the survey is included in Attachment 5a. The telephone and online survey will utilize similar questions.

Task 3: Telephone Survey

On December 12 and 13, 2019, a telephone survey of 453 DuPage County residents collected public opinion on issues related to water quality and the Graue Mill dam. Overall, the survey indicated that the public should support efforts to modify the Graue Mill dam and the elected officials who vote to do so, as long as the benefits of the dam modification are communicated clearly. Key takeaways from the telephone survey include:

- Graue Mill Dam is a relatively well-knowns and important to some DuPage County Residents;
- The quality of rivers, streams and natural habitat is a top issue for DuPage County Residents;
- Economic issues are important, a close second to water quality; and
- DuPage County Residents would support elected officials who vote to make dam modifications.

A full analysis of the telephone survey is included in Attachment 5b.

Task 4: Online Survey

On Thursday, February 21, 2019, the online survey for the project went live at RestoreSaltCreek.org. The survey questions are nearly identical to the telephone survey. The online survey will remain open through March 31, 2019. The RestoreSaltCreek.org website will be utilized during all phases of the project from outreach to design to construction as a means of keeping stakeholders and project collaborators up to date with project developments.
To facilitate dissemination of the survey to stakeholders and project collaborators, the DRSCW developed promotional materials for the survey. Items developed include a text, poster, and social media meme. All DRSCW members and known project stakeholders received these materials via email.

Task 5: In-depth Interviews/Focus Group

From January to March 2019, Aileron Communications conducted four one on one interviews with project stakeholders representing differing interests. Outline for the interviews is included

in Attachment 5c. Interviewees included Steve Sinderson (paddler/angler on Salt Creek); David Carlin and Dan Wagner (Oak Brook Chamber of Commerce and Economic Development Partnership); Rus Strahan (Head Miller at Graue Mill), and Don Fuller (President of the Fullersburg Woods Historical Society). Aileron prepared synopsis of each interview. Information learned from the interviews will guide the framework development for a 6-8 person focus group scheduled for April 3, 2019.

Task 6: Analysis, Strategy and Messaging

Aileron will analyze the information obtained via the telephone survey, electronic survey, interviews, and focus group and develop a strategy and messaging plan for the DRSCW. The strategy and messaging plan will guide the DRSCW through a public communications process aimed at building support for dam modification and highlighting the benefits and eventual design that the dam modification will take. The strategy and messaging plan is due to the DRSCW in April 2019.

1.5.3 Design Progress Report

In January 2019, the DRSCW published a Request for Qualifications for Engineering Services for Dam Modification and Stream Restoration. The DRSCW received eight (8) sets of qualifications. The DRSCW expected to enter into contract with a project design engineer in early 2019 and begin preliminary design and fieldwork in summer 2019.

1.6 Southern West Branch Physical Improvement

- Special Condition Listed Completion Date – December 2022
- Status – Concepts are being developed along with the Fawell Dam Modification Plan.

The DRSCW budgeted $1,465,071 for the period 2019 to 2021. The project will likely focus on enhancing the channel around the Fawell Dam following its modification.

1.7 Southern East Branch Stream Enhancement

- Special Condition Listed Completion Date – December 2023
- Status – In planning

The DRSCW has budgeted $2,500,000 for this project and anticipates expenditures in 2021-2023.

The 2017 Report provided details on the pre-project fieldwork conducted for the Project.

1.8. Hammel Woods Dam Modification

- Special Condition Listed Completion Date – December 2023
- Status – in the design and permitting phase

The LDRWC budgeted $600,000 for this project and anticipates expenditures in 2019-2021.

1.8.1 Site Description

The 2017 Annual Report provided a site description.

1.8.2 Design Characteristics

The 2017 Annual Report provided the design characteristics of the Project.

1.8.3 Permitting Requirements

The 2017 Annual Report provided details on the permitting requirements for the Project.

1.8.4 Design Progress Report

Feasibility study is complete and project is ready to go out for bid for a design/permit/build contract. The Lower DuPage River Watershed Coalition approved a Memorandum of Understanding (MOU) with the Forest Preserve District of Will County (FPDWC) to fund the design and construction of this project in March. The FPDWC is extending the contract with their consultant to start the design and permitting phase of this project. The design consultant will submit permit applications by mid to late summer. Bids for construction will go out shortly after the submittal of permit applications and construction will coincide with appropriate water level conditions for this project sometime in 2020.

1.8.5 Impact Evaluation

The LDRWC sampled bioassessment monitoring sites in 2012, 2015, and 2018 as part of the long-term Bioassessment Program. Sites sampled include above, below the dam, and within impoundment. In order to evaluate the success of the project, the LDRWC will conduct post-project monitoring.

1.9 Hammel Woods Dam to 119th Street in Plainfield Stream Enhancement

- Special Condition Listed Completion Date – December 2023
- Status – in planning

The LDRWC has budgeted $2,740,000.00 for this project and anticipated expenditures will be made from 2021-2023.

The 2017 Report provided details on the pre-project fieldwork conducted for the Project.

2.0 Chloride Reduction Program

The Special Condition Paragraph 3 requires NPDES holder participation in a watershed Chloride Reduction Program either directly or through the DRSCW and/or LDRWC. This section summaries the DRSCW and LDRWC Chloride Reduction Program activities in 2018/2019.

2.1 Technical Workshops

In 2007, the DRSCW held its first deicing workshop to highlight new deicing methods, NPDES water quality goals and best management practices to reduce chlorides and costs, in collaboration with APWA Chicago Metro Chapter. The following year, the DRSCW added a second workshop that targeted contractors responsible for snow and ice management of parking lots and sidewalks into an annual rotation. The DRSCW executes two workshops every year targeting personnel responsible for 1) public roads and 2) parking lots and sidewalks. Since 2007, our program has provided training and resources for numerous attendees at various agencies. In 2018 the program has reached 330 individuals from 73 agencies. Additionally, the DRSCW held a third workshop on November 18, 2014, in collaboration with Monroe Truck Equipment, which focused solely on equipment calibration. Calibrating equipment is an immediate, low-cost BMPs that can be implemented without capital upgrades.

- *Unduplicated Counts for Calibration Workshop (2014) = 16 attendees representing 1 organization (*these numbers exclude attendees and organizations that participated in any of the public roads and parking lots and sidewalks workshops)

Plate 1. *Demonstrations of equipment calibration at DRSCW Chloride Management Workshops.*

The DRSCW held two chloride reduction workshops during the reporting period April 1, 2017 to March 31, 2018.

The public roads deicing workshop held at DuPage County DOT on October 25, 2018 with the following agenda:

Plate 2. *DRSCW Public Road Deicing Workshop brochure, 2018.*

- 7:00 - 7:30 Registration and Breakfast
- 7:30 -7:35 Welcome and Housekeeping- *Jeff Peroni, Highway Maintenance Supervisor, DuPage County Department of Transportation*
- 7:35 – 7:55 Visualizing the Movement of Chloride in the Shallow Aquifers of McHenry County *Daniel Abrams, Groundwater Flow Modeler, Illinois State Water Survey*
- 7:55 – 8:20 Premium and Flexible Plow Blades for Effective Winter Operations, *Gardi Willis, Managing Director, Kueper North America, LLC*
- 8:20 – 8:45 Alternative Cutting Edges, *Scott Weber, Streets and Forestry Supervisor, Village of Hanover Park*
- 8:45 –8:50 Sponsor Overview
- 8:50 – 9:05 BREAK
- 9:05– 10:10 Tiered Road Use Panel: *Chris Drey, Superintendent of Public Works, Village of Shorewood; Jason Pauling, Street Supervisor, Village of Carol Stream; Joseph Dragovich, Roadway District 1 Manager, Illinois Tollway; Moderated by Scott Weber, Streets and Forestry Supervisor, Village of Hanover Park*
- 10:10 – 10:35 Chlorides, the Corrosion Challenge, *Charles (Chuck) Lawrence, Independent Consulting Engineer*
- 10:35 – 10:55 Chloride Toxicity: Reviewing the State's Water Quality Standard, *Stephen McCracken, The Conservation Foundation/DRSCW*
- 10:55 – 11:10 BREAK
- 11:10 – 11:30 Practicable Direct Liquid Application, *Craig Eldred, Public Services Director, City of Waconia,*
- 11:30 – 11:45 Wrap Up, Evaluations, Equipment Show

Attendance – 147 registered, 13 presenters/staff, 7 committee members/guests; 7 sponsors/exhibitors = 174 total. All participants received a certificate of attendance. We received 59 feedback forms from participants.

Plate 3. *Photographs of the DRSCW Public Roads Deicing Workshop, 2018.*

The parking lots and sidewalks deicing workshop was held at DuPage County DOT on October 18, 2018 with the following agenda:

- Ambient conditions and regulatory update: Stephen McCracken, The Conservation Foundation/DRSCW
- Information on developing efficient and cost-effective snow fighting operations, appropriate product selection, equipment selection, application rates, equipment calibration, ambient conditions monitoring. Presenters: Connie Fortin, Fortin Consulting and Chris Walsh, (former Public Works Director with City of Beloit, WI)
- Test on workshop materials.

Plate 4. *DRSCW Parking Lots and Sidewalks Deicing Workshop brochure, 2018.*

Attendance - 82 registrations, 5 presenters/staff, 2 exhibitors/staff = 89 total. All participants received a training certificate and participants who successfully completed the test are recognized on DuPage County Stormwater Management's Water Quality – Pollution Prevention/Good Housekeeping web page. The DRCCW received 68 program evaluations from participants.

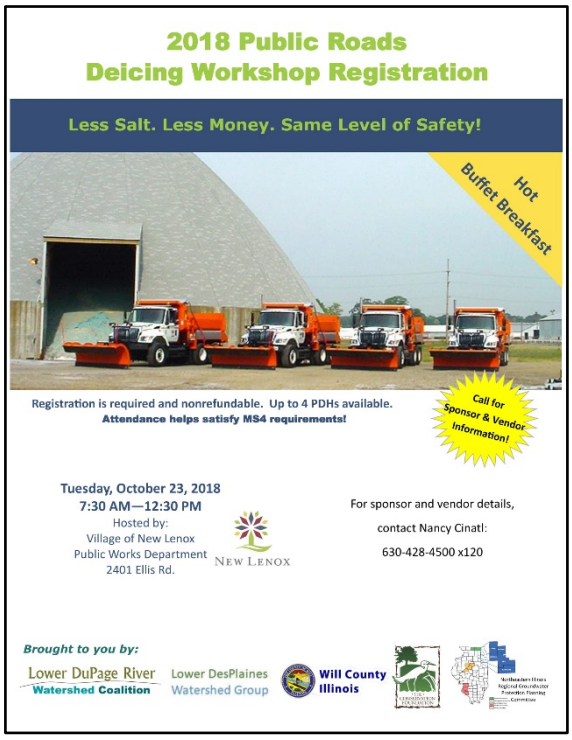
Plate 5. *Photographs from the DRSCW Parking Lots and Sidewalks Workshop, 2018.*

Lower DuPage River Watershed Coalition (LDRWC) in partnership with the Lower Des Plaines Watershed Group (LDWG) executed two chloride reduction workshops in the fall of 2018.

The public roads deicing workshop was held at the Village of New Lenox's Public Works Facility on October 23, 2018 with the following agenda:

- 7:30 am: Registration and Breakfast
- Welcome/ Housekeeping, *Shawn Vandenberg, Village of New Lenox*
- Visualizing the Movement of Chloride in the Shallow Aquifers, *Daniel Abrams, Illinois Water Survey*
- Environmental Impacts /Watershed Activities/Residential Outreach, Lower DuPage River Watershed Coalition & Lower Des Plaines Watershed Group, *Jennifer Hammer, The Conservation Foundation*
- *BREAK*
- Tour of New Lenox Public Facility – Focus on Good Housekeeping, *Shawn Vandenberg, Village of New Lenox*
- Meeting MS4 Requirements and Record Keeping, *John Kawka, Morris Engineering*
- BREAK
- Community Round-Table: Levels of Service & Evaluation: Village of Shorewood, Village of Channahon, Village of Plainfield
- 12:15pm: Closing Remarks and Evaluations

Plate 6. *LDRWC Public Roads Deicing Workshop Brochure, 2018.*



Attendance – 87 registered, 4 presenters, 3 staff, 5 exhibitors = 99 total. All participants received a certificate of attendance. We received 56 feedback forms from participants.

Plate 7. *Photographs from the LDRWC Public Roads Deicing Workshop, 2018.*

The parking lots and sidewalks deicing workshop was held at the Village of New Lenox's Public Works Facility on October 16, 2018 with the following agenda:

- Introduction of topic and the relevance to Will County, *Jennifer Hammer, The Conservation Foundation*
- Ambient conditions and regulatory update and information on developing efficient and cost-effective snow fighting operations, appropriate product selection, equipment selection, application rates, equipment calibration, ambient conditions monitoring. Presenters: *Connie Fortin, Fortin Consulting and Chris Walsh*, (former Public Works Director with City of Beloit, WI)
- Test on workshop materials.

Plate 7. *LDRWC Parking Lots & Sidewalk Deicing Workshop Brochure, 2018.*

Attendance - 14 registrations, 2 presenters, 3 staff, 6 exhibitors = 19 total. All participants received a training certificate. The LDRWC received 15 program evaluations from participants.

Plate 8. *Photographs from the LDRWC Parking Lots and Sidewalks Workshop, 2018.*

Additionally, during this reporting period, the LDRWC shared a seasonal outreach campaign for members to use in residential outreach efforts called Salt Smart. The winter "Salt Smart. Save More." campaign toolkit was distributed on November 8, 2018. The toolkit included social media posts; text for websites, emails and newsletters; sample letter to editor/ op-ed and press release; brochure; bill insert. A suggested implementation calendar was provided for consideration. LDRWC members purchased "Salt Smart. Save More." truck magnets and bumper stickers for municipal operations and 12oz plastic cups to distribute to residents which highlighted the amount of driveway or sidewalk area one cup of salt should cover. The web domain saltsmart.org was purchased and a website was built to highlight smart salting practices, as well as provide resources and advertise chloride related events.

Plate 8. *LDRWC Salt Smart logo.*

Plate 9. *LDRWC Salt Smart Cups and Vehicle Magnets.*

Plate 10. *Salt Smart Community Brochure.*

SALT SMART. SAVE MORE.

SALT SMART SAVE MORE

Midwest winters can be tough on our roads and commuters. Road salt is used to keep our roads safe, but the cost of using too much salt goes beyond the pavement.

Excess road salt damages vehicles and infrastructure, harms our pets and plants and degrades our rivers and wetlands. [Town] is using best winter practices to keep you safe while using less salt.

SALT SMART AT HOME

There is such a thing as too much salt!

Using the right amount of salt could make a big difference for our local waterways—and our pocketbooks. Using the right amount of salt keeps you safe, saves money and protects our river. Join [town] and reduce the amount of salt used on your driveways and sidewalks.

OUR COMMITMENT:
We will strive to use the best technology and practices within our means to keep roads and sidewalks safe all winter long. Smart salt use will ensure [Town] uses tax dollars responsibly and keeps our precious water resources healthy for generations to come.

SALT SMART. SAVE MORE.

Here are five tips for salting smart this winter:

1. **Shovel first.** Clear all snow from driveway and sidewalks before it turns to ice. Salt should only be used after the snow is removed and only in areas needed for safety.

2. **Size up.** More salt does not mean more melting. A 12 ounce coffee mug of salt should be enough for a 20-ft driveway or about 10 sidewalk squares.

3. **Spread.** Distribute salt evenly, not in clumps.

4. **Sweep.** If you see leftover salt on the ground after the ice melts, then you've used too much! Sweep up leftover salt to keep it out of our rivers and streams.

5. **Switch.** Rock salt stops working if the temperature is below 15 degrees. When temperatures drop that low, switch to sand for traction or choose a different deicer formulated for colder temperatures.

[City LOGO]

Keeping roads safe, spending responsibly and preserving the health of the DuPage River this winter.

Lower DuPage River
Watershed Coalition

[Town] is a part of the Lower DuPage River Watershed Coalition, a collection of communities and local stakeholders working together to improve the health of the DuPage River.

[Town or Coalition info--website]

Plate 11. *Salt Smart at Home Brochure.*

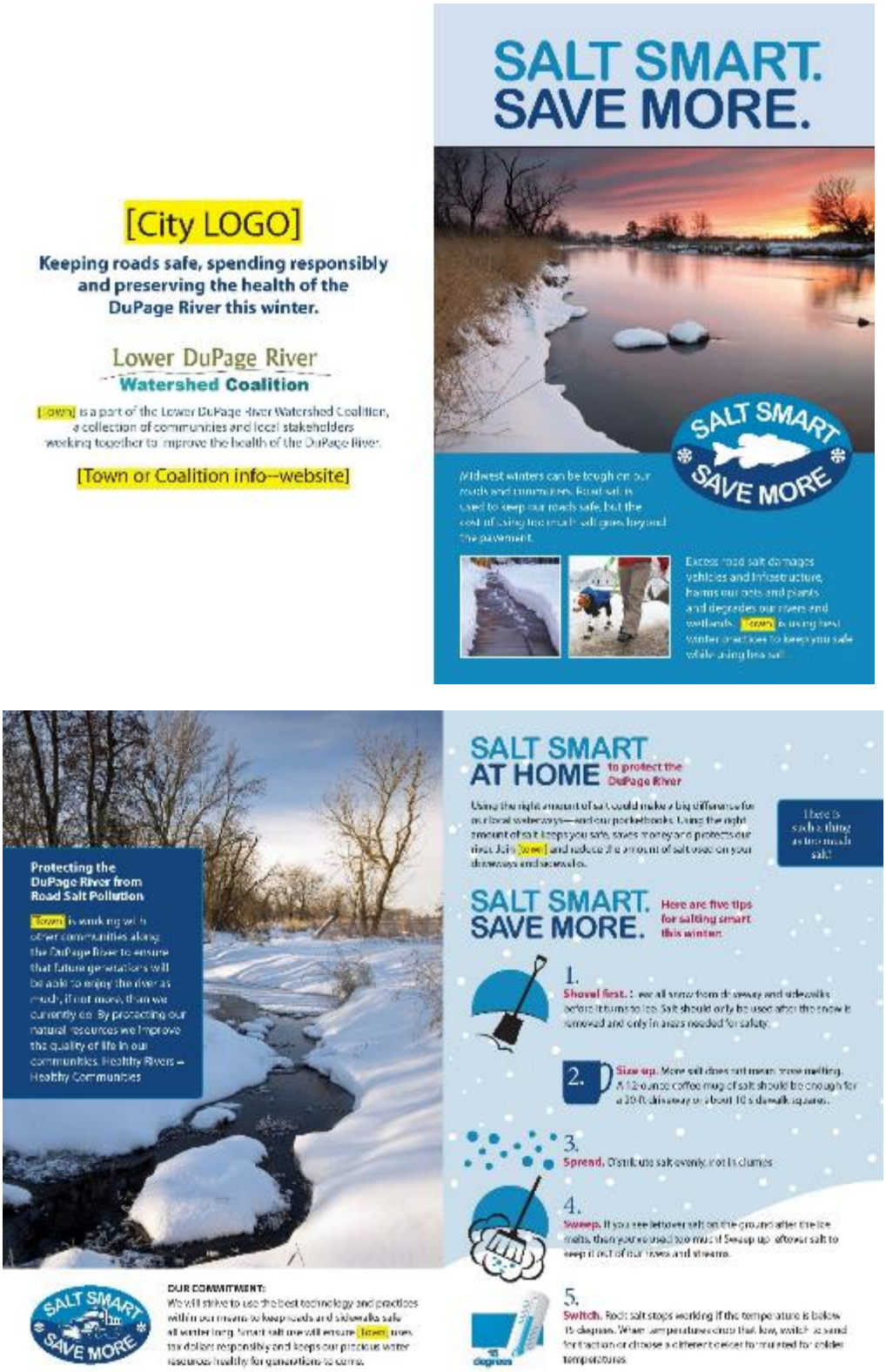
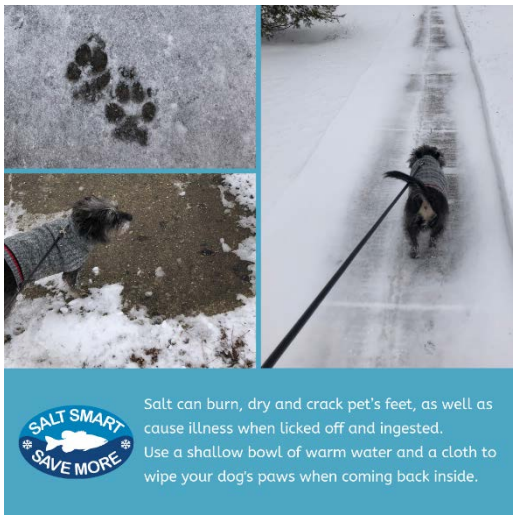
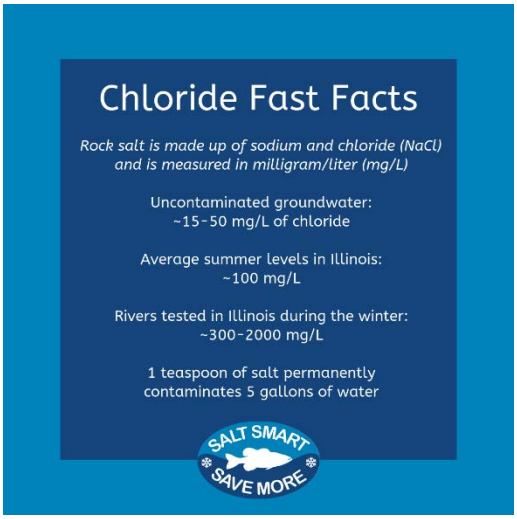
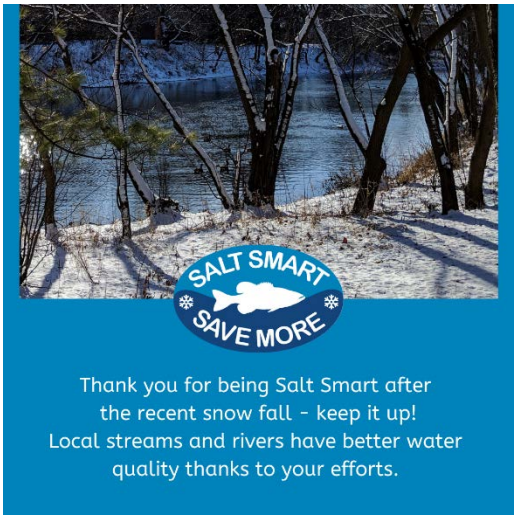


Plate 12. *Salt Smart Social Media Posts.*







2.2 Tracking BMP Adoption

The draft analysis of the 2018 chloride questionnaire responses forms is included in the 2018 Deicing Program Survey (draft) found in Attachment 6.

2.3 Monitoring

Ambient monitoring of winter conductivity was carried out at 5 locations in the program area in 2017-2018 (3 sites monitored by the DRSCW and 2 site monitored by MWRD). Conductivity is used to calculate chloride concentrations based on a relationship established by the DRSCW in 2007. Annual chloride concentrations for the winter months from 2006-2018 for 4 of the sites are depicted in Figure 6-9.

