15 December 2016 Reference No. 1545590-001-L-Rev1

Nelson Jatel
Okanagan Basin Water Board
1450 KLO Road
Kelowna, BC
V1W 3Z4

PRAIRIE CREEK RESTORATION – DALE MEADOWS PARK TO GIANT'S HEAD SCHOOL

Dear Mr. Jatel,

Golder Associates Ltd. (Golder) is pleased to submit this conceptual plan for restoration of Prairie Creek between Dale Meadows Park and Giant's Head School in Summerland, BC.

1.0 INTRODUCTION

Prairie Creek, also known as Prairie Valley Creek, is a second order stream and the second largest watershed in the District of Summerland at 1390 Hectares (Urban Systems 2006). At its headwater, it is fed by a 25.5 cm gate-valve-controlled pipe from the Trout Creek Water Reservoir near the west end of Dale Meadows Road; although it is likely that much of the water comes from non-point (groundwater) sources along its course. The stream meanders through farms and residential property for about 3 km from this spring source to the Dale Meadows ball diamonds (Figure 1). Much of the stream channel has been ditched along property lines or along the edges of farm fields or roadways. This means that the normal meander patterns, where a stream channel is sinuous and wanders back and forth, is absent. This also means that channel complexity features such as pools and riffles that would be found in a stream of this size are also absent. Without regular sorting of fines and gravels, aggrading in some places and degrading in others, the stream bed has built up in many areas. This can cause flooding in areas where the channel capacity has been reduced from aggradation[1].

Prairie Creek was once part of a large wet meadow complex that consisted of sloughs, shrub-carr areas, meandering streams, and cattail marshes. Agricultural practices that began in the Prairie Valley area during the late 1800s, and continued into the 1900s, resulted in the majority of wet meadow areas being filled for crop farming including orchards and pasture (Barclay, G. 1900).

[1] Aggradation is the build-up of stream beds by deposition of materials such as fines or gravels.

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Interestingly, even though Prairie Creek does not have a lake or even sizable ponds along its reaches, it supports fish including Rainbow Trout (*Oncorhynchus mykiss*) and Brook Trout (S*alvelinus fontinalis*). Each species was likely stocked by the provincial government into the Trout Creek Water Reservoir over 30 years ago and water releases from the reservoir would have resulted in fish being introduced to Prairie Creek. The lower section of Prairie Creek is accessible to fish from Okanagan Lake, and has received considerable attention for enhancement by local families and environmental advocates, and management for drainage by the District of Summerland.

The upper reaches of Prairie Creek are located on a low-gradient bench and are distinct from the steep-gradient lower reach (near Okanagan Lake), where portions of the creek have been diverted through storm sewers under developments and roadways. It appears that the majority of Prairie Creek flows have been diverted away from the main stream channel in the lower reach and now enter Okanagan Lake through a large storm pipe at Butler Street.

Structural Best Management Practices (BMPs) were recommended in the District of Summerland Master Drainage Plan (Urban Systems 2006). These included appropriate sizing of culverts and ditches to convey flows, while at the same time allowing for natural attenuation of runoff so that storm drains are not overloaded. Urban Systems (2006) recommended that open channels should function with a minimum of 0.3 metres of freeboard. This is an important point to consider when restoring or designing new stream channels.

2.0 PURPOSE

The Okanagan Basin Water Board, with some funding provided by the District of Summerland, have retained Golder to provide a conceptual plan to daylight a 130 m section of Prairie Creek between Dale Meadows ball fields and the Giants Head Elementary School. Runoff along this reach is currently conveyed through two 600 mm storm sewers within an easement on the school property near the property line. The primary purpose of this Conceptual Plan is to provide a technical document that can be used to support funding applications. Other purposes of the Conceptual Plan are to provide stream restoration information in a format that can be presented to community stakeholders for support and to initiate discussions with permitting agencies.

The storm pipes were installed during 1994 as part of the ballpark and school playground development. Local citizens (e.g., the Summerland Environmental Science Group and the Okanagan Similkameen Stewardship Society) have expressed interest in restoring the creek to a more natural form. Interest has increased after news of a successful daylighting stream restoration project at Fascieux Creek through the K.L.O. Middle School playground in Kelowna received media attention during 2014 and 2015.

3.0 CONCEPTUAL PLAN

A new 90 m segment of stream channel with meanders, pools, and riffles to create habitat complexity could be constructed adjacent to the storm sewers (Figure 2). The stream would be located on District of Summerland property within the Dale Meadows Park area. There appears to be sufficient space south of the piped alignment to create an open channel that can be an amenity to the public and provide valuable fish and wildlife habitat in an open-space setting.

After 90 m, the stream can either be directed back into the storm sewers or opened up into the school ground of Giant's Head Elementary. From the school it would travel about 50 m before joining back into the open stream channel located at the eastern edge of the school ground.

