AQUATIC MESOHABITAT ASSESSMENT STUDY

WEST CANADA CREEK HYDROELECTRIC PROJECT
FERC NO. 2701-NY

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DEFINITIONS OF TERMS, ACRONYMS, AND ABBREVIATIONS

Brookfield	Brookfield Renewable
cfs	cubic feet per second
Commission	Federal Energy Regulatory Commission
Erie or Licensee	Erie Boulevard Hydropower, L.P.
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
ft	foot/feet
GIS	geographic information system
GPS	Global Positioning System
ILP	Integrated Licensing Process
kW	kilowatt
MW	Megawatts
NAVD88	North American Vertical Datum of 1988
NYSDEC	New York State Department of Environmental Conservation
NYSCC	New York State Canal Corporation
PAD	Pre-Application Document
Project	FERC Project No. 2701, West Canada Creek Project
RM	River Mile
RTK	Real Time Kinematics
Relicensing	The process of acquiring a new FERC license for an existing hydroelectric project upon expiration of the existing FERC license
RSP	Revised Study Plan
SPD	Study Plan Determination
sq ft	square ft
Tailrace	Channel through which water is discharged from the powerhouse turbines
UAV	unmanned aerial vehicle or drone
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WGS84	World Geodetic System 1984
WSEL	Water surface elevation

1.0 INTRODUCTION

Erie Boulevard Hydropower, L.P. (Erie or Licensee), a Brookfield Renewable company (Brookfield), is the Licensee, owner, and operator of the existing West Canada Creek Hydroelectric Project (FERC Project No. 2701) (Project). The West Canada Creek Project consists of two developments, Prospect and Trenton, and is located on West Canada Creek in Oneida and Herkimer counties, New York. A detailed description of the Project is provided in the Pre-Application Document (PAD) (Erie 2018).

The Federal Energy Regulatory Commission (FERC or Commission) issued the current license for the Project on March 18, 1983, which expires February 28, 2023. Erie is pursuing a new license under FERC's Integrated Licensing Process (ILP) and intends to file an application for a new license with FERC before February 28, 2021. On December 11, 2018, Erie filed a Revised Study Plan (RSP), and on March 7, 2019, FERC issued the Study Plan Determination (SPD) approving the RSP with modifications. On October 31, 2019, Erie requested a revision of the Process Plan and Schedule, and on December 5, 2019, FERC granted this revision to change the Initial Study Report (ISR) filing date to March 7, 2020, to align with one year following the issuance of FERC's SPD.

As part of the study implementation and in accordance with FERC's SPD, Erie initiated consultation with agencies regarding aspects of the Project's relicensing studies. FERC identified specific topics for consultation with the U.S. Fish and Wildlife Service (USFWS) and New York State Department of Environmental Consultation (NYSDEC) regarding the Aquatic Mesohabitat Assessment, Macroinvertebrate and Mussel Surveys, Fish Assemblage Assessment, and Fish Entrainment and Turbine Passage Survival Assessment studies. Accordingly, Erie conducted consultation calls with USFWS and NYSDEC on April 18, 2019, July 16, 2019, and August 9, 2019. Documentation of this consultation was provided in the Study Progress Reports filed with FERC and distributed to the stakeholders on July 29, 2019, and October 31, 2019.

This report describes the methods and results of the Aquatic Mesohabitat Assessment Study. The Aquatic Mesohabitat Assessment Study was conducted by Kleinschmidt Associates (Kleinschmidt). The purpose of the Aquatic Mesohabitat Survey is to map the distribution and abundance of aquatic mesohabitat, quantitatively characterize the types of aquatic habitats that occur within the Project study area, and provide a basis for locating level loggers and transects, as well as identify locations for mussel, macroinvertebrate and electrofishing sampling locations.

Relative to the Aquatic Mesohabitat Assessment Study, Erie consulted with USFWS and NYSDEC (April 18, 2019) regarding the location and number of level loggers, and field survey methods, including methods to verify drone survey results. Per FERC's SPD, Erie's proposed 12.5-mile assessment downstream from Trenton to Newport impoundment was to be reallocated for a total survey length of 12.5 miles between Trenton to the confluence with Mohawk River. As agreed, to during the agency April 18, 2019 consultation call, Erie focused the detailed assessment at representative locations and those that include unique features (the location of these areas were identified as part of the consultation discussions) and then conducted general characterization of mesohabitat types for the other sections of the reaches.

Erie provided a technical memo to the USFWS and NYSDEC on July 3, 2019, summarizing the Aquatic Mesohabitat Survey field efforts, methodology, and preliminary results for the Prospect and Trenton bypass reaches and consulted with USFWS and NYSDEC on July 16, 2019 to review the preliminary results and discuss placement of water level loggers. Erie provided an additional technical memo to the USFWS and NYSDEC on August 3, 2019, and conducted a summarizing the field efforts, methodology, and preliminary results for the downstream West Canada Creek reaches. Erie conducted a consultation call with USFWS and NYSDEC on August 9, 2019, to review the preliminary results including review of the logger and transect locations for the study assessment. See consultation record in the Study Progress Reports filed with FERC on July 29, 2019, and October 31, 2019.

2.0 METHODOLOGY

2.1 STUDY AREA

In the RSP, Erie proposed that the Aquatic Mesohabitat Assessment study area include the Project bypass reaches within the existing Project boundary, and portions of West Canada Creek extending from the Trenton tailrace to the confluence of the Newport Dam impoundment. In the SPD, FERC recommended that Erie include additional study reaches downstream of Newport dam, with at least one reach downstream of Middleville, New York. FERC indicated that the total survey length of 12.5 miles proposed by Erie was adequate to characterize habitat, and to offset the extended downstream areas, by reducing the length of the survey between Trenton and Newport.

Following consultation with USFWS and NYSDEC[1], Erie revised the study area to include:

- Prospect bypass reach - extends from the toe of Prospect dam downstream to Trenton impoundment.
- Trenton bypass reach - extends from the toe of Trenton dam downstream to Trenton tailrace.
- Downstream West Canada Creek: Upper Reach - Trenton tailrace to Newport, Middle Reach - Newport to Kast Bridge, and Lower Reach - Kast Bridge to Mohawk River.

For the downstream West Canada Creek, Kleinschmidt collected general mesohabitat data for the entire reach from the Trenton tailwater downstream to the confluence with the Mohawk River in order to prevent data gaps in the general mesohabitat cover between the various sections of these reaches. In addition, Kleinschmidt deployed level loggers in the study area within the Prospect bypass reach, and downstream from the Trenton tailwater to document the extent of hydraulic change occurring between base flow and peaking flow events. Kleinschmidt collected additional information (i.e., transects) regarding the microhabitat (depth and wetted area) at those locations. See Figure 2-1 and Figure 2-2 for the location of the study reaches and logger/transect locations.

[1] See consultation record in the Study Progress Reports filed with FERC on July 29, 2019, and October 31, 2019.