Figure 6. *Annual chloride concentrations - winter months (2006-2018) for Salt Creek at Wolf Road.*

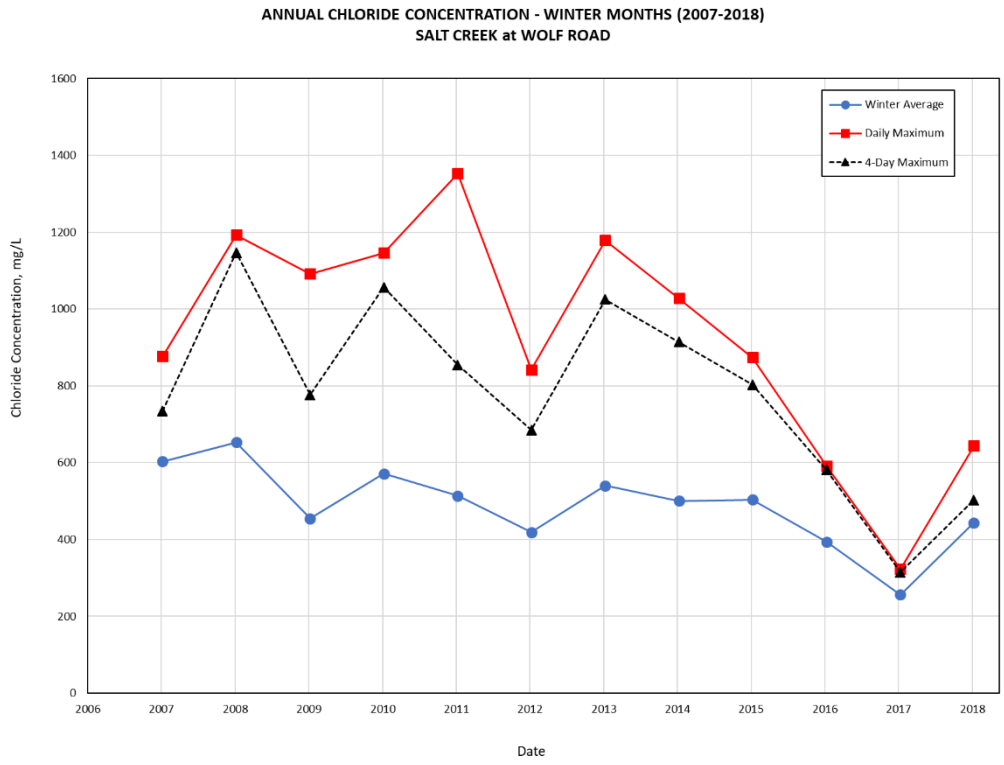


Figure 7. *Annual chloride concentrations - winter months (2006-2018) for Salt Creek at Busse Woods Main Dam.*

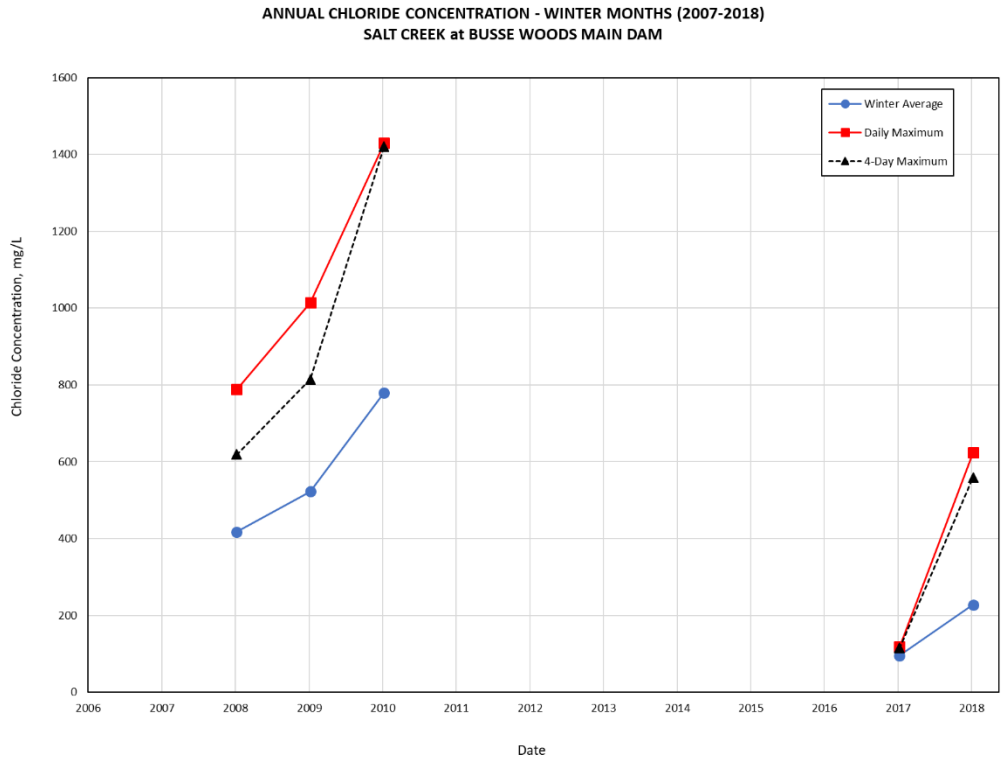


Figure 8. *Annual chloride concentrations - winter months (2006-2018) for East Branch at Hobson Road.*

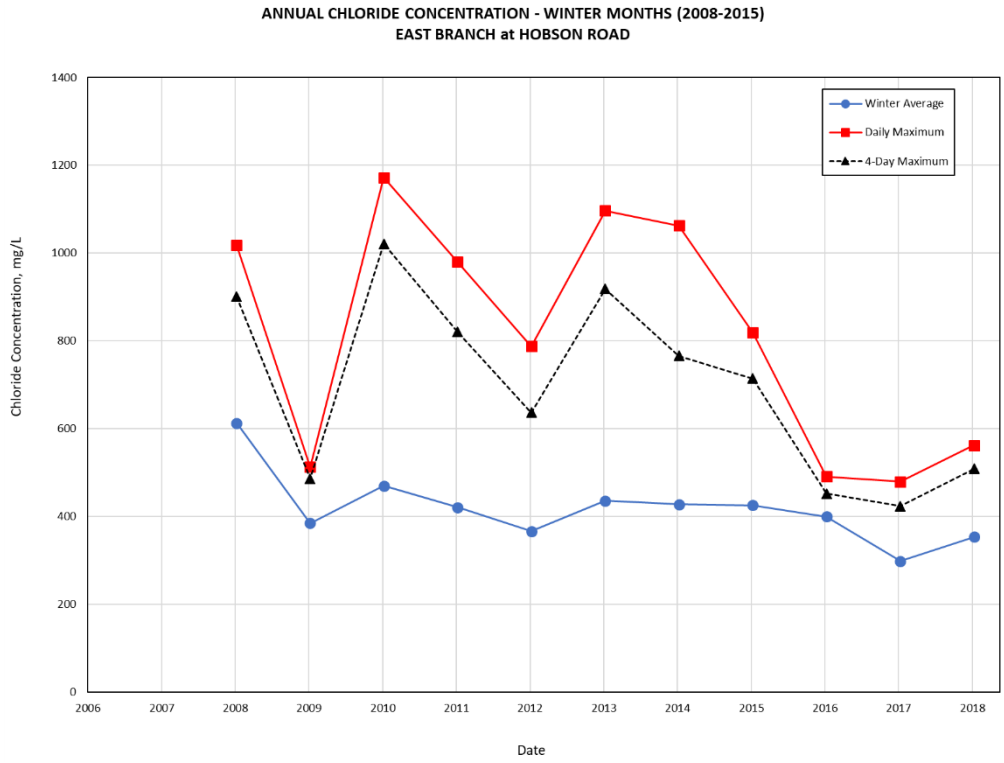
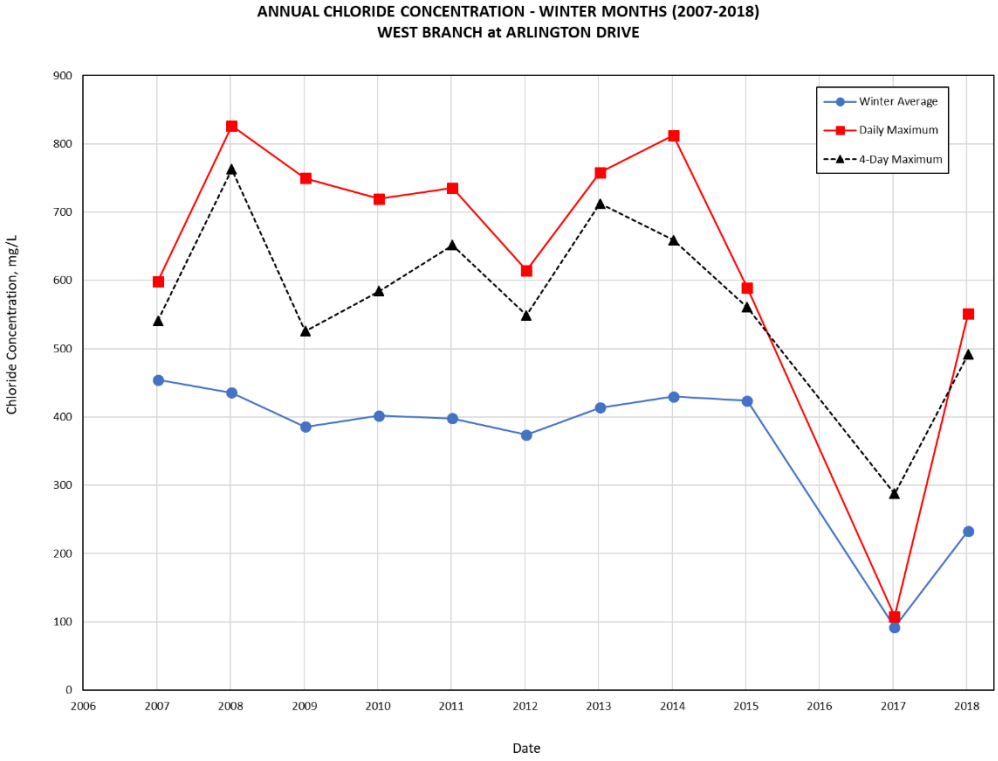


Figure 9. *Annual chloride concentrations - winter months from 2006-2018 for West Branch at Arlington Drive.*



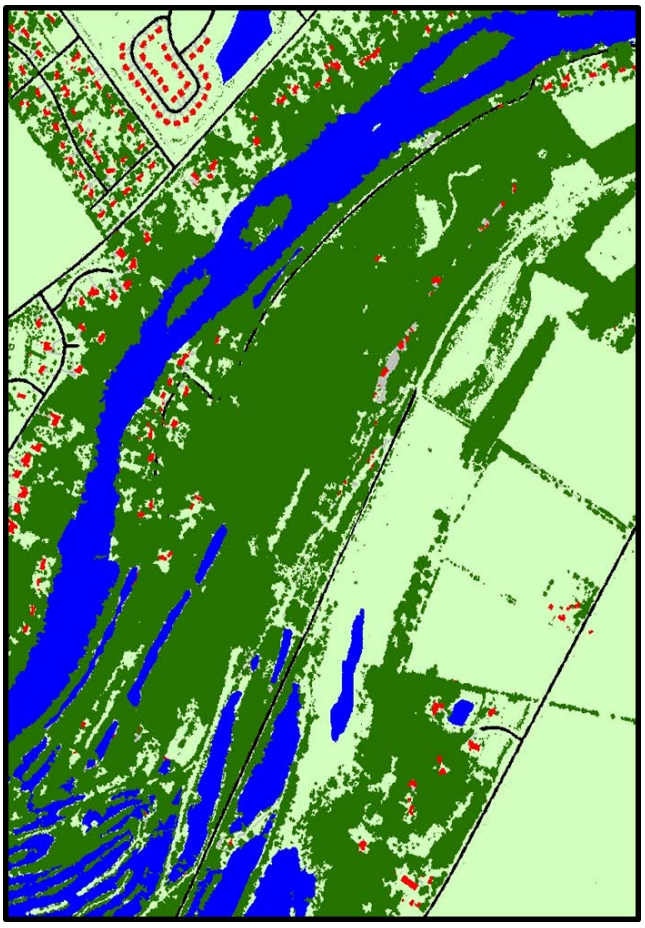
3.0 Nutrient Implementation Plan

The Special Condition Paragraph 10 requires NPDES holders in the DRSCW and LDRWC to develop a Nutrient Implementation Plan (NIP) for the watershed that identifies phosphorus input reductions by point source discharges, non-point source discharges and other measures necessary to remove DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203. Special Condition Paragraph 2 and Special Condition Paragraph 8.c. identify additional studies to be completed by the watershed workgroups. This section summarizes the DRSCW and LDRWC work in 2018/2019 on the studies.

3.1 IPS Model /Project Identification Study

- Special Condition Listed Completion Date – December 2018, Extended to July 2019
- Status – All stressor data sets is complete and stressor analysis is scheduled for completion by the end of April 2019. Draft findings will be reviewed by the DRSCW/LDRWC in April 2019 and a final report completed by June 30, 2019.

Plate 13. An example of the High resolution CRTI Canopy Dataset for the project area.



The objective of this project to update the DRSCW's Integrated and Prioritization Tool (IPS) model and develop a new list of prioritized projects for both the DRSCW and LDRWC watersheds.

The analysis area covers the watersheds of the Des Plaines River, Kiswaukee River, Kankakee River and the Fox River and uses data from the IEPA, DRSCW, LDRWC, and the Des Plaines River Watershed Workgroup (DRWW) for a total of 457 sample sites.

Data supplied by these organizations included the dependent variables of fish and macro-invertebrates (IBIs and QHEIs), and stressor variables including data water quality and habitat data. The analysis also requires substantial landscape data. This includes such

data as road density, canopy cover, land cover and landuse types. As summary of the data collected or constructed is included in Attachment 7.

In order to create this data, spatial buffers of each site were created with radii of at 30m, 100m and 500m. These spatial buffers were used to clip the landscape datasets. Where the feature was related to rain washoff the various spatial buffers were clipped to match the drainage basin draining to the data site. On features related to habitat, the whole spatial buffer area was used.

In two cases (Land use CMAP 2013 and the CRTI Canopy Dataset), the preferred data set did not cover the entire area. In these cases, secondary data sets containing lower resolution data were calibrated from the primary data set and used to generate data to fill in the missing areas. Another data set that required manipulation was road density data. This was calculated as a percentage of spatial buffer or drainage area basin covered by the road surface area. All but one of the counties were able to supply a file for roads but some were in a polyline format that allowed road miles to be calculated but not area. By comparing polyline files against the available right of way data, a suitable conversion factor was calculated that allowed a file to be generated that allowed road area to be calculated. The same methodology was used to generate data for the county that did not have right of way data in any format.

Regression analysis to establish correlations between the dependent and independent variables is ongoing and draft results will be available by early April.

3.2 QUAL 2K Updates for East Branch and Salt Creek

- Special Condition Listed Completion Date – December 2023
- Status – Not yet started

Model preparation, calibration, verification, and alternative evaluation are to begin in 2019. The DRSCW budgeted $152,910 for this effort and anticipates expenditures in 2019-2021. In 2018, the DRSCW gathered continuous DO data at three sites on Salt Creek and five on the East Branch DuPage River that will be utilized in the calibration and verification of the updated Qual 2K models.

3.4 NPS Phosphorus Feasibility Analysis

- Special Condition Listed Completion Date – December 2021
- Status – In planning

The DRSCW budgeted $183,610 for this effort and anticipates the majority of the expenditures in 2019-2021.

On July 24, 2018, the DRSCW held a consultant roundtable to discuss modeling and assessment options for nonpoint source pollution. Ten experts representing six consulting firms attended. Firms represented included Baxter and Woodman, Christopher Burke Engineering, Geosyntec Consultants, Hey and Associates, Strand Associates, and TetraTech. The 2-hour roundtable included discussions on the pros and cons of various nonpoint source and hydraulic/hydrologic models, siting and assessment of best management practices (BMPs), and identification of potential data gaps including chlorophyll A data that the DRSCW should consider addressing prior to any modeling efforts. The DRSCW will use information and guidance received at the roundtable as the foundation for their NPS Phosphorus Feasibility Analysis efforts in 2019.

3.4 Development of a Basin Wide Nutrient Trading Program

Special Condition 8.c. allows the DRSCW/LDWRC to develop and implement a trading program for the POTWs in the DuPage River and Salt Creek watersheds. The nutrient trading program will allow for the re-allocation of phosphorus loadings between two or more POTWs in the DuPage River and Salt Creek watersheds as long as the following two conditions are met:

- The trade allocated loadings will not exceed the anticipated loading from the uniform application of the applicable 1.0 mg/L monthly average effluent limitation among the POTW permits in the DRSCW watersheds; and
- The trade allocated loadings also remove DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203.

Special Condition 8.c. also allows for the implementation of the nutrient trading program within 10-year permit cycle by allowing the IEPA to modify the NPDES permits if the nutrient trading program meets the criteria detailed above.

In 2017, the DRSCW entered in to a contract with the team of TetraTech, Kieser and Assoc., Abt Assoc., and Earth & Water Group to lead the development of a basin wide nutrient trading program for the DuPage River and Salt Creek watersheds.

Estimated date of completion for the basin wide nutrient trading program is FY 2020-2021. Brief descriptions of the project's scope of work and work completed between April 1, 2018 and March 31, 2019 by Task is included below.

Phase I: Determining feasibility/viability of nutrient trading

Task 1: Project Kick-off and Schedule Analysis

This task was completed in 2017 and discussed in the 2017 Annual Report.

Task 2. Develop POTW Data Collection Checklist

This task was completed in 2017 and discussed in the 2017 Annual Report.

Task 3: Analyze and Define Eligibility Criteria

Eligibility criteria determine when, where, and what point and nonpoint sources are allowed to trade through the nutrient trading framework. This task will focus on analyzing and defining eligibility criteria for participating in trading, specifically baselines, geographic trading boundaries, and habitat project eligibility. Work on Task 3 is scheduled for 2019-2020.

Task 4: Analyze POTW Data and Fill Data Gaps

A memorandum drafted in 2017, documented missing data from that which was collected under Task 2. During 2018, the consultant team and DRSCW/LDRWC determined the reasons behind data gaps and determined how best to obtain that information. The DRSCW was able to acquire the majority of the missing data. In the case where data was not readily available, the consultant team's wastewater engineer cost experts used other valid, relevant data sources.

Task 5: Develop/Analyze POTW Nutrient Reduction Costs

Using the information from obtained from Tasks 1, 2, and 4, the Consultant Team conducted nutrient reduction cost analysis to determine potential point source trading market feasibility (i.e., supply and demand for phosphorus credit). The results of the preliminary supply and demand analysis show a variation in the average cost per pound of phosphorus removal to achieve each level of treatment (TP of 1.0 mg/L, 0.5 mg/L and 0.1 mg/L) in each subwatershed. This signifies that the opportunity for trading exists within and across subwatersheds. A Technical Memorandum summarizing Task 4 and 5 is included in Attachment 8a.

While unit cost differentials appear to signify the opportunity for point source trading exists within each subwatershed or among the Salt Creek, East Branch, West Branch, and Main Branch, the Project Team would need to conduct a more in-depth analysis potential supply and demand to determine the number of possible bilateral trades to evaluate the viability of markets. This type of analysis would be one of the final steps under Task 5 and is scheduled for 2020.

Task 6: Evaluate PS-NPS and Stream Restoration Trading

As part of the DRSCW and LDRWC's efforts to meet negotiated permit requirements and provide an opportunity to achieve future permitting relief, the watershed workgroups are examining the potential for offsetting nutrient reductions by incentivizing stream restoration projects implemented by the POTWs. These include projects identified by the Identification and Prioritization System (IPS) Model (Section 3.1) that go above and beyond those currently listed in the Special Conditions Paragraph 2 of NPDES permits. To identify potential equivalency between POTW nutrient load reduction requirements and instream restoration benefits, Kieser & Associates, LLC (K&A) has assessed similar stream restoration crediting efforts, programs, and methodologies used in other watersheds.

There appear to be existing stream restoration crediting approaches utilized in other U.S. watersheds that may be adapted to a number of the DRSCW/LDRWC's planned stream restoration projects and Special Condition Projects that are described in the 2018 DRSCW Special Condition Report (DRSCW, 2018). Some existing trading programs, like the Santa Rosa Nutrient Offset Program and the Chesapeake Bay Regional Water Quality Trading Program, use a crediting framework that allows phosphorus reduction crediting only for a limited range of stream restoration activities. Typically, these are activities associated with phosphorus load reductions that are readily quantifiable using established modeling approaches (Freshwater Trust 2014 & Schueler and Stack 2012). Many of the DRSCW/LDRWC's planned stream restoration projects include activities that have phosphorus reduction potential but no established methodologies for quantifying and crediting the associated phosphorus load reductions. Nonetheless, data collection and restoration-related efforts implemented by the watershed workgroups have shown ecological benefits associated with stream restoration. These demonstrable benefits may provide the opportunity to develop a framework that generates credits for a wider range of stream restoration activities.

K&A has prepared a Technical Memorandum summarizes existing efforts to credit nutrient reductions from stream restoration activities implemented elsewhere. It then provides a description of how previous watershed studies conducted by the DRSCW using the Qualitative Habitat Evaluation Index (QHEI), and potentially other indicators of instream benefits derived from stream restoration projects, may be incorporated into a broader crediting framework. The Technical Memorandum is included in Attachment 8b.

Work efforts in 2019-2020 will be focused on Task 6.

Phase II: Analyzing and developing appropriate market structures

Task 7: Develop Market Structure Recommendations

Under this task, the market structure of the DRSCW/LDWRC nutrient trading program and associated permitting options will be identified. Work on Task 7 is scheduled for 2020-2021.

Task 8: Prepare Nutrient Trading Framework, Guidelines and Templates

Under this task, the DRSCW/LDRWC will develop the technical and legal components of a nutrient trading framework tailored to the market structure selected under Task 7. This Task will also develop model trading agreements and permit conditions to support the nutrient trading market structure, as well as a matrix of legislative and regulatory conflicts that could potentially impact successful implementation of the nutrient trading program, coupled with recommendations. This task is scheduled for 2020-2021.

Task 9: Prepare Nutrient Trading Program Final Report

This task will aggregate the major decision points and recommendations from each task into a final report. This task will be the focus of 2021.

4.0 References

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Simpson, Karl W., and Robert W. Bode. 1980. *Common larvae of Chironomidae (Diptera) from New York state streams and rivers with particular reference to the fauna of artificial substrates.* Bulletin No. 439. New York State Museum.

ATTACHMENT 1

DRSCW SPECIAL CONDITIONS

DuPage/Salt Creek Special Condition XX.

1. The Permittee shall participate in the DuPage River Salt Creek Workgroup (DRSCW). The Permittee shall work with other watershed members of the DRSCW to determine the most cost effective means to remove dissolved oxygen (DO) and offensive condition impairments in the DRSCW watersheds.

2. The Permittee shall ensure that the following projects and activities set out in the DRSCW Implementation Plan (April 16, 2015), are completed (either by the permittee or through the DRSCW) by the schedule dates set forth below; and that the short term objectives are achieved for each by the time frames identified below:

Project Name	**Completion Date**	**Short Term Objectives**	**Long Term Objectives**
Oak Meadows Golf Course dam removal	December 31, 2016	Improve DO	Improve fish passage
Oak Meadows Golf Course stream restoration	December 31. 2017	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi
Fawell Dam Modification	December 31, 2018	Modify dam to allow fish passage	Raise fiBi upstream
Spring Brook Restoration and dam removal	December 31, 2019	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
Fullersburg Woods dam modification concept plan development	December 31, 2016	Identify conceptual plan for dam modification and stream restoration	Build consensus among plan
Fullersburg Woods dam modification	December 31, 2021	Improve DO, improve aquatic habitat (QHEI)	Raise miBi and fiBi
Fullersburg Woods dam modification area stream restoration	December 31, 2022	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
Southern West Branch Physical Enhancement	December 31, 2022	Improve aquatic habitat (QHEI)	Raise miBi and fiBi
Southern East Branch Stream Enhancement	December 31, 2023	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi

QUAL 2K East Branch and Salt Creek	December 31, 2023	Collect new baseline data and update model	Quantify improvements in watershed. Identify next round of projects for
NPS Phosphorus Feasibility Analysis	December 31, 2021	Assess NPS performance from reductions leaf litter and street sweeping	Reduce NPS contributions to lowest practical levels

3. The Permittee shall participate in implementation of a watershed Chloride Reduction Program, either directly or through the DRSCW. The program shall work to decrease DRSCW watershed public agency chloride application rates used for winter road safety, with the objective of decreasing watershed chloride loading. The Permittee shall submit an annual report on the annual implementation of the program identifying the practices deployed, chloride application rates, estimated reductions achieved, analyses of watershed chloride loads, precipitation, air temperature conditions and relative performance compared to a baseline condition. The report shall be provided to the Agency by March 31 of each year reflecting the Chloride Abatement Program performance for the preceding year (example: 2015-16 winter season report shall be submitted no later than March 31, 2017). The Permittee may work cooperatively with the DRSCW to prepare a single annual progress report that is common among DRSCW permittees.

4. The Permittee shall submit an annual progress report on the projects listed in the table of paragraph 2 above to the Agency by March 31 of each year. The report shall include project implementation progress. The Permittee may work cooperatively with the DRSCW to prepare a single annual progress report that is common among DRSCW permittees.