Crossing from the park to the school would mean that the new channel would have to be excavated under the pipes, a complication that could mean careful machine excavation. The conceptual plan is provided in the attached Figure 2.

Once the stream is opened on the school ground area, it can be used as the focus of an outdoor classroom. The classroom can consist of seating areas, locations to safely access the stream, and even a wetland area. Site safety features should be considered while balancing the stream restoration design and outdoor classroom needs. Access to the outdoor classroom area would be restricted to teacher-supervised sessions by use of fencing and locked gates.

The main advantage of creating a new stream channel while the creek is still contained within pipes is that a new channel can be created during low water conditions. If groundwater is encountered, it could be pumped onto open field areas to settle out fines before soaking back into the ground, and to let stream construction crews continue to work in dry conditions. Soil may be transported to adjacent properties that are prone to flooding, where it can be used in contouring or stored for future use. Sod can be stripped prior to excavation and used in the restored channel to control erosion and assist in revegetation.

Habitat structure within the new creek channel can be created by considering features such as:

- Undercut banks;
- Large woody debris complexes;
- Boulder clusters;
- Riffles/pools;
- Overhanging logs; and,
- Rock/log combinations.

Large rocks, logs, and stumps can be brought in from off-site or salvaged during excavation and clearing operations for a wetland / sediment detention pond upstream but still within the Dale Meadows Park area (Figure 2). The pond may be able to extend onto the neighbouring private property.

Sediment transport down Prairie Creek is a natural process that can be exacerbated by land development and roads. The stream daylighting project provides an opportunity to create a sediment trap upstream of the daylighted and restored stream segment. There is an ideal location at the northwest corner of Dale Meadows Park, where there currently exists an open space vegetated by grasses and by invasive Siberian elm trees (Figure 2 and attached photographs). See attached conceptual plan that shows the general alignment of the sediment pond and a wetland area that could be excavated on the fringe of the sediment pond. There may be an opportunity to expand the wetland onto private land (Johnson's) to the west to help address flooding issues on the farm field in that location.

The sediment pond can be accessed for construction and maintenance by widening an existing trail that leads from a parking area on the west side of the park. Recently planted riparian plants would need to be relocated prior to conducting access path improvements. Photographs of the trail and adjacent field are provided in Attachment 1.

4.0 ROADMAP TO RESTORATION

The following provides a logical approach to creation of the new habitat enhancement feature of Prairie Creek through Dale Meadows Park.

1) Submit conceptual plan to funding organizations with applications for funds to construct the new and restored stream channel.

2) Submit conceptual plan to FrontCounter BC with a *Water Sustainability Act* Section 11 Change Order application to alter the stream.

3) Request that the School District, through a visual presentation and a letter from OBWB, allow the stream channel to be opened up within the 50 m section within the southeast corner of the school ground.

    a. Provide the school with the option to create an outdoor classroom adjacent to a wetland created as part of the stream daylighting. Assure the school a safe playing environment by offering to install a chain link fence between the school playing field and the open water of the creek and wetland.

4) Provide additional information to regulatory agencies to support the *Water Sustainability Act* application.

5) Create preliminary and more-detailed designs that can be used by a contractor to build the new stream and ponds. Design should be of adequate detail that it can be used to estimate materials needed for the work. It can be field-fit with the aid of a qualified environmental professional experienced in stream restoration (also acting as environmental monitor).

6) Line up local supporters for in-kind donations of materials and equipment. The following general equipment, expertise, and materials will be required:

    a. A construction supervisor to oversee the stream restoration project;

    b. An excavator to undertake earthwork, such as digging and shaping the new stream channel;

    c. Dump trucks to transport soil from the channel and deliver materials to the site including rocks, gravel, tree trunks, root wads, and other large rocks;

    d. Materials such as logs, stumps, large and small rock, gravel, fence, a bridge;

    e. Lock blocks or large rocks for sediment detention pond;

    f. Pumps to keep excavation dry during stream channel and sediment pond excavation;

    g. Project manager to coordinate materials and volunteers;

    h. Environmental monitor for critical periods when stream channel is brought on line and pipes are removed, and when sediment pond is brought on line and segment of creek has potential to dry up (a fish salvage may be required); and,

    i. Non-profit agency to handle funds and disperse payments, as required.

7) Chart out a construction time-line that can be used to plan phasing and further refine resources required to complete the project.

8) Begin construction by creating wetland and sediment pond first, new stream channel second, and amenities last (outdoor classroom, etc.).

