Review of Redside Dace Habitat Corridor Realignments: Morphology, Sedimentology and Habitat Suitability within Aged Natural Corridor Designs

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Outline

- Natural Channel Design, Corridor Re-alignment, and Redside Dace Habitat
- Detailed Observations on Four Realigned Channels/Corridors
  - Habitat/Geomorphological Observations
  - Ecological Summary
- Conclusions
- Lessons Learned

Redside Dace (*Clinostomus elongatus)*

- Status: Endangered, listed in 2009
- Habitat is protected under law by MNRF
- Habitat threats: habitat loss due to urban and agricultural development

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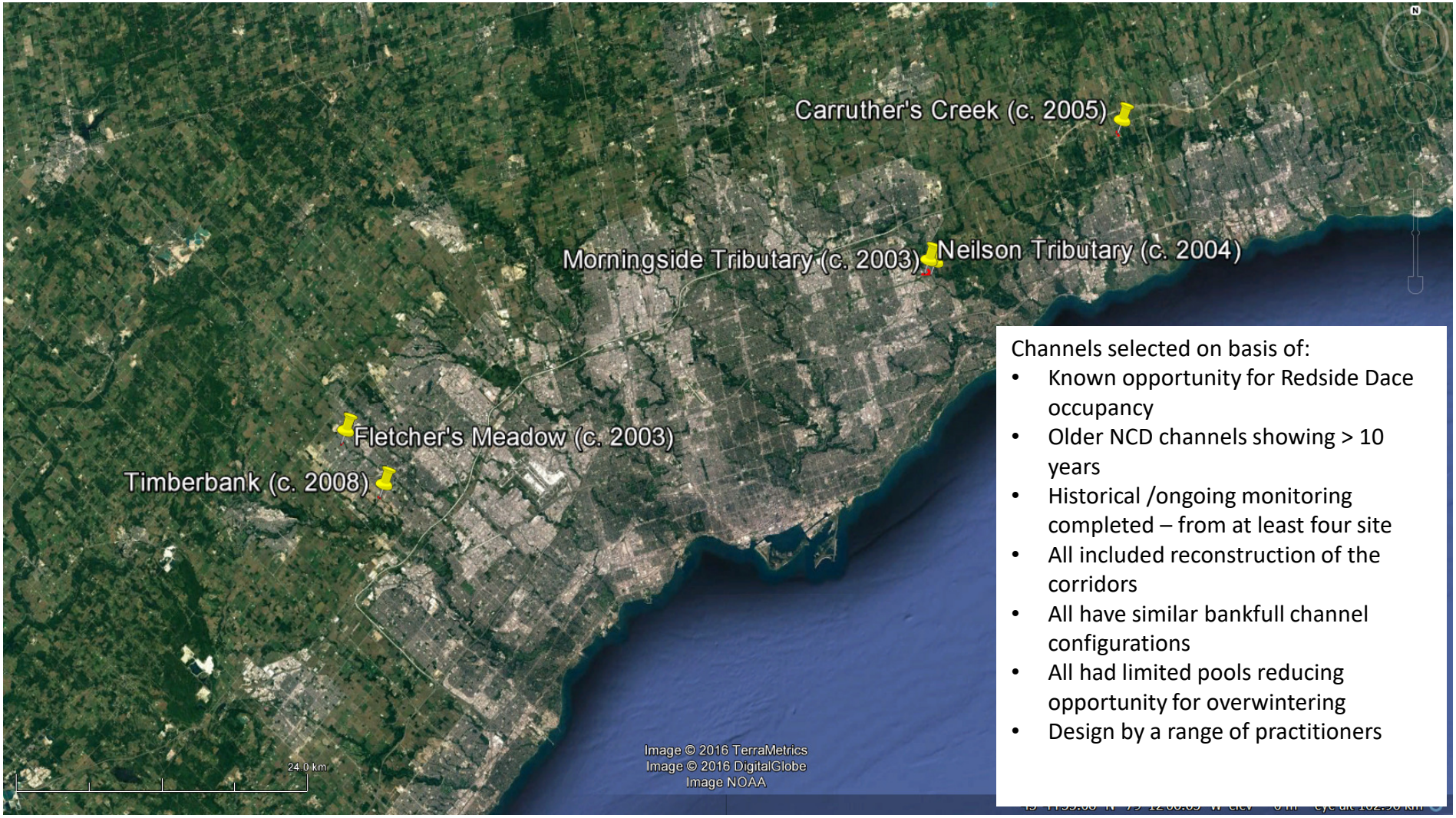
Preferred Habitat Characteristics

- Morphological elements
  - Deep pools (resident habitat / overwinter) and shallow riffles (spawning, oxygenation)
  - Banks: undercut with submerged branches and logs
  - Low velocity zones - near zero
  - Gravels for spawning
- Riparian elements
  - ***Open meadow*** surroundings with overhanging vegetation
  - Enhance infiltration through design elements
  - Remove barriers (e.g., dams, weirs)



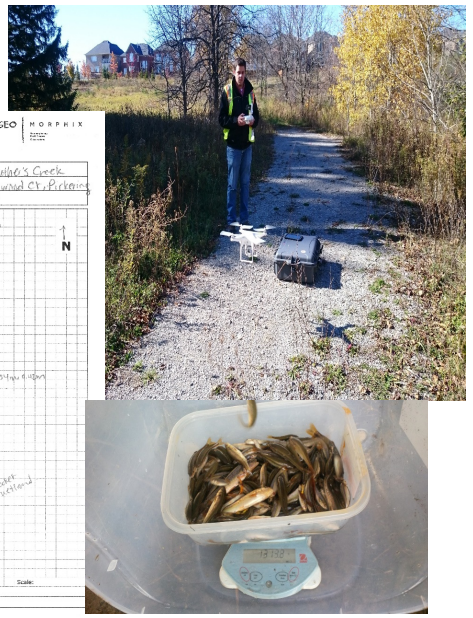
Channels selected on basis of:

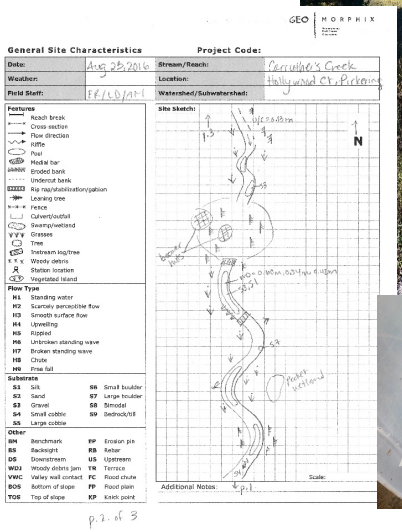
- Known opportunity for Redside Dace occupancy
- Older NCD channels showing > 10 years
- Historical /ongoing monitoring completed – from at least four site
- All included reconstruction of the corridors
- All have similar bankfull channel configurations
- All had limited pools reducing opportunity for overwintering
- Design by a range of practitioners

Why These Corridors?

- Four channels selected on basis of:
  - Known opportunity for Redside Dace occupancy
  - Older NCD channels showing > 10 years of evolution
  - Historical /ongoing monitoring completed – from at least four site – data for comparison
  - All the projects included full reconstruction of the corridors
  - All have similar bankfull channel configurations
  - All had limited deep pools reducing opportunity for overwintering
  - Design by a range of practitioners reducing a myopic review

Overview of Work Completed





General Site Characteristics — Project Code:

Date:	Aug 23/2016	Stream/Reach:	Carruther's Creek
Weather:		Location:	Holly wood Ct, Pickering
Field Staff:	FF/LD/AT	Watershed/Subwatershed:	

Features: Reach break; Cross section; Flow direction; Riffle; Pool; Medial bar; Eroded bank; Undercut bank; Rip rap/stabilization/gabion; Leaning tree; Fence; Culvert/outfall; Swamp/wetland; Grasses; Tree; Instream log/tree; Woody debris; Station location; Vegetated island

Flow Type: H1 Standing water; H2 Scarcely perceptible flow; H3 Smooth surface flow; H4 Upwelling; H5 Rippled; H6 Unbroken standing wave; H7 Broken standing wave; H8 Chute; H9 Free fall

Substrate: S1 Silt; S2 Sand; S3 Gravel; S4 Small cobble; S5 Large cobble; S6 Small boulder; S7 Large boulder; S8 Bimodal; S9 Bedrock/till

Other: BM Benchmark; BS Backsight; DS Downstream; WDJ Woody debris jam; VWC Valley wall contact; BOS Bottom of slope; TOS Top of slope; FP Erosion pin; RB Rebar; US Upstream; TR Terrace; FC Flood chute; FP Flood plain; KP Knick point

Site Sketch: N; Scale:; Additional Notes:

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- Surveys completed:
- Rapid assessments including:
  - sketch maps,
  - channel geometry,
  - velocity, and
  - substrate characteristics
- Sub-reach sketch maps – inventory habitat elements as well as mapping out sedimentology and morphological conditions within watercourse
- Drone Surveys – georeferenced aerial photos of site – review planform and riparian zone
- Late Summer Fish Surveys

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Carruther's Creek, Pickering

General Site Characteristics **Project Code:**

Date:	Aug 25, 2016	**Stream/Reach:**	Carruther's Creek
Weather:		**Location:**	Hollywood Cr, Pickering
Field Staff:	FR/LD/AM	**Watershed/Subwatershed:**	

Features
- Reach break
- Cross-section
- Flow direction
- Riffle
- Pool
- Medial bar
- Eroded bank
- Undercut bank
- Rip rap/stabilization/gabion
- Leaning tree
- Fence
- Culvert/outfall
- Swamp/wetland
- Grasses
- Tree
- Instream log/tree
- Woody debris
- Station location
- Vegetated island

Flow Type

H1	Standing water
H2	Scarcely perceptible flow
H3	Smooth surface flow
H4	Upwelling
H5	Rippled
H6	Unbroken standing wave
H7	Broken standing wave
H8	Chute
H9	Free fall

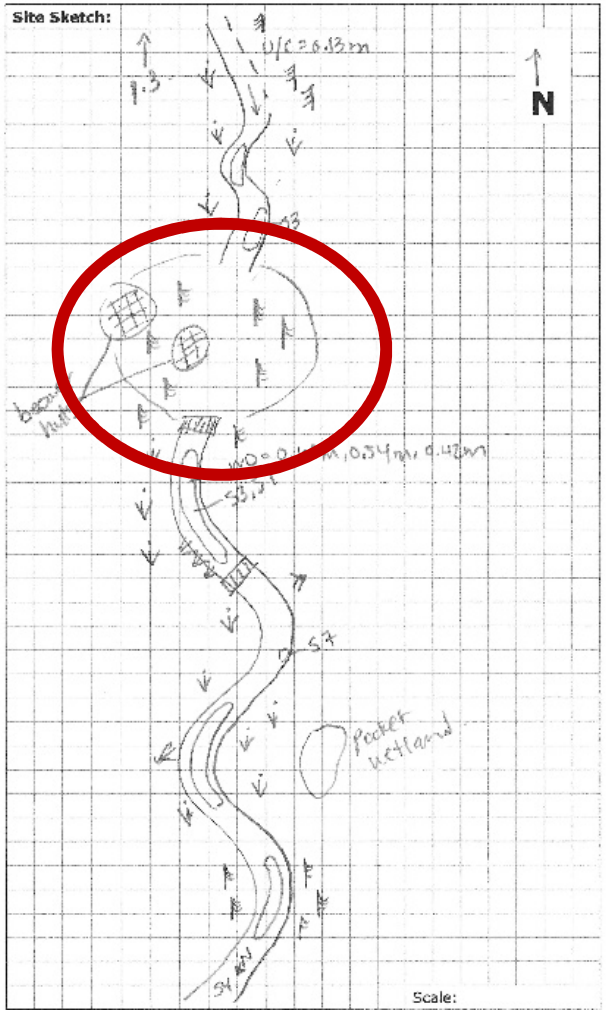
Substrate

S1	Silt	S6	Small boulder
S2	Sand	S7	Large boulder
S3	Gravel	S8	Bimodal
S4	Small cobble	S9	Bedrock/till
S5	Large cobble		