5. The Permittee shall develop a written Phosphorus Discharge Optimization Plan. In developing the plan, the Permittee shall evaluate a range of measures for reducing phosphorus discharges from the treatment plant, including possible source reduction measures, operational improvements, and minor low cost facility modifications that will optimize reductions in phosphorus discharges from the wastewater treatment facility. The permittee's evaluation shall include, but not necessarily be limited to, an evaluation of the following optimization measures:
    a. WWTF influent reduction measures.
        i. Evaluate the phosphorus reduction potential of users.
        ii. Determine which sources have the greatest opportunity for reducing phosphorus (e.g., industrial, commercial, institutional, municipal, and others).
            1. Determine whether known sources (e.g., restaurant and food preparation) can adopt phosphorus minimization and water conservation plans.
            2. Evaluate implementation of local limits on influent sources of excessive phosphorus.

b. WWTF effluent reduction measures.
    i. Reduce phosphorus discharges by optimizing existing treatment processes without causing non-compliance with permit effluent limitations or adversely impacting stream health.

        1. Adjust the solids retention time for biological phosphorus removal.
        2. Adjust aeration rates to reduce DO and promote biological phosphorus removal.
        3. Change aeration settings in plug flow basins by turning off air or mixers at the inlet side of the basin system.
        4. Minimize impact on recycle streams by improving aeration within holding tanks.
        5. Adjust flow through existing basins to enhance biological nutrient removal.
        6. Increase volatile fatty acids for biological phosphorus removal.

6. Within 24 months of the effective date of this permit, the Permittee shall finalize the written Phosphorus Discharge Optimization Evaluation Plan and submit it to IEPA. The plan shall include a schedule for implementing all of the evaluated optimization measures that can practically be implemented and include a report that explains the basis for rejecting any measure that was deemed impractical. The schedule for implementing all practical measures shall be no longer than 36 months after the effective date of this permit. The Permittee shall implement the measures set forth in the Phosphorus Discharge Optimization Plan in accordance with the schedule set forth in that Plan. The Permittee shall modify the Plan to address any comments that it receives from IEPA and shall implement the modified plan in accordance with the schedule therein.

   Annual progress reports on the optimization of the existing treatment facilities shall be submitted to the Agency by March 31 of each year beginning 24 months from the effective date of the permit.

7. The Permittee shall, within 24 months of the effective date of this permit, complete a feasibility study that evaluates the timeframe, and construction and O & M costs of reducing phosphorus levels in its discharge to a level consistently meeting a limit of 1 mg/L, 0.5 mg/L and 0.1 mg/L utilizing a range of treatment technologies including, but not necessarily limited to, biological phosphorus removal, chemical precipitation, or a combination of the two. The study shall evaluate the construction and O & M costs of the different treatment technologies for these limits on a monthly, seasonal, and annual average basis. For each technology and each phosphorus discharge level evaluated, the study shall also evaluate the amount by which the Permittee's typical household annual sewer rates would increase if the Permittee constructed and operated the specific type of technology to achieve the specific phosphorus discharge level. Within 24 months of the effective date of this Permit, the Permittee shall submit to the Agency and the DRSCW a written report summarizing the results of the study.

8. Total phosphorus in the effluent shall be limited as follows:

    a. If the Permittee will use chemical precipitation to achieve the limit, the effluent limitation shall be 1.0 mg/L on a monthly average basis, effective 10 years after the effective date of this permit unless the Agency approves and reissues or modifies the permit to include an alternate phosphorus reduction program pursuant to paragraph c or d below that is fully implemented within 10 years of the effective date of this permit.
    b. If the Permittee will primarily use biological phosphorus removal to achieve the limit, the effluent limitation shall be 1.0 mg/L monthly average to be effective 11 years after the effective date of this permit unless the Agency approves and reissues or modifies the permit to include an alternate phosphorus reduction program pursuant to paragraph c or d below that is fully implemented within 11 years of the effective date of this permit.
    c. The Agency may modify this permit if the DRSCW has developed and implemented a trading program for POTWs in the DRSCW watersheds, providing for reallocation of allowed phosphorus loadings between two or more POTWs in the DRSCW watersheds, that delivers the same results of overall watershed phosphorus point-source reduction and loading anticipated from the uniform application of the applicable 1.0 mg/L monthly average effluent limitation among the POTW permits in the DRSCW watersheds and removes DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203.
    d. The Agency may modify this permit if the DRSCW has demonstrated and implemented an alternate means of reducing watershed phosphorus loading to a comparable result within the timeframe of the schedule of this condition and removes DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203.

9. The Permittee shall monitor the wastewater effluent, consistent with the monitoring requirements on Page 2 of this permit, for total phosphorus, dissolved phosphorus, nitrate/nitrite, total Kjeldahl nitrogen (TKN), ammonia, total nitrogen (calculated), alkalinity and temperature at least once a month. The Permittee shall monitor the wastewater influent for total phosphorus and total nitrogen at least once a month. The results shall be submitted on NetDMRs to the Agency unless otherwise specified by the Agency.

10. The Permittee shall submit a Nutrient Implementation Plan (NIP) for the DRSCW watersheds that identifies phosphorus input reductions by point source discharges, non-point source discharges and other measures necessary to remove DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203. The NIP shall also include a schedule for implementation of the phosphorus input reductions and other measures. The Permittee may work cooperatively with the DRSCW to prepare a single NIP that is common among DRSCW permittees. The NIP shall be submitted to the Agency by December 31, 2023.

ATTACHMENT 2

LDRWC SPECIAL CONDTIONS

Bolingbrook STP#3 Special Condition XX.

1. The Permittee shall participate in the DuPage River Salt Creek Workgroup (DRSCW) and the Lower DuPage River Watershed Coalition (LDRWC). The Permittee shall work with other watershed members of the DRSCW and LDRWC to determine the most cost effective means to remove dissolved oxygen (DO) and offensive condition impairments in the DuPage River Salt Creek watershed.

2. The Permittee shall ensure that the following projects and activities set out in the DRSCW and LDRWC Implementation Plan (April 16, 2015), are completed (either by the permittee or through the DRSCW/LDRWC) by the schedule dates set forth below; and that the short term objectives are achieved for each by the time frames identified below. This condition may be modified to include additional projects due to participation in the Lower DuPage River Watershed Coalition.

Project Name	**Completion Date**	**Short Term Objectives**	**Long Term Objectives**
Oak Meadows Golf Course dam removal	December 31, 2016	Improve DO	Improve fish passage
IPS Tool/Project Identification Study	December 31, 2017	Improve DO	Improve fish passage
Oak Meadows Golf Course stream restoration	December 31. 2017	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi
Fawell Dam Modification	December 31, 2018	Modify dam to allow fish passage	Raise fiBi upstream
Hammel Woods Dam removal	December 31, 2019	Improve DO, reduce nuisance algae	Raise miBi and fiBi
Spring Brook Restoration and dam removal	December 31, 2019	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
Fullersburg Woods dam modification concept plan development	December 31, 2016	Identify conceptual plan for dam modification and stream restoration	Build consensus among plan
Fullersburg Woods dam modification	December 31, 2021	Improve DO, improve aquatic habitat (QHEI)	Raise miBi and fiBi
Fullersburg Woods dam modification area stream restoration	December 31, 2022	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
Southern West Branch Physical Enhancement	December 31, 2022	Improve aquatic habitat (QHEI)	Raise miBi and fiBi

Southern East Branch Stream Enhancement	December 31, 2023	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
Hammel Woods Dam to 119th Street in Plainfield Stream Enhancement	December 31, 2023	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
QUAL 2K East Branch and Salt Creek	December 31, 2023	Collect new baseline data and update model	Quantify improvements in watershed. Identify next round of projects for
NPS Phosphorus Feasibility Analysis	December 31, 2021	Assess NPS performance from reductions leaf litter and street sweeping	Reduce NPS contributions to lowest practical levels

3. The Permittee shall participate in implementation of a watershed Chloride Reduction Program, either directly or through the DRSCW/LDRWC. The program shall work to decrease DRSCW/LDRWC watershed public agency chloride application rates used for winter road safety, with the objective of decreasing watershed chloride loading. The Permittee shall submit an annual report on the annual implementation of the program identifying the practices deployed, chloride application rates, estimated reductions achieved, analyses of watershed chloride loads, precipitation, air temperature conditions and relative performance compared to a baseline condition. The report shall be provided to the Agency by March 31 of each year reflecting the Chloride Abatement Program performance for the preceding year (example: 2015-16 winter season report shall be submitted no later than March 31, 2017). The Permittee may work cooperatively with the DRSCW/LDRWC to prepare a single annual progress report that is common among DRSCW/LDRWC permittees.

4. The Permittee shall submit an annual progress report on the projects listed in the table of paragraph 2 above to the Agency by March 31 of each year. The report shall include project implementation progress. The Permittee may work cooperatively with the DRSCW/LDRWC to prepare a single annual progress report that is common among DRSCW/LDRWC permittees.

5. The Permittee shall develop a written Phosphorus Discharge Optimization Plan. In developing the plan, the Permittee shall evaluate a range of measures for reducing phosphorus discharges from the treatment plant, including possible source reduction measures, operational improvements, and minor low cost facility modifications that will optimize reductions in phosphorus discharges from the wastewater treatment facility. The permittee's evaluation shall

include, but not necessarily be limited to, an evaluation of the following optimization measures:

a. WWTF influent reduction measures.
    i. Evaluate the phosphorus reduction potential of users.
    ii. Determine which sources have the greatest opportunity for reducing phosphorus (e.g., industrial, commercial, institutional, municipal, and others).
        1. Determine whether known sources (e.g., restaurant and food preparation) can adopt phosphorus minimization and water conservation plans.
        2. Evaluate implementation of local limits on influent sources of excessive phosphorus.

b. WWTF effluent reduction measures.
    i. Reduce phosphorus discharges by optimizing existing treatment processes without causing non-compliance with permit effluent limitations or adversely impacting stream health.

        1. Adjust the solids retention time for biological phosphorus removal.
        2. Adjust aeration rates to reduce DO and promote biological phosphorus removal.
        3. Change aeration settings in plug flow basins by turning off air or mixers at the inlet side of the basin system.
        4. Minimize impact on recycle streams by improving aeration within holding tanks.
        5. Adjust flow through existing basins to enhance biological nutrient removal.
        6. Increase volatile fatty acids for biological phosphorus removal.

6. Within 24 months of the effective date of this permit, the Permittee shall finalize the written Phosphorus Discharge Optimization Evaluation Plan and submit it to IEPA. The plan shall include a schedule for implementing all of the evaluated optimization measures that can practically be implemented and include a report that explains the basis for rejecting any measure that was deemed impractical. The schedule for implementing all practical measures shall be no longer than 36 months after the effective date of this permit. The Permittee shall implement the measures set forth in the Phosphorus Discharge Optimization Plan in accordance with the schedule set forth in that Plan. The Permittee shall modify the Plan to address any comments that it receives from IEPA and shall implement the modified plan in accordance with the schedule therein.

   Annual progress reports on the optimization of the existing treatment facilities shall be submitted to the Agency by March 31 of each year beginning 24 months from the effective date of the permit.

7. The Permittee shall, within 24 months of the effective date of this permit, complete a feasibility study that evaluates the timeframe, and construction and O & M costs of reducing phosphorus levels in its discharge to a level consistently meeting a limit of 1 mg/L, 0.5 mg/L and 0.1 mg/L utilizing a range of treatment technologies including, but not necessarily limited to, biological phosphorus removal, chemical precipitation, or a combination of the two. The study shall evaluate the construction and O & M costs of the different treatment technologies for these limits on a

monthly, seasonal, and annual average basis. For each technology and each phosphorus discharge level evaluated, the study shall also evaluate the amount by which the Permittee's typical household annual sewer rates would increase if the Permittee constructed and operated the specific type of technology to achieve the specific phosphorus discharge level. Within 24 months of the effective date of this Permit, the Permittee shall submit to the Agency and the DRSCW/LDRWC a written report summarizing the results of the study.

8. Total phosphorus in the effluent shall be limited as follows:

    a. If the Permittee will use chemical precipitation to achieve the limit, the effluent limitation shall be 1.0 mg/L on a monthly average basis, effective 10 years after the effective date of this permit unless the Agency approves and reissues or modifies the permit to include an alternate phosphorus reduction program pursuant to paragraph c or d below that is fully implemented within 10 years of the effective date of this permit.
    b. If the Permittee will primarily use biological phosphorus removal to achieve the limit, the effluent limitation shall be 1.0 mg/L monthly average to be effective 11 years after the effective date of this permit unless the Agency approves and reissues or modifies the permit to include an alternate phosphorus reduction program pursuant to paragraph c or d below that is fully implemented within 11 years of the effective date of this permit.
    c. The Agency may modify this permit if the DRSCW has developed and implemented a trading program for POTWs in the DRSCW/LDRWC watersheds, providing for reallocation of allowed phosphorus loadings between two or more POTWs in the DRSCW/LDRWC watersheds, that delivers the same results of overall watershed phosphorus point-source reduction and loading anticipated from the uniform application of the applicable 1.0 mg/L monthly average effluent limitation among the POTW permits in the DRSCW watersheds and removes DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203.
    d. The Agency may modify this permit if the DRSCW/LDRWC has demonstrated and implemented an alternate means of reducing watershed phosphorus loading to a comparable result within the timeframe of the schedule of this condition and removes DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203.

9. The Permittee shall monitor the wastewater effluent, consistent with the monitoring requirements on Page 2 of this permit, for total phosphorus, dissolved phosphorus, nitrate/nitrite, total Kjeldahl nitrogen (TKN), ammonia, total nitrogen (calculated), alkalinity and temperature at least once a month. The Permittee shall monitor the wastewater influent for total phosphorus and total nitrogen at least once a month. The results shall be submitted on NetDMRs to the Agency unless otherwise specified by the Agency.

10. The Permittee shall submit a Nutrient Implementation Plan (NIP) for the DRSCW watersheds that identifies phosphorus input reductions by point source discharges, non-point source discharges and other measures necessary to remove DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203. The NIP shall also include a schedule for implementation of the phosphorus input reductions and other measures. The Permittee may work cooperatively with the DRSCW to prepare a single NIP that is common among DRSCW and LDRWC permittees. The NIP shall be submitted to the Agency by December 31, 2023.

ATTACHMENT 3

MACROINVERTEBRATE TAXA FOUND

AT THE PRESERVE AT OAK MEADOWS

Attachment 3: Macroinvertebrate Taxa found at the Preserve at Oak Meadows

	2010-2018 Taxa not included in Indicator Taxa table[c]	SC34	SC35	SC35B	SC35A
1801	*Turbellaria*	x	x	x	x
1900	*Nemertea*	x			
3600	*Oligochaeta*	x	x	x	x
4664	*Helobdella stagnalis*	x			
4964	*Erpobdella microstoma*	x	x		x
5800	*Caecidotea sp*		x	x	x
6201	*Hyalella azteca*	x	x	x	x
6700	*Crangonyx sp*				x
8250	*Orconectes (Procericambarus) rusticus*				x
16700	*Tricorythodes sp*	x	x	x	x
17200	*Caenis sp*	x			
22001	*Coenagrionidae*	x	x	x	x
22300	*Argia sp*		x	x	
23700	*Anax sp*	x	x		
51206	*Cyrnellus fraternus*				x
59001	*Leptoceridae*	x			
59500	*Oecetis sp*	x	x		
59550	*Oecetis inconspicua complex sp A*				x
59570	*Oecetis nocturna*		x		
68201	*Scirtidae*			x	
68700	*Dubiraphia sp*	x	x		
68707	*Dubiraphia quadrinotata*			x	
68708	*Dubiraphia vittata group*	x	x	x	
69901	*Circulionidae*		x		
76001	*Chironomidae*		x		
77120	*Ablabesmyia mallochi*		x		
77130	*Ablabesmyia rhamphe group*	x	x	x	
77470	*Coelotanypus sp*				x
77500	*Conchapelopia sp*			x	
77740	*Hayesomyia senata*		x		
77750	*Hayesomyia senata or Thienemannimyia norena*	x	x	x	x
78655	*Procladius (Holotanypus) sp*	x	x		x
79020	*Tanypus neopunctipennis*		x		x
79100	*Thienemannimyia group*		x		
80400	*Cricotopus sp*	x			
80410	*Cricotopus (C.) sp*		x		
80420	*Cricotopus (C.) bicinctus*	x	x	x	x
80490	*Cricotopus (Isodadius) intersectus group*				x
80510	*Cricotopus (Isodadius) sylvestris group*	x	x		x
81231	*Nanocladius crassicornus or N. (N) "rectinervis"*		x		
81240	*Nanocladius distinctus*		x		
82121	*Thienemanniiella lapopodema*	x			
82700	*Chironomini*	x			
82700	*Chironomus sp*		x		
82710	*Chironomus (C.) sp*	x			
82730	*Chironomus (C.) decorus group*	x	x	x	x
82800	*Cladopelma sp*	x			x
82820	*Cryptochironomus sp*	x	x	x	x
82880	*Cryptotendipes sp*		x		
82882	*Cryptotendipes sp 2*		x		
82885	*Cryptotendipes pseudotener*	x	x		x
83000	*Dicrotendipes sp*		x	x	
83002	*Dicrotendipes modestus*	x	x		x

	2010-2018 Taxa not included in Indicator Taxa table[c]	SC34	SC35	SC35B	SC35A
83040	*Dicrotendipes neomodestus*	x	x	x	x
83050	*Dicrotendipes lucifer*	x	x		x
83150	*Endochironomus sp*	x	x		
83158	*Endochironomus nigricans*	x	x		x
83300	*Glyptotendipes (G.) sp*	x	x	x	x
83400	*Harnischia sp*		x		
83400	*Harnischia curtilamellata*		x		
84000	*Parachironomus sp*		x		
84010	*Parachironomus "abortivus" (sensu Simpson & Bode, 1980)*				x
84040	*Parachironomus frequens*				x
84100	*Paracladopelma sp*		x		
84155	*Paralauterborniella nigrohalteralis*	x			
84210	*Paratendipes albimanus or P. duplicatus*	x	x		
84300	*Phaenopsectra obediens group*	x			
84470	*Polypedilum (P.) illinoense*	x	x	x	x
84520	*Polypedilum (Tripodura) halterale group*	x	x	x	
84540	*Polypedilum (Tripodura) scalaenum group*	x	x	x	x
84600	*Saetheria sp*		x		
84700	*Stenochironomus sp*		x		
85001	*Tanytarsisni*	x			
85200	*Cladotanytarsus sp*		x		
85230	*Cladotanytarsus mancus group*	x	x		x
85260	*Cladotanytarsus vanderwulpi group*		x		
85262	*Cladotanytarsus vanderwulpi group sp 2*		x		
85264	*Cladotanytarsus vanderwulpi group sp 4*		x		
85265	*Cladotanytarsus vanderwulpi group sp 5*		x		
85500	*Paratanytarsus sp*	x	x		
85800	*Tanytarsus sp*	x	x		
85821	*Tanytarsus glabrescens group #7*		x		
85840	*Tanytarsus sepp*	x	x		
89501	*Ephydridae*		x		
93200	*Hydrobiidae*	x			x
95100	*Physella sp*	x	x		x
96100	*Menetus (Micromenetus) sp*	x			
95900	*Gyraulus sp*		x		
96900	*Ferrissia sp*			x	
97001	*Bivalvia*		x		
97601	*Corbicula fluminea*	x	x	x	x
98001	*Pisidiidae*	x	x	x	x
98200	*Pisidium sp*	x	x		x
98600	*Sphaerium sp*	x		x	x

[c] **New 2018 taxa records for SC34, SC35, SC35b and SC35a are in red; new 2017 records are in blue.**

Pre-project number of taxa (non-indicator)	41	51	NA	23
Post-project additional taxa (non-indicator)	10	15	26	15
Total (excluding high value taxa)	51	66	26	38

	New Records Post Project	New or Extended Range Post Project	All Survey Taxa
High Value Taxa	8	13	15
Other, Non Indicator Taxa	25	50	94
Total	33	63	109

ATTACHMENT 4

SPRING BROOK RESTORATION AND

DAM REMOVAL (PHASE 2) OVERALL PLAN

TITLE : SPRING BROOK No. 1 CREEK & WETLAND RESTORATION - PHASE 2

OVERALL PLAN

DSGN.	JSL
DWN.	JSL
CHKD.	JJW
SCALE : 1"=150'	

NO.	DATE	NATURE OF REVISION
1	02/25/19	MISC. CORRECTIONS AND DUPAGE CO. COMMENTS
2		
3		
4		
5		
6		
7		
8		

CLIENT : FOREST PRESERVE DISTRICT OF DUPAGE COUNTY
3S580 NAPERVILLE ROAD
WHEATON, IL 60189
(630) 933-7200

WBKENGINEERING LLC
116 WEST MAIN STREET, SUITE 201
ST. CHARLES, ILLINOIS 60174
(630) 443-7755

WBK engineering

PROJECT NO. 18-0181
DATE : $PDATE
SHEET $OV1 OF$TSHTS
DRAWING NO.
OV1

PLOT DATE : 3/20/2019
USER NAME : slevenne
FILE NAME : W:\Projects\2018\18018 SpringBrookPh2.3\cadd\Civil\Dgn\Sht\OV_PLAN_01.dgn

ATTACHMENT 5

FULLERSBURG WOODS

PUBLIC OUTREACH MATERIALS

Telephone Survey Draft – Graue Mill Dam modification outreach

Hello. This is a short public opinion survey about DuPage county taxpayer's opinions as it relates to waterways and public resources. This is NOT a sales call of any kind. The survey was created by the DuPage River Salt Creek Workgroup. It should take you under five minutes to answer these short questions, and your opinions will help assure that we get accurate results…so let's get started.

First, we'd like to know if you are you familiar with the Graue Mill Dam at Fullersburg Woods in Oak Brook? (Y/N)

If you are familiar with the Graue Mill, press one.
If you are not familiar with the Graue Mill, press two

IF NOT FAMILIAR SKIP questions 2 and 3.

Have you visited the Graue Mill Dam in the last year? (Y/N)
If you have visited the Graue Mill in the last year, press one.
If you have Not visited the Graue Mill in the last year, press two.

How important would you say the Graue Mill Dam is to your local community?
Very important, press one.
Somewhat important, press two.
Not very important, press three.
If you're unsure, press four.

Now we'd like to know in general how important is the quality of rivers, streams, wildlife and natural habitat to your community?

Very important, press one.
Somewhat important, press two.
Not very important, press three.
Unsure, press four

How important are historic sites to your community?

Very important, press one.
Somewhat important, press two.
Not very important, press three.
Unsure, press four

Now we'd like to know which of the following you consider to be MOST important to you? I'll read the list twice to give you a chance to think about it. Here we go…

If saving taxpayers money is most important to you, press one.
If improving natural wildlife and habitat is most important to you, press two.
If preserving historic sites is most important to you, press three.
If improving water quality in streams and rivers is most important to you, press four.
If you're not sure, press five.
Again. [repeat above options]

Experts have found that modifying the dams on our waterways such as the Graue Mill Dam would improve water quality, wildlife habitat and recreation. If modifying the dam is necessary to improve water quality, wildlife habitat and recreation, would you support doing so?

If you support modifying the Graue Mill Dam, press ONE.
If you prefer leaving the Graue Mill Dam unchanged, press TWO.
If unsure, press THREE

Experts have found that modifying Graue Mill and other alternative measures could save taxpayers $180 million dollars that would otherwise be required for wastewater treatment upgrades. If you prefer to:

Modify the Graue Mill Dam, press ONE.
Leave the dam unchanged even though wastewater treatment improvements will be required, press TWO.
If unsure, press THREE.

Finally, would you be MORE LIKELY or LESS LIKELY to support an elected official who voted to make dam modifications to improve natural habitats, wildlife, water quality and save taxpayers money?

If you would be MORE LIKELY to support an elected official who voted to make dam modifications, press ONE.
If you would be LESS LIKELY to support an elected official who voted to make dam modifications, press TWO.
If it makes no difference, press THREE.

Gender
Age

AILERON

December 17, 2018

Graue Mill Dam Phone Survey Results Analysis

A telephone survey conducted on December 12 and 13, 2018 collected public opinion data from DuPage County residents related to water quality and the Graue Mill Dam specifically. The survey was conducted on behalf of the DuPage River Salt Creek Workgroup (DRSCW) and collected 453 responses, on both land line and mobile phones, which provides a statistically significant sample with a margin of error of 4.53%.

Overall – the survey indicated that the public should support efforts to modify the Graue Mill Dam and the elected officials who vote to do so, as long as the benefits of dam modification are communicated clearly.

- **Graue Mill Dam is a relatively well-known and important to some DuPage County Residents**

  33% of respondents were familiar with Graue Mill Dam and roughly 11% of those surveyed had visited in the past year. Of those familiar with the dam, the majority felt that it was "important to their community." 37% said that Graue Mill Dam is very important and 37% replied that the Dam is somewhat important. This data shows that a segment of DuPage County residents has a connection to the Graue Mill Dam, though the majority (67%) were not familiar with the dam.