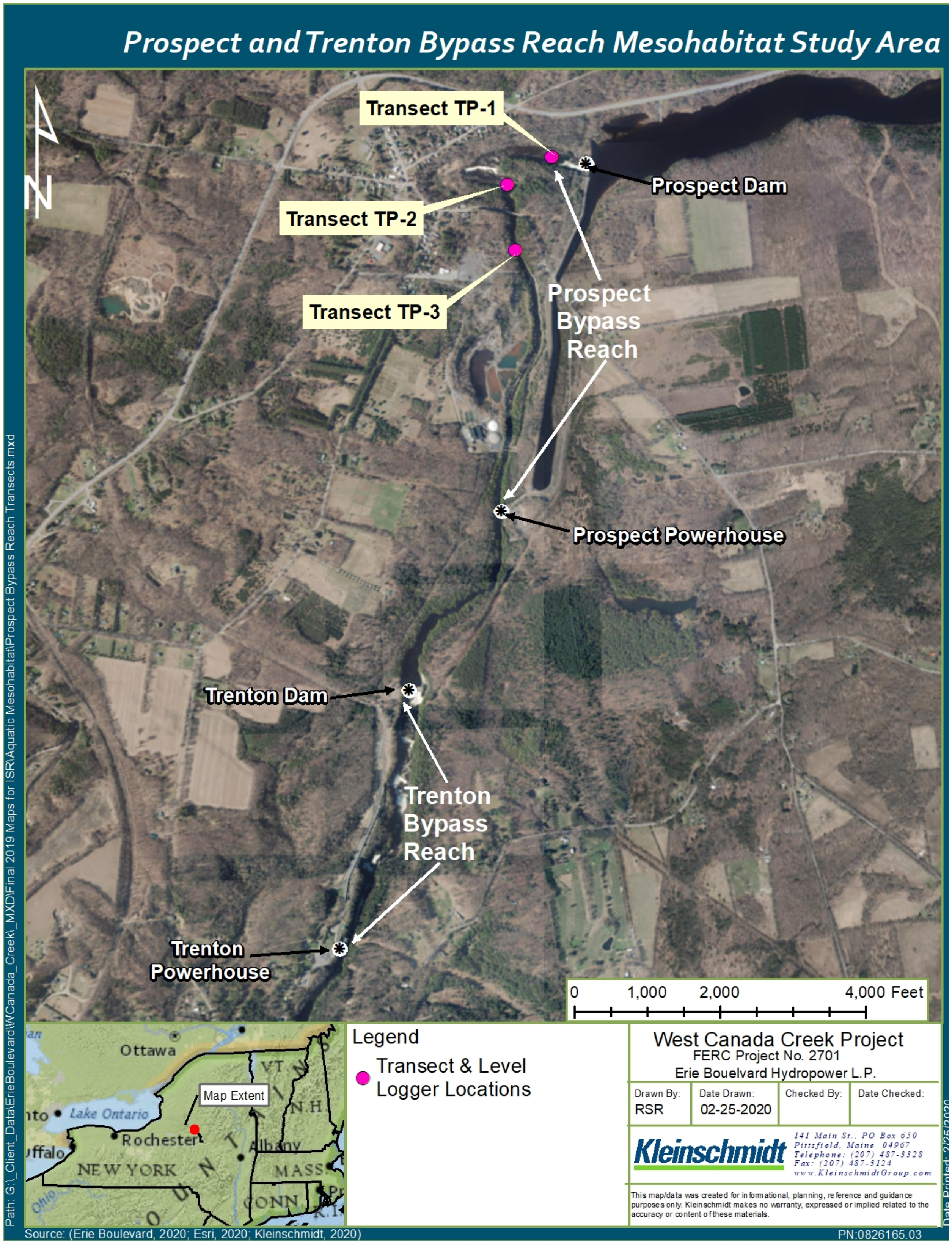


FIGURE 2-1 LOCATION OF THE PROSPECT AND TRENTON BYPASS REACH MESOHABITAT STUDY REACHES

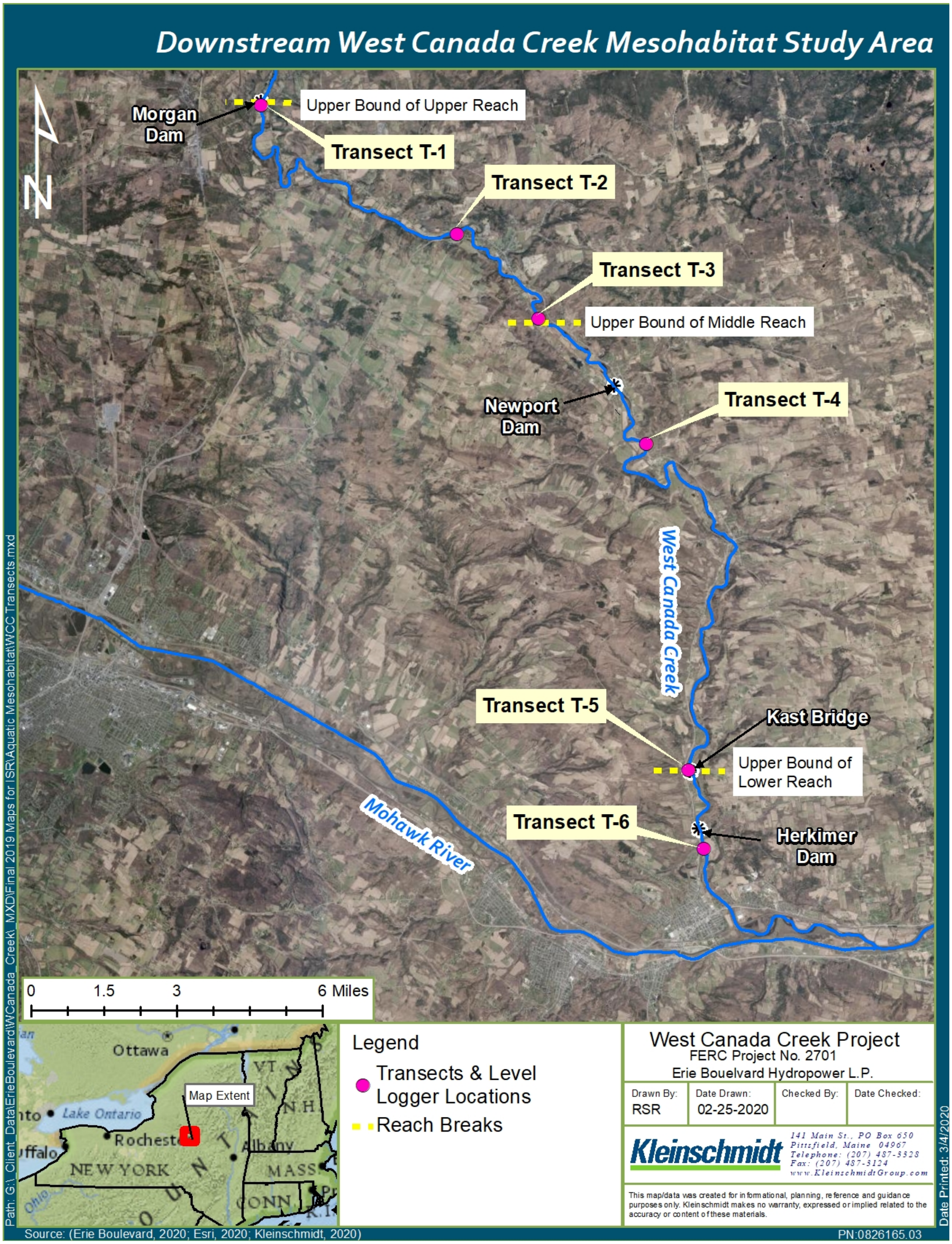


FIGURE 2-2 LOCATION OF THE DOWNSTREAM WEST CANADA CREEK MESOHABITAT STUDY REACHES

2.2 DATA COLLECTION

2.2.1 AQUATIC MESOHABITAT MAPPING

2.2.1.1 PROSPECT AND TRENTON BYPASS REACHES

For the Prospect and Trenton bypass reaches, data were collected via an unmanned aerial vehicle (UAV or drone) survey, on May 29 and 30, 2019, with flow in the bypass reaches held to leakage to allow stream channel features to be clearly visible. Both lighting and water clarity quality were suitable for viewing. A DJI model Phantom 4 Real Time Kinematic (RTK) (DJI 2019) was deployed, equipped with a high-resolution camera (1 inch CMOS sensor; 20 megapixels; Lens: 84-degree field of view) and both global positioning system (GPS) and RTK geo-positioning systems to provide sub-meter spatial accuracy (Photo 2-1).

A Federal Aviation Administration (FAA)-certified (FAA 2019) drone pilot operated the aircraft assisted by a spotter to maintain line-of-sight drone contact. An experienced aquatic biologist recorded mesohabitat types, boundaries, cover quality and substrate. The drone was flown in a continuous downstream direction to the limit of visibility, after which the drone returned to home and was taken to the next consecutive downstream launch location.

Prior to a flight, the drone was stationed over an object with a known elevation (such as a Project spillway, or decking) to calibrate altitude relative to the ground. The drone was generally flown at a height above ground of 30 to 50 feet, unless navigation temporarily required otherwise. This altitude provided good overall channel coverage and excellent image clarity for purposes of defining substrate particle size and cover quality. The drone was operated from upstream to downstream at a slow rate of speed, with the camera looking downward. The drone was hovered immediately above each mesohabitat boundary so that a photo could be taken to geo-locate the boundary. The photo also captured relevant substrate and cover information and recorded latitude/longitude, and altitude metadata. At least one additional photo was taken from that position looking downstream at an oblique angle to characterize the entire mesohabitat segment.

PHOTO 2-1 RTK GEO-POSITIONING SYSTEM (*left*) AND DRONE DEPLOYMENT (*right*).

The pilot and the biologist monitored the controller video screen view as the drone moved slowly downstream. The photo and geolocation process was repeated each time a significant change in dominant substrate, cover type and quality, or the boundary with the next mesohabitat type was encountered. For each section the pilot and biologist noted the mesohabitat types, dominant substrates, cover types, and cover quality based on direct observation and professional judgement.

A handwritten data sheet was used to record each individual photo, and summarize the relevant mesohabitat type, substrate and cover as observed during the flight. Data were downloaded to a laptop computer for detailed review at the end of each day's survey; and latitude and longitude of each photo was entered in ArcMap and viewed to independently verify spatial accuracy.

2.2.1.2 WEST CANADA CREEK DOWNSTREAM REACHES

For the downstream reach (West Canada Creek from Trenton tailrace to confluence with Mohawk River) data were collected from July 9 through 11, 2019, via traditional methodology (float trip). Data were collected when the discharge of the Project was set daily at 500 cubic feet per second (cfs) or less, which resulted in flows no higher than 700 cfs (due to cumulative tributary inflow) occurring further downstream at the Kast Bridge U.S. Geological Survey (USGS) gage (01346000). This flow was high enough to facilitate safe and efficient navigation, but low enough to be wadable in shallows, enabled distinct breaks in mesohabitat units to be readily observed, and substrates to be viewed. Lighting and water clarity were suitable for viewing.

Two aquatic biologists traversed West Canada Creek in a 15-foot canoe, and recorded data using a Trimble Geo 5T handheld GPS unit equipped with a data dictionary to record menu-driven habitat information. The canoe was paddled in a downstream direction and paused at each mesohabitat boundary to collect a boundary waypoint. The canoe was maneuvered broadly through each segment so that dominant substrate could be characterized.

Substrate was visually observed through a combination of viewing scope, wading, and/or by probing deeper areas with a 6-foot rod. It was occasionally not possible to define substrates in deep pools, in which case "unknown" was recorded. At the end of traversing each mesohabitat unit, the crew discussed and agreed to which substrate(s) were dominant and recorded the information prior to entering the next unit. A handwritten data sheet and large-format river charts were used as field aids to record each individual habitat unit observed during the float. Mesohabitat segments were field-referenced to the nearest 0.1 river-mile (RM) as indicated on the charts, with RM 0.0 being the confluence of West Canada Creek with the Mohawk River downstream from Herkimer, New York.

2.2.1.3 CLASSIFICATIONS

For all of the reaches (Prospect and Trenton bypass reaches and the downstream reaches), mesohabitat substrate types were classified according to the following categories:

- Pool – placid, slow flowing, well-defined hydraulic control;
- Riffle – fast flowing, broken or turbulent water surface, no hydraulic control;
- Run – moderate flowing, unbroken, shallow (less than 3-feet-deep), hydraulic control;
- Run-riffle complex – runs contiguously bracketing short, low-gradient riffles that would be submerged into the adjacent runs at higher flows;
- Run-pool complex - an alternating run and pool sequence with gradual, rather than sharply defined boundaries that may shift somewhat at different flows;

- Glide – fast/moderate flowing, deep, hydraulic control;
- Minor – these included high-gradient rapids, and other features that were small in area or uncommon features;
- Ledge – areas of expansive horizontal bedrock; and
- Drop – small, sharp vertical wall that is too small to be classified as a waterfall.

In addition, dominant substrates in each habitat type were classified using the Brusven substrate scale (Bovee 1982)[2]., as follows:

- Fines – sand and smaller;
- Small gravel – particles 4-25 millimeters (mm) across;
- Medium gravel – particles 25-50 mm across;
- Large gravel – particles 50-75 mm across;
- Small cobble – particles 75-150 mm across;
- Medium cobble – particles 150-225 mm across;
- Large cobble – particles 225-300 mm across;
- Small boulder – particles 300-600 mm across; and
- Large boulder – particles > 600 mm across.

Cover types were also classified and included the following categories: object cover (included boulders, logs, snags, etc.); turbulence/foam; depth; and/or overhead (included tree canopy, undercut bank, overhangs). Cover quality was qualitatively classified as: high quality cover (typically dense boulders, logs, pool depth greater than 4 feet, and/or tree canopy); low - nonexistent cover (exposed ledge, scattered or small boulders and cobbles, and pools less than 1 foot deep); and medium cover (intermediate between the other two categories).

2.2.2 LEVEL LOGGERS

In the SPD, FERC recommended that Erie deploy water level loggers from July 1 through September 30, set the loggers to record every 15 minutes. Level logger data were used to build stage-discharge relationships at mesohabitat transect locations, so that changes in mesohabitat

[2] The Brusven scale (Bovee, 1982) is a modification of the originally-proposed Wolman scale (Wolman 1954) that classifies gravels and cobbles into subcategories compatible with most Habitat Suitability Indices used in instream flow studies.

wetted area and depth could be calculated. Level logger deployment duration was intended to capture a sufficient range of flow-related water level changes to build the curves.

Onset model HOBO Water Level (13 feet) - U20L level loggers were deployed at six locations in the downstream reach of West Canada Creek between July 1 through September 30, at the locations indicated for the water quality data loggers. The level loggers recorded continuous stage data (15 minute increments) in near proximity to where habitat transect data were gathered. Deployment included encasing the logger in a perforated polyvinyl chloride (PVC) stilling basin which was affixed to a concrete cinderblock in a vertical orientation. Each cinderblock was secured to the shoreline using a ¼-inch steel cable. Deployment sites with natural features in the river that provide protection from high flows and debris, (e.g., downstream from a large boulder or shoreline escarpment) were selected to avoid gear loss or damage.

As per the RSP, Kleinschmidt deployed two level loggers within the Prospect bypass reach, one at Prospect tailrace, one at Trenton tailrace, and six downstream between Trenton tailrace and the confluence of West Canada Creek with the Mohawk River. Erie consulted with NYSDEC and USFWS on April 18, 2019, July 16, 2019, and August 9, 2019, regarding the location and number of level loggers and the transect locations. Based on this consultation, Kleinschmidt maintained the level logger locations with the exception of moving one logger that was located in P_14 where it was influenced by backwatering from the Newport impoundment, to a location slightly upstream of the Newport impoundment to RR_1 in the riffle-run complex. The USFWS and NYSDEC recommended that the upper logger in Prospect bypass reach be relocated to the Ri_2 reach or some alternative method be implemented to obtain data for this reach relative to flow levels. [3]. Kleinschmidt subsequently placed an additional level logger within the Ri_2 reach to collect additional data regarding this location. Figure 2-1 provides the locations of the level loggers in the Prospect bypass reach.

Kleinschmidt stratified logger locations among the three segments of the downstream study reach (West Canada Creek from Trenton tailrace to confluence with Mohawk River). The loggers were installed prior to July 1 per the FERC study plan determination mobilization dates. This resulted in deployment at high river flow that obscured mesohabitat details. Following

[3] See consultation record in the Study Progress Reports filed with FERC on July 29, 2019, and October 31, 2019.

review of these locations at a low flow the level logger located at RM 19.7 (located in the Newport-Kast Bridge segment) appeared to be potentially influenced by backwatering from the Newport Dam impoundment. Therefore, following consultation with USFWS and NYSDEC, Kleinschmidt relocated this level logger upstream of the Newport dam area (approximately RM 20.3), in a riffle-run complex mesohabitat, which represents over 50 percent of the mesohabitat in this segment. The other five level loggers were located in representative mesohabitats within each respective segment, and therefore, these loggers remained in their existing locations. Figure 2-2 provides the locations of the level loggers in the downstream reach.