5.0 TECHNICAL CONSIDERATIONS

The new stream channel must be stable and able to safely convey flood waters during large flow events (e.g., 1/100-year return period). It should also provide habitat complexity. The existing stream channel near the project site appears to have a bottom width of about 1 m and a bankfull depth of about 1 m (cross section of about 3 m^2 at the pedestrian bridge crossing from Prior Place to Dale Meadows Park) (Figure 3). According to the Urban Systems (2006) report, the gradient in the project area is approximately 0.3%. This means that the ground only drops about 0.26 m from the start of the culvert to the outlet at the east side of the school yard (130 m length). Topographic information for the Site should be confirmed by a qualified survey company.

The 1/100-year flow estimates of Prairie Creek near Dale Meadows were reported to be approximately in the range of 0.5 m^3/s to 0.8 m^3/s (Urban Systems 2006). Given that the new stream channel will incorporate features such as logs and rocks, and meanders to simulate a natural stream alignment, then the roughness of the channel will be increased compared to the ditch system that is upstream. Assuming a Manning n coefficient of 0.050 (channel roughness) to account for increased roughness in the new stream, a steady uniform flow depth would be approximately 0.7 m. With 0.3 m freeboard, the total channel depth would be 1 m. These preliminary estimates need to be re-evaluated during the future design stages for the project. An example of a typical stream cross section after daylighting and enhancement is provided in Figure 4

The 130 m distance and 0.3% gradient will allow for the creation of riffle and pool sequences that can result in turbulent sections with gravel and rock bottoms and interspersed pools that would have silty bottoms and could support aquatic vegetation. The two types of habitats would provide places for fish, aquatic birds, aquatic mammals, and turtles to coexist in the restored stream section. An example cross section of a pond in the new stream section is provided on Figure 5.

The District of Summerland has needed to dredge sediment from the creek bed from time to time (Dave Hill, 2016, personal communication). The creation of pool sequences would provide settlement areas for sediment and eventually result in flat, shallow areas filled with gravel and silt – no longer functioning as a pond. One potential solution to avoid the reduction of habitat quality by sediment aggradation is to create a trap for sediment upstream of the restored stream section. The trap would be cleaned out as part of a regular maintenance program (perhaps every three to five years). Ponds and wetlands are natural settlement areas, and over time a pond will transition to a wetland as sediments from the surrounding watershed settles out.

A potential spot for a sediment trap is at the northwest corner of the park property, adjacent to a farm field. The stream could be diverted into a dugout, deep enough and large enough for course sediment to drop out of solution. A very large pond would be required to drop fine sediment out of suspension. The size of the sediment detention pond is constrained by the size of land area available. There is an area of about 450 m^2 in the clearing depicted on Figure 2. If the pond has an average depth of 1.3 m, then the storage volume of the pond would be in the order of 585 m^3. The pond could be dredged when needed, depending on sediment transport rates down Prairie Creek. A conceptual cross section of the sediment pond area is provided on Figure 6. There is potential to increase the sediment pond size by adding some area from the adjacent property owner. This option should be investigated since it could also act to mitigate flooding of the adjacent farm field. A right of way would likely be required to allow the District to access portions of the pond that are placed on property owned by others.

6.0 PERMITTING TIMELINE

Permitting for the project is expected to be relatively straight forward. As an example, the following permits and approvals were required during Golder's work for the stream daylighting project at Fascieux Creek through KLO Middle School in Kelowna.

- *Water Sustainability Act* (WSA) authorization to change a stream (Change Order under Section 11).
- Municipal Environmental Development Permit.
- Fish salvage permit from FrontCounter BC.
- Letter of permission from municipality to dispose of waste or soil and to collect large woody debris and rocks from the local landfill (may need to pull pipe section and dispose at landfill).
- Letters of support from the District of Summerland and from the local School District to agree to works occurring on their lands.
- Work window extension for Change Order if timing of stream restoration falls outside the least-risk fish window.

Timing for the permits will be contingent on supplying comprehensive information for the stream daylighting project in the applications. This could include the creation of an environmental management plan detailing how the works will be conducted with minimal effects on the environment. The WSA Change Order can take 60 days or longer if support from First Nations is required. The municipal development permit and letters of support can be applied for at the same time and would be expected to take less time to process.

7.0 CLOSURE

We trust this meets your current needs for a description of the conceptual plan to restore this reach of Prairie Creek in Summerland. Please contact the undersigned directly if you have any questions regarding this letter.

Yours very truly,

GOLDER ASSOCIATES LTD.