- **The quality of rivers, streams and natural habitat is a top issue for DuPage County residents.**

  95% of respondents said that rivers, streams and habitat was either very important (75%) or somewhat important (20%) to their community. When presented with five options, 46% said that improving water quality in streams and rivers was most important to them, 16% said that wildlife habitat was most important and 31% said that saving taxpayers money was most important. Residents expressed strong support for modifying the Graue Mill dam in order to improve water quality habitat and recreation (81%). This support was even stronger than the economic message that modifying the dam would save taxpayers $180 million dollars (79%).

- **Economic issues are important, a close second to water quality.**

  When presented with five options, 31% said that saving taxpayers money was most important to them, the second choice after improving water quality (46%). When it was explained that modifying Graue Mill Dam and other measures would save taxpayers $180 million, 79% responded that they would prefer to modify the dam – this was very strong support, though slightly weaker than support for modifying the dam to improve water quality (81%). The survey has a margin of error of 4.53%, so we would consider the support in questions four and five to be equivalent.

- **DuPage County residents would support elected officials who voted to make dam modifications.**

The strongest message from the survey was that residents would support elected officials who voted to make dam modification to improve water quality and save taxpayers money. 85% would be more likely to support these officials compared to only 2% that would be less likely to support them.

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chicago, illinois 60603

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fax: 312.629.3696
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Recommendations:

Based on this data, we can begin to shape a successful public outreach strategy for the dam modification project. The DRSCW should acknowledge that the Graue Mill Dam is considered an important asset by many residents of DuPage County. When explaining the need to modify the dam, the workgroup should highlight how dam modifications will both improve water quality and create major savings for taxpayers. The dam modification project will achieve water quality and economic results that are important to the vast majority of DuPage County residents. The data indicates that, if the workgroup is able to help DuPage County residents understand this context for the project, the public should support modifying the Graue Mill Dam.

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Graue Mill Dam – In-Depth Interview Outline Draft

This conversation is part of an effort by the DuPage River Salt Creek Workgroup to gather public feedback about Fullersburg Woods and the Graue Mill Dam. The Workgroup is working to gather information that will help identify ways to improve water quality, preserve important resources and save taxpayers money.

Background (adjust based on subject):

What is the first thing that comes to mind when you think about Graue Mill?

What do you like most about it?

What do you do when you visit Graue Mill and Fullersburg Woods?

How could Fullersburg Woods and/or Graue Mill be improved?

What role does the dam play in your visits to Graue Mill and Fullersburg Woods?

Water Quality:

What are your impressions of water quality in Salt Creek behind Graue Mill Dam?

Are you familiar with the proposals to modify the dam in order to improve water quality in Salt Creek?

(If yes) How would you summarize what is being proposed?

(If unfamiliar) Water quality experts have found that modifying dams is a sure way to improve water quality, fish passage, and wildlife habitat in creeks and rivers. Do you think that's an option for Graue Mill Dam?

Why / why not?

What would be the worst-case scenario for modifying the dam at Graue Mill?

What sort of modification could work?

What are the main things that should be considered when making a decision about modifying the dam?

The Workgroup in looking for input from the community on the idea of modifying the Graue Mill dam. Who should they consult?

Regulations:

The Workgroup came about because of water quality and fish population issues in the DuPage River and Salt Creek.

Their job is to find effective and economical ways to improve water quality so that rivers and creeks meet federal standards.

Modifying dams is the most effective and lowest-cost way to meet federal water quality standards and allow for fish passage.

Another option is upgrading wastewater treatment systems without modifying dams. This option would cost taxpayers about $180 million and will provide temporary regulatory relief but will not solve the underlying issues (blocked fish passage, low dissolved oxygen levels, etc.).

How do you think the Workgroup should act?

What are the most important things to consider when making the decision?

ATTACHMENT 6

2018 DEICING PROGRAM SURVEY (DRAFT)

BAXTER & WOODMAN Consulting Engineers

DuPage River Salt Creek Workgroup

Chloride Education and Reduction Program

2018 Deicing Program Survey

DRAFT

March 26, 2019

Section 1
Background and Purpose

The DuPage River Salt Creek Workgroup (DRSCW) is a coalition of communities, sanitary districts, environmental organizations, and professionals working to improve the ecological health of Salt Creek and the Upper DuPage River. DRSCW is responding to water quality requirements for chloride as the East and West Branch of the DuPage River and Salt Creek have been identified as having chloride related impairments. Total Maximum Daily Load (TMDL) analysis performed by the Illinois Environmental Protection Agency recommended significant reductions in chloride loading for each of the streams to meet the water quality standard for chloride (500 mg/L).

DRSCW formed a Chloride Committee and the Chloride Education and Reduction Program to develop and promote alternatives to conventional roadway deicing practices and support the implementation of the alternatives. An element of the program is gathering information from municipal deicing programs via survey questionnaires to benchmark municipal activities and identify positive changes in roadway deicing program practices. This report serves to summarize the responses received from the 2018 deicing program survey.

Funding for the program and this report is provided in part by the Illinois Environmental Protection Agency through Section 319 of the Clean Water Act and DRSCW member dues.

1.1 Background Information

Municipal road salting was identified as a source of chloride loading to DRSCW watersheds. As a result, DRSCW distributed a survey questionnaire to about 80 municipalities and public works agencies in November 2006 and April 2007 to obtain baseline information about deicing practices throughout the watersheds. Thirty-nine responses to the survey were received, forming an informed baseline of the deicing programs implemented in the watersheds. A similar survey was distributed in 2010. Thirty-two public agencies responded to the 2010 survey which helped to note positive changes in local deicing practices. The 2012, 2014, and 2016 the surveys generated 34, 27 and 43 responses respectively. Thirty-nine (39) agencies responded to the 2018 survey.

1.2 Goals of the Questionnaires

The 2018 Deicing Program Survey was conducted in the spring of 2018 to follow up with agencies on any changes and/or improvements in their deicing programs, potentially because of DRSCW Chloride Reduction Program efforts, and any resulting effects on salt application rates.

The 2018 survey questionnaire asked for information about deicing practices and strategies per the following categories:

- General deicing and snow removal information
- Deicing and snow removal equipment

- Application rates
- Salt storage
- Equipment maintenance and calibration
- Management and record-keeping

The responses to the survey are summarized in Section 2 of this report. The responses are compared to those received in earlier surveys to determine if any changes or improvements have occurred. The survey and response data are **Available upon Request**.

Section 2
Survey Responses

2.1 Survey Responses

Thirty-nine agencies responded to the 2018 survey. The following subsections summarize the responses in each of the categories described in Section 1. The survey and all responses are **Available upon Request**. Note that not all agencies provided responses to all questions, and some agencies answered some questions in different ways, resulting in some inconsistencies in survey results.

2.1.1 General Deicing and Snow Removal Information

The survey asked agencies for general deicing and snow removal information. All responding agencies provided some information. Survey responses indicated approximately 7,074 lane miles of road serviced by deicing programs throughout the watersheds.

2.1.1.1 Salt Application and Price

The majority of agencies indicated an average salt application rate of 200-300 pounds per lane mile (lbs/lm). **Figure 2-1 shows** the respondent's salt application rate distribution, comparing 2012-2018 averages to the 2016 and 2018 survey responses.

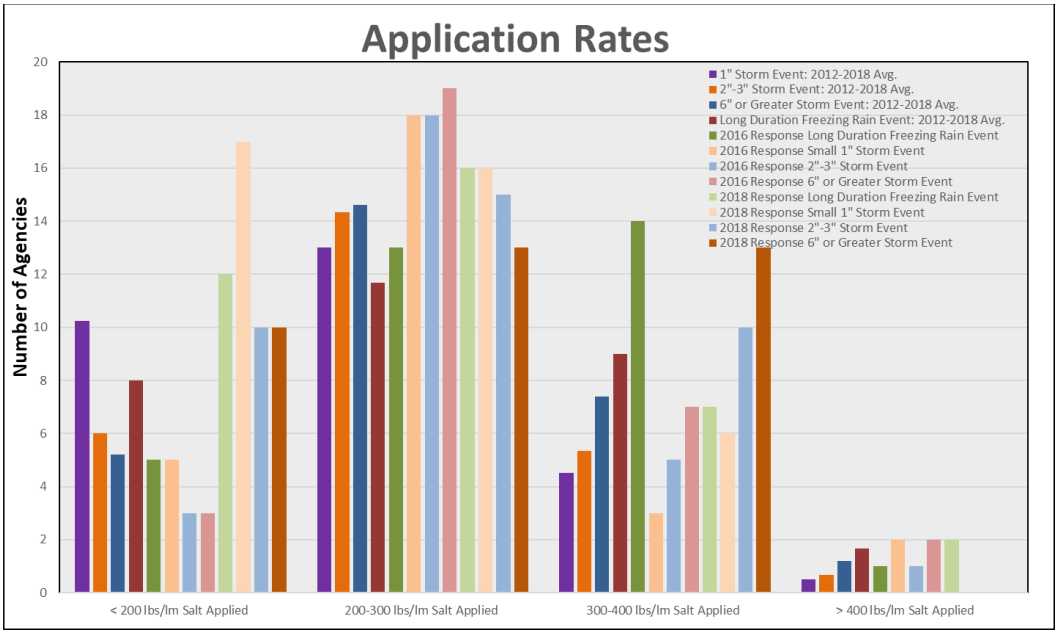

Figure 2-1 – Average Salt Application Rates

Survey responses generally indicate that more agencies are applying less salt per lane mile than in previous years for smaller winter storm events, and more salt per lane mile for the largest of events.

Regarding salt prices, 23 of the 39 agencies responding agencies indicated an increase in salt or deicing product prices over the past few years. Six (6) agencies reported a decrease in salt or deicing product price over the past few years. Nine (9) agencies indicated that product prices have remained the same.

2.1.1.2 Deicing, Anti-Icing, Pre-Wetting, and Deicing Agents

Information about deicing, pre-wetting, and anti-icing practices, as well as the deicing agents used was requested by the survey. The following is a list of deicing agents used by respondents:

- Each of the 39 responding agencies reported the use of salt
- Twenty-eight (28) agencies reported the use of dry rock salt
- Nineteen (19) agencies used liquid calcium chloride
- Ten (10) agencies reported the use of pre-manufactured liquid products

From the 39 responders, 26 reported using pre-wetting practices. This year's survey asked what percentage of total salt usage was pre-wetted prior to application. Of those agencies pre-wetting salt, responses ranged from 20 to 100% of total slat used, with the majority pre-wetting 90 to 100%.

Twenty-one (21) responders implement ant-icing practices. Benefits to anti-icing were noted as:

- Lowered salt usage
- Safer roadways
- Melts ice at lower temperatures /easier plowing / prevent freezing
- Reduced time spent plowing
- Reduce call-ins for minor snow events

Barriers to anti-icing were reported as:

- Lack of equipment / cost of equipment / limited vehicle storage
- Lack of personnel
- Political pressures
- Size of town / type of roads

2.1.1.3 Weather and Pavement Temperature Forecasting

Out of the agencies responding, 27 agencies use an advanced weather forecasting service, which is a similar percentage of responders from the previous 2016 survey. Twenty-seven (27) respondents make use of pavement temperature for winter event deicing response, which is a slight increase from the previous survey.

2.1.2 Deicing and Snow Removal Equipment

All agencies use snow plows or similar equipment. Twenty-nine (29) agencies have mechanically controlled spreading equipment, and 32 have computer-controlled equipment. Equipment for spreading liquids is used by 31 agencies.

2.1.3 Salt Storage

2018 survey responses indicated the following salt storage practices:

- Thirty-seven (37) agencies responded that salt storage areas are fully enclosed storage structure or have impervious storage pads.
- Thirty-five (35) agencies store salt on an impervious pad.
- Thirty-seven (37) agencies indicated that drainage from their storage area(s) is controlled or collected.
- Twenty-four (24) agencies indicated that they store salt in a single storage area.
- Thirty-four (34) agencies store salt in an enclosed area.
- Thirty-two (32) reported that residual salt in loading areas is swept up.
- Six responders indicated they have salt storage areas which are not fully enclosed or on an impervious pad, which is a decrease by 8% from 2016.

2.1.4 Equipment Maintenance, Cleaning, and Calibration

Thirty-three (33) agencies indicated that they calibrate their de-icing equipment, an increase in the number of agencies performing calibration as a best management practice. Most agencies providing calibration information perform calibration annually, with 3 agencies calibrating at least 2 times per season, 3 agencies calibrating every 2 years, and 6 agencies calibrating after major maintenance or repairs (in addition to annually.

Thirty-seven (37) agencies responded that equipment is washed at an indoor wash station draining to a sanitary sewer. One (1) agency indicated outdoor washing in areas not drained to a sanitary sewer. Two (2) respondents reported collecting and reusing wash water for brine making. Sixteen (16) responders reported having brine making equipment, and 1 responder indicated the equipment is shared with other townships.

2.1.5 Management and Record-Keeping

Twenty-five (25) agencies indicated that operators are trained annually (or more often). Thirteen (13) of the remaining agencies train at the start of employment and one agency did not specify a training schedule.

From a management standpoint, the rate of salt application is established by the director or supervisor in 35 agencies, solely by the operators in two (2) agencies, and one agency did not report. During spreading, the rate of product application is controlled solely by

the operator in 26 agencies, by the operator in addition to other measures in 34 agencies, automatically in 2 agencies, and set at a fixed rate in 2 agencies. Twenty nine (29) agencies reported having set guidelines for equipment speed to control bounce and scatter and loss of salt from the road surface.

Regarding record keeping, thirty-two (32) agencies keep records per winter storm event, 25 keep records per truck, and 25 kept records per season. Twenty-eight (28) agencies keep more than one type of record for program management. Two (2) agencies reported keeping no records.

Seven (7) responders indicate contractors are utilized for clearing operations. Most responding agencies use contractors to clear cul-de-sacs. One uses a contractor to clear 20% of the road system.

2.2 Survey Analysis

The following subsections provide survey conclusions developed by comparing information from the 2016 survey to responses received from the 2014 survey or previous surveys. Forty-three (43) agencies responded to the 2016 survey, while 27 agencies responded to the 2014 survey. The number of new agencies responding to the survey is a positive for the amount of information provided for study and program participation overall, but results in some changes or inconsistencies in information trends.

2.2.1 Alternative Methods and Practices Analysis

Many of the questions in the survey focused on the use of alternative deicing agents, methods, and practices such as pre-wetting and anti-icing. **Figure 2-2** illustrates the percentage of respondents that use various deicing agents as reported on the 2007, 2010, 2012, 2014, 2016, and 2018 questionnaires.

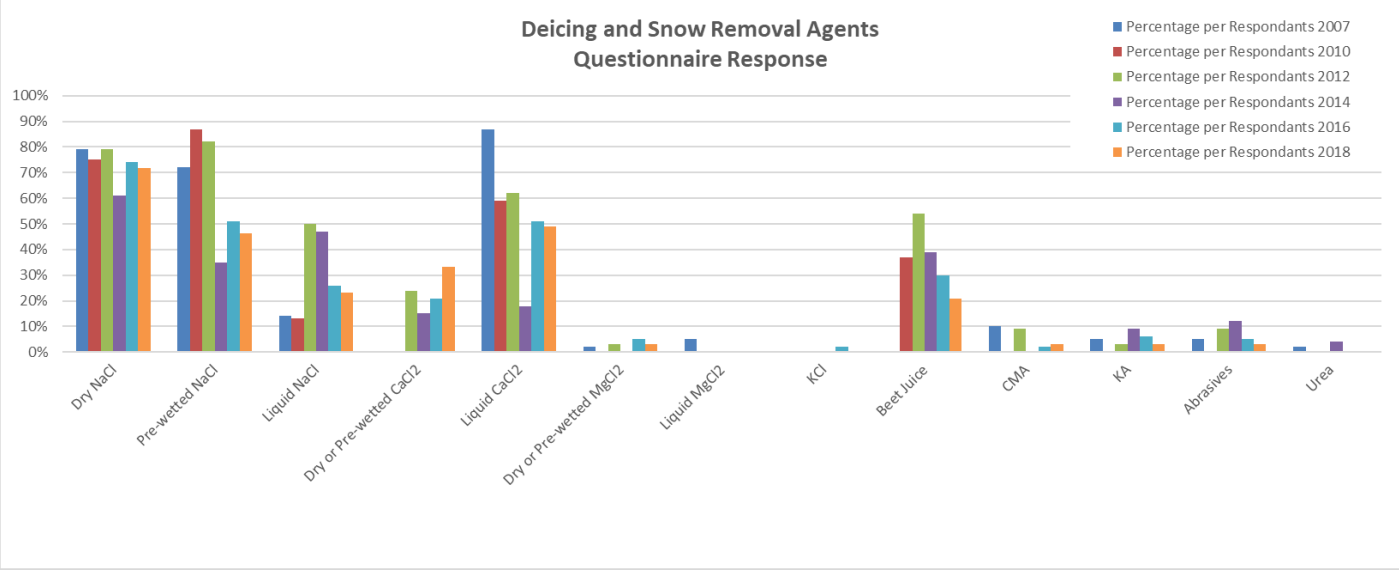

Figure 2-2 – Deicing and Snow Removal Agents

The survey results indicated dry and pre-wetted salt (NaCl) may have slightly decreased from the previous surveys In 2018, 46% of agencies reported using pre-wetted salt, however previous program information suggests that the level of implementation of pre-wetting is much higher than this throughout the watershed. The 2018 survey percentages may be skewed by agencies which did not report, and inexperience with the type of information being asked by the survey. Follow up with individual agencies for future surveys may be needed.

Other analysis observations include:

- Results show a 12% increase in dry or pre-wetted Calcium Chloride ($CaCl_{2)}$.
- Results show a small decrease in the use of dry or pre-wetted Magnesium Chloride ($MgCl_2$).
- No 2018 responders use liquid $MgCl_2$, Urea, or Potassium Chloride (KCL). The 2016 survey reported no MgCl2 or Urea as well, but only one responder for KCL.
- The use of Calcium Magnesium Acetate (CMA) has slightly increased since 2016.
- Potassium Acetate (KA) and Abrasives have decreased since 2016.
- Beet Juice usage was at a peak in 2012, and has declined.

This year's survey asked agencies for the application rate of salt pre-wetting liquids, and application rate of anti-icing liquids to roadways. Application rates for pre-wetting ranged from 5 to 30 gal/ton of salt. Application rates for anti-icing ranged from 10 to 50 gal/lane mile.

In 2007, 14 agencies reported the use of anti-icing practices. Since then the number of reporting agencies has been

- 2010 - 20 agencies
- 2012 - 20 agencies
- 2014 - 13 agencies
- 2016 - 26 agencies

In 2018, 21 reporting agencies implemented anti-icing practices. This trend suggests improvement in the use of anti-icing BMPs over time, with the most widespread use in 2016.

Similar to the 2016 survey results, 2 of the responding agencies reuse vehicle wash-water for making brine solution. The responders who reported reuse of wash water in 2016 are not the same as in 2018.

2.2.2 Salt Application Rates

In 2007, survey respondents were asked about their average annual salt usage. In 2012, 2014, 2016, and again in 2018 respondents were asked about annual salt usage. Respondents gave their annual usage for each winter season which provides a good benchmark for how weather has affected salt application rates. **Figure 2-3** shows an approximated annual salt usage in lbs/lane mile for each watershed in the study area reported from the 2007, 2012, 2014, 2016, and 2018 surveys.

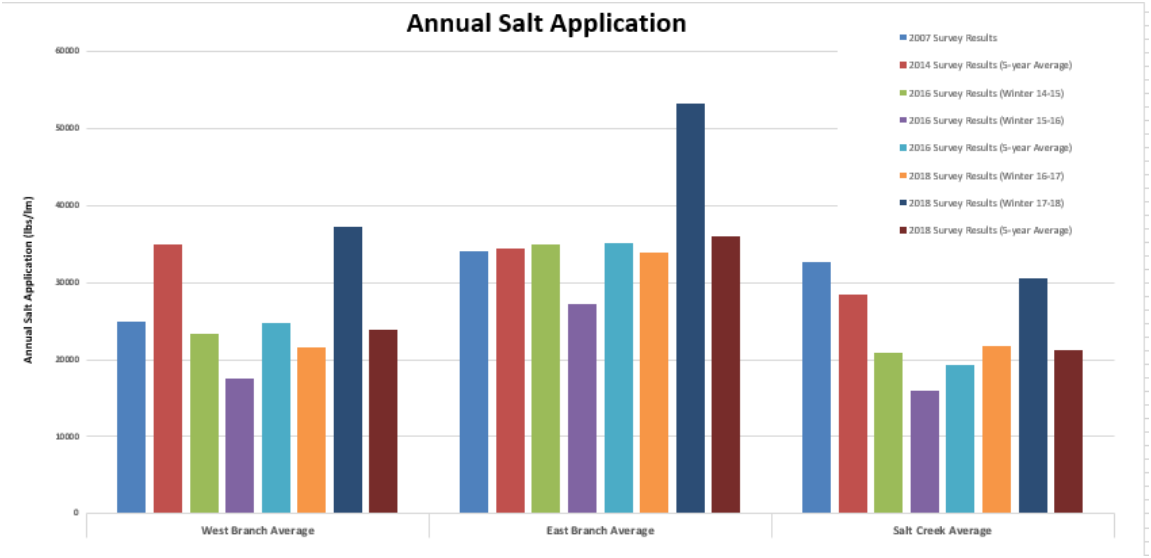

Figure 2-3 – Annual Salt Application Reported from 2007 - 2018

Annual salt application rates generally decreased from 2007 – 2012 in the watersheds, and increased from 2012-2014 as a result of winter precipitation and storm event frequency variation. 2018 survey responses indicated that the per lane mile use of salt in the 2017-18 winter was noticeably larger from that in most previous years. The number and type of winter storm events occurring each year and the different agencies providing usage information for each survey make developing direct usage trends or correlations difficult.

Survey respondents were asked about the average salt application rate per lane mile for specific winter storm events. This information more comparably describes a community's salt usage, or application rate. Figure 2-1 shows salt application rates reported from the 2010, 2012, 2014, 2016, and 2018 surveys. In general, the number of agencies applying 200-300 lbs/lm has increased from 2012 to 2018 for Long Term Freezing Rain event (LTFR) and 1" storm events.

Both annual salt usage data and salt application rates provide insight into individual agency programs and salt application across watersheds, as well as a valuable benchmark for future survey and Chloride Reduction Program efforts. Both of the above

values will continue to be requested of agencies in future surveys to compare and report deicing program improvements, and presumed water quality improvements.

2.3 Survey Conclusions

The purpose of the 2018 survey was to gather follow-up information to determine if alternative deicing practices are being implemented in the DuPage River/Salt Creek watersheds. Thirty-nine (39) agencies responded to the 2018 survey, similar in number to the 2016 survey (two less in 2018). As different agencies provided information, the 2018 survey results may be skewed by the unique practices of the agencies providing information this year, and inexperience with the type of information being asked by the survey. Follow up with individual agencies for future surveys may be needed.

- Almost all agencies in the program area have covered permanent salt storage facilities; however there are still some opportunities for storage and salt handling improvements across the watersheds.

- Almost all agencies are using pre-wetted salt, either as a pre-wetted product or by pre-wetting the salt on board spreading equipment immediately before applying to road surfaces. Some agencies are not fully implementing pre-wetting practices. The 2018 survey asked what percentage of total salt usage was pre-wetted prior to application. Of those agencies pre-wetting salt, responses ranged from 20 to 100% of total slat used, with the majority pre-wetting 90 to 100%.

- Twenty nine (29) agencies reported having set guidelines for equipment speed to reduce bounce and scatter and loss of salt from the road surface.

- For the 2018 survey, 21 responders reported the implementation of ant-icing practices. The benefits of anti-icing were noted as:
    - Lowered salt usage
    - Safer roadways
    - Melts ice at lower temperatures /easier plowing / prevent freezing
    - Reduced time spent plowing
    - Reduce call-outs for minor snow events

- Agencies are implementing anti-icing at different levels within their operations, with varying success. The level of implementation could be expanded over time. The barriers to implementing anti-icing practices were reported as:
    - Lack of equipment / cost of equipment
    - Limited vehicle storage available
    - Lack of personnel
    - Size of town / type of roads
    - Political pressures

- Out of the agencies responding, 27 agencies use an advanced weather forecasting service, which is a similar percentage of responders from the previous 2016 survey. Twenty-seven (27) respondents make use of pavement temperature for winter event deicing response, which is a slight increase from the previous

survey. Several communities within the program area are not making use of these practices.