2.2.3 MESOHABITAT TRANSECTS

A transect was located in the immediate vicinity of each level logger. Each transect and the corresponding level logger was surveyed using local datum. A tailpin and headpin was established at or above the bank crest, and a measuring tape accurate to 0.1 ft was erected between them; vertical stations were located along each transect at each point where there was an observable change in elevation, slope, substrate/cover type or velocity. Substrate information was collected at each station across each transect concurrent with the bed elevation survey. Classification of substrate was based on substrate diameter and particle size classification following Bovee (1982). A staff gage was established in the study site and monitored during hydraulic data collection to ensure that stable stream flow conditions persisted during measurements. If stream flow became unstable, measurements would cease until stability was re-established. Velocity measurements were obtained at each wetted vertical by wading, either by using an electronic Marsh-McBirney Flowmate 2000 meter attached to a top-set rod, or by using a Sontek ADCP unit tethered to the transect line and drawn laterally across the creek with bridles[4]. Mean column velocity was determined by a single measurement at six-tenths of the water depth in depths less than 2.5 feet, and the average of paired two-tenths and eight-tenths measurements for depths between 2.5 feet and 4.0 feet.

[4] The ADCP was also used to profile stream bed elevations *in lieu* of a traditional optical bed profile in some instances, such as unwadeable transects

2.2.4 GAGING OF TRENTON MINIMUM FLOW RELEASE VALVE

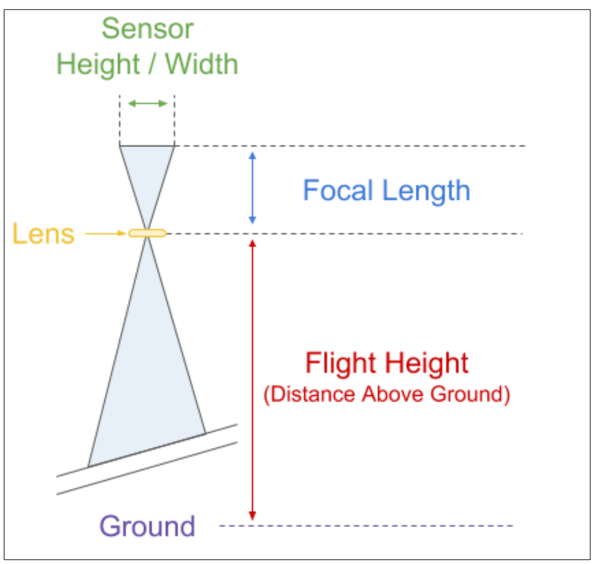
The USFWS requested a validation of the automated minimum flow release valve discharge at Trenton Station. The discharge measurements were conducted using an Acoustic Doppler current profiler (ADCP) unit. Additional discussion of data collection and results is provided in Section 3.3.

2.3 DATA ANALYSIS

2.3.1 AQUATIC MESOHABITAT MAPPING

2.3.1.1 PROSPECT AND TRENTON BYPASS REACHES

When the drone collects images, metadata is written to each image file, including but not limited to the drone's location (latitude, longitude, altitude) in World Geodetic System 1984 (WGS84). These metadata were used to georeference the photographic images by calculating the ground sampling distance (GSD) of each pixel in the image (Propeller Aero 2019). The GSD is the distance between the center points of each sample on the ground, where each sample is a pixel in the image (Figure 2-3).



Source: Propeller Aero 2019

FIGURE 2-3 RELEVANT FACTORS FOR CALCULATING GSD

The GSD for both the height (GSD_h) and width (GSD_w) of each cell were calculated and the larger value of the two is the value used to scale the image. The GSD for pixel height and width is given with:

$$GSD_h = \frac{a * h_s}{l * h_i}$$

and

$$GSD_w = \frac{a * w_s}{l * w_i}$$

respectfully, where a is height above ground in meters, h_s is the height of the (drone) sensor in millimeters, h_i is the height of the image in pixels, l is the focal length of the sensor in millimeters, w_s is the sensor width in millimeters and w_i is the width of the image in pixels (Propeller Aero 2019).

Table 2-1 summarizes the drone parameters were used in the calculations based on the metadata for the collected images.

TABLE 2-1 DRONE PARAMETERS USED IN GSD CALCULATIONS

PARAMETER	VALUE	UNITS
Image width (w_i)	5472	Pixels
Image height (h_i)	3078	Pixels
Sensor Width	13.2	mm
Sensor Height	8	mm
Focal Length	9	mm

Although each image's metadata lists a value for altitude, this value is not the flight height (distance above ground) value that is needed for the GSD calculation. To calculate the flight height (a), height above ellipsoid in WGS84 was converted to an orthometric derived geoid height in North American Vertical Datum of 1988 (NAVD88) using a geoid height calculator (Unacvo 2019).

Once altitude was converted into NAVD88, flight height (a) was calculated by subtracting the ground elevation from altitude at each location to calculate GSD for each image. A digital elevation model was created for the area using New York FEMA 2017 LiDAR (NYS GIS Clearinghouse 2019), and the resulting elevation values were extracted from the raster beneath each image's centroid or center location using the latitude and longitude values from its metadata.

Coordinates were then used to georeference the center of each image and GSD values to rescale each image within ArcGIS Pro (2019). The images were then reviewed by both a GIS technician and the biologist who collected the data. based on field data sheets, original photographs, and professional judgement to transcribe (via polygon) the boundaries of the identified mesohabitat areas on these images for further assessment of the sediment particle size.

At least 30 individual sediment grains (e.g., cobble, gravel, boulder) of observed dominant substrate were measured in each high-resolution photograph within each predefined mesohabitat area to calculate the range, mean and modal particle diameter, and classify the particles. Based on these calculations, dominant substrates in each habitat type were classified using the Brusven substrate scale (Bovee 1982). In some cases with heterogenous substrates, the two most-predominant substrate classes were assigned a relative percent dominance within an individual mesohabitat unit.

2.3.1.2 WEST CANADA CREEK DOWNSTREAM REACHES

Spatial data were downloaded and entered into an ArcView graphic information system (GIS) platform following quality assurance/quality control (QA/QC).Linear distance of each mesohabitat unit was computed to the nearest foot based on the distance between boundaries following the thread of the Creek. Relative abundance of each mesohabitat was computed as the sum of all similar mesohabitat units.

2.3.2 LEVEL LOGGERS

Downloaded level logger output (*water surface elevation*) was converted to study site elevation datum and related to discharge. Discharge at the level logger was calculated by creating a stage-discharge curve specific to each transect by means of correlation plots of discharge versus elevation from the level logger data in MS Excel. In the Prospect bypass, leakage discharge was manually gaged at the time of logger installation, including measurements of waterfall inflows in the middle section of the bypass reach. Additional spillage discharges into the bypass were obtained from Project operating records.

Outflow data from Trenton (adjusted for Morgan Dam diversion) was used for the discharge, due to the proximity of the transect to Trenton station for the downstream West Canada Creek sites, for transect 1 (immediately downstream from Morgan Dam). Transects 2 to 6 were located further downstream so that tributary inflow also influenced discharge, and thus Trenton discharge did not account for the added variability. Therefore discharges at these transects were prorated based on the ratio of the drainage area of the transect relative to that of the Kast Bridge

USGS gage (01346000). Transect drainage areas were computed using USGS Streamstats. Time series level logger and Kast Bridge USGS flow data were correlated. A-time offset of about 1 to 4 hours depending on site was readily observed; the prorated Kast Bridge flow data were then manually adjusted to match level logger data.

2.3.3 MESOHABITAT TRANSECTS

Wetted area was calculated as a function of discharge by determining water surface elevations (WSELs) at specific flow increments from the stage-discharge curve regression line associated with each transect. For the Prospect bypass, these flows included leakage (TP-1 and TP-2 at approximately 1 cfs and TP-3 at approximately 3 cfs), 10 cfs, 25 cfs, and 50 cfs. For West Canada Creek, Trenton discharges used were 160, 500, 1,000, 1,500 cfs[5]. Table 2-2 shows the estimated equivalent flow at each downstream transect relative to Trenton discharges based on the drainage area proration.

TABLE 2-2 ESTIMATED FLOW AT DOWNSTREAM WEST CANADA CREEK MESOHABITAT TRANSECTS THAT CORRESPOND TO TRENTON STATION DISCHARGES

DISCHARGE (CFS)							
TRENTON STATION	**T-1**	**T-2**	**T-3**	**T-4**	**T-5**	**KAST BRIDGE**	**T-6**
160	160	185	189	194	218	220	220
500	500	578	591	605	681	688	688
1,000	1,000	1,155	1,183	1,210	1,362	1,375	1,377
1,500	1,500	1,733	1,774	1,815	2,042	2,063	2,065

The stage-discharge curve was applied to the transect bed profile, and this produces a value for wetted width at each flow. The linear distance of the mesohabitat type within the applicable creek segment corresponding to the transect (calculated from Phase 1 mesohabitat study data) was then multiplied by the wetted width to compute wetted area at each flow increment.

Depth distribution was calculated by determining WSELs at the specified flow increments and applying those elevations to the related transect bed profile elevations along measured intervals (cells) of each transect . Depth was calculated as the difference between WSEL and bed elevation for each wetted cell width/ Depths were binned and graphed using 1-foot depth intervals. The stage discharge curves for the Prospect bypass reach transects were based on level

[5] These flow intervals were selected to represent increments spanning a reasonable range of operations.

logger WSELs collected at flows ranging from 1.2 to 600 cfs. The stage discharge curves for the downstream West Canada Creek transects were based on level logger WSELs captured at flows ranging from approximately 336 to 4,474 cfs (as measured at the Kast Bridge USGS gage and prorated for each transect).

2.4 VARIANCES FROM APPROVED STUDY PLAN

Kleinschmidt conducted additional mesohabitat mapping of the entire downstream West Canada Creek reach from Trenton tailrace to confluence with the Mohawk River (approximately 33 river miles) as compared to FERC SPD recommended 12.5 river miles.

3.0 STUDY RESULTS

3.1 MESOHABITAT MAPPING

3.1.1 PROSPECT BYPASS REACH

The Prospect bypass reach is approximately 7,131 feet (1.3 miles) long. From the spillway downstream to the Military Road bridge the reach is approximately 200-250 feet wide; the upper 0.3 miles is dominated by a continuous horizontal, smooth bedrock ledge, with pockets of pool and riffle mesohabitat types. There is a significant waterfall at the downstream end of this ledge, followed by a plunge pool and widened area composed of broken rubble, boulder cobble and other alluvial materials eroded from the banks that form a widened channel containing short braids. This area appears to be in dynamic disequilibrium, i.e., the bed materials and profile appear to have shifted periodically in response to hydraulic energy from the waterfall during periods of high flow. At a sharp bend in the river, the channel enters a bedrock-controlled gorge, which includes a deep pool complex including a short riffle that terminates at the Military Road bridge (Photo 3-1).

Below Military Road, the reach runs south in a relatively straight line, and enters a narrow bedrock-controlled channel surrounded by steep vertical canyon walls, with almost no sloping embankments. Waterfalls along the eastern embankment provide streams of groundwater inflow to the reach (Photo 3-2 and Photo 3-3). Substrates are largely bedrock ledge and scattered deposits of boulder and cobble, with few fines such as silt, sand or small gravel. Mesohabitat in this segment is predominantly alternating pools and short riffles composed of alluvial boulder and cobble/gravel overlaying bedrock substrate. The downstream 0.2 mile of this reach is a long, narrow pool that is backwatered from the powerhouse tailrace (Photo 3-4).

Of a total of 7,131 feet (1.3 miles) of bypass reach, pool and riffle comprised approximately 68 percent of the reach mesohabitat types. Minor mesohabitats such as the fall (Prospect Falls), and eroded stream below the fall, and backwatered pool above the tailrace, collectively comprise approximately 20 percent of the reach. Both run mesohabitat and the smooth horizontal ledge above the falls each occupy approximately 6 percent of the reach (Table 3-1). Pool types include a deep scour pool at the toe of the falls, and a backwatered pool at the downstream end of the bypass reach, as well as additional riverine pools scattered throughout the reach. Detailed mesohabitat, substrate and cover maps are presented in Appendix A.