Other

BM	Benchmark	EP	Erosion pin
BS	Backsight	RB	Rebar
DS	Downstream	US	Upstream
WDJ	Woody debris jam	TR	Terrace
VWC	Valley wall contact	FC	Flood chute
BOS	Bottom of slope	FP	Flood plain
TOS	Top of slope	KP	Knick point

Site Sketch:

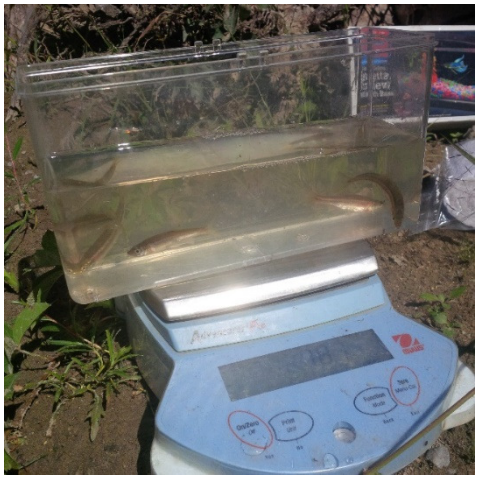


Additional Notes: p.1

Carruther's Creek, Pickering

Range of Water Depths	0.42m-1m
Range of Velocities	Pool
	-0.009 m/s - 0.007 m/s
Undercutting	0.08m - 0.40m
Habitat Features	Rooted emergent
Riffle Substrate	Clay/silt, gravel, cobble, rootlets
Pool Substrate	Clay/silt, sand, rootlets
Bank Substrate	Clay/silt, rootlets
Riparian Vegetation	Major localized gaps, Canopy coverage: 60-79% shading
Large obstructions	6 beaver dams (1 breached)

Carruther's Creek, Pickering



- Electrofishing survey completed on September 15, 2016
- Base flow at approximately 2 lpm at time of survey
- Channel maturing with moderate riparian cover
- No riffles, very shallow slope and deep pools present
- Channel dominated with muck and submergent vegetation
- Riffle/pool sequence upstream of Highway 7
- Watercress present in pools
- Seven species of fish collected
- Seven Redside Dace captured during survey reach

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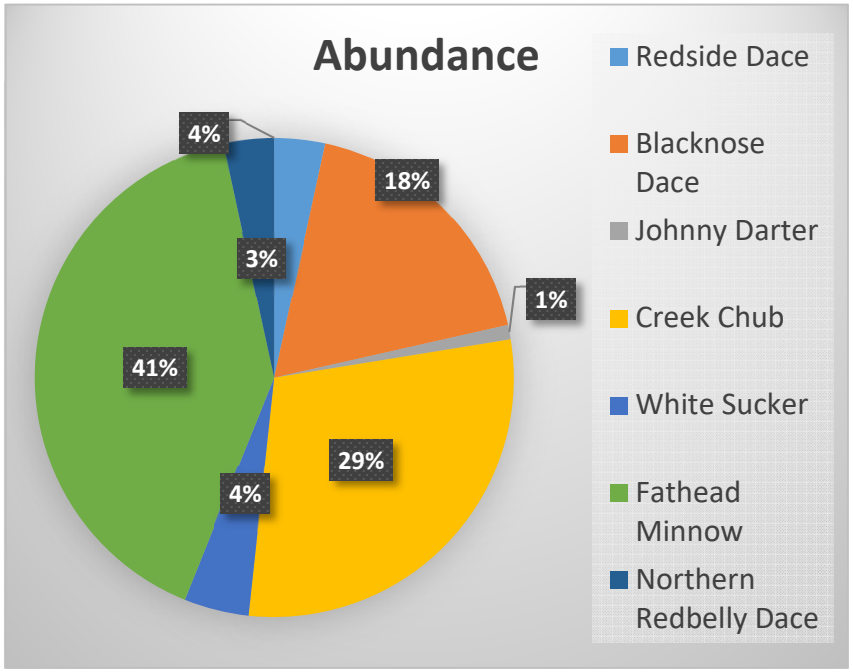
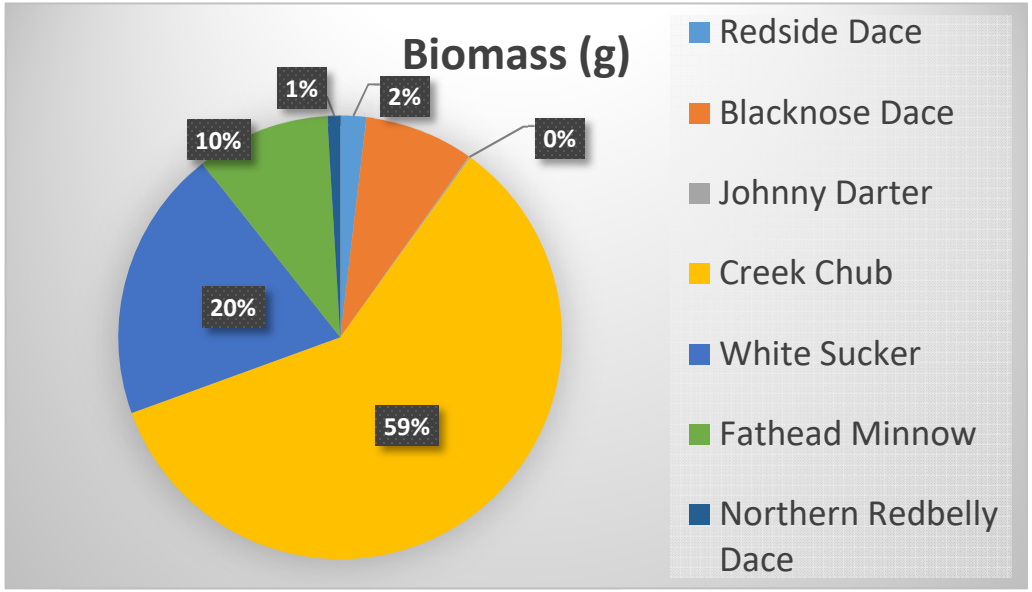
Carruther's Creek, Pickering