Geoffrey Cahill, P.Eng.
Water Resources Engineer

Darryl Arsenault, M.Sc., R.P.Bio.
Associate, Senior Biologist

GC/DA/syd

Attachments: Figures 1 to 6
Attachment 1 – Photographs

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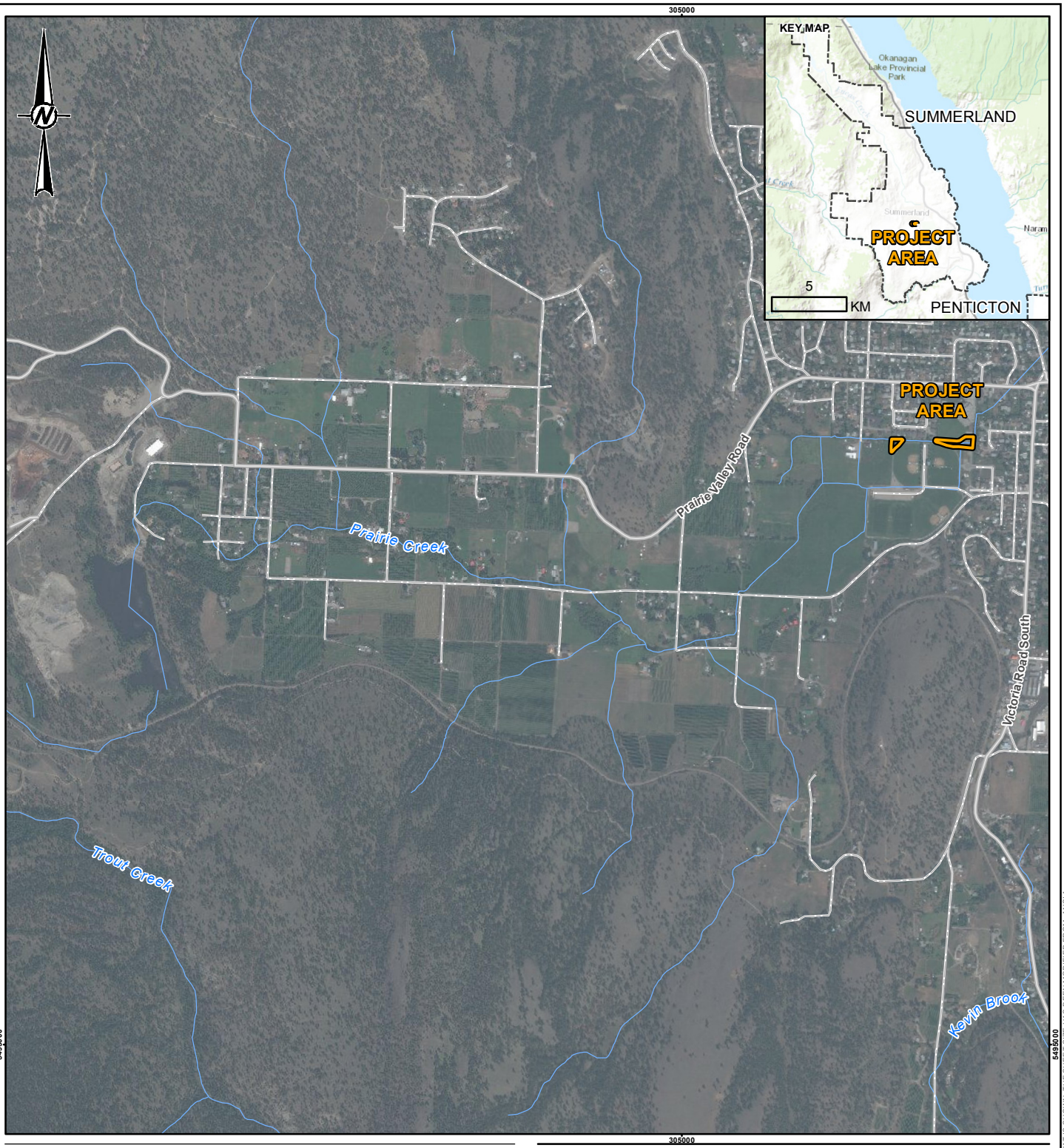
8.0 REFERENCES

Barclay, George. 1900. Letter from George Barclay to J.M. Robinson regarding potential sale of Trout Creek Ranch.

Hill, Dave. 2016. Personal communication with former Superintendent of Public Works at the District of Summerland (Retired).

Urban Systems Ltd. 2006. District of Summerland Master Drainage Plan.