PHOTO 3-1 DOWNSTREAM TERMINATION OF UPPER REACH SMOOTH LEDGE AT WATERFALL IN PROSPECT BYPASS REACH, PLUNGE POOL AND ALLUVIAL EROSION

PHOTO 3-2 GROUNDWATER WATERFALL INFLOWS TO LOWER PROSPECT BYPASS REACH

PHOTO 3-3 GROUNDWATER WATERFALL INFLOWS TO LOWER PROSPECT BYPASS REACH

PHOTO 3-4 POOL THAT IS BACKWATERED FROM THE PROSPECT POWERHOUSE TAILRACE; VIEW LOOKING DOWNSTREAM

TABLE 3-1 RELATIVE ABUNDANCE OF MESOHABITAT UNITS IN THE PROSPECT BYPASS REACH

MESOHABITAT	LENGTH (FT)	PERCENT (%) OF TOTAL
Pool	2,702	38
Riffle	2,137	30
Minor (*falls, drops, etc.*)	1,441	20
Run	446	6
Horizontal Ledge	405	6
Total	**7,131**	**100**

The 10 riverine pools are generally basin-like with vertical walls and bedrock substrate, and varied in depth, with three of them providing high quality cover due to depths greater than four feet, and three providing moderate cover quality. The 10 riffles are generally underlain with bedrock substrate strewn with cobble and boulder (Appendix A).

Substrates in the bypass reach are well scoured, reflecting the hydraulic energy of seasonal high flows; fines such as sand, silt and small gravel are not present in large quantities, ledge and bedrock comprise 58 percent of the dominant substrates found among all mesohabitat units (Table 3-2; Appendix A). The next most common dominant substrate was small boulder (18 percent).

TABLE 3-2 RELATIVE ABUNDANCE OF DOMINANT SUBSTRATES IN THE PROSPECT BYPASS REACH

SUBSTRATE	LENGTH (FT)	PERCENT (%) OF TOTAL
Ledge	4,159	58
Small Boulder	1,278	18
Medium Cobble	500	7
Small Cobble	443	6
Medium Gravel	357	5
Large Cobble	304	4
Large Boulder	89	1
Total	**7,131**	**100**

3.1.2 TRENTON BYPASS REACH

The Trenton bypass reach is approximately 3,703 feet (0.7-mile) long. From the spillway downstream, the reach is approximately 200-feet-wide. The substrate is dominated by a continuous horizontal, smooth ledge, with small pockets of pool and riffle. There are significant waterfalls (Mill Dam Falls, Upper High Falls, Lower High Falls, and Sherman Falls), each followed by a plunge pool (Photo 3-5). These falls disconnect the instream habitat as they create three terraced reaches that are fish movement barriers.

The bedrock-controlled reach runs southerly in a relatively straight line in a deep bedrock-controlled vertical-walled canyon, with no sloping embankments. Substrates are ledge and highly scoured, scattered deposits of boulder and cobble, with no fines such as silt, sand or small gravel. Mesohabitat in this segment is predominantly alternating pools separated by short, shallow riffles (Photo 3-6). The downstream 0.2 mile of this reach consists of a narrower channel with two deep riverine pools separated by a short riffle. The lower pool is somewhat backwatered from the powerhouse tailrace (Photo 3-7).

PHOTO 3-5 UPPER PORTION OF TRENTON BYPASS REACH

PHOTO 3-6 LOWER PORTION OF TRENTON BYPASS REACH, SHOWING POOL AND RIFFLE COMPLEX

PHOTO 3-7 LOWER PORTION OF TRENTON BYPASS REACH, SHOWING POOL BACKWATERED BY TAILRACE

Mesohabitat types primarily consist of alternating pool (37 percent) and riffle (24 percent) and two small runs (9 percent) separated by a short pool (Table 3-3). Miscellaneous minority mesohabitat habitat types, such as falls, comprise 30 percent of the reach. Pool types included a deep scour pool at the toe of each fall, and a backwatered pool at the downstream end of the bypass reach, as well as additional small riverine pools scattered throughout the reach. The six pools varied in depth, with three of them providing good quality cover due to depths greater than four feet (Appendix B).

TABLE 3-3 RELATIVE ABUNDANCE OF MESOHABITAT UNITS THE TRENTON BYPASS REACH

MESOHABITAT	LENGTH (FT)	PERCENT (%) OF TOTAL
Pool	1,388	37
Riffle	872	24
Minor	1,098	30
Run	345	9
Total	**3,703**	100

Substrates in the bypass reach are well scoured, reflecting the hydraulic energy of seasonal high flows; fines such as sand, silt and small gravel are not present, Ledge and bedrock comprise 85 percent of the dominant substrates found among all mesohabitat units, with the balance comprised of large and small boulders (Table 3-4; Appendix B).

TABLE 3-4 RELATIVE ABUNDANCE OF DOMINANT SUBSTRATES IN THE TRENTON BYPASS REACH

SUBSTRATE	LENGTH (FT)	PERCENT (%) OF TOTAL
Ledge	3,136	85
Large Boulder	433	12
Small Boulder	135	4
Total	**3,703**	100

3.1.3 DOWNSTREAM WEST CANADA CREEK

West Canada Creek flows south-southeasterly for approximately 33 miles between Trenton tailrace and the confluence with the Mohawk River, through rolling hills composed of rural forest, agriculture and residential land. This portion of West Canada Creek is free-flowing except for three low head dams in Barneveld, Newport, and Herkimer, New York. Downstream of the Trenton Dam (approximately 1 mile) is the Morgan Dam (Nine Mile Creek Feeder Dam). The

Morgan Dam is owned and operated by the New York State Canal Corporation (NYSCC) and is used to divert navigation flows into the Nine Mile Feeder Canal.

Approximately 13 miles downstream of the Morgan Dam is the Newport Dam associated with the Newport Hydroelectric Project which operates under an exempt FERC license (FERC No. 5196) with a 1,960-kilowatt (kW) capacity. Further downstream, approximately 26 miles below the Morgan Dam is the Herkimer Dam associated with the Herkimer Hydroelectric Project (FERC No. 9709), with a licensed capacity of 1,680 kW. West Canada Creek is dominated by low to moderate gradient slope, and alluvial substrates such as gravel, cobble and boulder. There are a few areas where the channel is controlled by bedrock, but these are infrequent and short in length. For purposes of this mesohabitat assessment it appears there are three distinct segments, including: (1) Trenton to Newport; (2) Newport to Kast Bridge, and (3) Kast Bridge to Mohawk River.

Upper Reach- Trenton Tailrace to Newport. From Trenton Development tailrace downstream to approximately two miles above Newport, the river is generally approximately 120 feet or less in width and dominated by cobble. There are distinct riffles, runs and occasional pools. Banks are generally forested with little evidence of erosion or slumping. Photo 3-8 is representative of the location downstream of Morgan Dam.

PHOTO 3-8 WEST CANADA CREEK, APPROXIMATELY ONE MILE DOWNSTREAM FROM MORGAN DAM

Middle Reach- Newport to Kast Bridge. Gradient increases in this section downstream from below Newport to Kast Bridge. At RM 22 the creek bends 90 degrees south by a ledge outcrop, descends a riffle that begins as a steep rapid and enters a reach with extensive riffles and boulder substrates. This section has several long runs punctuated by short, low-gradient riffles that are inundated at slightly higher flows, and substrates such as large cobble and boulder predominate; channel width is variable and exceeds 200 feet in places. There are occasional higher gradient steep rapids that extend for short distances. There is a USGS gage at Kast Bridge (gage no. 01346000). Photo 3-9 and Photo 3-10 are representative of the location downstream of Newport.

Photo 3-9 West Canada Creek, looking up- and downstream approximately two miles downstream from Newport

Photo 3-10 West Canada Creek, riffle complex looking up- and downstream approximately two miles upstream from Kast Bridge

<u>Lower Reach- Kast Bridge to Mohawk River</u>. Below Kast Bridge (RM 7.2) the gradient eases, boulders are less prevalent, and the creek is consistently at least 200-feet-wide. At Herkimer, the river enters the Mohawk River floodplain, confluences with a side arm of the Mohawk at RM 3.0, and abruptly follows an easterly course parallel to the Mohawk River, somewhat meandering

through alluvial lowlands. Substrates in this lowermost reach are dominated by large gravel and small cobble. Photo 3-11 is representative of the location downstream of Herkimer Dam.

PHOTO 3-11 WEST CANADA CREEK, 0.5 MILE UPSTREAM AND ONE MILE DOWNSTREAM FROM HERKIMER DAM

3.1.3.1 TRENTON TAILRACE TO CONFLUENCE WITH MOHAWK RIVER (ALL REACHES COMBINED)

The entire study area between Trenton tailrace and the confluence with the Mohawk River, is a total of 172,656 feet (32.7 miles). Most of the overall mesohabitat is comprised of run-riffle complex (30 percent), run (25 percent) and riffle (17 percent), and minor mesohabitats that include rapids and backwaters (Table 3-5). Detailed mesohabitat, substrate and cover maps are presented in Appendix C. Two re-occurring mesohabitats were encountered in addition to rapids, riffle, run, pool, glide, and backwater mesohabitats. These were riffle-run complex and run-pool complex.

PHOTO 3-12 EXAMPLE OF A SEGMENT OF A LOW-GRADIENT RIFFLE-RUN COMPLEX ON WEST CANADA CREEK

TABLE 3-5 RELATIVE ABUNDANCE OF MESOHABITAT UNITS IN WEST CANADA CREEK BETWEEN TRENTON TAILRACE AND THE MOHAWK RIVER CONFLUENCE

MESOHABITAT	LENGTH (FT)	PERCENT (%) OF TOTAL
Riffle-Run complex	51,216	29.7
Run	42,768	24.8
Riffle	29,568	17.1
Pool	19,008	11.0
Run-Pool complex	14,256	8.3
Rapids	8,448	4.9
Backwater	5,280	3.1
Glide	2,112	1.2
Total	**172,656**	**100**

Substrates are diverse, but are dominated by large, medium and small cobble (45 percent), followed by boulder (18 percent) and small gravel (8 percent) (Table 3-6). In some areas where no single substrate was dominant, large gravel and small cobble, and large cobble and small boulder were classified as co-dominant. Fines (6 percent) and bedrock (4 percent) were uncommon. Detailed mesohabitat, substrate and cover maps are presented in Appendix C.

TABLE 3-6 RELATIVE ABUNDANCE OF DOMINANT SUBSTRATES IN WEST CANADA CREEK BETWEEN TRENTON TAILRACE AND THE MOHAWK RIVER CONFLUENCE

SUBSTRATE	LENGTH (FT)	PERCENT(%) OF TOTAL
Large Cobble	40,392	23.4
Small Cobble	19,800	11.5
Medium Cobble	16,632	9.6
Small Boulder	16,368	9.5
Large Boulder	15,312	8.9
Small Gravel	14,256	8.3
Small Cobble/ Gravel	13,728	8.0
Fines	10,032	5.8
Bedrock	7,392	4.3
Large Cobble/ Small Boulder	5,280	3.1
Cobble/Fines	4,224	2.4
Cobble/Boulder	3,168	1.8
Large Cobble/ Bedrock	2,640	1.5
Unknown	1,584	0.9
Large Gravel	1,320	0.8
Medium Cobble/Small Cobble	528	0.3
Total	**172,656**	**100**

3.1.3.2 UPPER REACH -TRENTON TAILRACE TO NEWPORT

Of a total of 56,496 feet (10.7 miles) of the upper reach area run, the predominant mesohabitats are run (37 percent) and run-pool complex (25 percent); followed by pools (19 percent), and riffles (16 percent) (see Table 3-7). Glide mesohabitat is a minor feature (3 percent).

TABLE 3-7 RELATIVE ABUNDANCE OF MESOHABITAT UNITS IN THE UPPER WEST CANADA CREEK BETWEEN TRENTON TAILRACE TO ABOVE NEWPORT

MESOHABITAT	LENGTH (FT)	PERCENT (%) OF TOTAL
Run	21,120	37.4
Run-Pool Complex	14,256	25.2
Pool	10,560	18.7
Riffle	8,976	15.9
Glide	1,584	2.8
Total	**56,496**	**100.0**

Small gravel, and various sized cobbles collectively comprise 80 percent of the dominant substrates in this reach (Table 3-8). Fines contribute less than 10 percent, and large gravel, bedrock and boulders collectively contribute less than 10 percent to dominant substrates in this reach.