- This year's survey asked agencies for the application rate of salt pre-wetting liquids, and application rate of anti-icing liquids to roadways. Application rates for pre-wetting ranged from 5 to 30 gal/ton of salt. Application rates for anti-icing ranged from 10 to 50 gal/lane mile.

- Seven (7) responders indicate contractors are utilized for clearing operations. Most responding agencies use contractors to clear cul-de-sacs. One uses a contractor to clear 20% of the road system.

- Eighteen (18) agencies reported changes made to their program due to local deicing program workshops in 2018, indicating agencies are hearing about alternative ways to implement deicing practices at the workshops and are testing new practices that could reduce overall salt usage.

In order to perform a more definitive trend analysis of program improvements and reductions in salt usage, additional information will need to be collected over time. Information should continue to be collected to characterize any deicing program BMP improvements and resulting reductions in salt usage occurring within the DRSCW watersheds.

ATTACHMENT 7

IPS DATA SOURCES

Data Layer	Source Data	Manipulation	Source Agency	Other Notes
Residential development within buffers (30m, 500m, 1000m)	CMAP sites (1100)	Clipped to circular buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Residential development within buffers, clipped to basins (30m, 500m, 1000m)	CMAP sites (1100)	Clipped to basin, clipped to buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Commercial development within buffers (30m, 500m, 1000m)	CMAP sites (1200)	Clipped to circular buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Commercial development within buffers, clipped to basins (30m, 500m, 1000m)	CMAP sites (1200)	Clipped to basin, clipped to buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Industrial development within buffers (30m, 500m, 1000m)	CMAP sites (1300)	Clipped to circular buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Industrial development within buffers, clipped to basins (30m, 500m, 1000m)	CMAP sites (1300)	Clipped to basin, clipped to buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Institutional development within buffers (30m, 500m, 1000m)	CMAP sites (1400)	Clipped to circular buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Institutional development within buffers, clipped to basins (30m, 500m, 1000m)	CMAP sites (1400)	Clipped to basin, clipped to buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Trans/Comm/Util/Waste within buffers (30m, 500m, 1000m)	CMAP sites (1500)	Clipped to circular buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Trans/Comm/Util/Waste within buffers, clipped to basin (30m, 500m, 1000m)	CMAP sites (1500)	Clipped to basin, clipped to buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Agricultural area within buffers (30m, 500m, 1000m)	CMAP sites (2000)	Clipped to circular buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Agricultural area within buffers, clipped to basins (30m, 500m, 1000m)	CMAP sites (2000)	Clipped to basin, clipped to buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Open Space within buffers (30m, 500m, 1000m)	CMAP sites (3000)	Clipped to circular buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Open Space within buffers, clipped to basins (30m, 500m, 1000m)	CMAP sites (3000)	Clipped to basin, clipped to buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Other landuse within buffers (30m, 500m, 1000m)	CMAP sites (4000, 5000, 6000, 9000)	Clipped to circular buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Other landuse within buffers, clipped to basins (30m, 500m, 1000m)	CMAP sites (4000, 5000, 6000, 9000)	Clipped to basin, clipped to buffers, tabulated	Chicago Metropolitan Agency for Planning (CMAP)	
Road Density within buffers, clipped to basin	County ROW or Buffered Tigerlines	Clipped to upstream basin, tabulated	Various counties, if available. Otherwise, we created it.	To create our own ROW files, we used 200ft buffers for Interstates, 40ft buffers for 2-lane roads, and 60-foot buffers for 4-lane roads.
Impervious surface within buffers (30m, 500m, 1000m)	NLCD Imperviousness	Clipped to circular buffers, tabulated	National Land Cover Dataset (NLCD)	
Impervious surface within buffers, clipped to basins (30m, 500m, 1000m)	NLCD Imperviousness	Clipped to basin, clipped to buffers, tabulated	National Land Cover Dataset (NLCD)	
Total Impervious surface within subcatchment, upstream of sampling point	NLCD Imperviousness	Clipped to upstream basin, tabulated	National Land Cover Dataset (NLCD)	
Forest Cover within buffers (30m, 500m, 1000m)	Chicago Canopy Dataset	Clipped to circular buffers, tabulated	Spatial Analysis Laboratory at the University of Vermont	http://letters-sal.blogspot.com/search?q=chicago
Forest Cover within buffers, clipped to basins (30m, 500m, 1000m)	Chicago Canopy Dataset	Clipped to basin, clipped to buffers, tabulated	Spatial Analysis Laboratory at the University of Vermont	http://letters-sal.blogspot.com/search?q=chicago
Total Forest Cover within subcatchment, upstream of sampling point	Chicago Canopy Dataset	Clipped to upstream basin, tabulated	Spatial Analysis Laboratory at the University of Vermont	http://letters-sal.blogspot.com/search?q=chicago
Soil K-factor at the monitoring site	SSURGO Soil Survey	None	Natural Resources Conservation Service (NRCS) Soils	
Channel flashiness at the monitoring site	SSURGO Soil Survey	None	Natural Resources Conservation Service (NRCS) Soils	
Wetland coverage within subcatchment, upstream of sampling point	NLCD General	Clipped to upstream basin, tabulated	National Land Cover Dataset (NLCD)	
Lake/Open Water coverage within subcatchment, upstream of sampling point	NLCD General	Clipped to upstream basin, tabulated	National Land Cover Dataset (NLCD)	
Dams	Various Agencies	Compiled and merged point shapefiles and metadata from 6 sources	Various Agencies	Dams removed in the last 20 years were included in the data set.

ATTACHMENT 8

BASIN WIDE NUTRIENT TRADING PROGRAM

TECHNICAL MEMORANDUMS

TETRA TECH

MEMO

To:	DuPage River Salt Creek Workgroup (DRSCW)
From:	Nutrient Trading Framework Project Team
Date:	September 5, 2018 (Updated November 11, 2018)
Subject:	**Final Task 4 Technical Memo: Wastewater Treatment Plant Data Collection, Analysis and Summary of Results**

1.0 INTRODUCTION

The first phase of the DuPage River Salt Creek Workgroup (DRSCW) Nutrient Trading Framework development focused on the feasibility analysis of phosphorus trading among wastewater treatment plants (WWTPs) in the Salt Creek, East Branch DuPage River, West Branch DuPage River, and the Lower DuPage River. To determine potential supply and demand, Tasks 2 and 4 focused on collecting, compiling, and analyzing relevant data on existing WWTP operation and performance and potential enhanced nutrient removal (ENR) upgrade opportunities and costs. The Project Team submitted a draft technical memorandum under Task 4 to DRSCW on November 20, 2017 that provided a WWTP data analysis status report, including a summary of findings and data gaps.This technical memorandum is the final technical memorandum under Task 4, summarizing the technical approach and methodologies used, as well as the results of the overall effort under Task 4.

2.0 METHODS

The data collection methods for Task 4 focused on using the best and most robust WWTP evaluation and upgrade cost data available, while maximizing the efficiency of the data collection efforts. Accordingly, the Project Team used three primary approaches to develop reliable upgrade cost estimates. These approaches, listed in order of confidence, are as follows:

1. Using reported cost estimates prepared by the dischargers' engineering consultants and presented in Phosphorus Discharge Optimization Plan (PDOP) and Feasibility Study (FS) reports for each WWTP.
2. Using cost curves developed using the data from the reported PDOP/FS cost estimates to provide a "second-level" estimate for WWTPs without PDOP/FS reports (as of June 1, 2018).
3. Using external WWTP upgrade costing references for those WWTPs without PDOP/FS reports and otherwise not compatible with the cost curves (i.e., either out of range for interpolation/extrapolation or an existing ENR plant).

WWTP-specific data were supplemented using responses to the information form provided in Appendix A by dischargers not scheduled to have their PDOP/FS prepared in time for this evaluation, and through additional follow-up inquiries of dischargers for specific information as needed to refine cost estimates.

The Project Team reviewed the information provided by dischargers (e.g., PDOP/FS reports, responses to specific information requests) and recorded data important for the analysis in a master data collection spreadsheet. In addition to summary worksheets for evaluating all of the WWTPs together, the Project Team

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prepared worksheets for each individual WWTP whose upgrade costs were based on FS reports or external references (Items 1 and 3 in the list above). Table 1 summarizes the types of data recorded for each WWTP.

Table 1. Data recorded in WWTP-specific worksheets in master database

Data Category	Data Listing
General Information	WWTP Name, PDOP/FS Consultant Company Name
Existing WWTP Characteristics	Average Daily Flow (Design and Actual); Maximum Daily Flow (Design); Influent TP Concentration; Effluent TP Concentration; Process Description
Cost Data (for 1.0, 0.5 and 0.1 mg/l LOT Upgrades)[1]	Capital Cost; O&M Cost; 20-Year Life-Cycle Cost
Costing Assumptions	Debt Financing Interest Rate; Inflation Rate; Term
Other FS Data of Interest	Description of Nitrogen Removal Options Considered; Summary of User Rate Data and Impacts; Use of Orthophosphate for Corrosion Control in Potable Water System
Optimization Information	Summary of Optimization Opportunities

[1] Data analysis included only the costs for the "recommended alternative" or lowest cost alternative

Once the Project Team obtained these data for a given WWTP, the Project Team then reviewed cost data in detail to ensure relative consistent costing assumptions were applied among the different WWTPs. In some cases, life-cycle cost calculations used raw capital and O&M costs reported by the FS consultants to ensure consistency. An interest rate of 5%, inflation rate of 3% and term of 20 years served as the basis for evaluation. The Project Team used these assumptions because they were both reasonable and the most common set of assumptions used by consultants in the FS reports (thus requiring the least amount of data manipulation to ensure consistency).

Other important data management assumptions are listed below.

- Salvage/replacement costs were left in FS estimates, but not included in those prepared by the project team (the difference is insignificant).
- Seasonal variations in costs were averaged (e.g., 10 versus 15 degrees C).
- Where various alternatives were presented, the estimates associated with monthly average (versus "annual" or "seasonal") level of technology (LOT) compliance were used.
- Where various alternatives were presented, the FS-recommend alternative or lowest cost alternative was used as the cost basis.

After the Project Team summarized data for each WWTP in the individual worksheets, several key pieces of data were transferred to a master summary worksheet. These data included the following:

- Whether the WWTP is already designed for enhanced phosphorus removal (EPR), yes/no
- Design Average Daily Flow (DADF), MGD
- Actual Average Daily Flow (AADF), MGD
- Influent Total Phosphorus Concentration (TPin), mg/l
- Effluent Total Phosphorus Concentration (TPout), mg/l
- 20-year Net Present Value (NPV) Life-Cycle Cost (LCC) for 1.0, 0.5 and 0.1 mg/l TP LOTs, $USD

Using these data, the Project Team developed unit costs (NPV LCC per pound of TP removed) for each facility, based on both current actual flows and design flows. Intermediary calculations are also detailed within the worksheet, and include the following:

- TPin in units of lbs/year, under both design (DTPin) and actual (ATPin) flow conditions

$$DTPin = DADF \times TPin \times 8.34 \times 365$$

$$ATPin = AADF \times TPin \times 8.34 \times 365$$

- TPout in units of lbs/year, under both design and actual flow conditions

$$DTPout = DADF \times TPout \times 8.34 \times 365$$

$$ATPout = AADF \times TPout \times 8.34 \times 365$$

- Effluent TP in units of lbs/year under the three LOTs (1.0, 0.5, 0.1 mg/l), under both design and actual flow conditions

$$DTPlot = DADF \times TPlot \times 8.34 \times 365$$

$$ATPlot = AADF \times TPlot \times 8.34 \times 365$$

- Incremental TP reduction in units of lbs/year under the three LOTs (1.0, 0.5, 0.1 mg/l), under both design and actual flow conditions

$$DTPdiff = DTPout - DTPlot$$

$$ATPdiff = ATPout - ATPlot$$

LCCs were then divided by DTPdiff and ATPdiff to calculate the unit costs per pound of TP reduced annually for each LOT.

2.1 COST CURVES

As previously indicated, the Project Team used cost curves to estimate upgrade costs, when applicable, for WWTPs with PDOP/FS reports scheduled for completion later than this analysis.

Cost curves were developed by plotting WWTP design flow as the independent (x-axis) variable versus 20-year LCC as the dependent (y-axis) variable and fitting linear trendlines to the data to facilitate interpolation for those WWTPs whose costs were to be estimated. Only WWTPs with robust cost data estimated using FS or external references were used to develop the cost curves. Additionally, only cost data from WWTPs not designed for ENR were used in the analysis. Appendix B presents the cost curves developed for this analysis.

3.0 RESULTS

Table 2 provides a summary describing the status of WWTP-specific data and costing data sources used for each WWTP in the evaluation.

Table 2. Status and cost data estimation source for each WWTP

WWTP	ENR (yes/no)	Status	Cost Data Source
Addison-LaRocca	No	Complete	FS
Addison-North	No	Complete	FS

WWTP	ENR (yes/no)	Status	Cost Data Source
Barlett	No	Complete	FS
Bensenville	Yes	Complete	FS
Bloomingdale	No	Complete	FS
Bollingbrook 1	Unknown	No information received	Cost Curves
Bollingbrook 2	Unknown	No information received	Cost Curves
Bollingbrook 3	Unknown	No information received	Cost Curves
Carol Stream	No	Complete	FS
Crest Hill	No	Complete	FS
Downers Grove	No	Complete	FS
DuPage Greene Valley	No	Complete	FS
Elmhurst	No	PDOP/FS not provided	Cost Curves
Glenbard	No	Complete	FS/Cost Curves (for 0.1 mg/l LOT)
Glendale Heights	No	Complete	FS
Hanover Park	No	Complete	FS
Itasca	Yes	Complete	FS
Joliet Aux Sable	No	No information received	Cost Curves
MWRDGC Egan	No	PDOP/FS not provided	Jiang, et al. (2005); Washington State Dept. of Ecology (2011)
MWRDGC Hanover	No	PDOP/FS not provided	Cost Curves
Naperville Springbrook	No	PDOP/FS not provided	Jiang, et al. (2005); Washington State Dept. of Ecology (2011)
Plainfield North	Yes	PDOP/FS not provided	U.S. EPA (2008)
Roselle - Botterman	No	Complete	FS
Roselle - Devlin	No	Complete	FS
Salt Creek SD	No	Complete	FS
Village of Minooka	No	No information received	Cost Curves
West Chicago	No	Complete	FS

WWTP	ENR (yes/no)	Status	Cost Data Source
Wheaton	No	Complete	FS
Wood Dale North	Yes	PDOP/FS not provided	U.S. EPA (2008)
Wood Dale South	No	PDOP/FS not provided	Cost Curves

Figures 1 and 2 provide a summary of net present value costs for the WWTPs (note that WWTPs are shown on the x-axis in order from the lowest (left side) to highest (right side) design daily flow in each figure). Unit costs (cost per pound TP reduced) are summarized for LOTs of 1.0 mg/l, 0.5 mg/l and 0.1 mg/l in Figures 3, 4 and 5, respectively.