LEGEND

- PROJECT AREA
- HIGHWAY
- LOCAL ROAD
- LOCAL STREET
- WATERCOURSE

0 400 800

1:20,000 METRES

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SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY
DATUM: NAD83 PROJECTION: UTM ZONE 11

CLIENT
OKANAGAN BASIN WATER BOARD

PROJECT
DAYLIGHTING PRAIRIE CREEK AT GIANT'S HEAD SCHOOL

TITLE
SITE LOCATION

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-06-08
DESIGNED	DJA
PREPARED	AD
REVIEWED	DJA
APPROVED	DJA

PROJECT NO.	CONTROL	REV.	FIGURE
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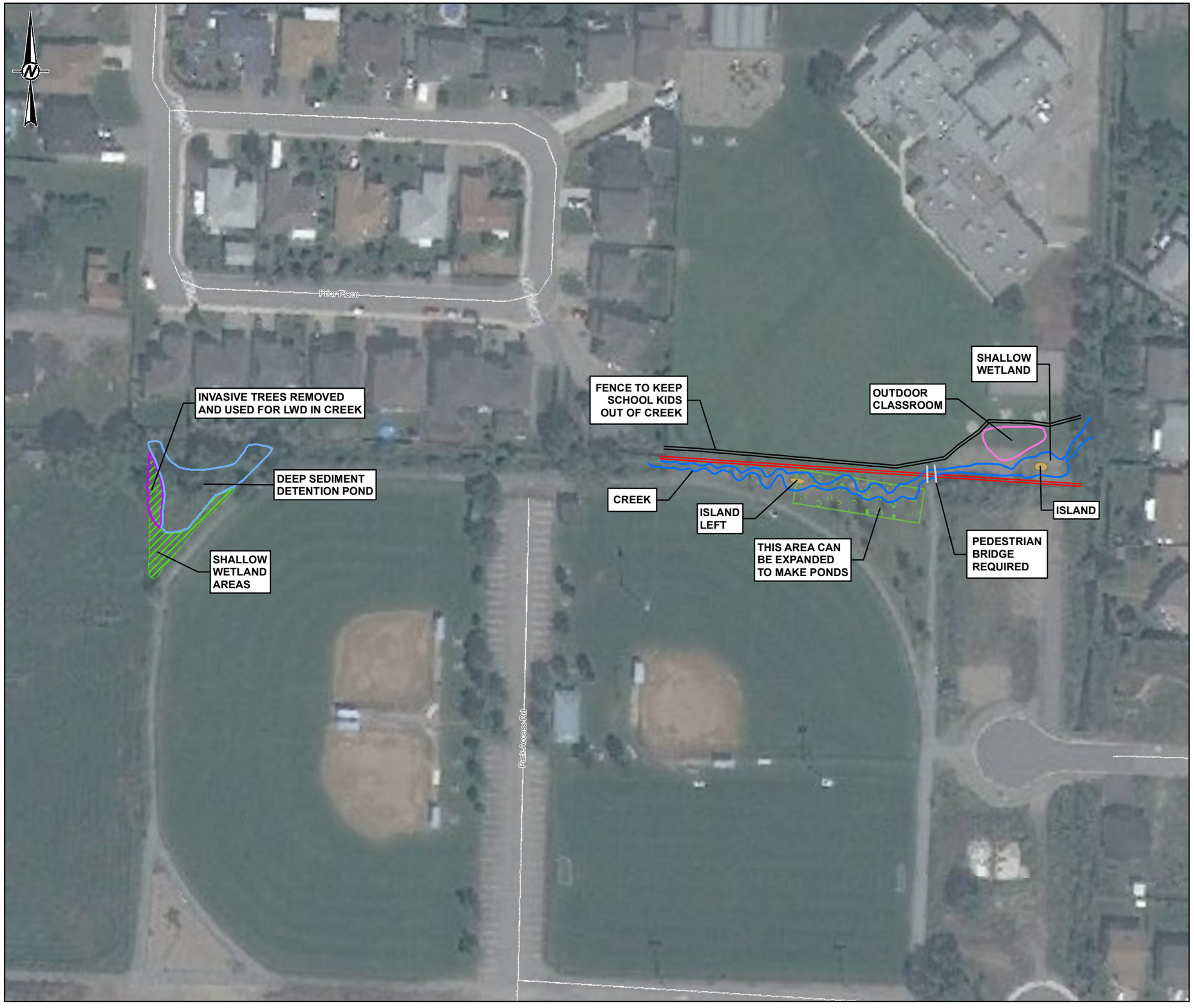

LEGEND

- CREEK
- FENCE
- HAND DIG CREEK UNDER PIPES
- PEDESTRIAN BRIDGE REQUIRED
- LOCAL ROAD
- ISLAND
- OUTDOOR CLASSROOM
- POND EXPANSION AREA
- DETENTION PONT
- WETLAND
- INVASIVE TREES

0 25 50

1:1,200 METRES

REFERENCES

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DATUM: NAD83 PROJECTION: UTM ZONE 11

CLIENT
OKANAGAN BASIN WATER BOARD

PROJECT
DAYLIGHTING PRAIRIE CREEK AT GIANT'S HEAD SCHOOL

TITLE
CONCEPT PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-06-07
DESIGNED	DJA
PREPARED	AD
REVIEWED	DJA
APPROVED	DJA