TABLE 3-8 RELATIVE ABUNDANCE OF DOMINANT SUBSTRATES IN THE UPPER WEST CANADA CREEK BETWEEN TRENTON TAILRACE TO ABOVE NEWPORT

SUBSTRATE	LENGTH (FT)	PERCENT (%) OF TOTAL
Small Gravel	14,256	25.2
Small Cobble	13,464	23.8
Large Cobble	9,768	17.3
Medium Cobble	7,656	13.6
Fines	4,752	8.4
Small Boulder	2,112	3.7
Bedrock	1584	2.8
Large Boulder	1,584	2.8
Large Gravel	1,320	2.3
Total	**56,496**	**100.0**

3.1.3.3 MIDDLE REACH - NEWPORT TO KAST BRIDGE

The middle reach area consists of a total of 78,144 feet (14.8 miles), the reach is comprised of riffle-run complex (Photo 3-13) (50 percent), followed by run (15 percent); riffle (14 percent); and rapids (11 percent) as the next most common mesohabitat (Table 3-9). This reflects the higher-gradient character of this creek segment. Pool and glide mesohabitats are minor features.

PHOTO 3-13 EXAMPLE OF A SEGMENT OF A LOW-GRADIENT RIFFLE-RUN COMPLEX ON THE MIDDLE REACH OF WEST CANADA CREEK

TABLE 3-9 RELATIVE ABUNDANCE OF MESOHABITAT UNITS IN WEST CANADA CREEK FROM NEWPORT TO KAST BRIDGE

MESOHABITAT	LENGTH (FT)	PERCENT (%)OF TOTAL
Riffle-Run Complex	39,072	50.0
Run	11,616	14.9
Riffle	11,088	14.2
Rapids	8,448	10.8
Pool	7,392	9.5
Glide	528	0.7
Total	**78,144**	**100.0**

Large cobble is the single most dominant substrate (23 percent) in this reach, and various sized boulders collectively comprise 36 percent of dominant substrates (Table 3-10). Fines, small cobble, bedrock, and various mixed co-dominant substrates each contribute less than 10 percent to dominant substrates in this reach.

TABLE 3-10 RELATIVE ABUNDANCE OF DOMINANT SUBSTRATES IN WEST CANADA CREEK FROM NEWPORT TO KAST BRIDGE

SUBSTRATE	LENGTH (FT)	PERCENT (%) OF TOTAL
Large Cobble	17,952	23.0
Small Boulder	14,256	18.2
Large Boulder	13,728	17.6
Medium Cobble	5,808	7.4
Bedrock	5,808	7.4
Cobble/Fines	4,224	5.4
Fines	3,696	4.7
Large Cobble/ Small Boulder	3,168	4.1
Cobble/Boulder	3,168	4.1
Large Cobble/ Bedrock	2,640	3.4
Small Cobble	1,584	2.0
Unknown	1,584	2.0
Medium Cobble/Small Cobble	528	0.7
Total	**78,144**	**100.0**

3.1.3.4 LOWER REACH- KAST BRIDGE TO CONFLUENCE WITH MOHAWK RIVER

Of a total of 38,016 feet (7.2 miles) of the lower reach area, riffle-run complex (32 percent); run (26 percent) and riffle (25 percent) are the next most common mesohabitats and are almost evenly represented (Table 3-11). Pool and backwater mesohabitats are minor features.

TABLE 3-11 RELATIVE ABUNDANCE OF MESOHABITAT UNITS IN WEST CANADA CREEK FROM KAST BRIDGE, NY TO MOHAWK RIVER CONFLUENCE

MESOHABITAT	LENGTH (FT)	PERCENT(%) OF TOTAL
Riffle-Run Complex	12,144	31.9
Run	10,032	26.4
Riffle	9,504	25.0
Backwater	5,280	13.9
Pool	1,056	2.8
Total	**38,016**	**100.0**

Small cobble/gravel is the single most dominant substrate (36 percent) in this reach, followed by large cobble (33 percent) and small cobble (13 percent); collectively these three categories account for 82 percent of dominant substrates in this reach (Table 3-12). Fines, medium cobble, large cobble/small boulder co-dominant substrates each account for less than 10 percent of dominant substrates in this reach.

TABLE 3-12 RELATIVE ABUNDANCE OF DOMINANT SUBSTRATES IN WEST CANADA CREEK FROM KAST BRIDGE TO MOHAWK RIVER CONFLUENCE

SUBSTRATE	LENGTH (FT)	PERCENT (%) OF TOTAL
Small Cobble/ Gravel	13,728	36.1
Large Cobble	12,672	33.3
Small Cobble	4,752	12.5
Medium Cobble	3,168	8.3
Large Cobble/ Small Boulder	2,112	5.6
Fines	1,584	4.2
Total	**38,016**	**100.0**

3.2 MESOHABITAT TRANSECTS

3.2.1 PROSPECT BYPASS REACH

3.2.1.1 TRANSECT TP-1 RIFFLE

Transect TP-1 is in the riffle occupying the widened section of the Prospect bypass reach between the spillway and the falls (Photo 3-14 and Photo 3-15), which is fragmented from the rest of the bypass reach. It is 202 feet in length and approximately 290 feet wide. Substrate is dominated by horizontal bedrock, with scattered well-scoured boulders deposited on top of it including a raised boulder bar. There is a well-defined channel on the river-left side of the transect.

PHOTO 3-14 VIEW LOOKING DOWNSTREAM OF MESOHABITAT REPRESENTED BY TRANSECT TP-1

PHOTO 3-15 VIEW OF TRANSECT TP-1

Table 3-13 summarizes changes in wetted area at flows between leakage (approximately 1 cfs) and 50 cfs. Wetted width occupies a relatively small cross section of the channel at all flows and increases from 34 to 57 feet. This results in a change in wetted area from 6,868 square feet to 11,514 square feet (Table 3-13, Figure 3-1 and Figure 3-2). This range of flows covers the thalweg but does not wet the raised boulder bar. Depths at both leakage and 10 cfs are two feet or less; approximately 1/3 of the width is between 2 and 3 feet deep at 10 cfs. At 25 and 50 cfs, there are slight increases in areas 2-3 feet deep (Figure 3-3).

TABLE 3-13 CHARACTERISTICS OF TRANSECT TP-1 RIFFLE

DISCHARGE (CFS)	WETTED WIDTH (FT)	LINEAR DISTANCE (FT)	WETTED AREA (SQ FT)
Leakage (1)	34	202	6,868
10	35	202	7,070
25	36	202	7,272
50	57	202	11,514

