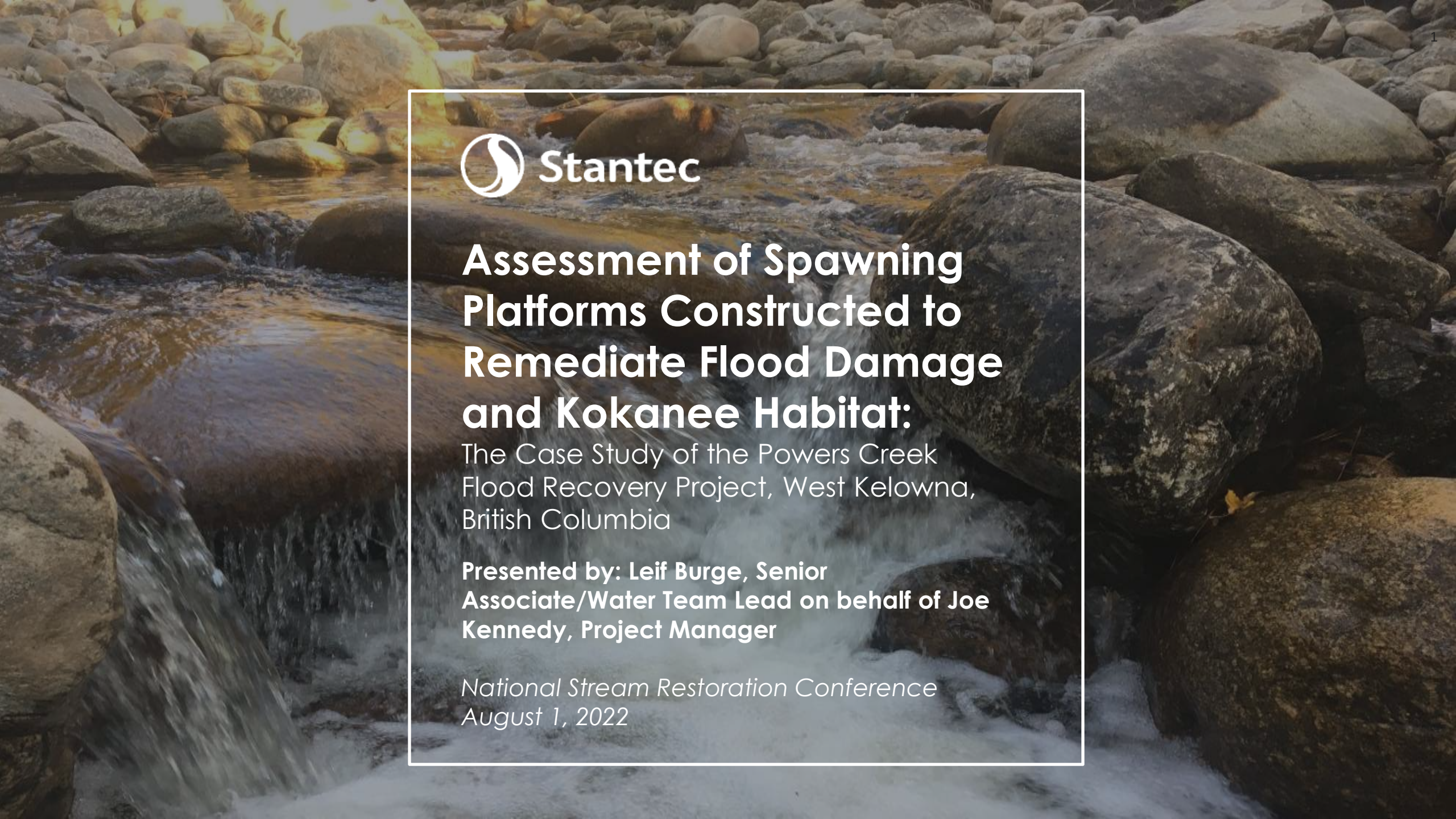

Stantec

Assessment of Spawning Platforms Constructed to Remediate Flood Damage and Kokanee Habitat:

The Case Study of the Powers Creek Flood Recovery Project, West Kelowna, British Columbia

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National Stream Restoration Conference
August 1, 2022

Agenda

- Background and History
- Research
- Key Findings
- Q/A

Introduction

Major flooding took place in May 2017.