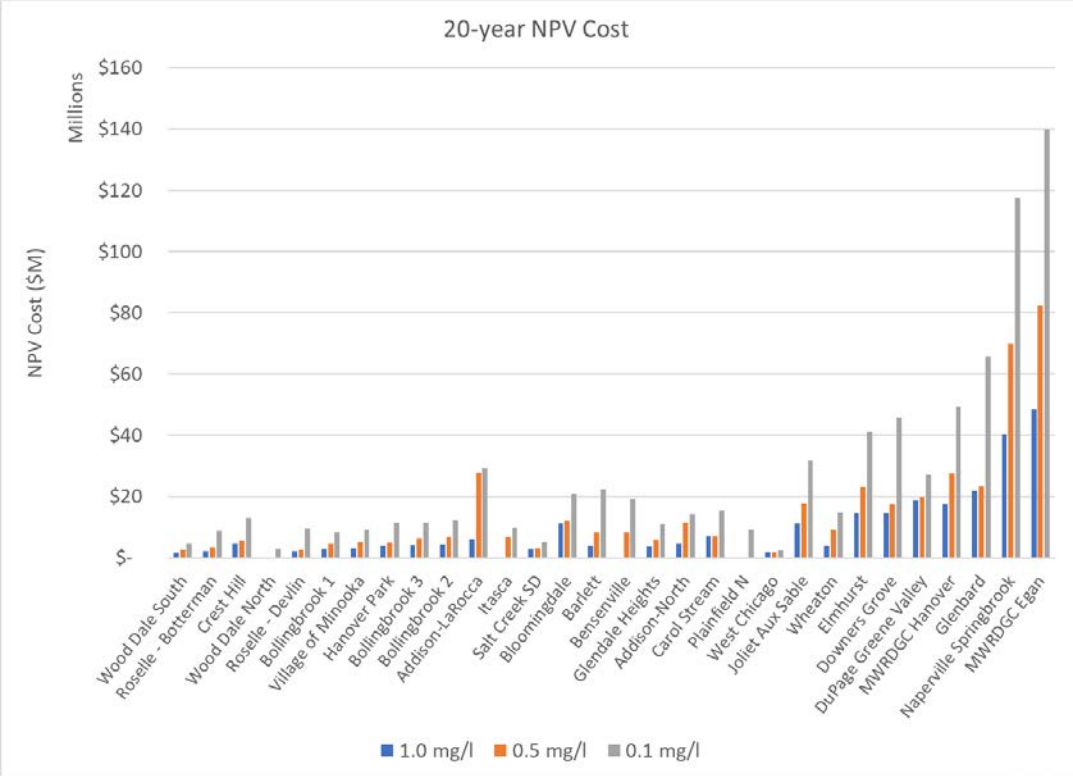


Figure 1. 20-year life cycle cost for WWTP upgrades to ENR

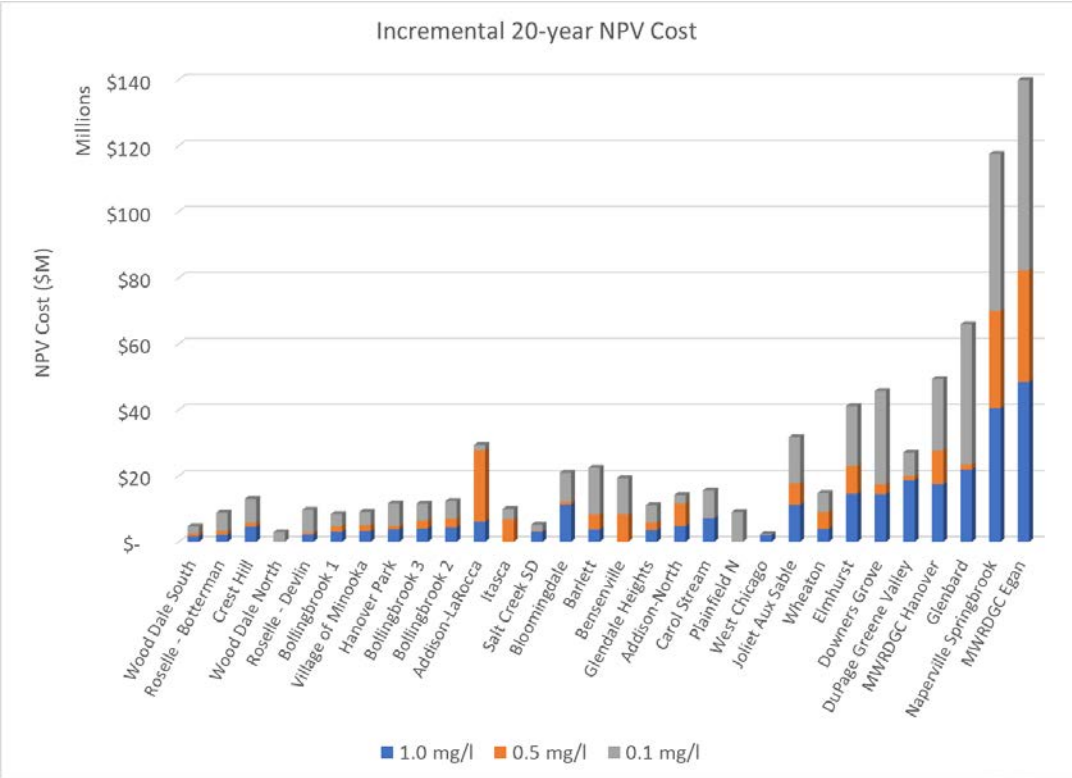


Figure 2. Incremental 20-year life cycle cost for WWTP upgrades to ENR

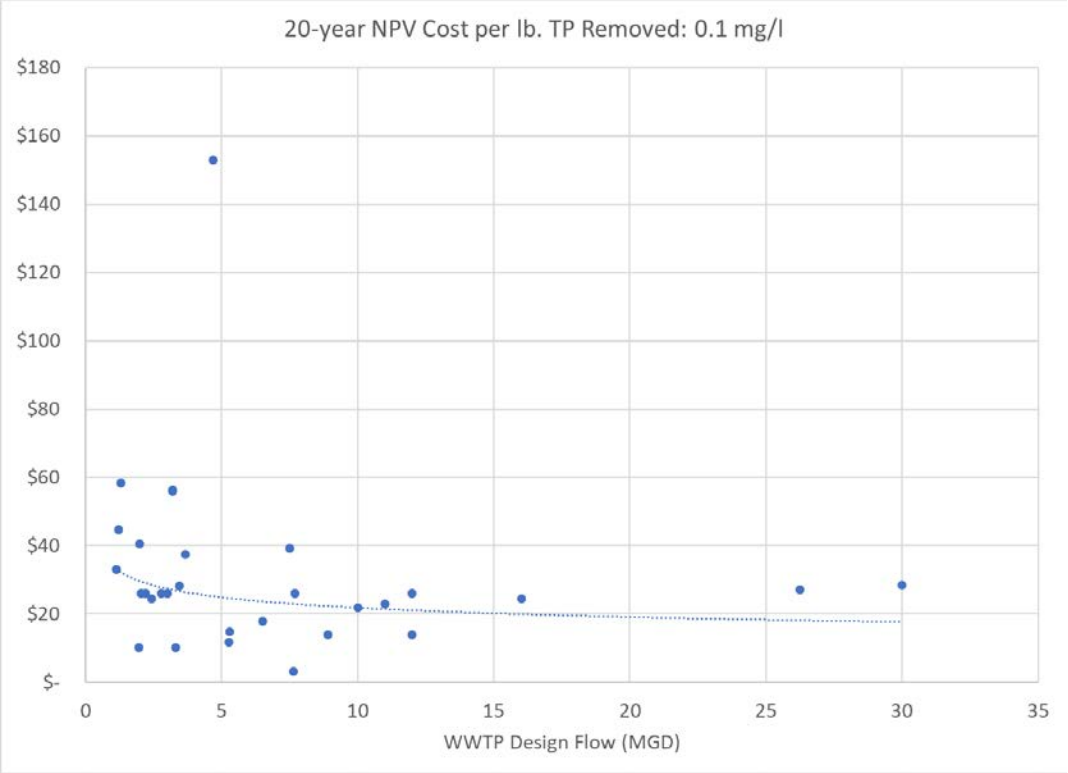


Figure 3. Unit costs for 0.1 mg/l TP LOT

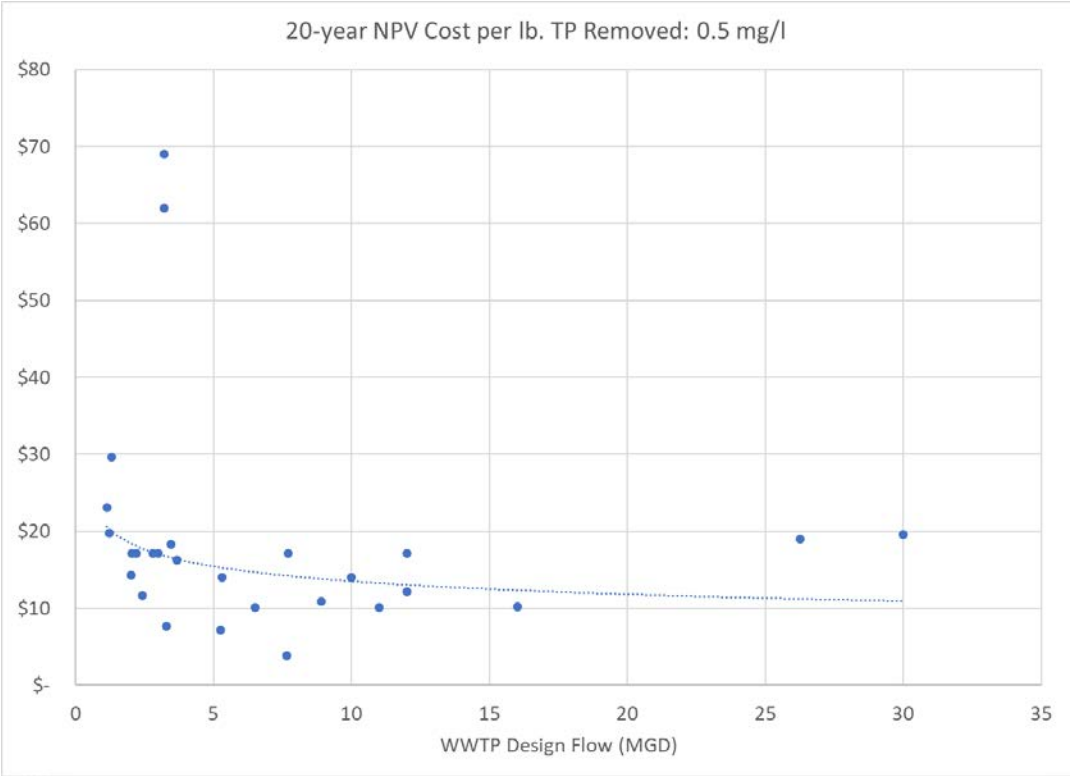


Figure 4. Unit costs for 0.5 mg/l TP LOT

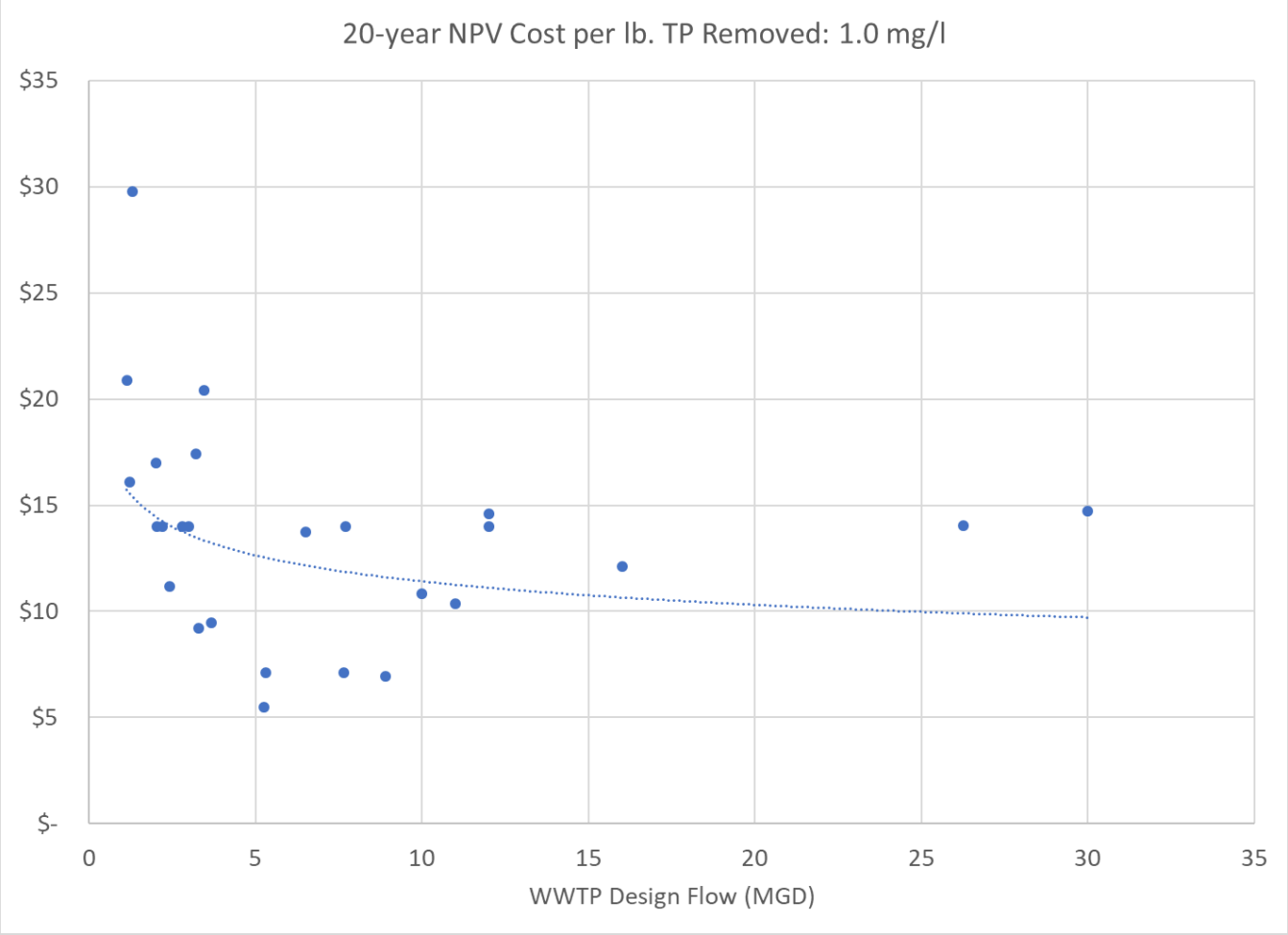


Figure 5. Unit costs for 1.0 mg/l TP LOT

4.0 POTENTIAL FOR POINT SOURCE TRADING

Using the information from this analysis, the Project Team initiated Task 5, the nutrient reduction cost analysis to determine potential point source trading market feasibility (i.e., supply and demand for phosphorus credit). The technical details of Task 5 are documented in a forthcoming technical memorandum. The results of the preliminary supply and demand analysis show a variation in the average cost per pound of phosphorus removal to achieve each LOT in each subwatershed. This signifies that the the opportunity for trading exists within and across subwatersheds. Figure 6 shows the average cost per pound of phosphorus removed for each LOT by subwatershed.

While unit cost differentials appear to signify the opportunity for point source trading exists within each subwatershed or among the East Branch, West Branch, and Main Branch, the Project Team would need to conduct a more in-depth analysis potential supply and demand to determine the number of possible bilateral trades to evaluate the viability of markets. This type of analysis would be one of the final steps under Task 5.

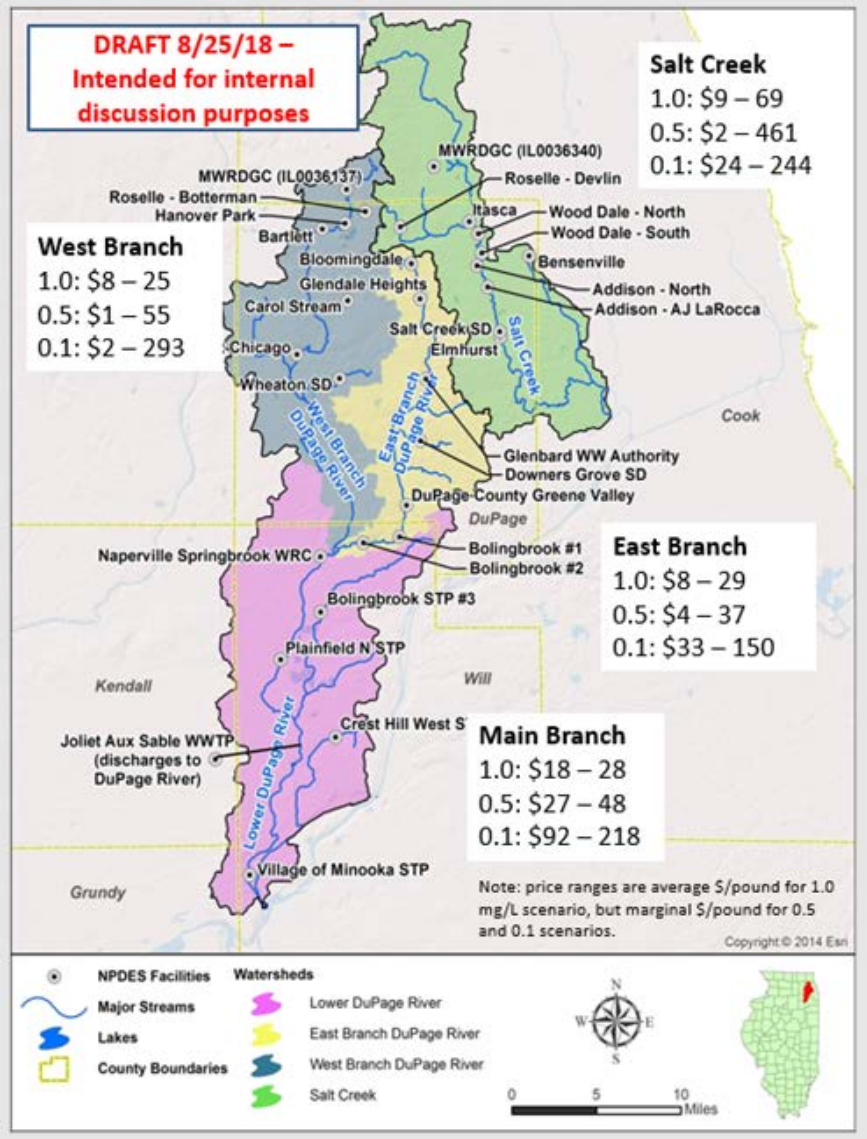


Figure 6. Average costs per pound of TP removal at each LOT by subwatershed

5.0 REFERENCES

Jiang, F., M.B. Beck, R.G. Cummings, K. Rowles, and D. Russell. 2005. Estimation of Costs of Phosphorus Removal in Wastewater Treatment Facilities: Adaptation of Existing Facilities. Water Policy Working Paper #2005‐011. February 2005.

U.S. EPA. 2008. Municipal Nutrient Removal Technologies Reference Document, Volume 1 – Technical Report. United States Environmental Protection Agency, Office of Wastewater Management, Washington, D.C. EPA‐823‐R‐08‐006. September 2008.

Washington State Department of Ecology. 2011. Technical and Economic Evaluation of Nitrogen and Phosphorus Removal at Municipal Wastewater Treatment Facilities. Publication 11-10-060. Prepared by Tetra Tech, June 2011.

APPENDIX A. INFORMATION FORM FOR PDOP/FS FACILITIES

Facility Name: _____

Secondary/Tertiary Treatment Process (clearly indicate whether current facility is designed for nutrient removal): _____

_____

Parameter	Design	Actual Measured
Average Daily Flow (MGD)		
Maximum Daily Flow (MGD)		
Average TP in (mg/l)		
Average TP out (mg/l)		

Please enter the requested information for all options considered in the feasibility study (do not use lines or add lines as needed):

Treatment Option	Effluent TP	Capital Cost	20-year O&M Cost	20-year Lifecycle Cost[1]
	1 mg/l			
	1 mg/l			
	1 mg/l			
	0.5 mg/l			
	0.5 mg/l			
	0.5 mg/l			
	0.1 mg/l			
	0.1 mg/l			
	0.1 mg/l			

[1] **Use interest rate of 5%, inflation rate of 3%, term of 20 years and 2017 dollars if possible. If not, please indicate basis.**

Provide brief summary of TP reduction optimization opportunities: _____

_____

_____

_____

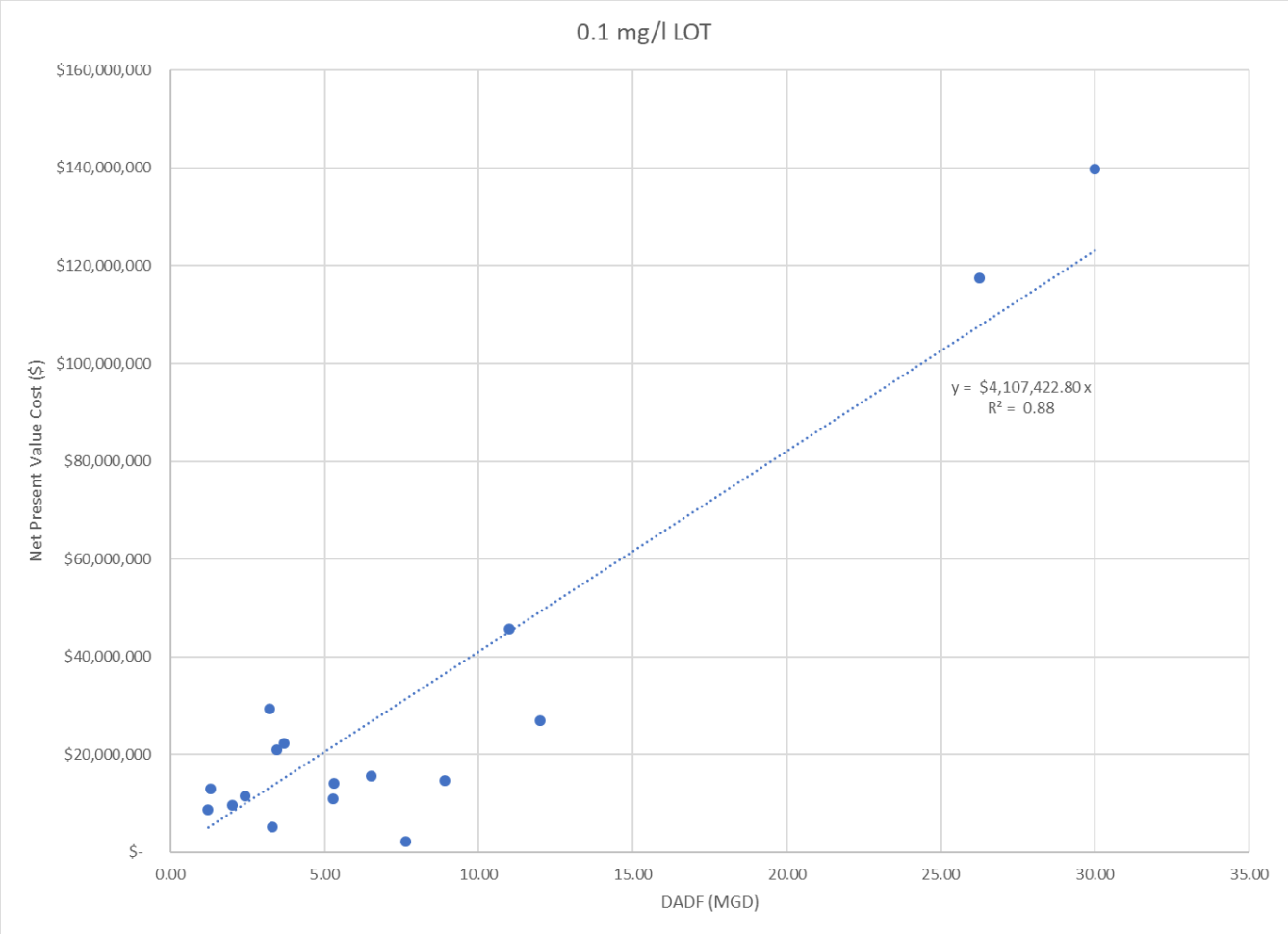
_____

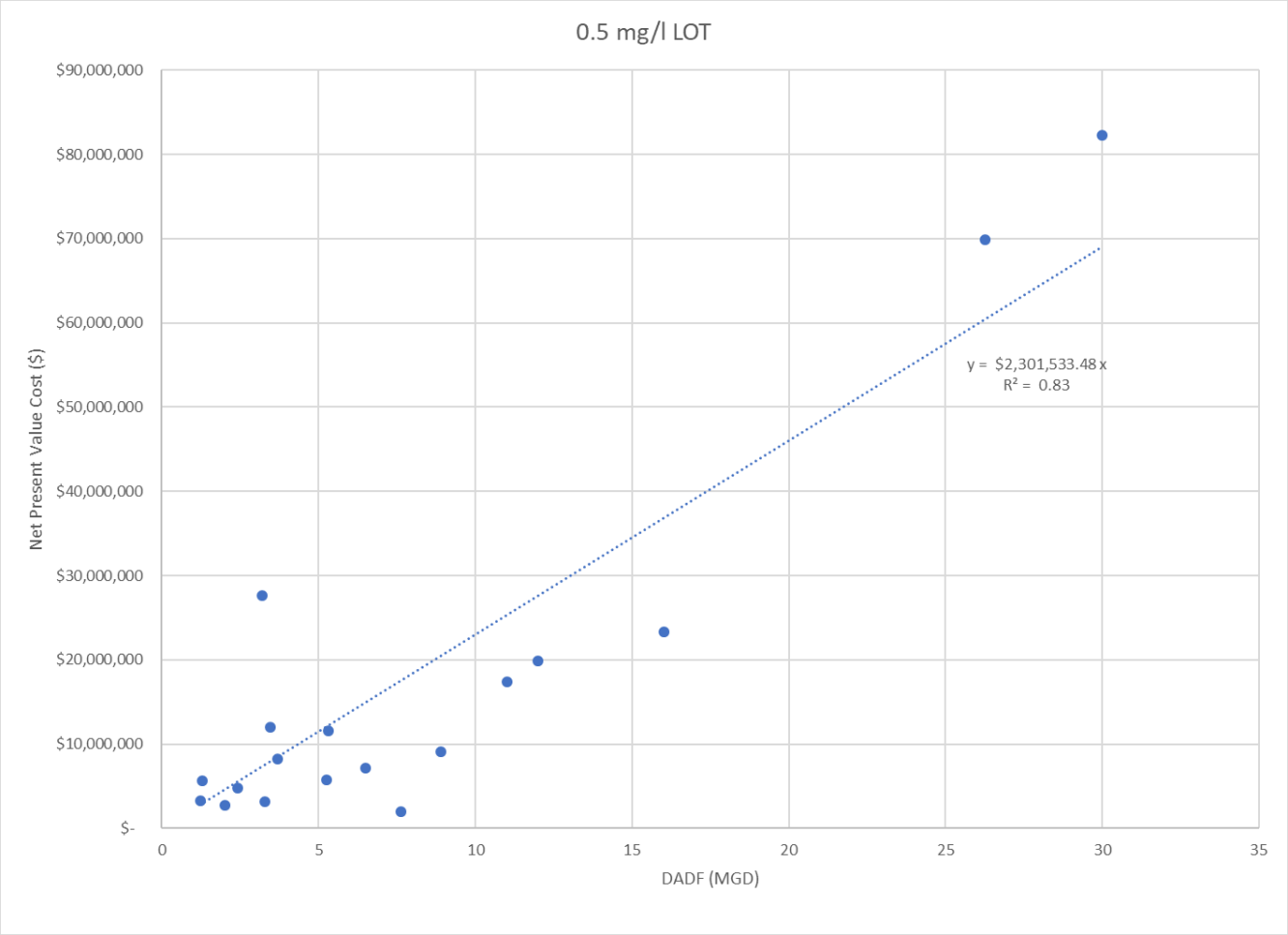
_____

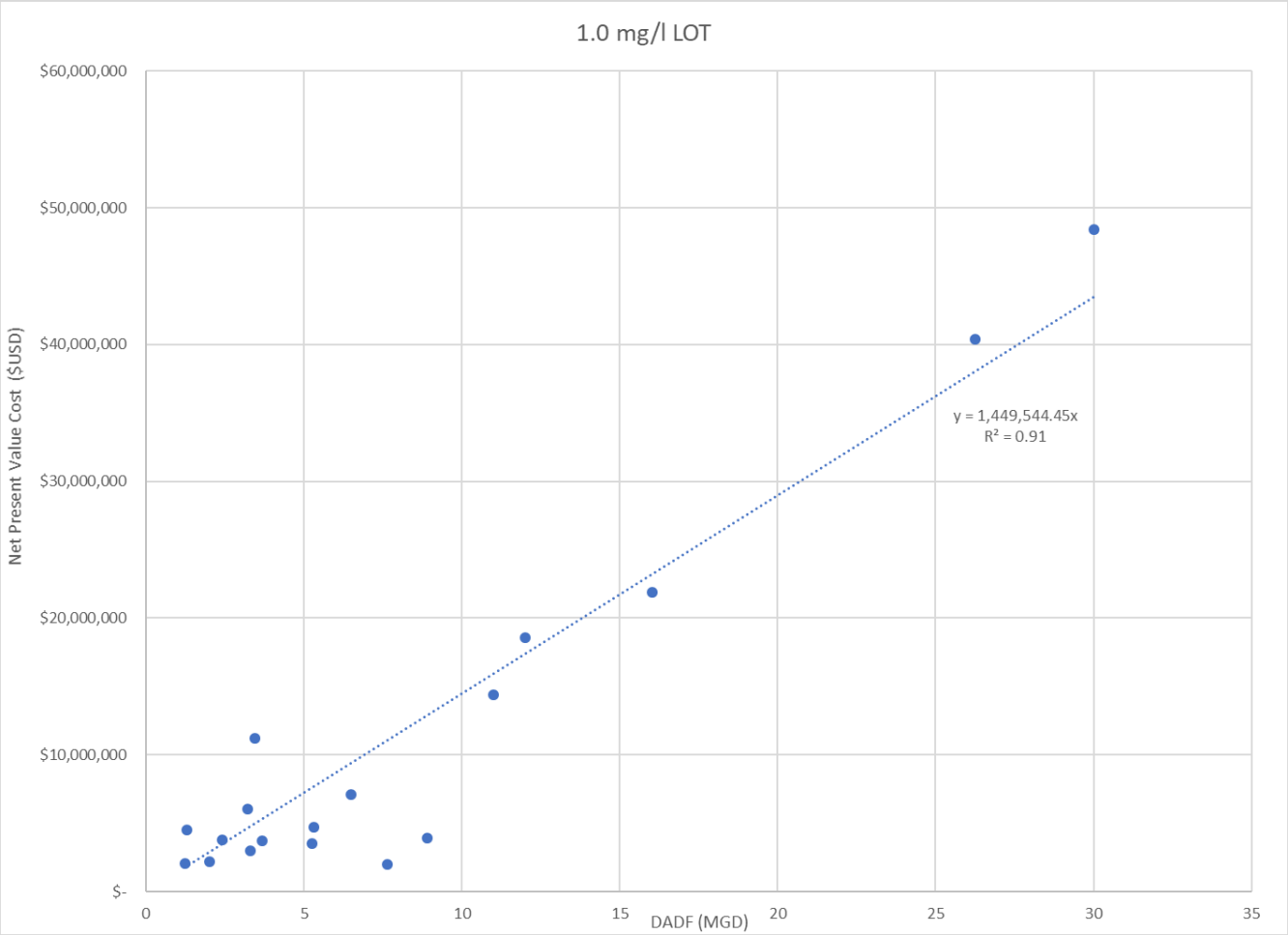
Do your drinking water providers add orthophosphate for corrosion control? Y/N

Have you estimated the potential effect of the alternatives on residential rates? Y/N (If yes, please note page number: _____)

APPENDIX B. COST CURVES




0.5 mg/l LOT
$90,000,000
$80,000,000
$70,000,000
$60,000,000
$50,000,000
$40,000,000
$30,000,000
$20,000,000
$10,000,000
$-
Net Present Value Cost ($)
0
5
10
15
20
25
30
35
DADF (MGD)
y = $2,301,533.48 x
R² = 0.83


1.0 mg/l LOT
$60,000,000
$50,000,000
$40,000,000
$30,000,000
$20,000,000
$10,000,000
$-
Net Present Value Cost ($USD)
0
5
10
15
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KIESER & ASSOCIATES
ENVIRONMENTAL SCIENCE & ENGINEERING

TECHNICAL MEMORANDUM

To:	DuPage River Salt Creek Workgroup (DRSCW)	**Date:**	November 5, 2018
From:	David Chen, K&A Doug McLaughlin, K&A	**cc:**	Mark Kieser, K&A Kellie DuBay, Tetra Tech Jennifer Olson, Tetra Tech
RE:	Stream Restoration Crediting Framework - **DRAFT**		

1.0 INTRODUCTION

The DuPage River Salt Creek Workgroup (DRSCW) is a group of local, publicly owned treatment works (POTWs) and communities working toward the attainment of designated uses of aesthetic quality, aquatic life, and primary contact in the DuPage River and Salt Creek in northeast Illinois. The POTWs within the DRSCW are currently required by their NPDES (National Pollutant Discharge Elimination System) permit to achieve an effluent phosphorus limit of 1.0 mg/L on a monthly average basis. However, this effluent phosphorus limit may potentially be decreased from 1.0 mg/L to 0.5 mg/L. As part of the DRSCW's efforts to meet negotiated permit requirements and provide an opportunity to achieve future permitting relief, the DRSCW is examining the potential for offsetting nutrient reductions by incentivizing stream restoration projects implemented by the POTWs. These include projects identified by the DRSCW's Identification and Prioritization System (IPS) Tool that go above and beyond those currently listed in the Special Conditions section of NPDES permits. To identify potential equivalency between POTW nutrient load reduction requirements and instream restoration benefits, Kieser & Associates, LLC (K&A) has assessed similar stream restoration crediting efforts, programs, and methodologies used in other watersheds. This Technical Memorandum describes a draft stream restoration crediting framework for the DRSCW to assess this equivalency.