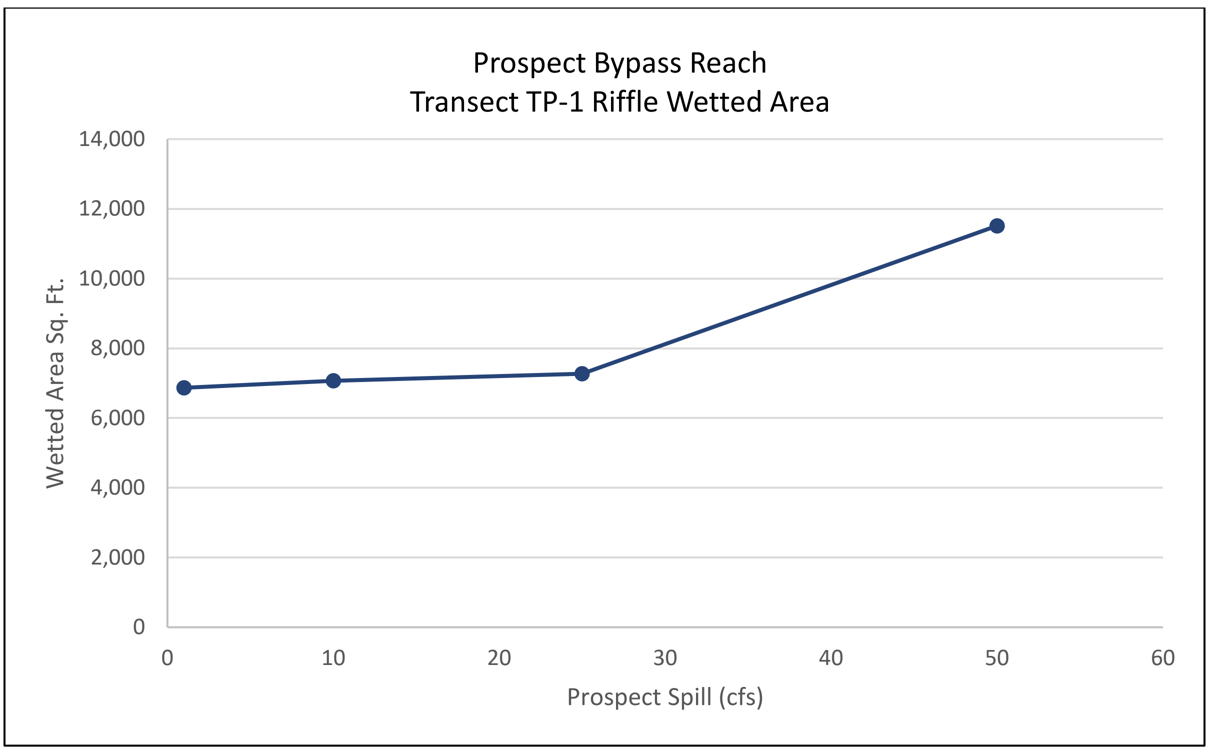


FIGURE 3-1 TRANSECT TP-1 RIFFLE WETTED AREA

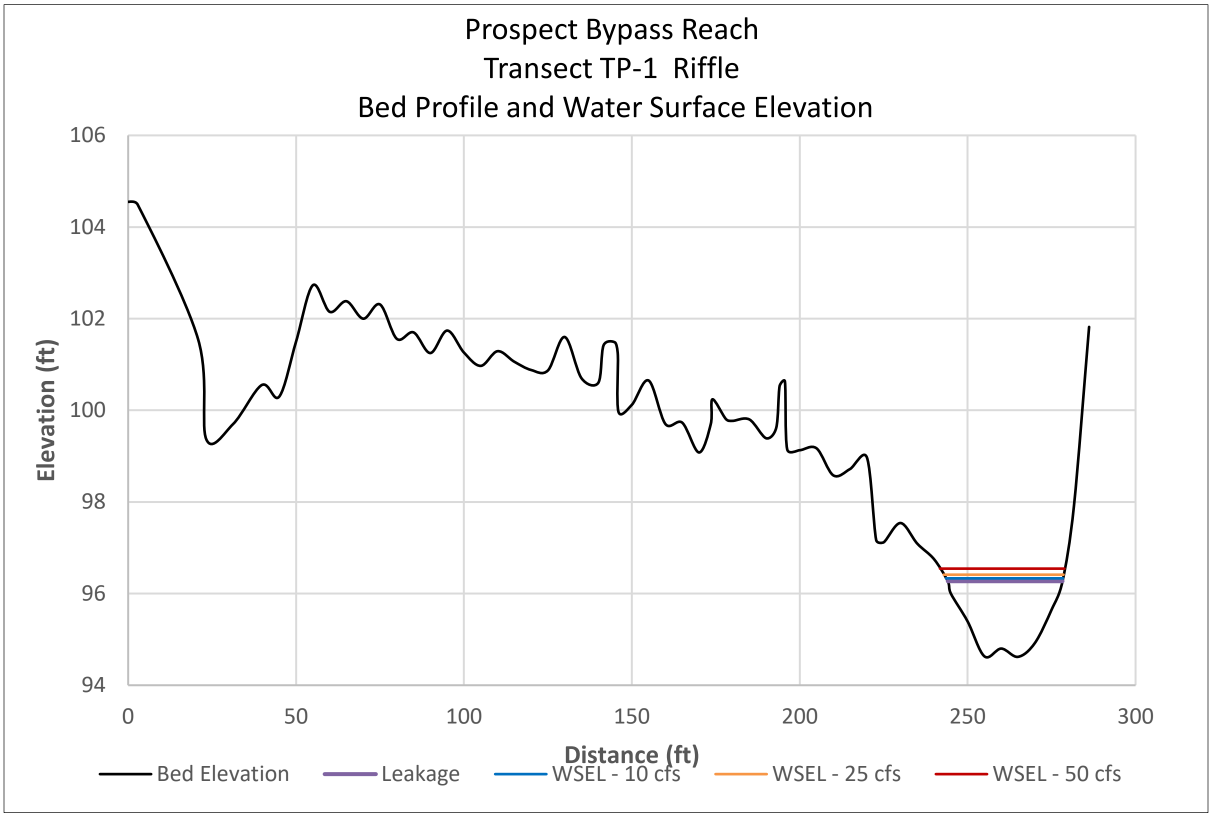


FIGURE 3-2 TRANSECT TP-1 RIFFLE BED PROFILE

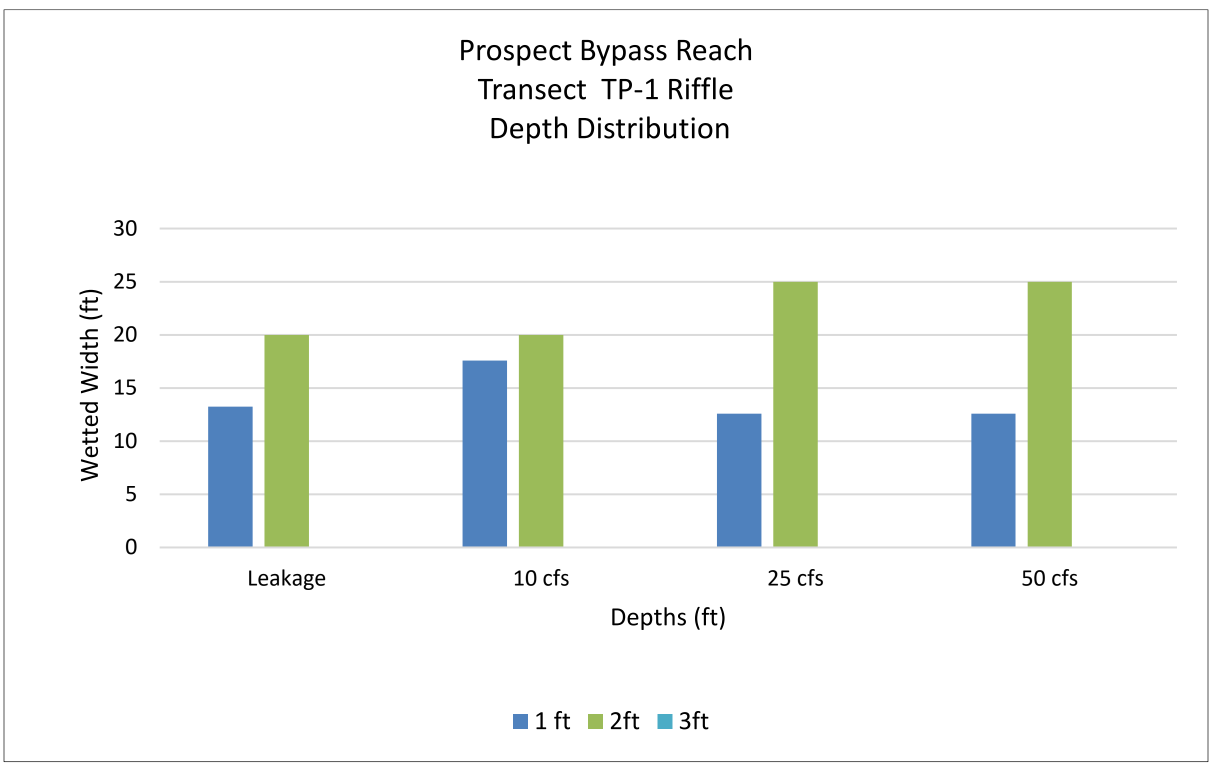


FIGURE 3-3 TRANSECT TP-1 RIFFLE DEPTH DISTRIBUTION

3.2.1.2 TRANSECT TP-2 RIFFLE

Transect TP-2 is in a riffle occupying the middle section of the bypass reach near the Military Road Bridge in an area of alternating short riffles and small pools (Photo 3-16 and Photo 3-17). It represents 369 overall feet of riffle and is approximately 107 feet wide. Substrate is dominated by bedrock, with scattered deposits of gravel, and cobble. The channel is confined by steep, near-vertical embankments.

PHOTO 3-16 VIEW (LOOKING DOWNSTREAM) OF MESOHABITAT REPRESENTED BY TRANSECT TP-2

PHOTO 3-17 VIEW OF TRANSECT TP-2

Wetted width increases from 72 to 77 feet between leakage (approximately 1 cfs) and 50 cfs. There is a relatively rapid increase in wetted area between leakage (1 cfs) and 10 cfs from approximately 26,568 square feet to 28,413 square feet, and negligible increases in wetted area at higher flows (Table 3-14, Figure 3-4 and Figure 3-5). Mesohabitat represented by this transect provide more gross wetted area at any flow than any of the other transects in the bypass reach. Depths at all flows is predominantly 1 foot or less. Between 10 and 50 cfs there are slight increases in areas 1-2 feet deep (Figure 3-6).

TABLE 3-14 CHARACTERISTICS OF TRANSECT TP-2 RIFFLE

DISCHARGE (CFS)	WETTED WIDTH (FT)	LINEAR DISTANCE (FT)	WETTED AREA (SQ FT)
Leakage (1)	72	369	26,568
10	73	369	26,937
25	74	369	27,306
50	77	369	28,413