Damage to public infrastructure, impacts to public safety, and degradation of kokanee salmon habitat.

The City of West Kelowna initiated flood recovery in accordance with Federal and Provincial requirements.

One of the **key goals** being to design and construct kokanee spawning habitat to address kokanee salmon impacts (installation of log sills).

Powers Creek

Located along the downstream-most reach of the mainstream channel in the Powers Creek Watershed.

Drains a catchment of approximately 145 km^2 and flows into Okanagan Lake and is a controlled system with six reservoirs.

Powers Creek Treatment Plant is located approximately 7.5 km upstream of the study site.

This area has agriculture, urban development, and forestry development.

Map showing the three project reaches in Lower Powers Creek with inserts showing the flood-affected conditions within reaches (Stantec, 2018b)

Project Overview

The 2017 freshet event resulted in the deposition of material and the aggradation of the Powers Creek channel bed.

Deposition within the Lower Powers Creek channel reduced the flow capacity and caused localized flooding (Stantec, 2018b).

Based on site observations on June 12, 2018, the deposited material covered spawning areas for kokanee.

Stantec (2018a) described the deposition in Reach 3 as typical of an alluvial fan, where high bed loads from upstream coupled with low graded floodplains and slow water velocities result in the downstream deposition.

Research

This thesis presents the case study of Lower Powers Creek and asseses the restoration works, using depth, velocities, and Froude numbers to assess kokanee spawning habitat.

Assessment of spawning platforms designed and constructed using:

- Log sills
- Gravel
- Cobble

Research Questions

I

Are the spawning platforms stable (no erosion or deposition)?

II

Do the spawning platforms provide the substrate conditions appropriate for spawning kokanee?

III

Do the spawning platforms provide depths and velocities within the range of values predicted by the Habitat Sustainability Index curves provided by Ptolemy (2016)?

IV

Are the spawning beds being used by kokanee during the spawning season (September and October)?

Research Methodology

The research was comprised of two main components: a field assessment and an analysis.

Field Assessments were completed in September and October 2019 and included a channel survey and kokanee spawning assessments.

An assessment of the study site was completed September 19 to 22, 2019 to collect substrate, depth, velocity, and Froude measurements on spawning platforms 5 to 8.

Kokanee spawning count and spawning area surveys were completed between September 9 and October 8, 2019.

Analysis

The analysis was completed on the data collected in the field. The data was tabulated in spreadsheets and analyzed using Microsoft Excel and GIS (ArcMap v10.6).

The analysis was sorted into five categories:

1. **Habitat Unit Assessment:** A GIS was used to analyze the spawning platforms based on dimensional measurements.
2. **Substrate Suitability Assessment:** An analysis of the spawning platform substrate characteristics was completed based on data collected during the field assessment.
3. **Spawning Survey:** Based on the spatial distribution, clusters of high use spawning areas were identified, confirming the use of the spawning platforms by kokanee. The analysis confirms whether the spawning platforms provided preferred kokanee spawning habitat.
4. **Habitat Suitability Index Assessment:** Velocity and depth data collected from spawning platforms during the field assessment were compared to the HSI curves for kokanee developed from the Okanagan area (Ptolemy, 2016).
5. **Froude Number Assessment:** Froude numbers were calculated based on the depth and velocity measured at each cross section point and compared to river spawning preferences for sockeye salmon presented in Davis et al. (2018).

Channel Assessment Results

The channel assessment found that the spawning platforms were stable (no significant erosion or deposition) and provided the required habitat type (riffle and pool) and substrate (25 mm to 50 mm) for spawning kokanee.

Minor areas of deposition were observed in platforms 5, and sub-platforms 6-1, 6-3, and 7-2.

Deposition was observed on portions of two of the ten log sill structures (log sills 1 and 5). All ten log sills appeared to be stable, providing grade control and riffle features within each platform.