PROJECT NO.	CONTROL	REV.	FIGURE
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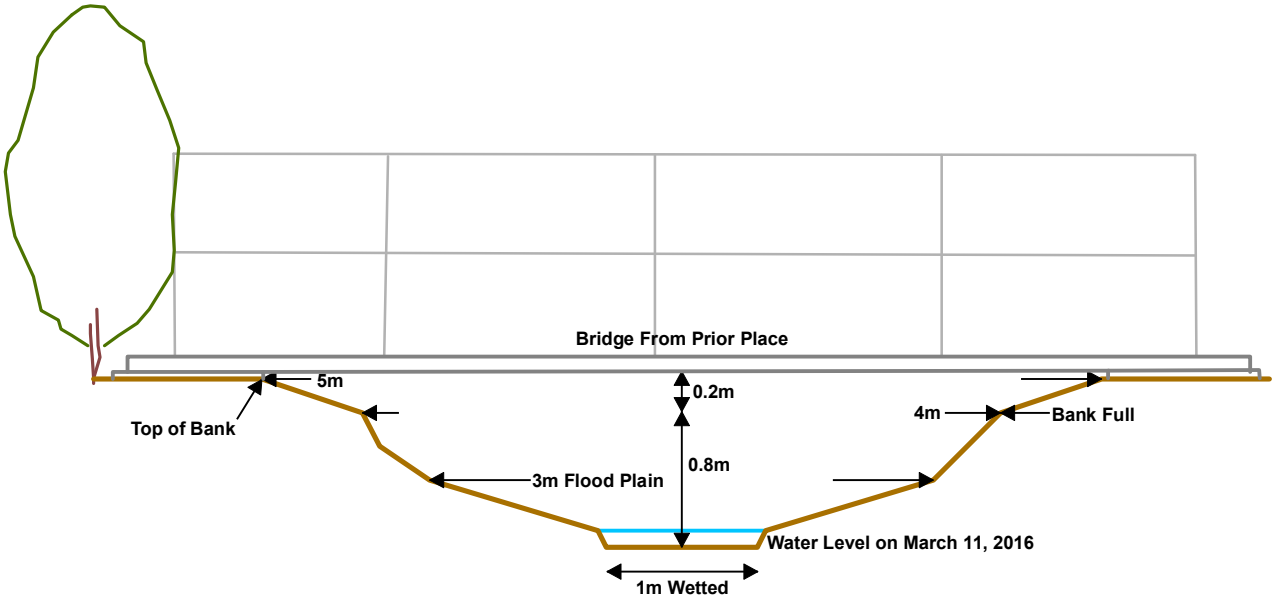

LEGEND

- BRIDGE
- GROUND
- RAILING
- WATER

0 1 2

1:45 METRES

REFERENCES

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CLIENT
OKANAGAN BASIN WATER BOARD

PROJECT
DAYLIGHTING PRAIRIE CREEK AT GIANT'S HEAD SCHOOL

TITLE
TYPICAL PRAIRIE CREEK CHANNEL CROSS SECTION AT BRIDGE

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-06-08
DESIGNED	DJA
PREPARED	AD
REVIEWED	DJA
APPROVED	DJA

PROJECT NO.	CONTROL	REV.	FIGURE
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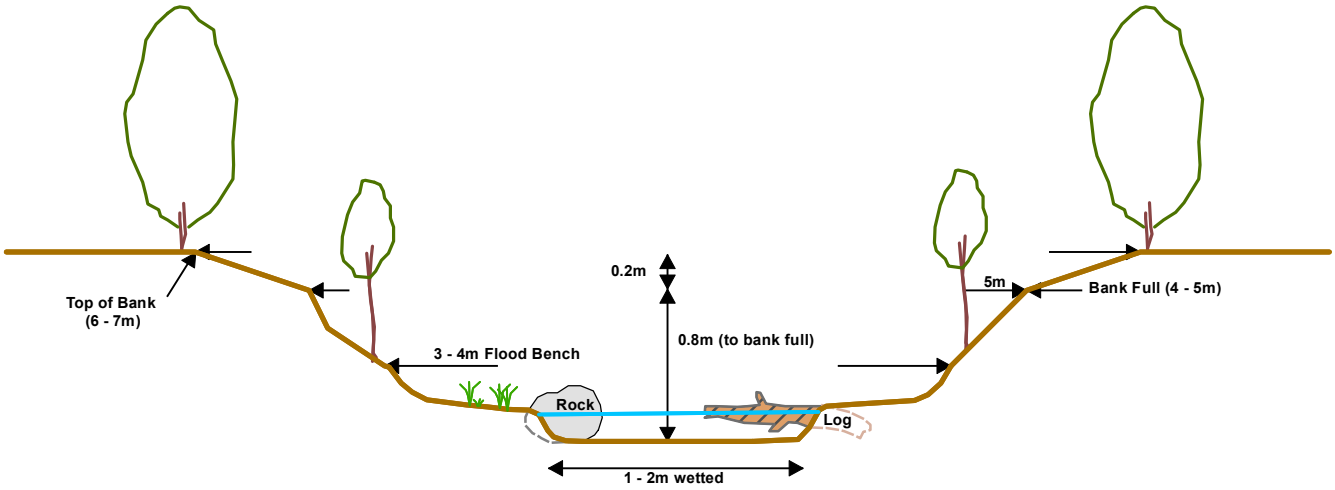