- 230 electrofishing seconds
- 30 m reach
- Resident fish community dominated by Creek Chub
- Good pool depth but limited woody cover
- Channel lacks slope and suitable coarse sediment for Redside Dace spawning



Churchville Creek: Timberbank

General Site Characteristics **Project Code:**

Date:	Aug. 29, 2016	**Stream/Reach:**	Churchville Creek, Tr 68b
Weather:	30°C, sunny	**Location:**	Timberbank
Field Staff:	ER/AM	**Watershed/Subwatershed:**	

Features
- Reach break
- Cross-section
- Flow direction
- Riffle
- Pool
- Medial bar
- Eroded bank
- Undercut bank
- Rip rap/stabilization/gabion
- Leaning tree
- Fence
- Culvert/outfall
- Swamp/wetland
- Grasses
- Tree
- Instream log/tree
- Woody debris
- Station location
- Vegetated island

Flow Type

H1	Standing water
H2	Scarcely perceptible flow
H3	Smooth surface flow
H4	Upwelling
H5	Rippled
H6	Unbroken standing wave
H7	Broken standing wave
H8	Chute
H9	Free fall

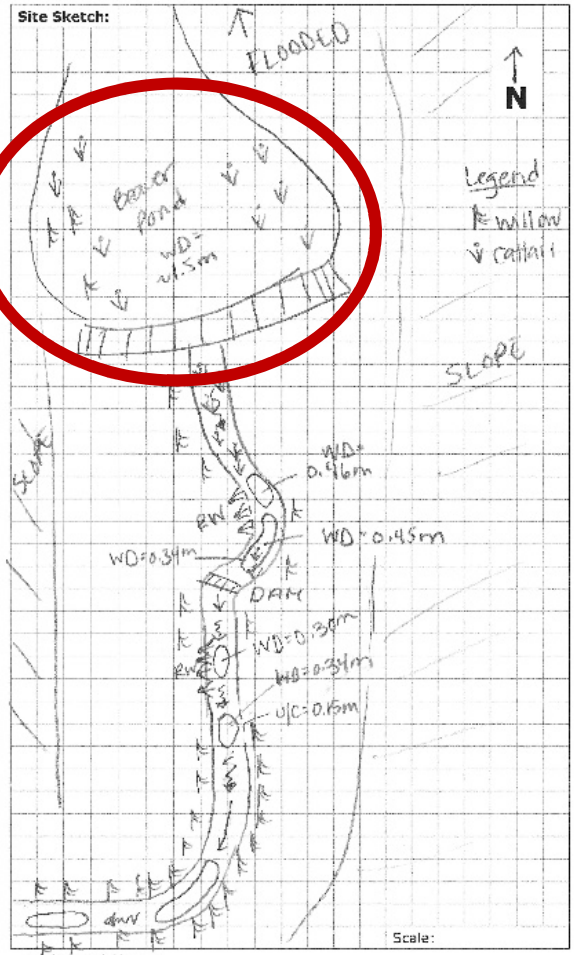
Substrate

S1	Silt	**S6**	Small boulder
S2	Sand	**S7**	Large boulder
S3	Gravel	**S8**	Bimodal
S4	Small cobble	**S9**	Bedrock/till
S5	Large cobble		

Other

BM	Benchmark	**EP**	Erosion pin
BS	Backsight	**RB**	Rebar
DS	Downstream	**US**	Upstream
WDJ	Woody debris jam	**TR**	Terrace
VWC	Valley wall contact	**FC**	Flood chute
BOS	Bottom of slope	**FP**	Flood plain
TOS	Top of slope	**KP**	Knick point

Site Sketch:



Additional Notes:

Churchville Creek: Timberbank

Range of Water depth	0.34m - 1.5m
Range of Velocities	Pool
	-0.006 m/s 0.044 m/s
Undercutting	0.15 m
Habitat Features	Rooted emergent/ submergent
Riffle Substrate	Clay/silt, gravel, cobble, rootlets
Pool Substrate	Clay/silt, sand, rootlets
Bank Substrate	Clay/silt, rootlets
Riparian Vegetation	Major localized gaps, Canopy coverage: >80 % shading
Large obstructions	2 Beaver dams (1 was 15m across)
Notes	Large amounts of flooding due to beaver dams

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Churchville Creek, Timberbank

- Electrofishing survey completed on August 25, 2016
- Base flow at approximately 200 lpm at time of survey
- Channel maturing with dense riparian cover and dense woody cover in pools
- Riffles composed of cobbles, gravel and finer coarse sediment
- Beaver present with constructed dams
- Four species of fish collected
- Redside Dace captured 2.5 km downstream in 2009 by Stantec