The particle size distribution measured on the channel bed at 6 of the 9 platforms had at least 50% of the particles between 25 and 50 mm. The percentage of suitable substrate between 25 and 50 mm was highest at sub-platform 7-1sp (89%) and lowest at sub-platform 6-3 (23%).

Spawning Platforms 5 and 6

Photograph showing deposition at log sill 1 in platform 5 (October 6, 2019).

Photograph showing spawning platform 6, showing sub-platforms 6-1, 6-2, and 6-3 (October 6, 2019).

Spawning Platform 7

Spawning platform 7, showing LWD in sub-platform 7-1sp (October 6, 2019).

Spawning platform 7, showing sub-platforms 7-1, 7-2, and 7-3 (October 6, 2019).

Spawning Platform 8

Photograph showing spawning platform 8 (October 6, 2019).

Spawning Count and Spawning Area Survey

The overall results indicated that all spawning platforms, except sub-platform 6-3, had evidence of active spawning.

Analyses showed that 17% (45.7 m^2) of the available 268.7 m^2 of total spawning platform area (for all platforms and sub-platforms) had evidence of spawning activity–108 individuals.

A 6.9 m^2 area with evidence of spawning activity was observed directly downstream of large woody debris in platform 5.

The greatest number of individual kokanee and areas with evidence of spawning activity were observed at platform 7-1sp with counts of 33 individuals, and areas of spawning totaling 13.4 m^2 (38.3% of the total platform area).

Habitat Suitability Comparisons

HSI scores for depth measurements showed that 20 out of 21 cross sections had scores in the excellent category (0.9 to 1.0).

Locations where spawning was observed on platforms 7 and 8 were in the good (0.7 to 0.89) or excellent (0.9 to 1.0) HSI score range.

Spawning platform 5 (cross sections 5a and 5b) showed that eight out of twenty measurements fell within the poor category (0.1- 0.39) and the none category (< 0.1) for HSI score range.

Within spawning platform 6, sub-platforms 6-1 and 6-2 showed evidence of spawning, while sub-platform 6-3 did not .

Spawning platform 7 (cross sections 7-1sp, 7-1, 7-2, and 7-3) showed a cluster of depth and velocity measurements in the good and excellent HSI score range.

Spawning platform 8 (cross sections 8-1, 8-2, and 8-3) showed that sixteen out of thirty measurements fell within the good and excellent HSI score category.

Froude Number Comparisons

Sixty five percent (65%) of the average Froude number values for each cross section fell within the preferred range for sockeye salmon (Long, Cunjak, and Newbury, 2006).

Froude Numbers were compared to the D_{50} grain size at each spawning platform (and sub-platform). The data generally fell within the preferred values for both the Froude number and substrate.

- There does not seem to be a relationship between Froude numbers and the D_{50}.
- The D_{50} is generally above 25 mm. This is likely because of the size of material used in the reconstruction was on the low range of the design material (25 to 50 mm).
- Froude numbers generally fell below 0.40.

Fifty (50%) percent of the D_{50} particle size data points were above the preferred particle size range of 25 to 50 mm. Spawning activity was identified within Froude number ranges of 0.1 to 0.5.

Based on the spawning count data and the areas identified with of spawning activity, 7-1sp performed the best out of all the spawning platforms and sub-platforms. Froude numbers ranged from 0.27 to 0.44, and D_{50} particle sizes ranged from 22 to 38 mm.

Results

The suitability of depths and velocities for spawning kokanee is well documented (Slaney, 1997; Roberge et al., 2002; Ptolemy, 2016; and, Davis, et al., 2018).

Substrate for spawning kokanee does not appear to be as well documented (Davis et al., 2018; and Stantec, 2018a).

In Lower Powers Creek, the particle sizes measured on platforms 5, 6, 7, and 8 (not including sub-platform 6-3) were generally within the preferred ranges (25 to 50 mm).

Depth and flow measurements collected from all the spawning platforms were generally within the range of HSI values from Ptolemy (2016).

Results of the research showed that the Froude numbers for kokanee have a relationship to those of sockeye salmon. Froude numbers at locations where spawning activity was documented ranged from 0.09 to 0.48. (0.2 to 0.4).

Questions?

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