LEGEND

- GROUND
- VEGETATION
- WATER
- LOG
- ROCK

0 1 2

1:40 METRES

REFERENCES

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CLIENT
OKANAGAN BASIN WATER BOARD

PROJECT
DAYLIGHTING PRAIRIE CREEK AT GIANT'S HEAD SCHOOL

TITLE
TYPICAL PRAIRIE CREEK CHANNEL CROSS SECTION AFTER DAYLIGHTING AND ENHANCEMENT

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-06-07
DESIGNED	DJA
PREPARED	AD
REVIEWED	DJA
APPROVED	DJA

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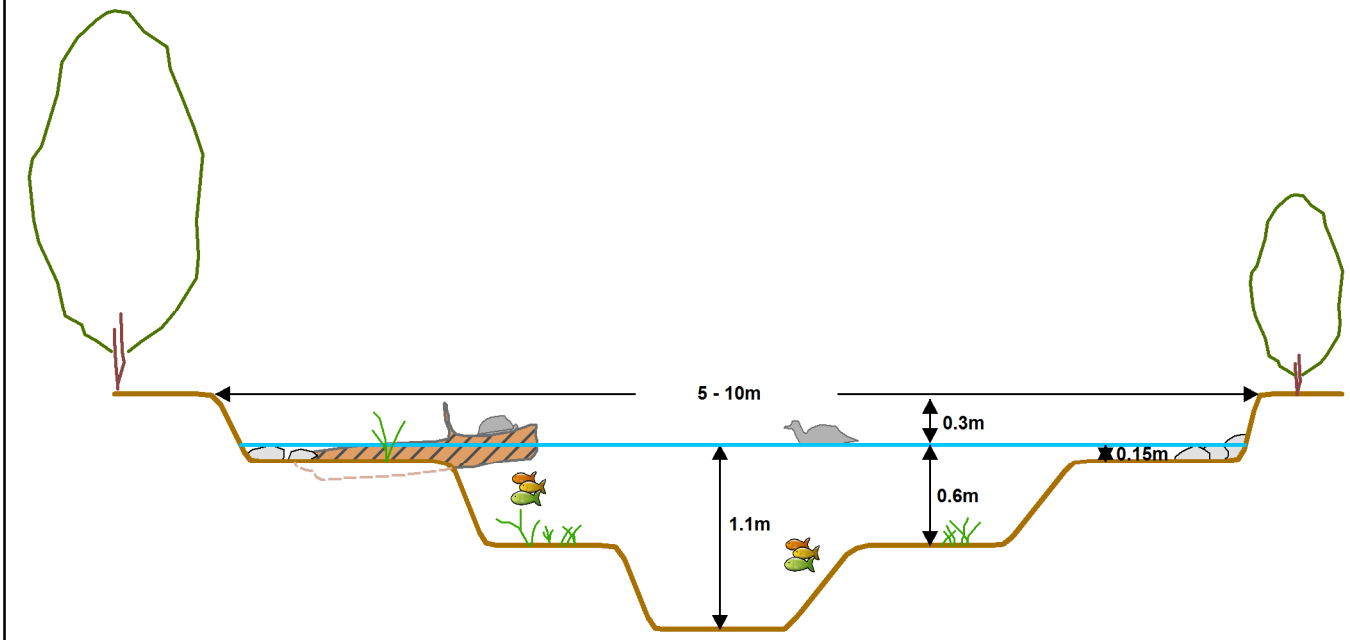