Photo credit: Mark Pomeroy

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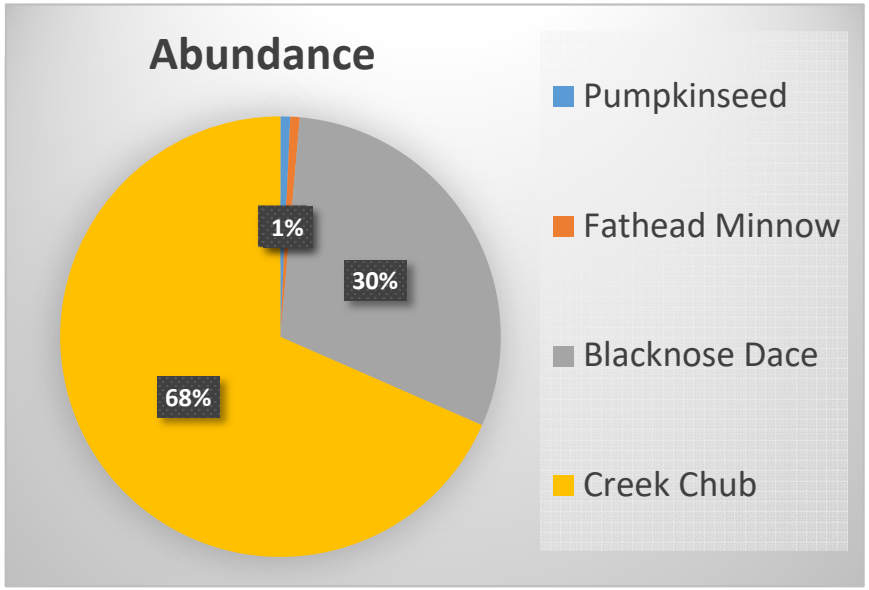
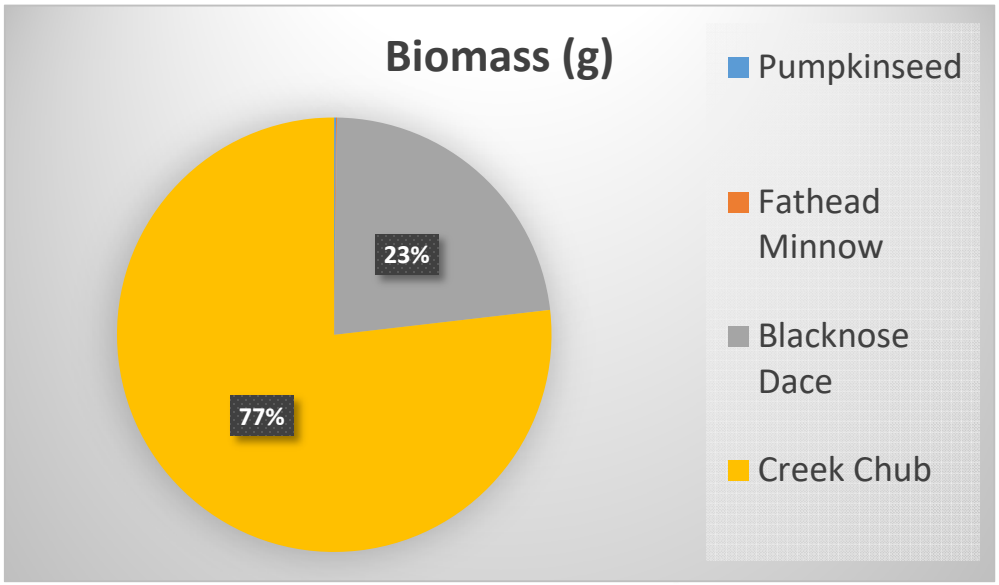
Churchville Creek, Timberbank



- 480 electrofishing seconds
- 80 m reach
- Resident fish community dominated by Creek Chub
- Channel provides suitable habitat for all life stages of Redside Dace



Morningside Creek, Scarborough

General Site Characteristics **Project Code:**

Date:	Aug 23, 2016	**Stream/Reach:**	Morningside Creek
Weather:		**Location:**	U/S Seasons Drive
Field Staff:	TR/LD/AM	**Watershed/Subwatershed:**	

Features

- Reach break
- Cross-section
- Flow direction
- Riffle
- Pool
- Medial bar
- Eroded bank
- Undercut bank
- Rip rap/stabilization/gabion
- Leaning tree
- Fence
- Culvert/outfall
- Swamp/wetland
- Grasses
- Tree
- Instream log/tree
- Woody debris
- Station location
- Vegetated island

Flow Type

H1	Standing water
H2	Scarcely perceptible flow
H3	Smooth surface flow
H4	Upwelling
H5	Rippled
H6	Unbroken standing wave
H7	Broken standing wave
H8	Chute
H9	Free fall

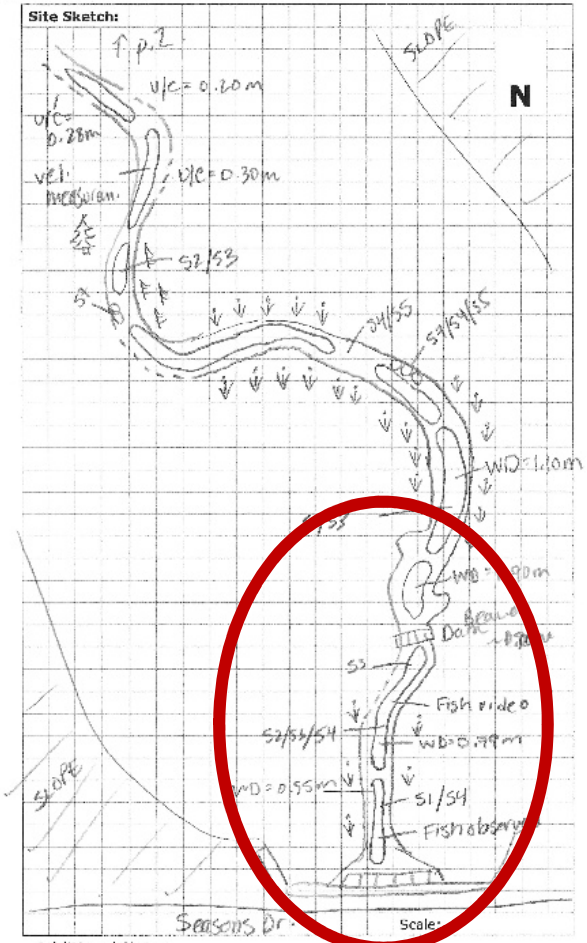
Substrate

S1	Silt	**S6**	Small boulder
S2	Sand	**S7**	Large boulder
S3	Gravel	**S8**	Bimodal
S4	Small cobble	**S9**	Bedrock/till
S5	Large cobble		