There appear to be existing stream restoration crediting approaches utilized in other U.S. watersheds that may be adapted to a number of the DRSCW's planned stream restoration projects and Special Condition Projects that are described in the 2018 DRSCW Special Condition Report.[1] Some existing trading programs, like the Santa Rosa Nutrient Offset Program and the Chesapeake Bay Regional Water Quality Trading Program, use a crediting framework that allows phosphorus reduction crediting only for a limited range of stream restoration activities. Typically, these are activities associated with phosphorus load reductions that are readily quantifiable using established modeling approaches.[2,3] Many of the

[1] DRSCW. 2018. *DuPage/Salt Creek Special Conditions report March 31, 2018*. Naperville, IL: DuPage River Salt Creek Workgroup. http://www.dupagerivers.org/wp-content/uploads/2018/04/DRSCW-LDRWC_SpecialConditionsReport17-18_03312018.pdf

[2] The Freshwater Trust. 2015. *City of Santa Rosa Nutrient Offset Program instream action plan development: Draft crediting methodology*. http://santa-rosa.granicus.com/MetaViewer.php?clip_id=671&meta_id=59843

[3] Schueler, T. and B. Stack. 2012. *Recommendations of the expert panel to define removal rates for individual stream restoration projects. Final report*. Submitted to Urban Stormwater Work Group Chesapeake Bay

DRSCW's planned stream restoration projects include activities that have phosphorus reduction potential but no established methodologies for quantifying and crediting the associated phosphorus load reductions. Nonetheless, data collection and restoration-related efforts implemented by the DRSCW have shown ecological benefits associated with stream restoration. These demonstrable benefits may provide the opportunity to develop a framework that generates credits for a wider range of stream restoration activities.[4]

This Technical Memorandum summarizes existing efforts to credit nutrient reductions from stream restoration activities implemented elsewhere. It then provides a description of how previous watershed studies conducted by the DRSCW using the Qualitative Habitat Evaluation Index (QHEI), and potentially other indicators of instream benefits derived from stream restoration projects, may be incorporated into a broader crediting framework.

2.0 SUMMARY OF STREAM RESTORATION NUTRIENT CREDITING EFFORTS IN OTHER WATERSHEDS

Historically, stream restoration activities have been evaluated for crediting largely in the context of wetland and stream mitigation programs. As more scientific literature has been developed surrounding the relationship between stream restoration activities and nutrient load reduction, a few watersheds in the U.S. have begun to assess and incorporate stream restoration as a nutrient load reduction-generating activity in their water quality trading frameworks. As such, many of the efforts to quantify the nutrient load reduction of stream restoration activities summarized below are based on the reduction of sediment and sediment-bound nutrients rather than benefits that relate to habitat and aquatic life.

2.1 Chesapeake Bay Regional Water Quality Trading Program

Several Chesapeake Bay states have considered expanding the use of stream restoration activities to meet nutrient and sediment load reduction targets under the Chesapeake Bay Total Maximum Daily Load (TMDL). In response, an expert panel prepared a report of recommendations to the Bay states suggesting nutrient and sediment removal rates for individual stream restoration projects for use in both mitigation and water quality trading.[5] The 2012 report contains a review of available science, basic eligible conditions for stream restoration projects, four protocols for stream restoration crediting, and accountability mechanisms. The literature reviewed by the panel and used to form the basis of the protocols focused primarily on research conducted within the Chesapeake Bay Watershed or the Eastern U.S. Since release of this report, several efforts to credit stream restoration activities for nutrient load

Partnership. https://www.chesapeakebay.net/channel_files/18983/attachment_b1--urban_stream_restoration_panel_final_report_12062012.pdf

[4] DRSCW. 2016. *DuPage River Salt Creek Workgroup (DRSCW) implementation plan*. Naperville, IL: DuPage River Salt Creek Workgroup. http://drscw.org/wp/wp-content/uploads/2015/03/DRSCW-Implementation-Plan-05-22-2014-Final.pdf

[5] Schueler, T. and B. Stack. 2012. *Recommendations of the expert panel to define removal rates for individual stream restoration projects. Final report*. Submitted to Urban Stormwater Work Group Chesapeake Bay Partnership. https://www.chesapeakebay.net/channel_files/18983/attachment_b1--urban_stream_restoration_panel_final_report_12062012.pdf

reductions have adapted these crediting protocols, including the City of Santa Rosa Nutrient Offset Program and crediting guidance provided by the Water Environment & Reuse Foundation (WE&RF).[6,7]

2.1.1 Stream Restoration Activities with Quantifiable Nutrient Load Reductions

The expert panel created four protocols to estimate nutrient and sediment load reductions associated with four types of stream restoration activities. In each protocol, the panel stressed the importance of verifying the long-term performance of activities and recommended limiting credits generated to five years with the opportunity to renew upon verification of maintenance and performance. The four protocols developed by the panel are described as follows.

2.1.1.1 Protocol 1: Credit for Prevented Sediment during Storm Flow

This protocol applies to stream restoration practices that prevent channel or bank erosion from an urban stream. The protocol follows a three-step process: 1) estimating stream sediment erosion rates and annual sediment loading, 2) converting erosion rates to nutrient loads, and 3) estimating load reduction attributed to restoration. A modified "Bank Assessment for Non-point Source Consequences of Sediment" (BANCS) method is used to estimate the stream bank erosion rate. The BANCS method utilizes two common bank erodibility estimation tools: the Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) methods. Stream bank erosion is then converted to a nutrient load by multiplying by the median nutrient concentrations of eroding bank soils. The protocol then includes a conservative assumption that projects would be 50% effective in reducing sediment and nutrient loading from the stream reach. A suggested alternative is the use of erosion estimates from BANCS with low BEHI and NBS scores to represent "natural" conditions and to credit the difference between the predicted erosion rate and the "natural" erosion rate.

2.1.1.2 Protocol 2: Credit for Instream and Riparian Nutrient Processing during Base Flow (Nitrogen Only)

This protocol applies to design features used to promote denitrification during base flow within a stream's hyporheic zones (i.e., where groundwater and surface water mix at the stream bottom). This protocol only provides annual nitrogen reduction credits and is not applicable for phosphorus crediting.

2.1.1.3 Protocol 3: Crediting for Floodplain Reconnection Volumes during Storm Flow

This protocol applies to stream restoration activities that reconnect stream channels to their floodplains. The approach assumes that phosphorus and nitrogen removal is a result of increased surface water contact within adjacent floodplains. The protocol outlines the following four steps: 1) estimating the floodplain connection volume in the available floodplain area, 2) estimating the nutrient removal rate attributable to floodplain reconnection for the floodplain connection volume, 3) computing the annual nutrient load delivered during storms, and 4) multiplying the pollutant load by the estimated project removal rate to define the nutrient load reduction credit. Estimating the floodplain connection volume involves hydrologic and hydraulic modeling of the sub-watershed, stream, and floodplain. Additionally, the restoration project area must demonstrate that regulatory floodplain elevations are maintained, including National Flood Insurance Program-based floodplain management regulations, and that the

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[6] The Freshwater Trust. 2015. *City of Santa Rosa Nutrient Offset Program instream action plan development: Draft crediting methodology*. http://santa-rosa.granicus.com/MetaViewer.php?clip_id=671&meta_id=59843

[7] Bledsoe et al. 2016. *Final report: Stream restoration as a BMP: Crediting guidance*. WERF1T13. Alexandria, VA: Water Environment & Reuse Foundation. https://www.werf.org/a/ka/Search/ResearchProfile.aspx?ReportId=WERF1T13

stream channel has adequate sediment transport capacity. The protocol uses a series of curves developed by the Center for Watershed Protection to assist in defining the fraction of annual rainfall that is treated under various depths of floodplain connection treatment equivalent to a rainfall depth. These curves represent the annual runoff volume treated as a function of floodplain storage volume for several rainfall depths that allow runoff to access the floodplains. The protocol then utilizes curves to calculate the nutrient removal rate, and hydrologic and hydraulic modeling to calculate the load based on the volume of runoff that accesses the floodplain. Load estimates for urban watersheds are then derived using the unit area nutrient loading rates for impervious land developed for the restoration project's river basin segment. The protocol suggests the use of Chesapeake Bay Tools such as the Chesapeake Assessment Scenario Tool (CAST), Maryland Assessment Scenario Tool (MAST), and Virginia Assessment Scenario Tool (VAST) to derive the unit area loads.

2.1.1.4 Protocol 4: Credit for Dry Channel Regenerative Stormwater Conveyance

This protocol applies to the drainage area of a qualifying dry channel Regenerative Stormwater Conveyance (RSC) used for stormwater treatment. The protocol approach is derived from the Urban Stormwater Retrofit Expert Panel which utilizes an adjustor curve to determine nutrient removal rates based on the depth of captured rainfall over the contributing impervious area treated by an individual urban stormwater retrofit such as a wet pond, a swale, permeable pavement, and bioretention.

2.1.2 Stream Restoration Activities without Quantifiable Nutrient Load Reductions

The 2012 report does not address solutions or policies for incorporating stream restoration activities that do not fall into one of the four protocols described above.

2.2 City of Santa Rosa (California) Nutrient Offset Program

A water quality trading program is currently being developed for the Laguna de Santa Rosa Watershed under a TMDL.[8] The Laguna Watershed has been significantly impacted by development resulting in a reduction in aquatic habitat and ecological processes. The watershed is currently impaired for dissolved oxygen, indicator bacteria, mercury, nitrogen, phosphorus, sediment/siltation, and temperature. The City of Santa Rosa, Sonoma County Water Agency, and the Laguna de Santa Rosa Foundation are interested in translating eight stream restoration projects, with a total estimated cost of $50.2 million, into nutrient offset credits under the developing water quality trading program. The City of Santa Rosa, with the help of the Freshwater Trust, has explored the feasibility of nutrient crediting for stream restoration activities and developed a draft stream restoration crediting methodology for the City of Santa Rosa Nutrient Offset Program Instream Action Plan. The resulting 2015 Draft Instream Action Crediting Methodology developed crediting approaches and data requirements for these stream restoration activities and determined preliminary credit estimates for the planned stream restoration activity.[9] A list of planned stream restoration projects can be found in Appendix A of this K&A Technical Memorandum.

[8] North Coast Regional Water Quality Control Board. 2018. Laguna de Santa Rosa-Hydrologic Sub-areas 114.21, 114.22, 114.23. https://www.waterboards.ca.gov/northcoast/water_issues/programs/watershed_info/russian_river/laguna_de_santa_rosa/

[9] The Freshwater Trust. 2015. *City of Santa Rosa Nutrient Offset Program instream action plan development: Draft crediting methodology*. http://santa-rosa.granicus.com/MetaViewer.php?clip_id=671&meta_id=59843

2.2.1 Stream Restoration Activities with Quantifiable Nutrient Load Reductions

The draft crediting methodology for the Laguna de Santa Rosa addresses crediting for three stream restoration activities: increasing lateral connectivity, legacy nutrient removal, and reducing stream bank erosion. The draft quantification and crediting methodologies are described as follows.

2.2.1.1 Nutrient Load Reductions through Increased Lateral Connectivity

The draft stream restoration crediting methodology defines lateral connectivity as the periodic inundation of floodplains during high-flow events. Associated stream restoration activities that increase lateral connectivity would include activities that increase cross-sectional and longitudinal complexity. The crediting approach is adapted from Protocol 3 of the Chesapeake Bay Regional Water Quality Trading Program. This approach compares the current baseline frequency and volume of overbank flows to the frequency and volume after restoration. The quantification approach would require hydrologic and hydraulic modeling to calculate the volume of water in contact with floodplains under varying runoff conditions and apply estimated nutrient removal rates. The Chesapeake Bay Protocol 3 utilizes the following annual reduction efficiencies from Jordan (2007):[10]

- Total nitrogen: 20% load reduction
- Total phosphorus: 30% load reduction
- Total suspended solids: 20% load reduction

2.2.1.2 Legacy Nutrient Removal

For the City of Santa Rosa, restoration projects for the removal of legacy nutrients, sediment, and organic material were explored as a means of reducing the invasive aquatic macrophyte, *Ludwigia* and its habitat. The crediting approach taken by the City of Santa Rosa for the removal of legacy sediment is to quantify either: 1) the reduction in internal phosphorus loading, or 2) reductions in nutrient loads to the system. Calculations for determining internal phosphorus loading reductions from sediment removal projects are based on equations derived from the QUAL2K and WASP models.[11,12] Note that phosphorus crediting based on calculations of internal phosphorus loading reductions will be a conservative estimate of water quality improvement as additional benefits may result from the reduction of nutrient loads downstream of the restoration project. The quantification method for nutrient loads removed from the system would require sediment and nutrient sampling and analysis to determine the mass of nutrients removed with the sediment.

2.2.1.3 Nutrient Load Reductions through Reduced Stream Bank Erosion

Stream restoration activities that are considered in this nutrient offset program to reduce stream bank erosion include stabilizing stream banks and preventing channel widening resulting in sediment loading. The quantification approach was adapted from Protocol 1 of the Chesapeake Bay Regional Water Quality Trading Program which includes two methods of calculating bank erosion rates: 1) monitoring physical changes in streambanks, and 2) estimating stream bank erosion using the BANCS method. The Chesapeake Bay regional Water Quality Trading Program's Protocol 1 assumes a conservative 50%

[10] Jordan, T. 2007. *Wetland restoration and creation best management practice (agricultural)*. Definition of nutrient and sediment reduction efficiencies for use in calibration of the Phase 5.0 Chesapeake Bay Program Watershed Model. Edgewater, MD: Smithsonian Environmental Research Center.
[11] Tufts University Department of Civil & Environmental Engineering. 2015. QUAL2K. http://www.qual2k.com/
[12] US EPA. 2018. Water Quality Analysis Simulation Program (WASP). https://www.epa.gov/ceam/water-quality-analysis-simulation-program-wasp

effectiveness of erosion reduction. The Santa Rosa Nutrient Offset Program draft crediting methodology adapted this protocol to allow monitoring to be used to demonstrate higher efficiency rates, which can be applied to the project to generate more credits.

2.2.2 Stream Restoration Activities without Quantifiable Nutrient Load Reductions

The draft crediting methodology acknowledges that nutrient load reductions associated with some proposed stream restoration projects cannot currently be adequately estimated. The Freshwater Trust and City of Santa Rosa's approach to addressing such restoration activities is to credit only stream restoration project elements that have nutrient load reduction estimates as part of their methodologies, and acknowledge that this likely represents a lower bound of instream nutrient reduction benefits.

2.3 WE&RF Stream Restoration as a BMP: Crediting Guidance

The Water Environment & Reuse Foundation (WE&RF) 2016 report, *Stream Restoration as a BMP: Crediting Guidance,* establishes a framework for crediting nutrient- and sediment-related benefits from stream restoration activities.[13] The report provides the technical considerations for which a suite of stream restoration practices are well-suited for nutrient crediting, crediting methods, data requirements, and considerations for longevity, uncertainty, and regional geomorphologic differences. The WE&RF Stream Restoration Crediting Guidance takes into account relevant scientific literature when evaluating the benefits of stream restoration practices (including considerations and feedback from Santa Rosa and the Chesapeake Bay States) and provides guidance for nutrient crediting. The scientific basis supporting conclusions about which practices and nutrients (i.e., nitrogen or phosphorus) are suitable for nutrient crediting is presented in the guidance document and will not be summarized here.

2.3.1 Stream Restoration Activities with Quantifiable Nutrient Load Reductions

The WE&RF Crediting Guidance recommends that stream restoration and enhancement activities for nutrient crediting include bed and bank stabilization, riparian buffers, instream enhancement, and floodplain restoration. An overview of these activities, along with several important considerations for their implementation was provided as Table 3-1 in the Guidance. A description of each is provided below. Note that although instream enhancement was found to be suitable for nitrogen crediting, it was not found to be suitable for phosphorus crediting.

2.3.1.1 Bank and Bed Stabilization

The general quantification approach recommended in the guidance is derived from Schueler and Stack's approach utilizing bank erosion rates to be converted to sediment loads and associated phosphorus (and potential nitrogen) loads.[14]

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[13] Bledsoe et al. 2016. *Final report: Stream restoration as a BMP: Crediting guidance*. WERF1T13. Alexandria, VA: Water Environment & Reuse Foundation. https://www.werf.org/a/ka/Search/ResearchProfile.aspx?ReportId=WERF1T13

[14] Schueler, T. and B. Stack. 2013. *Recommendations of the Expert Panel to define removal rates for individual stream restoration projects*. Ellicott City, MD: Chesapeake Stormwater Network and Center for Watershed Protection. http://chesapeakestormwater.net/wp-content/uploads/dlm_uploads/2013/10/stream-restoration-short-version.pdf

2.3.1.2 Riparian Buffers

Quantification of riparian buffer benefits for sediment phosphorus removal focuses on sediment and particulate phosphorus retention during overland flow. This approach would require a known buffer width and slope, inflowing sediment load, and the sediment-phosphorus concentration. The incoming sediment load in surface runoff can be estimated based on long-term monitoring, back-calculated from sediment accumulation rates, or appropriate models such as the Revised Universal Soil Loss Equation (RUSLE), Soil and Water Assessment Tool (SWAT), or the Water Erosion Prediction Project (WEPP). Direct monitoring of sediment phosphorus concentration is considered ideal, but representative values based on adjacent land use and soil type can be utilized.

2.3.1.3 Instream Enhancement (Nitrogen Only)

Instream enhancement was not found to be suitable for phosphorus crediting by the guidance; little to no sediment removal is expected since the instream enhancement restoration techniques impact biogeochemical processes. The guidance does suggest two approaches for crediting nitrogen based on denitrification by estimating the hyporheic exchange between the floodplain and stream channel.

2.3.1.4 Floodplain Reconnection

Quantification of phosphorus loading from floodplain reconnection activities requires estimates of average instream water quality concentrations immediately upstream of the floodplain reconnection project (preferably at the flow rates or state at which the stream accesses the floodplain), stage-storage curves for the restored floodplain area, flow-stage rating curves for the associated stream segment, flow-duration curves, and estimated phosphorus concentrations during shallow flooding events.

2.3.2 Stream Restoration Activities without Quantifiable Nutrient Load Reductions

The WE&RF Crediting Guidance describes some stream restoration activities that are considered not suitable for nutrient crediting. These included dam removal, channel reconfiguration, and actions taken in the watershed outside of the stream corridor to mitigate damaging effects of land use or other disturbances [e.g., green infrastructure, agricultural best management practices (BMPs)]. The WE&RF Crediting Guidance does not recommend crediting nutrient reduction for dam removal, citing concerns over the potential for mobilization of stored material and transport to downstream waterbodies. The Guidance also found that there was little empirical data to support the idea that channel reconfiguration would provide consistent reductions in downstream sediment delivery, balancing changes in sediment capacity/supply and the need to prevent channel erosion in the restored reach. Additionally, the Guidance described quantifying the pollutant removal benefits of channel reconfiguration alone as difficult since channel reconfigurations are often completed in conjunction with other stream restoration techniques. Although the Guidance acknowledges the potential pollutant reduction benefits of actions taken in the watershed outside the stream corridor, the Guidance is primarily concerned with more direct stream restoration actions. The Guidance does state that beneficial watershed actions could be used as a consideration for reducing the uncertainty factors applied to other stream restoration activities.

2.4 Stream Restoration Nutrient Credit Policies in Other Watersheds

For other existing water quality trading programs that focus on nutrient reduction, policies for stream restoration activities have generally been addressed only in the context of crediting the conversion of agricultural land to some form of riparian buffer. For example, conversion of agricultural land to a riparian buffer is a recognized non-point source (NPS) BMP in the Ohio River Basin Trading Pilot and in

Maryland's Draft Trading and Offset Policy and Guidance Manual for NPS crediting.[15,16] In Virginia's Chesapeake Bay Watershed Nutrient Credit Exchange Program, implementing a riparian buffer is a programmatic baseline requirement for generating NPS credits from agricultural lands and does not count towards nutrient crediting.[17] Existing policies in other watersheds that address other stream restoration activities such as channel modification typically address crediting for wetland mitigation. One such example is the Vermont State Wetland Program.[18]

3.0 POTENTIAL DUPAGE RIVER-SALT CREEK STREAM RESTORATION CREDITING FRAMEWORK

The DRSCW seeks to identify and address priority ecosystem stressors and their adverse impact in the Illinois DuPage River and Salt Creek watersheds.[19] To help achieve this goal, the DRSCW has developed a science-based project Identification and Prioritization System (IPS) to estimate the instream aquatic habitat and ecological benefits from a range of stream restoration project alternatives. Although phosphorus load reduction may represent a contributing factor in reducing stressors to aquatic communities in these watersheds, the reduction of phosphorus is generally an ancillary benefit and not the primary stressor identified by the IPS. Yet the implementation of IPS and resulting restoration projects have yielded considerable ecological benefits for streams in which those projects have occurred. In the case of the DuPage River and Salt Creek watersheds, the DRSCW may have an opportunity to use the improvements in aquatic community habitat quality projected for specific stream restoration activities to reduce uncertainty of instream benefits and increase the breadth of phosphorus reduction creditable activities. The following section describes: 1) the Qualitative Habitat Evaluation Index (QHEI) scores as an indicator of habitat and aquatic ecosystem quality, 2) an approach for establishing the basis for a crediting framework that utilizes the QHEI, 3) potential application of the crediting framework to the DRSCW's planned stream restoration projects, and 4) an approach to broaden potential ecosystem service-related credits beyond QHEI improvements alone.

3.1 Summary of the Qualitative Habitat Evaluation Index

To understand the instream benefits of stream restoration projects, the DRSCW is currently utilizing the Qualitative Habitat Evaluation Index (QHEI) as a metric and indicator of instream health. The QHEI is a "physical habitat index designed to provide an empirical, quantified evaluation of the lotic macrohabitat characteristics that are important to fish assemblages."[20] The index was developed by Ohio EPA in 1989,

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[15] Electric Power Research Institute. 2018. Ohio River Basin Trading Project. http://wqt.epri.com/overview.html

[16] Maryland Department of the Environment. 2016. *Final draft: Maryland trading and offset policy and guidance manual Chesapeake Bay*. https://mde.maryland.gov/programs/Water/Documents/WQTAC/Final_Draft_Tradiing_Manual_91916.pdf

[17] Virginia Department of Environmental Quality. 2011. *Nutrient trading in the Chesapeake Bay Watershed of Virginia*.

[18] Agency of Natural Resources Department of Environmental Conservation. Vermont Wetland Rules. http://dec.vermont.gov/watershed/wetlands/jurisdictional/rules

[19] DRSCW. 2016. *DuPage River Salt Creek Workgroup (DRSCW) implementation plan*. Naperville, IL: DuPage River Salt Creek Workgroup. http://drscw.org/wp/wp-content/uploads/2015/03/DRSCW-Implementation-Plan-05-22-2014-Final.pdf

[20] DuPage-Salt Creek Work Group, Lower DuPage Watershed Coalition, and Midwest Biodiversity Institute. 2012. Quality Assurance Project Plan: Biological and Habitat Assessment of the DuPage River and Salt Creek Watersheds. *Revision 3.0*.

with guidelines for the index updated in 2006, and has been adapted for use throughout the U.S.[21] The QHEI was developed to address constraints associated with conducting large-scale monitoring programs, providing a rapid assessment tool that yields meaningful information about stream health and takes advantage of the knowledge and insights of experienced field biologists. The QHEI method evaluates the following variables:

- Types and quality of substrate
- Types and amounts of instream cover
- Various characteristics of channel morphology
- Riparian zone extent and quality
- Bank stability and conditions
- Pool-run-riffle quality and characteristics
- Slope or gradient

To ensure that assessors are able to visually interpret these variables with sufficient consistency, annual crew leader training in QHEI use is required.

3.2 Crediting Approach Using QHEI

Similar to the crediting programs described in the previous section of this memorandum, some types of restoration projects considered by the DRSCW have clearly quantifiable nutrient load reduction benefits, while others do not (e.g., dam removal and/or modification). In addition, a number of the DRSCW's planned stream restoration projects also may have phosphorus reduction potential but no available methodologies for adequately quantifying the phosphorus reductions associated with all elements of the stream restoration project. All IPS-identified projects do, however, have an associated estimated increase in the QHEI score, and improved QHEI has been shown to be associated with improved aquatic ecosystem quality (Rankin et al. 1999). Gazendam et al. (2011) used QHEI to aid planning and design of stream restoration projects in Ontario. Miltner and McLaughlin (2018) found that QHEI provided a sufficient basis for screening the likely condition of macroinvertebrates in headwater streams in Ohio to help establish management priorities for headwater streams. In addition, Miltner and McLaughlin (2018) and McLaughlin and Reckhow (2017) showed that statistical modeling using a probability-based approach could provide a useful method to quantify the ecosystem improvements that may be expected from increases in QHEI.