LEGEND

- FISH
- GROUND
- VEGETATION
- WATER
- LOG
- ROCK
- WILDLIFE

0 1 2

1:45 METRES

REFERENCES

1. CROSS-SECTION CREATED BY GOLDER ASSOCIATES

CLIENT
OKANAGAN BASIN WATER BOARD

PROJECT
DAYLIGHTING PRAIRIE CREEK AT GIANT'S HEAD SCHOOL

TITLE
TYPICAL POND CROSS SECTION

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-06-08
DESIGNED	DJA
PREPARED	AD
REVIEWED	DJA
APPROVED	DJA

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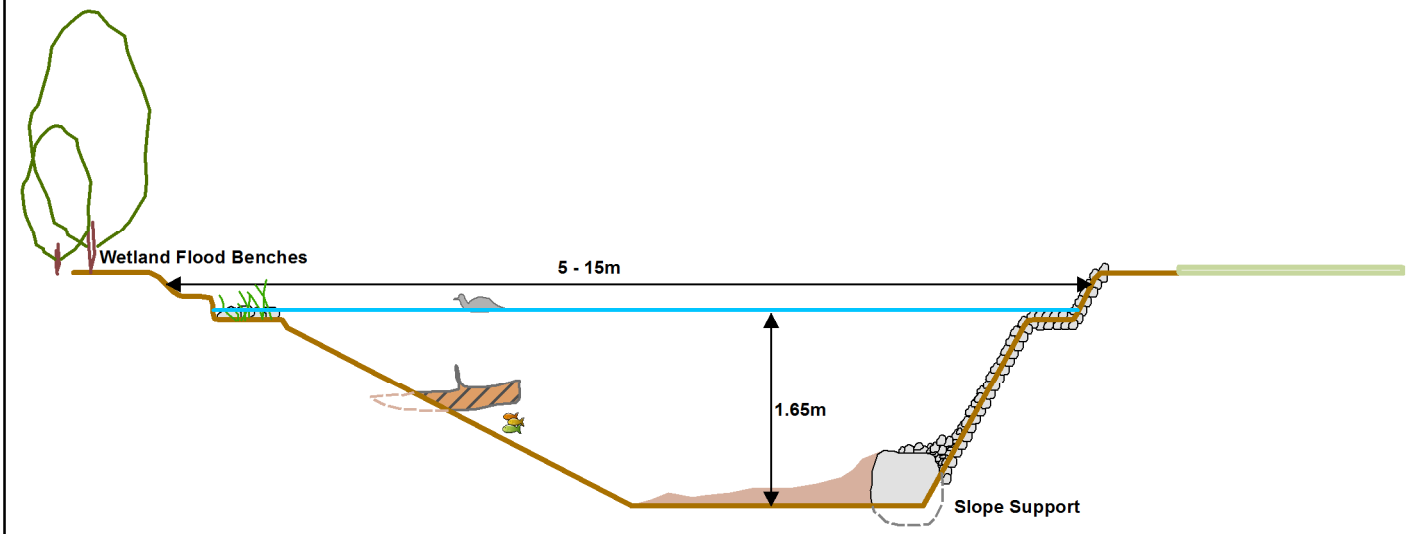

LEGEND

- FISH
- GROUND
- PATHWAY
- VEGETATION
- WATER
- LOG
- ROCK
- sediment
- WILDLIFE

0 1 2

1:65 METRES

REFERENCES

1. CROSS-SECTION CREATED BY GOLDER ASSOCIATES

CLIENT
OKANAGAN BASIN WATER BOARD

PROJECT
DAYLIGHTING PRAIRIE CREEK AT GIANT'S HEAD SCHOOL

TITLE
TYPICAL SEDIMENT TRAP

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-06-08
DESIGNED	DJA
PREPARED	AD
REVIEWED	DJA
APPROVED	DJA

PROJECT NO.	CONTROL	REV.	FIGURE
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PATH: \\golder.gds\gal\burnaby\CAD-GIS\Client\Okanagan Basin Water Board\Summerland\09 PROJECTS\1545590\02 PRODUCTION\1000\MXD\Report\1545590 REPORT FIG6 CROSS SECTION TYPICAL SEDIMENT POND - Copy.mxd PRINTED ON: 2016-07-22 AT: 3:07:57 PM

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ATTACHMENT 1
Photographs

Photograph 1: Section of Prairie Creek piped through Giants Head School ground (taken facing east on March 11, 2016).

Photograph 2: Section of Prairie Creek piped through Giants Head School ground (taken facing west on March 11, 2016).

Photograph 3: Upstream end of culverts (11 March 2016).

Photograph 4: Downstream end of culverts (November 2009). Credit: Ecoscape

Photograph 5: Looking upstream at Prairie Creek from culverts at Giants Head School ground (11 March 2016).

Photograph 6: Looking downstream at bridge crossing from Dale Park to Prior Place (11 March 2016).

Photograph 7: Access trail to potential sediment pond area (11 March 2016). This trail would need to be widened for trucks. Plants would need to be relocated (see pink flagging).

Photograph 8: Farm field beside access path to sediment pond (11 March 2016). Flooding during springtime is an issue.

Photograph 9: Access to potential sediment detention pond area (11 March 2016). Siberian elm trees would need to be removed.

Photograph 10: Potential sediment detention pond area.

Photograph 11: School ground area where there is potential for an outdoor classroom (11 March 2016).

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