Other

BM	Benchmark	**EP**	Erosion pin
BS	Backsight	**RB**	Rebar
DS	Downstream	**US**	Upstream
WDJ	Woody debris jam	**TR**	Terrace
VWC	Valley wall contact	**FC**	Flood chute
BOS	Bottom of slope	**FP**	Flood plain
TOS	Top of slope	**KP**	Knick point

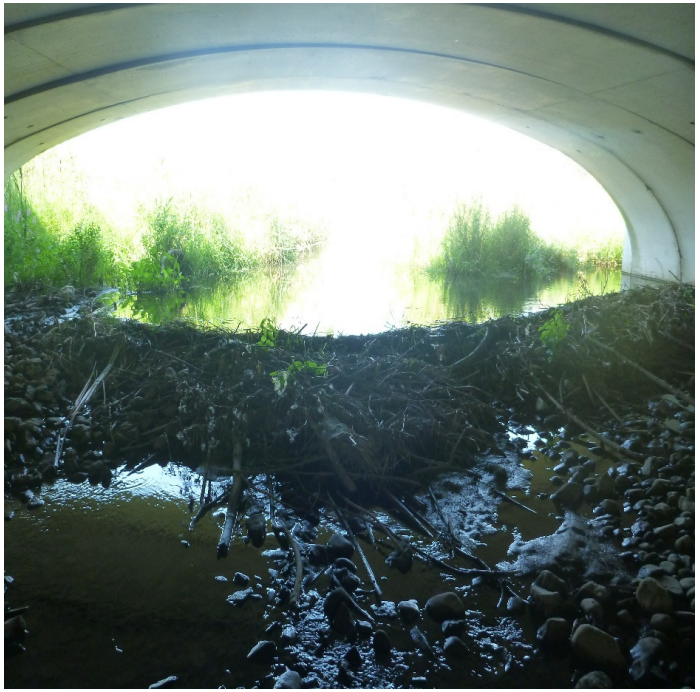
Site Sketch:



Additional Notes:

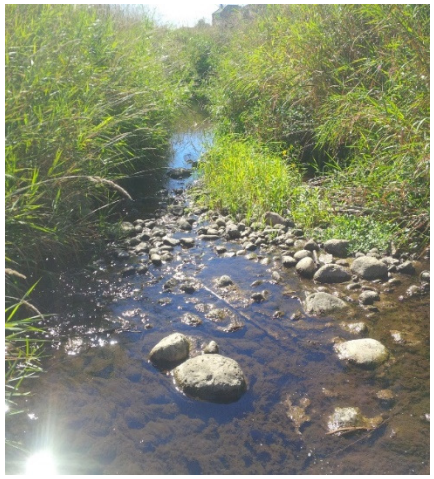
Morningside Creek, Scarborough

Range of Water depth	0.55m- 1.10m
Range of Velocities	Riffle
	-0.009 m/s - 0.385 m/s
Undercutting	0.05m- 0.30m
Habitat Features	Rooted submergent
Riffle Substrate	Gravel, Cobble
Pool Substrate	Sand, gravel, parent
Bank Substrate	Clay/silt
Riparian Vegetation	Major localized gaps, Canopy coverage: <50 % shading
Large obstructions	Large amounts of flooding due to 5 Beaver dams
Notes	Flooded since 2013, fish observed



Morningside Tributary, Rouge River

- Electrofishing survey completed on September 15, 2016
- Base flow at approximately 20 lpm at time of survey
- Channel maturing with moderate riparian cover
- Riffles composed of cobbles and gravel
- Beaver present with constructed dams
- Nine species of fish collected
- Four Redside Dace captured during survey



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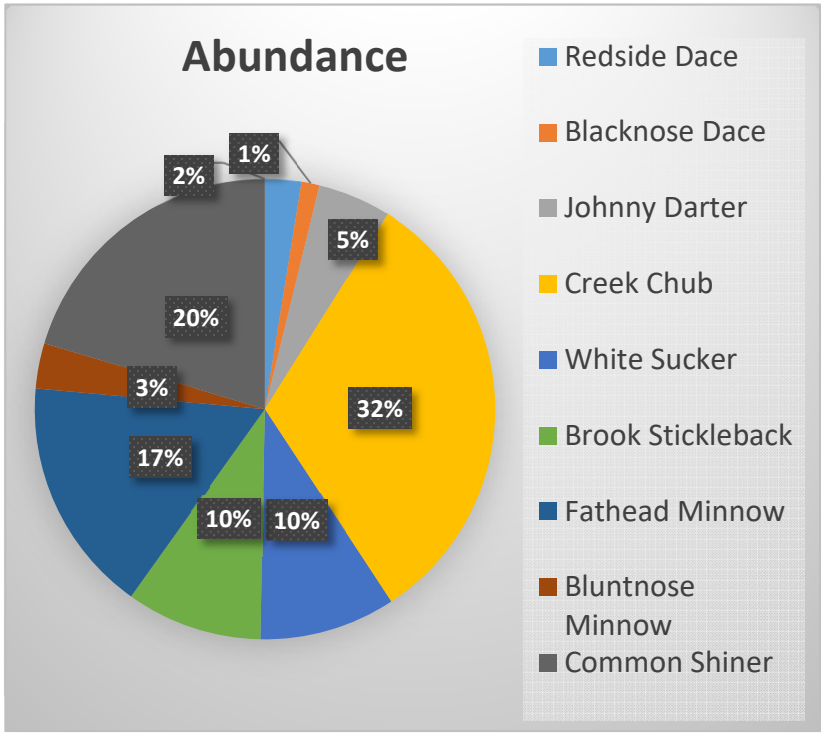
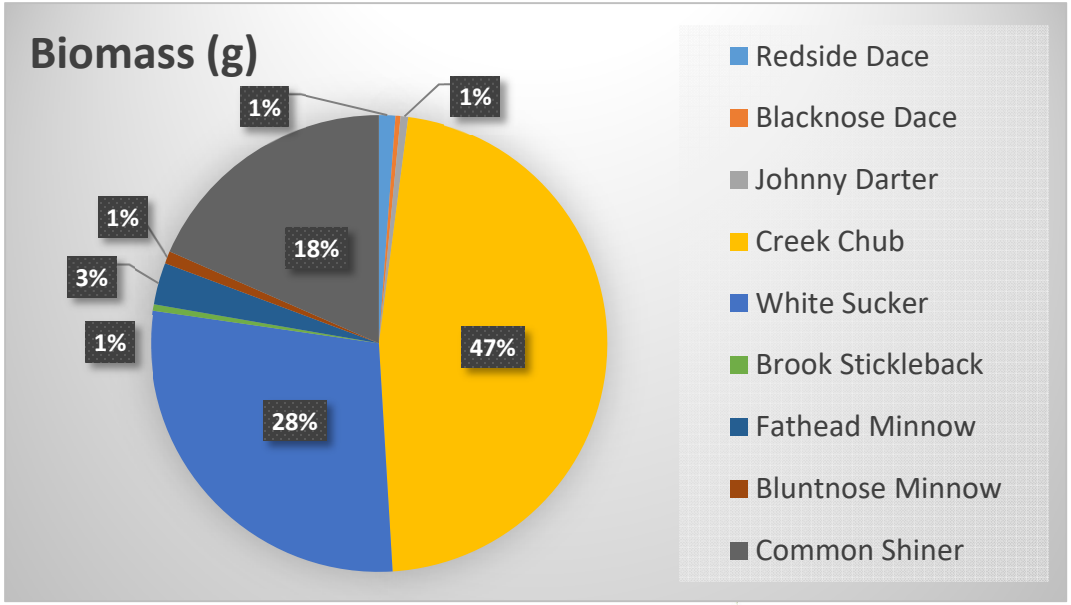
Morningside Tributary, Rouge River