Thus, DRSCW could consider developing a crediting approach that combines existing nutrient reduction crediting methodologies (where appropriate) with additional crediting opportunities derived from the increased confidence that stream restoration will result in desired ecosystem benefits. This combined approach would broaden the range of available credits derived from stream restoration projects and increase the likelihood of achieving improved ecosystem quality compared with crediting programs that focus on nutrient reductions alone. Important aspects of the approach are discussed in the following sections. A more detailed overview of the tasks that may be required to develop the scientific information needed to support such an approach in the DuPage/Salt Creek watershed is addressed in Section 4.0 of this Technical Memorandum.

[21] State of Ohio Environmental Protection Agency. 2006. *Methods for assessing habitat in flowing waters: Using the Qualitative Habitat Evaluation Index (QHEI)*. Groveport, OH: Ohio Environmental Protection Agency, Division of Surface Water. http://www.epa.state.oh.us/portals/35/documents/qheimanualjune2006.pdf

3.2.1 Using QHEI Score Improvements and Corresponding Ecosystem Benefits to Reduce the Trading Ratio for Phosphorus Loads

For stream restoration projects with more certainty surrounding the methodology in estimating its overall phosphorus load reduction, the associated increase in the QHEI score could be used to decrease the trading ratio for stream restoration project equivalency to POTW discharges. This would encourage projects that provide greater certainty of both phosphorus load reductions and instream ecological benefits. The reduced trade ratio would apply to the phosphorus load reductions that can be calculated for the project, whether that is the entire project or associated only with select project elements. Illustrations of this crediting approach used with the DRSCW's planned stream restoration projects are further described in Scenario 1 and 2 of Section 3.3.

3.2.2 Using QHEI/Phosphorus Relationships to Translate Benefits from QHEI Improvements into Equivalent Phosphorus Load Reduction Benefits

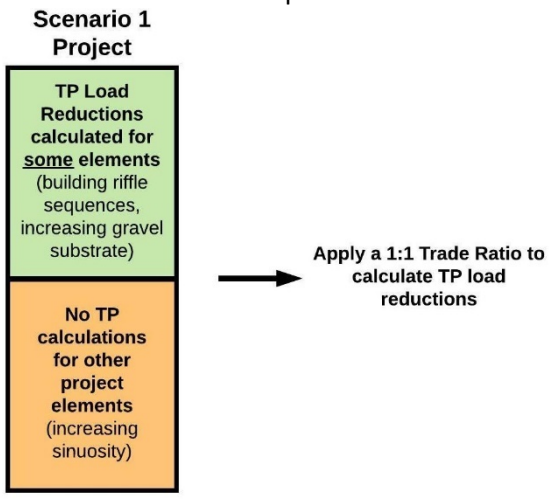
For stream restoration projects with less certainty surrounding the methodology for estimating overall phosphorus load reduction, relationships between QHEI and total phosphorus may exist that can provide a translator between QHEI reductions and total phosphorus reductions. The resulting QHEI/Total Phosphorus Equivalency Factor could be applied to translate the QHEI score increase from a stream restoration project to an equivalent phosphorus load reduction. An appropriate uncertainty trading ratio can be applied to the equivalent phosphorus load to calculate phosphorus reduction credits. An illustration of this crediting approach used with the DRSCW's planned stream restoration is further described in Scenario 3 of Section 3.3.

3.3 Application of Crediting Framework to DRSCW Stream Restoration Projects

Although the scientific literature and efforts surrounding the relationship between stream restoration activities and nutrient load reduction is growing, many projects will invariably have some stream restoration activities that are not readily quantifiable for phosphorus load reductions. Described below are three scenarios for crediting that the DRSCW may encounter when seeking nutrient reduction credits and how the potential crediting framework could address each scenario.

3.3.1 Scenario 1: Partially Quantifiable Phosphorus Load Reduction from Stream Restoration Project

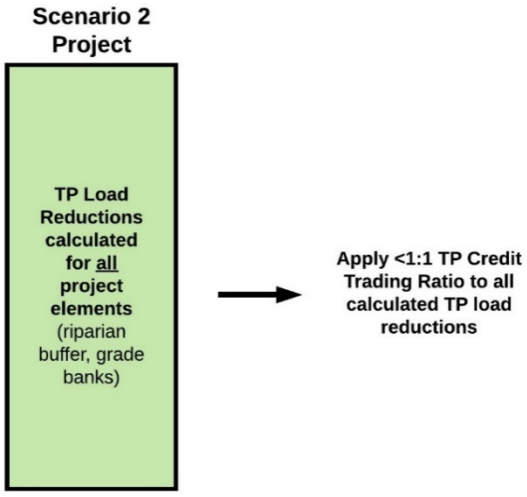
In Scenario 1, a stream restoration project has a projected QHEI score increase and only some stream restoration elements are readily quantifiable for phosphorus load reduction. An example of this is Project WB01 identified by the IPS tool consisting of building riffle sequences, increasing presence of gravel substrates, and increasing channel sinuosity. In this scenario, phosphorus load reduction from constructing riffle sequences and increasing gravel substrate can be estimated. However, the phosphorus load reduction from increased channel sinuosity can be challenging to estimate with currently available scientific literature. Although phosphorus load reductions from stream restoration activities such as increased channel sinuosity may not be readily quantifiable for crediting, a trade ratio such as 1:1 could be applied to the estimated phosphorus load reductions attributed to the activities that are readily quantifiable (riparian planting). This trade ratio could be



applied due to increased certainty of instream benefits associated with the estimated QHEI score increase associated with the project. It is also worth noting that it may be possible to utilize a crediting approach where different trade ratios can be applied to the quantifiable and non-quantifiable stream restoration activities.

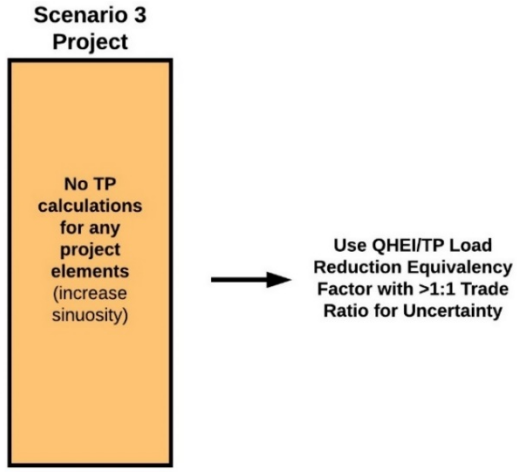
3.3.2 Scenario 2: Fully Quantifiable Phosphorus Load Reduction from Stream Restoration Project

In Scenario 2, a stream restoration project has a projected QHEI score increase and all stream restoration activities are readily quantifiable for phosphorus load reductions. An example of this is Project WB37 identified by the IPS tool consisting of establish riparian buffers and grading banks. Phosphorus load reductions can be estimated for these project elements by adapting existing crediting protocols and methodologies. In such a scenario, the project could have a trade ratio less than 1:1 applied to all calculated phosphorus load reductions associated with the project. Like in Scenario 1, this trade ratio could be applied due to increased certainty of instream benefits associated with the projected QHEI score increase associated with the project.



3.3.3 Scenario 3: No Quantifiable Phosphorus Load Reduction from Stream Restoration Project

For stream restoration projects with less certainty surrounding the methodology used to estimate its overall phosphorus load reduction, it may be possible to develop a QHEI/Total Phosphorus Load Equivalency Factor that can translate the QHEI score increase to an equivalent phosphorus load reduction benefit. This scenario would require that a relationship between QHEI and TP load reduction be developed using relevant field data, modeling, and/or literature. An appropriate uncertainty trading ratio can be applied to the equivalent phosphorus load to calculate phosphorus reduction credits. For example, Project EB07 identified by the IPS tool consists of activities that increase sinuosity. Phosphorus load reductions from increased sinuosity are not readily quantifiable with existing protocols and methodologies. However, the project is expected to increase the QHEI score and generate instream benefits, and phosphorus loads may be reduced through reduced sediment erosion. This may provide a basis to credit the ecological benefit of QHEI improvement in terms of an equivalent phosphorus load reduction. A trade ratio greater than 1:1 can then be applied to account for uncertainty.



3.3.4 Potential Scenarios for Future DRSCW Projects

To understand nutrient crediting scenarios to which DRSCW's planned stream restoration projects may belong in this potential stream restoration crediting framework, K&A reviewed the 26 projects identified by the IPS tool. K&A identified whether project elements of these stream restoration activities were

readily quantifiable by the crediting protocols and methodologies used by other watersheds described in Section 2. Table 1 summarizes how the 26 projects are distributed across the three scenarios. Table 2 provides details on the IPS projects in relation to quantifiable elements by the respective nutrient crediting scenario. Note that none of the 26 projects are listed under Special Condition #2 in NPDES permits for POTWs in the DRSCW.

Table 1. Distribution of IPS Projects by Nutrient Crediting Scenario

Nutrient Crediting Scenario	Description	Total # of Projects	# of Projects in East Branch	# of Projects in West Branch
Scenario 1	Some project element stream restoration activities are readily quantifiable	15	9	6
Scenario 2	All project element stream restoration activities are readily quantifiable	10	3	7
Scenario 3	No project element stream restoration activities are readily quantifiable	1	1	0

Table 2. Assessment of IPS Project Elements for Nutrient Crediting Quantification and Potential Nutrient Crediting Scenario

Project Name	Waterbody Name	Project Element Description	Readily Quantifiable for TP* (Y/N)	Schedule		Potential Nutrient Crediting Scenario
				2023 to 2032	2033 to 2042	
EB06	Rott Creek	Establish riparian buffer	Y		X	1
		Increase channel sinuosity	N			
EB07	St. Joseph Creek	Increase channel sinuosity	N	X		3
EB12	East Branch DuPage River	Build 2 pool riffle sequences	Y		X	1
		Increase presence of gravel substrates	Y			

Project Name	Waterbody Name	Project Element Description	Readily Quantifiable for TP* (Y/N)	Schedule		Potential Nutrient Crediting Scenario
				2023 to 2032	2033 to 2042	
		Increase channel sinuosity	N			
		Grade banks	Y			
EB19	East Branch DuPage River	Build 2 riffles	Y		X	1
		Increase presence of gravel substrates	Y			
		Increase channel sinuosity	N			
		Grade banks	Y			
EB21	East Branch DuPage River	Build 2 riffle sequences	Y		X	1
		Increase presence of gravel substrates	Y			
		Increase channel sinuosity	N			
		Grade banks	Y			
		Increase riparian buffer	Y			
EB23	East Branch DuPage River	Increase presence of gravel substrates**	Y		X	2
EB26	East Branch DuPage River	Build 2 riffle sequences	Y		X	1
		Increase presence of gravel substrates	Y			
		Increase channel sinuosity	N			
		Grade banks	Y			
		Increase riparian buffer	Y			

Project Name	Waterbody Name	Project Element Description	Readily Quantifiable for TP* (Y/N)	Schedule		Potential Nutrient Crediting Scenario
				2023 to 2032	2033 to 2042	
EB30	East Branch DuPage River	Increase presence of gravel substrate	Y		X	1
		Increase channel sinuosity	N			
		Grade banks	Y			
EB31	East Branch DuPage River	Build 2 riffles	Y	X		1
		Establish riparian buffer	Y			
		Increase channel sinuosity	N			
		Grade banks	Y			
EB32	East Branch DuPage River	Increase channel sinuosity	N	X		1
		Grade banks	Y			
EB34	East Branch DuPage River	Build 2 riffles	Y		X	2
		Increase presence of gravel substrates	Y			
		Grade banks	Y			
EB35	East Branch DuPage River	Increase gravel substrate	Y		X	1
		Increase channel sinuosity	N			
		Grade banks	Y			
EB36	East Branch DuPage River	Build 2 riffle sequences	Y		X	2
		Increase presence of gravel substrates	Y			
		Grade banks	Y			

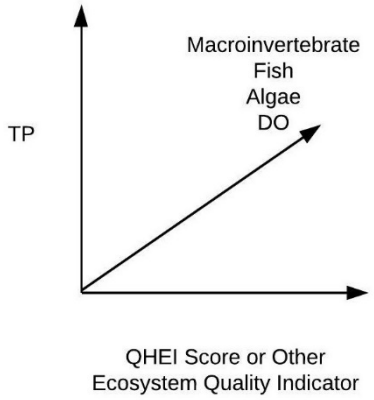
Project Name	Waterbody Name	Project Element Description	Readily Quantifiable for TP* (Y/N)	Schedule		Potential Nutrient Crediting Scenario
				2023 to 2032	2033 to 2042	
		Increase riparian buffer	Y			
WB01	Kress Creek	Build 2 riffle sequences	Y		X	1
		Increase presence of gravel substrates	Y			
		Increase channel sinuosity	N			
		Grade banks	Y			
		Increase riparian buffer	Y			
WB12	W. Branch DuPage R.	Build 2 pool riffle sequences	Y	X		1
		Increase presence of gravel substrates	Y			
		Increase channel sinuosity	N			
		Grade banks	Y			
WB19	Klein Creek	Build 2 pool riffle sequences	Y	X		1
		Increase presence of gravel substrates	Y			
		Increase channel sinuosity	N			
		Grade banks	Y			
WB20	W. Branch DuPage R.	Build 2 riffles	Y		X	2
		Increase presence of gravel substrates	Y			
		Grade banks	Y			

Project Name	Waterbody Name	Project Element Description	Readily Quantifiable for TP* (Y/N)	Schedule		Potential Nutrient Crediting Scenario
				2023 to 2032	2033 to 2042	
WB27	W. Branch DuPage R.	Increase presence of gravel substrates	Y		X	2
WB28	W. Branch DuPage R.	Increase presence of gravel substrates	Y		X	2
WB33	W. Branch DuPage R.	Build 2 riffles	Y	X		1
		Increase channel sinuosity	N			
		Grade banks	Y			
WB34	W. Branch DuPage R.	Build 2 pool	Y	X		2
		Build riffle sequences	Y			
		Increase presence of gravel substrates	Y			
		Grade banks	Y			
WB35	W. Branch DuPage R.	Increase gravel substrate	Y	X		1
		Increase channel sinuosity	N			
		Grade banks	Y			
		Create 2 pools at site	Y			
WB36	W. Branch DuPage R.	Dam Modification for fish passage.	N	X		1
		Establish riparian planting on exposed sediment	Y			
WB37	W. Branch DuPage R.	Establish riparian buffer	Y	X		2
		Grade banks	Y			

Project Name	Waterbody Name	Project Element Description	Readily Quantifiable for TP* (Y/N)	Schedule		Potential Nutrient Crediting Scenario
				2023 to 2032	2033 to 2042	
WB38	W. Branch DuPage R.	Build 2 riffles	Y		X	2
		Increase presence of gravel substrates	Y			
		Grade banks	Y			
WB40	W. Branch DuPage R.	Build 2 riffles	Y		X	2
		Increase presence of gravel substrates	Y			

*Source: Bledsoe et al. 2016. *Final report: Stream restoration as a BMP: Crediting guidance*. WERF1T13. Alexandria, VA: Water Environment & Reuse Foundation.
https://www.werf.org/a/ka/Search/ResearchProfile.aspx?ReportId=WERF1T13
**Assumed to be the intended project element (Data entry error with original source)

In addition to the above scenarios utilizing QHEI, an analysis of available field data could yield a more complete understanding of relationships in the DuPage River-Salt Creek ecosystem that affect stream conditions. This additional understanding could further support improved trading ratios in both Scenario 1 and 3 described above. For example, site-specific and/or relevant regional data, supported with scientific literature, may yield sufficient relationships between QHEI, total phosphorus (concentration or load reduction), and other stream ecosystem response measures. Other measures might include dissolved oxygen concentrations, chlorophyll concentrations (or another indicator of primary productivity), macroinvertebrate index of biotic integrity (IBI), and/or fish IBI. It may then be possible to more fully quantify stream ecosystem improvements and/or develop equivalency factors that relate phosphorus load reductions with other ecosystem improvement indicators in addition to QHEI, leading to improved trading ratios.



3.4 Benefits of Stream Restoration Crediting Approach

This approach to a crediting framework would provide the DRSCW various benefits that would assist the Workgroup in making strategic investments to achieve fully supporting aquatic communities in the DuPage River. This opportunity is described as follows.

3.4.1 Provides Flexibility to Consider a Variety of Stream Restoration Projects

This crediting approach provides a way for stream restoration projects to be credited for phosphorus reductions even when methodologies for crediting certain stream restoration activities are uncertain or absent. This is particularly important in the context of the DRSCW's planned stream restoration projects as 16 of the 26 projects scheduled through 2042 have some or all project elements that would

otherwise receive no phosphorus reduction crediting using the available crediting methodologies reviewed in Section 2.

3.4.2 Incentivizes Stream Restoration Projects with Instream Benefits

A potential conflict that is presented in other nutrient offset or nutrient trading programs is the opportunity for dischargers to prioritize projects based on their ability to generate the greatest phosphorus reductions instead of the ability to address the greatest primary stressors. However, since this approach pairs decreases in a project's phosphorus trading ratio with increases in a project's QHEI score, this crediting approach reduces the likelihood of this conflict. This might be attributable to dischargers being incentivized to implement projects that provide both higher credit generation and instream ecological benefits.

3.4.3 Drives Future Innovation, Research, and Refinement

A unique benefit of this crediting approach is that it incentivizes dischargers to continually refine the relationship between stream restoration activities and nutrient load reductions to reach a more favorable trade ratio. This approach encourages dischargers to innovate and seek quantification of all potential phosphorus reduction credits associated with a stream restoration project through new research, monitoring, and assessment.

4.0 SUGGESTED NEXT STEPS

Establishing the scientific basis needed to inform a stream restoration crediting approach based on QHEI and/or other important stream quality indicators requires a demonstration of one or both of the following:

a) Improving stream habitat variables within a stream reach is likely to result in reduced phosphorus loads from that reach. This could yield a QHEI/TP equivalency factor so that a reduction in phosphorus load can be estimated for every unit of QHEI increase expected from stream restoration.
b) Improving stream habitat variables within a stream reach is likely to result in improved ecological indicators (e.g., macroinvertebrate or fish index of biotic integrity, dissolved oxygen). This could yield a quantifiable stream ecosystem improvement in one or more ecosystem quality indicator variables for every unit of QHEI or other habitat quality variable (e.g., QHEI sub-components).

Feedback on the potential Stream Restoration Crediting Framework is needed from the DRSCW, Illinois EPA, and others to determine the potential for data to support the approach and the viability of this approach in a regulatory environment. If the proposed approach is determined to be potentially viable, next steps would focus on identifying and/or developing quantitative relationships between stream habitat variables, phosphorus reduction, and/or stream ecosystem quality indicators, and describing their use as a basis for a stream restoration crediting approach and selecting trade ratios for Scenarios 1 and 3 described above. Current and past work by Midwest Biodiversity Institute (MBI) and others may provide much of the information needed.

To further develop the stream restoration crediting approach, the Project Team suggests creating a roadmap that identifies the needed data and analyses and, where relevant, entities that are in the process of conducting activities that can inform this approach. For example, the Project Team envisions that the roadmap would include a literature review and analysis of pertinent stream water quality and biological data to establish appropriate lines of evidence in support of the quantitative relationships needed to generate equivalent phosphorus credits. Of particular interest are relationships that may be used to develop phosphorus reduction equivalency factors and quantify other beneficial ecosystem responses associated with stream restoration and QHEI improvements.

In addition, evaluation of other relevant existing data sets could increase the available lines of evidence to support this approach. For example, as part of the Illinois Nutrient Reduction Strategy, data collected by the Illinois Environmental Protection Agency from across the state were analyzed using a number of statistical approaches to support efforts of the Illinois Nutrient Science Advisory Committee (NSAC). The results of these analyses from watersheds in northeastern Illinois could be reviewed to identify potentially useful relationships if such data were publicly accessible.

Also, DRSCW could investigate the use of probability-based Bayesian Network (BN) models to quantify and communicate the nature and strength of relationships among multiple stream ecosystem indicator variables (e.g., QHEI, total phosphorus, chlorophyll *a*, dissolved oxygen, macroinvertebrate and fish IBIs). BN models have been used to provide "forecasts" indicating the likelihood of achieving specific desired numeric ecosystem restoration goals, such as a macroinvertebrate index threshold value. These likelihood estimates could be used directly to generate trade ratios. Note that BN modeling is not anticipated as part of the current scope of work.

5.0 REFERENCES

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APPENDIX A

Table 2. *Planned restoration projects with potential for nutrient offset crediting in the Laguna de Santa Rosa watershed. All cost estimates include construction, design and permitting costs. The cost of credit cycle management, including calculation, verification, registration, and monitoring is not included in these estimates. (This is only a partial, unprioritized list of potential instream projects, not meant to be exhaustive.)*

Potential Project Area	Instream Restoration Actions	General Location	Project Feasibility	Estimated Timeline	Estimated Costs	Credit Calculation Methodology	Data Needs to Determine Nutrient Offset Credits
Potential Project Developer: City of Santa Rosa ***							
Upper Colgan Creek	Constructed riffles, instream meanders, regrade banks, increase canopy	Tributary	Feasible	2020-2030	$5.2 million	5.1 Increased lateral connectivity 5.2 Legacy nutrient removal 5.3 Reduced streambank erosion	Hydraulic model, incoming nutrient & sediment loads. Streambank erosion rates, soil nutrient content.
Lower Colgan Creek Phase 2	Constructed riffles, instream meanders, regrade banks, increase canopy	Tributary	Feasible	2016	$3.5 million	5.1 Increased lateral connectivity 5.2 Legacy nutrient removal 5.3 Reduced streambank erosion	Hydraulic model, incoming nutrient & sediment loads. Streambank erosion rates, soil nutrient content.
Lower Colgan Creek Phase 3	Constructed riffles, instream meanders, regrade banks, increase canopy	Tributary	Feasible	2018	$4.5 million*	5.1 Increased lateral connectivity 5.2 Legacy nutrient removal 5.3 Reduced streambank erosion	Hydraulic model, incoming nutrient & sediment loads. Streambank erosion rates, soil nutrient content.
Roseland Creek Restoration Project	Stream remeander, large wood placements, boulders, constructed riffles, restoring sinuosity	Tributary	Feasible	2020	$10 million	5.1 Increased lateral connectivity 5.2 Legacy nutrient removal 5.3 Reduced streambank erosion	Hydraulic model, incoming nutrient & sediment loads. Streambank erosion rates, soil nutrient content.
Paulin Creek Restoration Project	Instream meander, expand creek cross section width, replace culvert pipe with a bridge	Tributary	Feasible	2018 or later	$6 million	5.1 Increased lateral connectivity 5.2 Legacy nutrient removal 5.3 Reduced streambank erosion	Hydraulic model, incoming nutrient & sediment loads. Streambank erosion rates, soil nutrient content.
Santa Rosa Creek Restoration - Pierson Reach	Riffles, reconnect creek to groundwater	Tributary	Less feasible	2020-2024	$10 million**	5.1 Increased lateral connectivity 5.2 Legacy nutrient removal 5.3 Reduced streambank erosion	Hydraulic model, incoming nutrient & sediment loads. Streambank erosion rates, soil nutrient content.
Potential Project Developer: Sonoma County Water Agency, Laguna de Santa Rosa Foundation ****							
Exclusionary Fencing on the Laguna, South of Occidental Road	Setback fencing installed along Laguna. Develop alternative livestock water source. Stabilize bank and re-vegetate.	Laguna Mainstem	Feasibility conditional on private Landowner consent	2015-2016	$1 million	5.3 Reduced streambank erosion	Streambank erosion rates, soil nutrient content.
Restoration of the Laguna, North of Occidental Road	Channel remeander, *Ludwigia* and sediment removal, re-vegetation	Laguna Mainstem	Feasible. Initial stage, conceptual planning. Requires working with SCWA and CaDFW	2020-2025	$10 million	5.1 Increased lateral connectivity 5.2 Legacy nutrient removal	Hydraulic model, incoming nutrient & sediment loads. Legacy sediment nutrient and organic matter content.

Source: The Freshwater Trust. 2015. *City of Santa Rosa Nutrient Offset Program instream action plan development: Draft crediting methodology*, pp. 18-19. http://santa-rosa.granicus.com/MetaViewer.php?clip_id=671&meta_id=59843