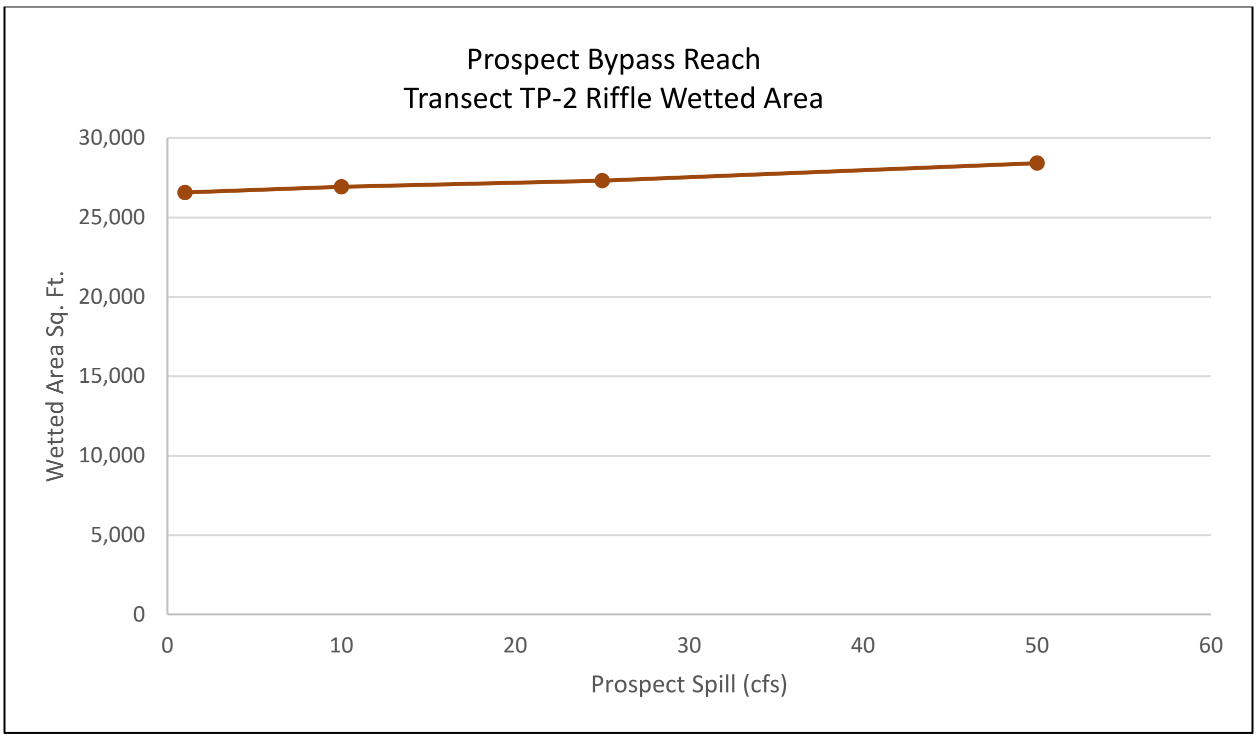


FIGURE 3-4 TRANSECT TP-2 RIFFLE WETTED AREA

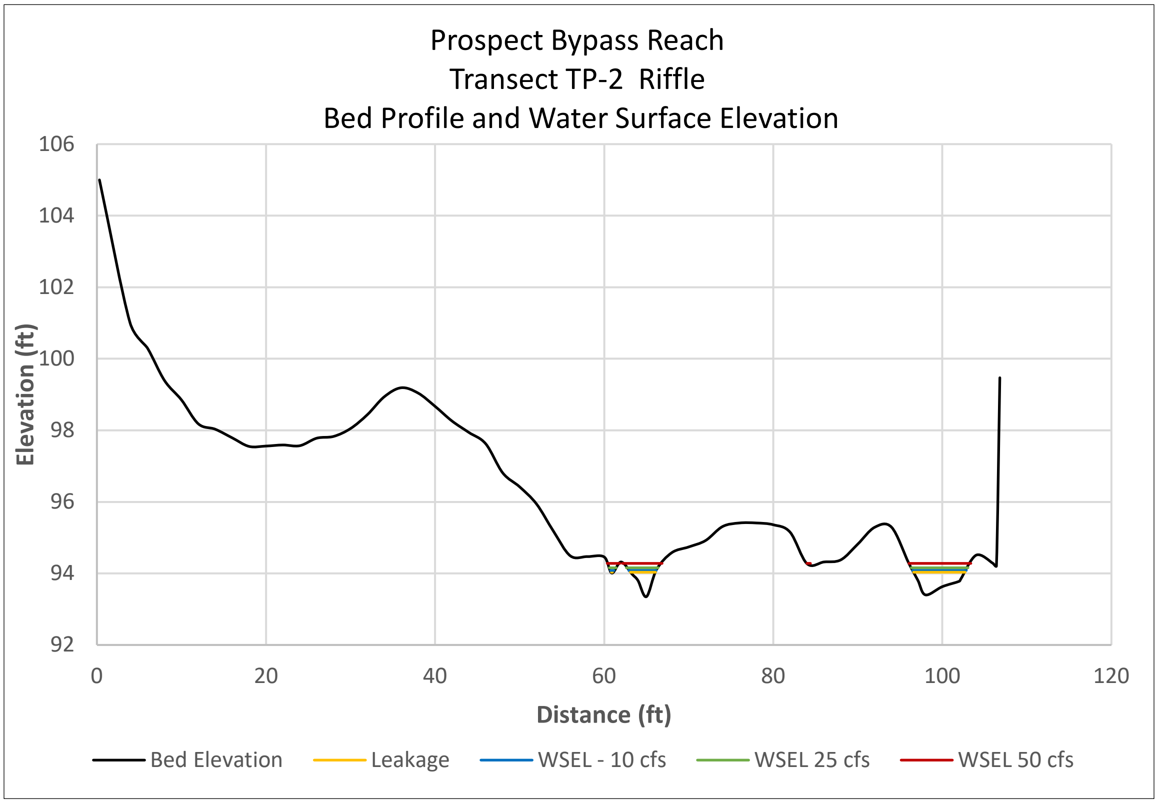


FIGURE 3-5 TRANSECT TP-2 RIFFLE BED PROFILE

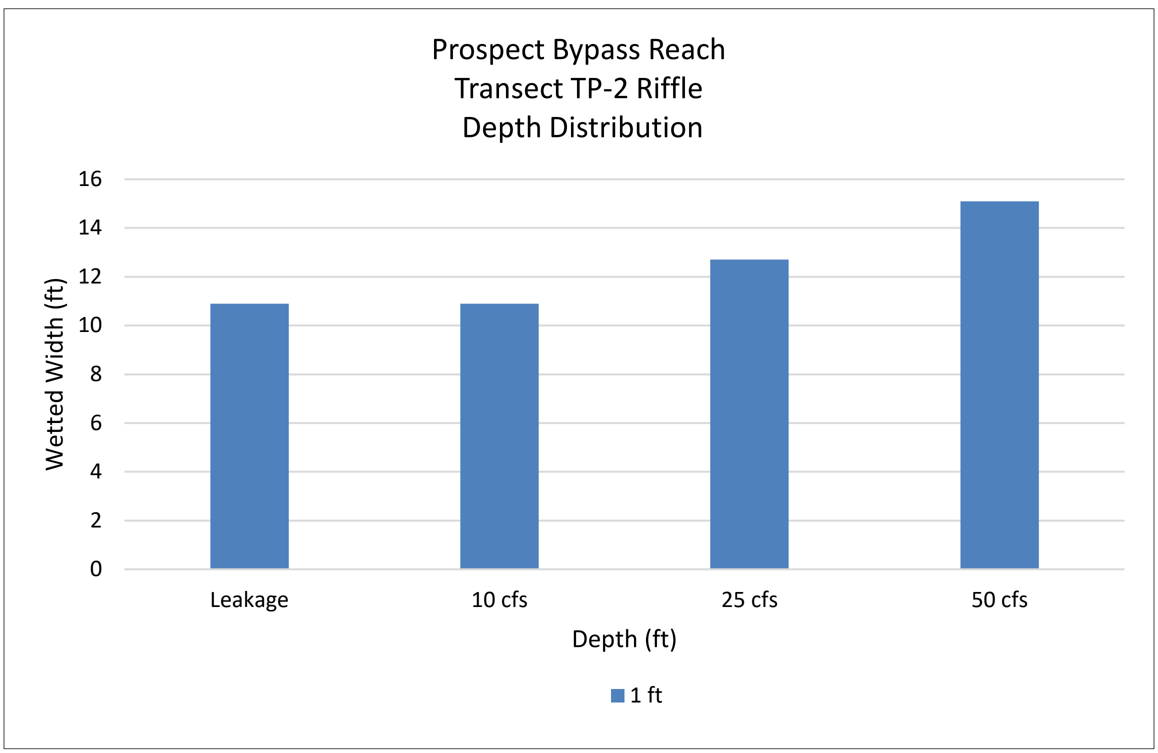


FIGURE 3-6 TRANSECT TP-2 RIFFLE DEPTH DISTRIBUTION

3.2.1.3 TRANSECT TP-3 RIFFLE

Transect TP-3 is in a riffle occupying the lower section of the bypass reach in the steep-walled gorge segment between the Military Road Bridge and the confluence with the tailrace. This area consists of alternating gravel bar riffles and pools (Photo 3-18 and Photo 3-19). It represents 1,523 overall feet of riffle and is approximately 72 ft wide. Substrate is dominated by gravel, with scattered deposits of cobble, and fines. The channel is in a canyon, confined by steep, vertical embankments.

PHOTO 3-18 VIEW LOOKING DOWNSTREAM OF MESOHABITAT REPRESENTED BY TRANSECT TP-3

PHOTO 3-19 VIEW LOOKING UPSTREAM OF MESOHABITAT REPRESENTED BY TRANSECT TP-3

In addition to discharge from the Prospect dam, this site also receives approximately 2 cfs additional inflow emanating from the river-left bluffs. Wetted width increases from 10 to 13 feet between leakage (approximately 3 cfs including additional inflow) and 50 cfs. The most rapid increase in wetted area occurs between leakage and 10 cfs but increases at a slightly reduced rate at higher flows (Table 3-15, Figure 3-7 and 3-8). Depths at all flows are predominantly 1 foot or less. Between 25 and 50 cfs there are slight increases in areas 1-2 feet deep (Figure 3-9).

TABLE 3-15 CHARACTERISTICS OF TRANSECT TP-3 RIFFLE

DISCHARGE (CFS)	WETTED WIDTH (FT)	LINEAR DISTANCE (FT)	WETTED AREA (SQ FT)
Leakage (3)	10	1,523	15,230
10	11	1,523	16,753
25	12	1,523	18,276
50	13	1,523	19,799

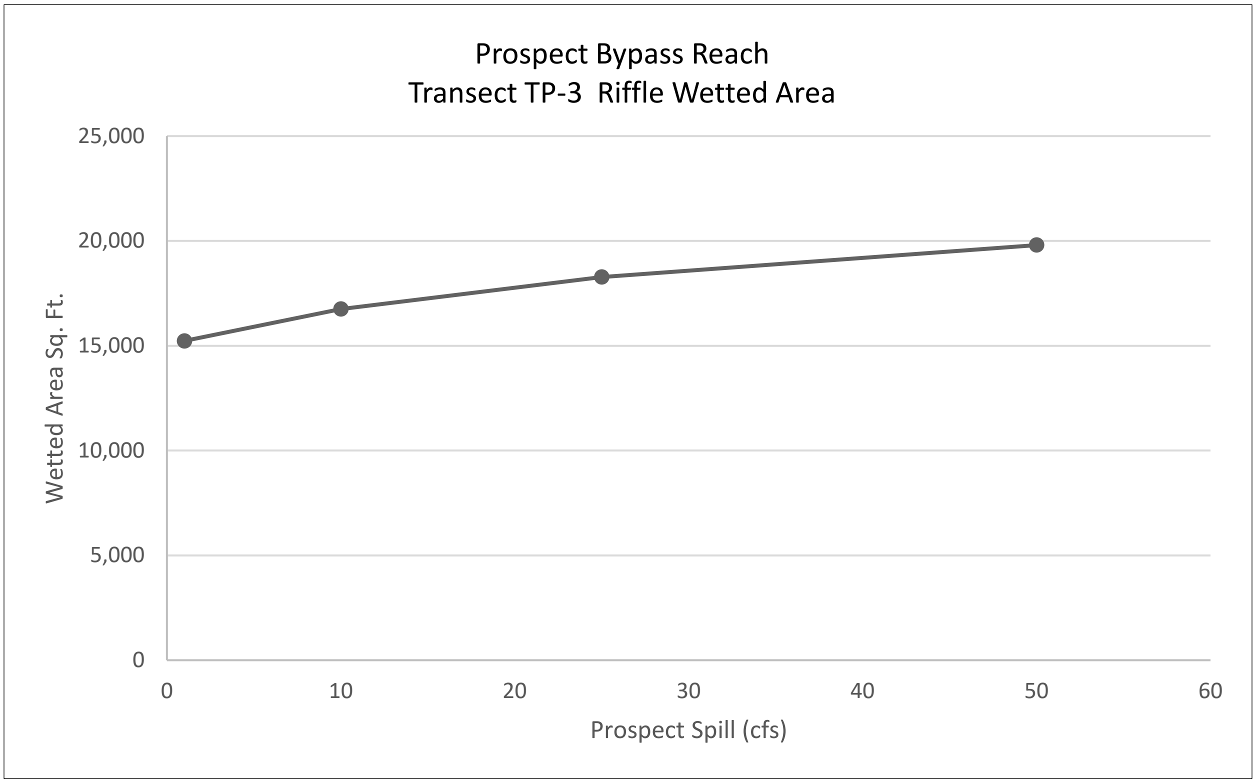


FIGURE 3-7 TRANSECT TP-3 RIFFLE WETTED AREA

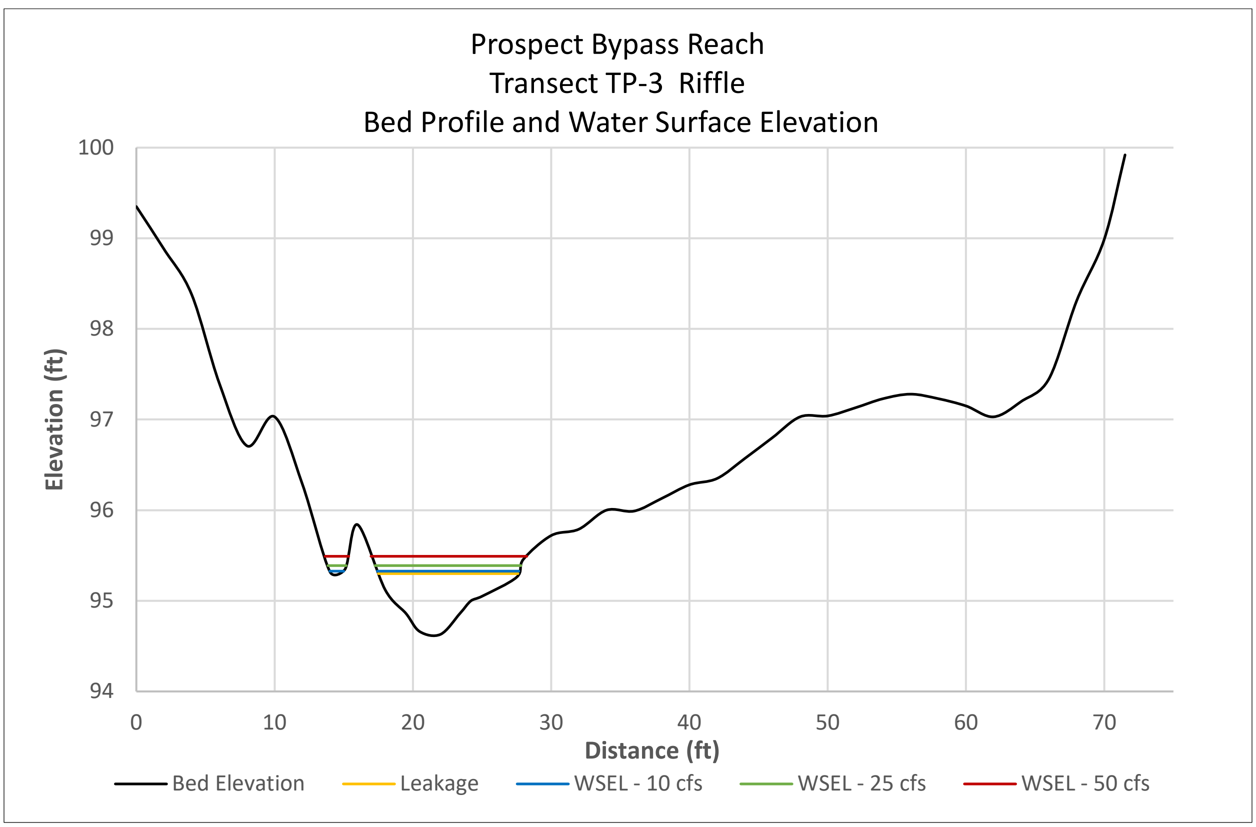


FIGURE 3-8 TRANSECT TP-3 RIFFLE BED PROFILE

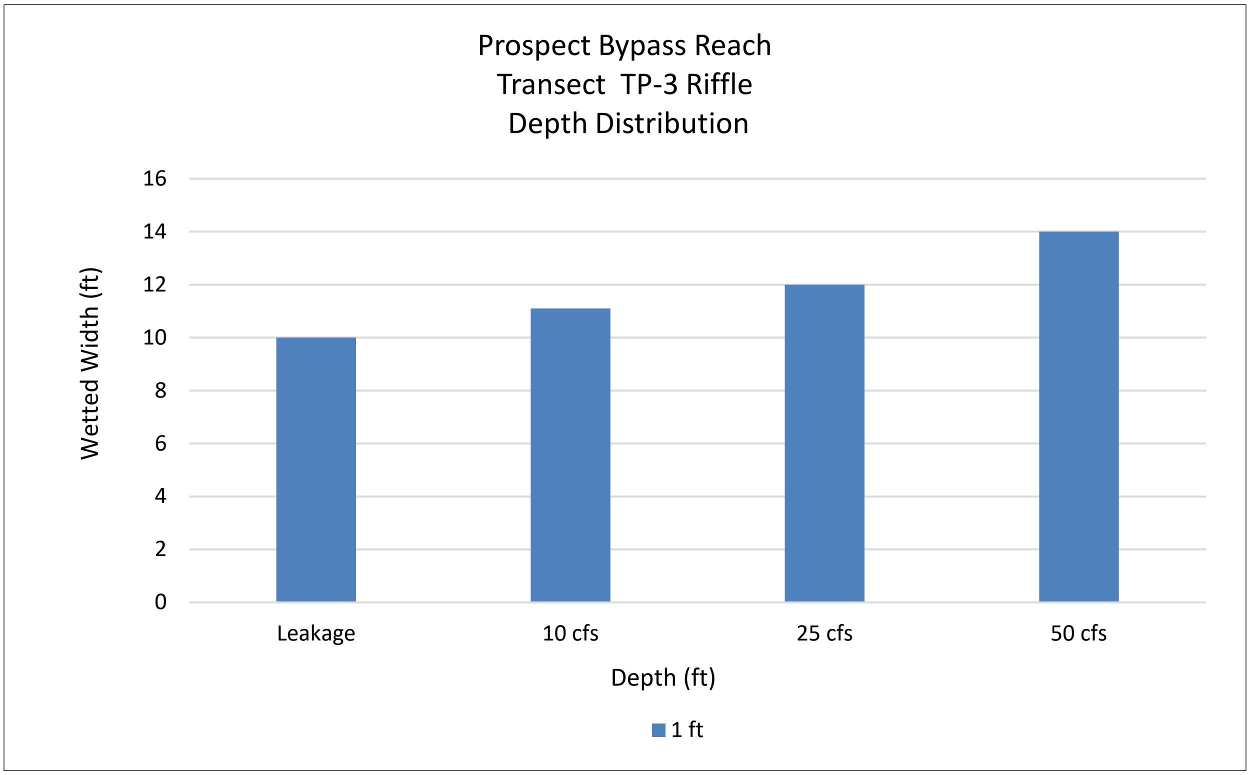


FIGURE 3-9 TRANSECT TP-3 RIFFLE DEPTH DISTRIBUTION

3.2.2 DOWNSTREAM WEST CANADA CREEK

For clarity, flows referenced are those released at the Trenton station. See Section 2.3.3 for additional information.