- 305 electrofishing seconds
- 30 m reach
- Resident fish community dominated by Creek Chub
- Channel lacks large woody debris in pools
- Plastic mesh in channel from original erosion blankets
- Culvert substrate oversized and limiting fish passage



Fletcher's Creek, Brampton

General Site Characteristics **Project Code:**

Date:	Aug 24 2016	**Stream/Reach:**	Fletcher's Creek
Weather:	20°C, sunny	**Location:**	Fletcher's Meadow
Field Staff:	AM/ER	**Watershed/Subwatershed:**	

Features

- Reach break
- Cross-section
- Flow direction
- Riffle
- Pool
- Medial bar
- Eroded bank
- Undercut bank
- Rip rap/stabilization/gabion
- Leaning tree
- Fence
- Culvert/outfall
- Swamp/wetland
- Grasses
- Tree
- Instream log/tree
- Woody debris
- Station location
- Vegetated island

Flow Type

H1	Standing water
H2	Scarcely perceptible flow
H3	Smooth surface flow
H4	Upwelling
H5	Rippled
H6	Unbroken standing wave
H7	Broken standing wave
H8	Chute
H9	Free fall

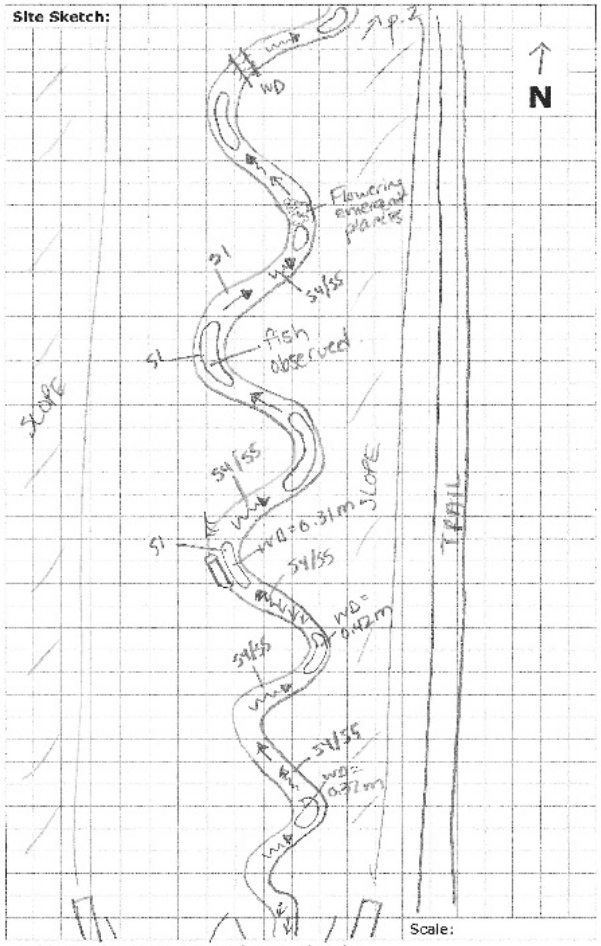
Substrate

S1	Silt	**S6**	Small boulder
S2	Sand	**S7**	Large boulder
S3	Gravel	**S8**	Bimodal
S4	Small cobble	**S9**	Bedrock/till
S5	Large cobble		

Other

BM	Benchmark	**EP**	Erosion pin
BS	Backsight	**RB**	Rebar
DS	Downstream	**US**	Upstream
WDJ	Woody debris jam	**TR**	Terrace
VWC	Valley wall contact	**FC**	Flood chute
BOS	Bottom of slope	**FP**	Flood plain
TOS	Top of slope	**KP**	Knick point

Site Sketch:



Additional Notes: Edenbrook Hill Dr.

Aerial photo: 16-08-29

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Fletcher's Creek, Brampton

Range of Water depth	0.55m- 1.10m
Range of Velocities	Pool
	-0.006 m/s - 0.044 m/s
Undercutting	0
Habitat Features	Rooted emergent
Riffle Substrate	Cobble
Pool Substrate	Clay/silt
Bank Substrate	Clay/silt
Riparian Vegetation	Major localized gaps, Canopy coverage: <50 % shading
Large obstructions	No beaver dams
Notes	Standing water, no flow

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Fletcher's Creek, Credit River

- Electrofishing survey completed on August 25, 2016
- Base flow at approximately 40 lpm at time of survey
- Channel maturing with dense riparian cover with some large woody cover in pools
- Riffles composed of cobbles
- Channel dominated with muck
- Beaver present with constructed dams
- Six species of fish collected
- YOY Redside Dace captured in same survey reach in 2011 by Credit Valley Conservation

Photo credit: Brydon McVeigh

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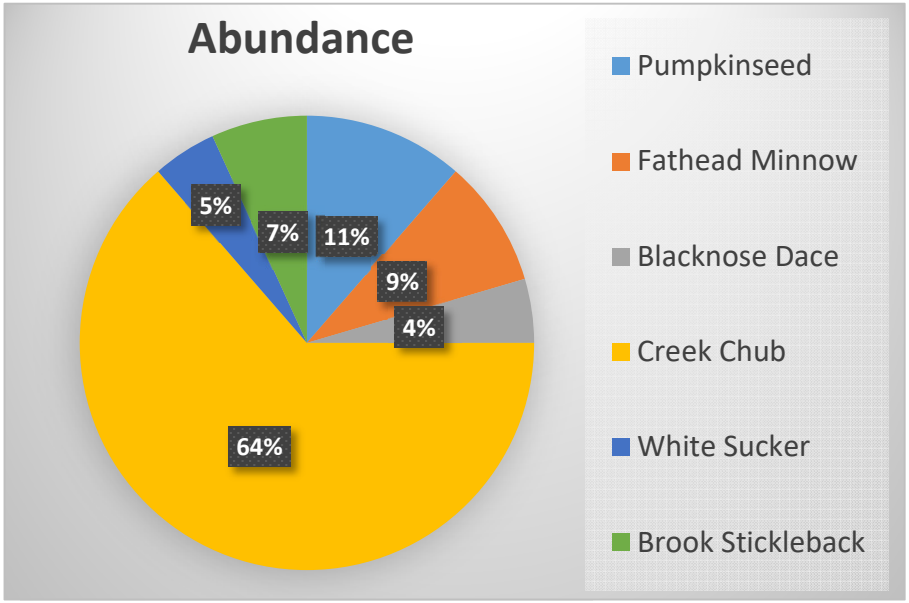
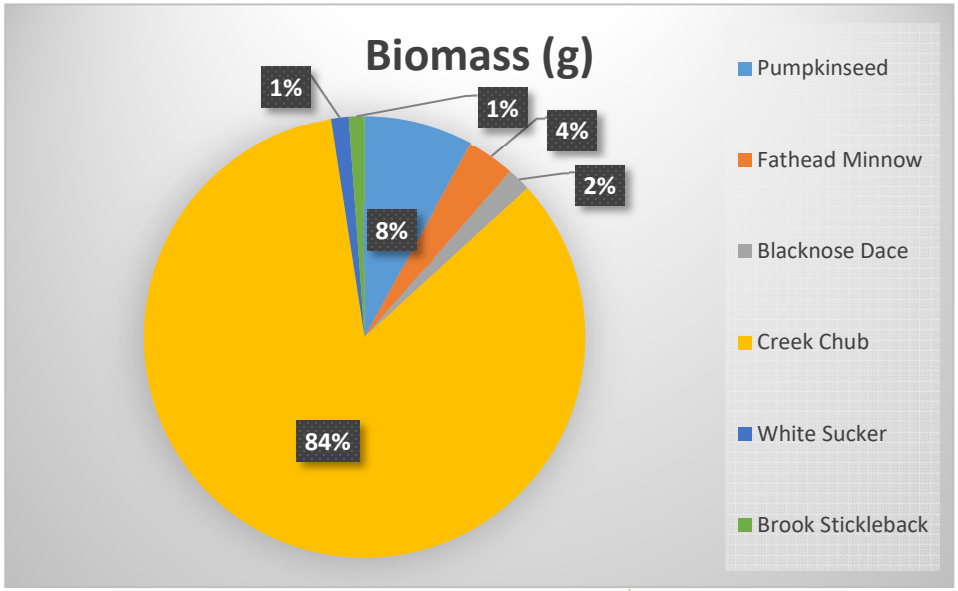
West Fletcher's Creek, Credit River



- 466 electrofishing seconds
- 100 m reach
- Resident fish community dominated by Creek Chub
- Channel lacks suitable coarse sediment for Redside Dace spawning



Conclusions

- Redside Dace will use constructed natural channels
- Corridors are providing for diverse and healthy fish communities
- In most of the channels reviewed, physical characteristics are still suitable for Redside Dace including morphology, substrate, wood debris, undercuts, and overhanging vegetation
- Surveys over the first 10 years showed relatively modest adjustments in substrate, cross sectional geometry
- In recent years significant changes in floodplain and channel characteristics where beavers have been present
- Pools > 1 m depth even during low flow conditions in systems that would otherwise have been considered seasonal habitat
- Increased overwintering potential for Redside Dace

Lessons Learned

- Even channels that have been stable for more than a decade can show rapid changes due to the influence of external disturbances, such as beavers
- Beavers may occupy the systems when vegetation reaches a certain size – all the channels were a similar age and relied heavily of pioneering plant species – this could explain the recent changes across the corridors
- The current overwintering potential, floodplain connectivity and morphological variability were likely not anticipated by the designers – this is a good thing
- Important to recognize that the corridors we install can mature into overwintering habitat for Redside dace, moving forward
- Goes to show how unpredicted natural events like the presence of beaver activity can shape a channel
- Issue with oversized riffle substrates at Fletchers' illustrating that designers and agency reviewers need to be cautious in balancing erosion/instability concerns with the finer substrate needs of riffle spawning species

Thanks to Margaret Berube, Liz Miller, Jason Krompart, Emily Rick, Alex Meeker, and Lindsay Davis

THANK YOU…

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