3.2.2.1 TRANSECT T-1 RIFFLE

Transect T-1 is the upper reach area in a riffle a short distance downstream from the Dover Road bridge below Morgan Dam. This area consists of boulder and cobble- dominated riffles (Photo 3-20) with an asymmetric cross-sectional profile and a depositional berm on the river-left side of the channel. It represents almost two miles (10,179 feet) of overall riffle mesohabitat. The transect is approximately 200 feet wide from top of bank. Substrate has scattered deposits of gravel primarily on the river-left stream margin.

PHOTO 3-20 VIEW LOOKING DOWNSTREAM, TRANSECT T-1

Wetted width increases from 83 to 152 feet between 160 and 1,500 cfs; wetted area increases most rapidly between Trenton releases of 160 and 500 cfs where there is an inflection point (Table 3-16, Figure 3-10 and Figure 3-11), and increases at a reduced rate at higher flows. Depths at flows of 160 cfs are predominantly 3 foot or less. Between 500 and 1,500 cfs there are gradual increases in areas 3-5 feet deep, with 2-3 foot depths predominating at flows of 1,000 cfs or greater (Figure 3-12).

TABLE 3-16 CHARACTERISTICS OF TRANSECT T-1 RIFFLE

DISCHARGE (CFS)	WETTED WIDTH (FT)	LINEAR DISTANCE (FT)	WETTED AREA (SQ FT)
160	83	8,393	696,619
500	126	8,393	1,057,518
1,000	142	8,393	1,191,806
1,500	152	8,393	1.275,736

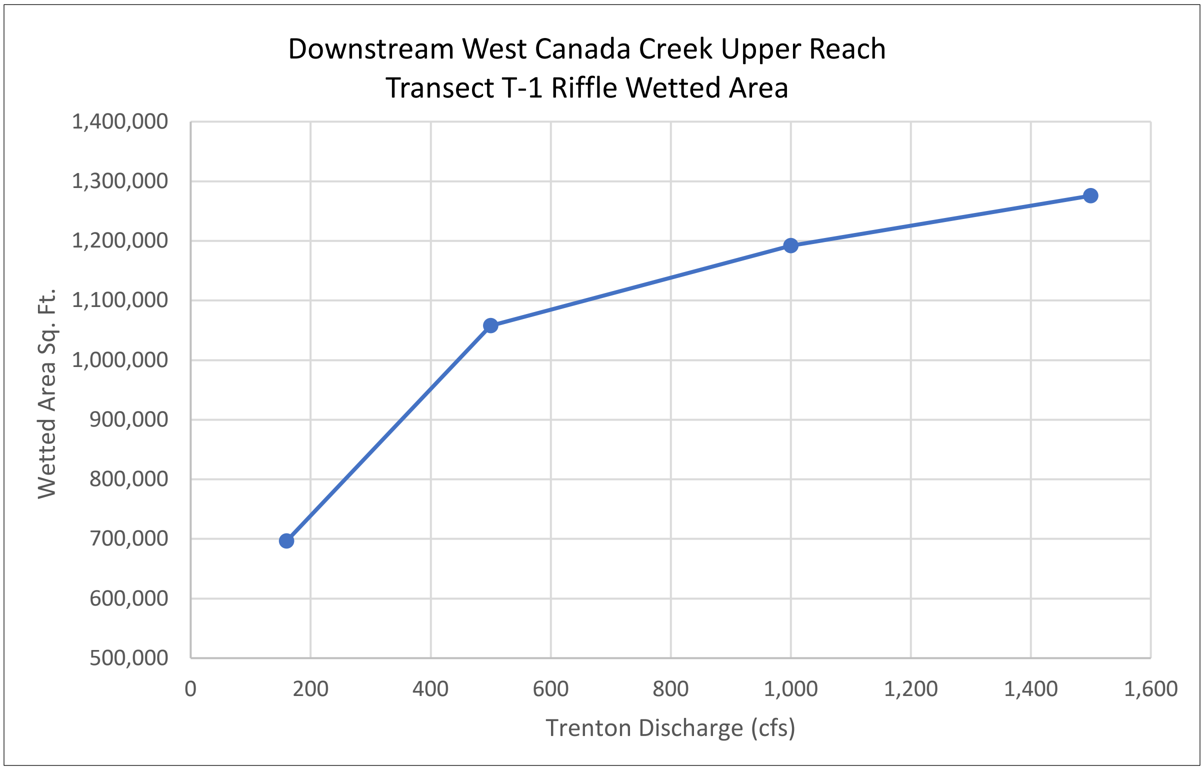


FIGURE 3-10 TRANSECT T-1 RIFFLE WETTED AREA

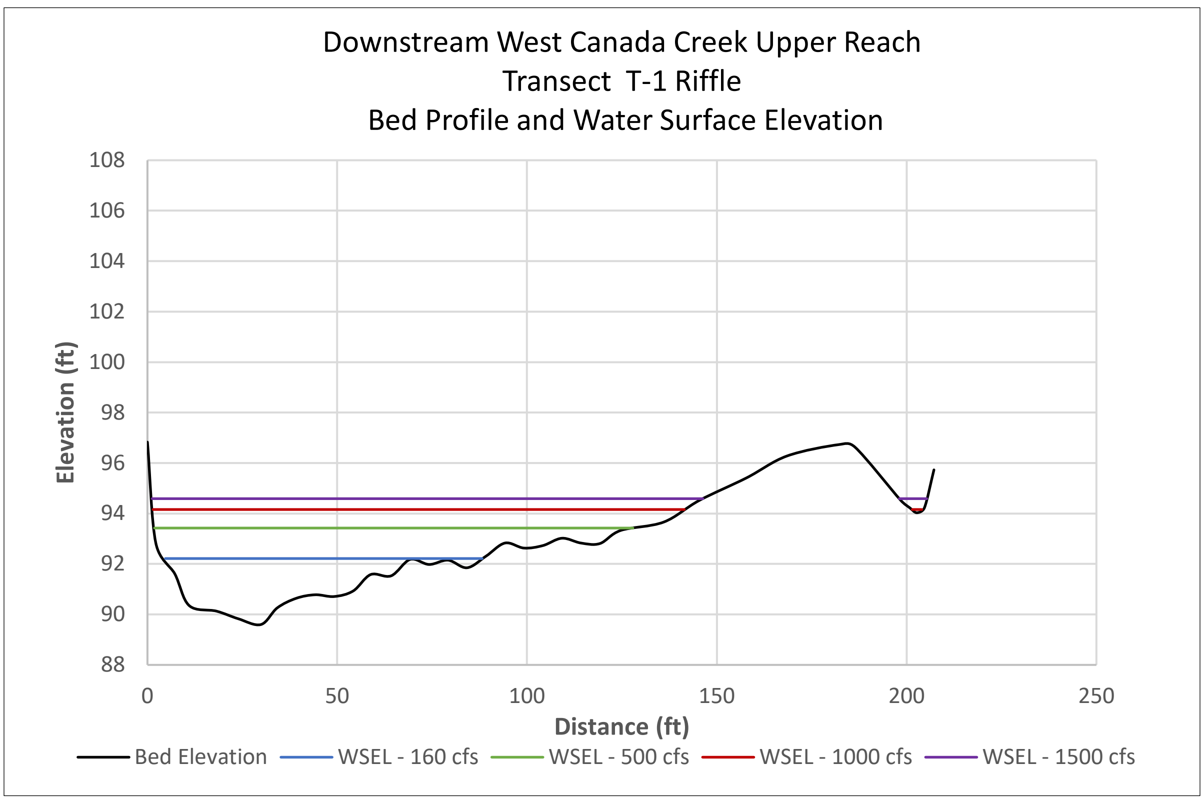


FIGURE 3-11 TRANSECT T-1 RIFFLE BED PROFILE

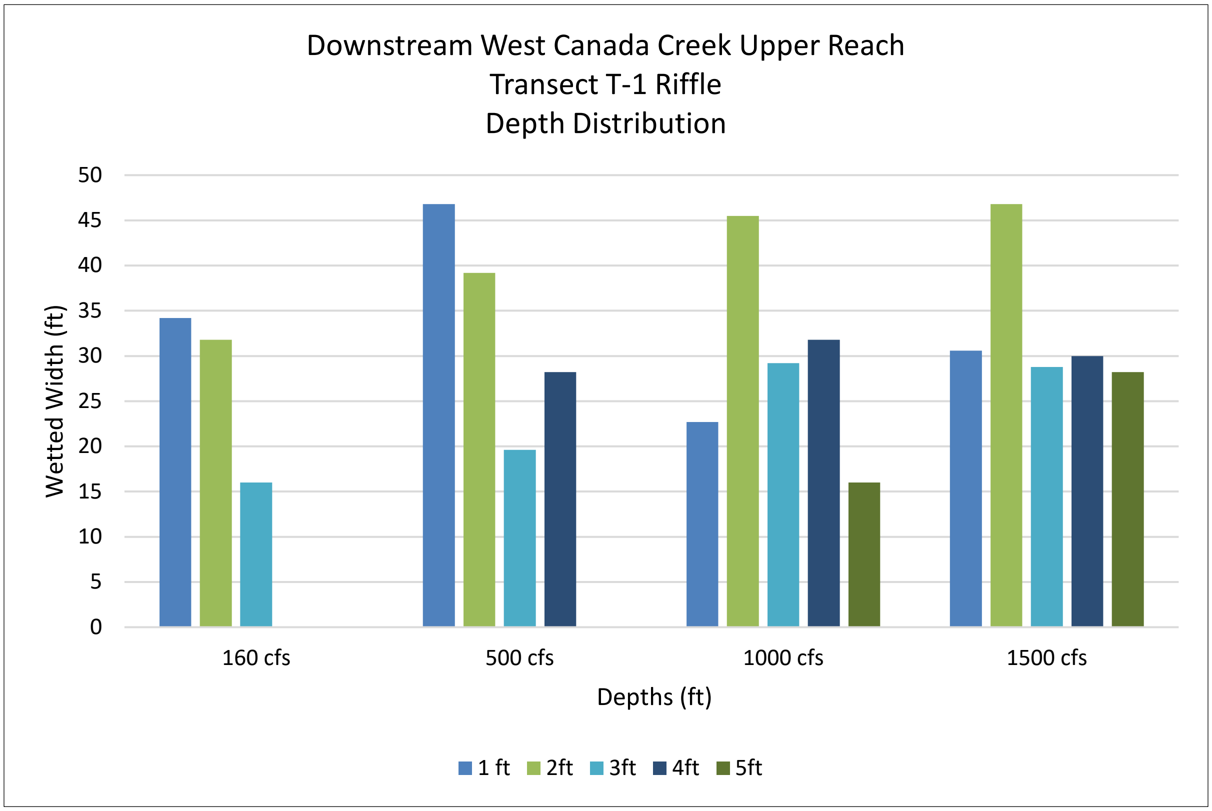


FIGURE 3-12 TRANSECT T-1 RIFFLE DEPTH DISTRIBUTION

3.2.2.2 TRANSECT T-2 RUN-POOL COMPLEX

Transect T-2 is in a low gradient run-pool complex in Poland, NY. This area consists of gravel and fines-dominated substrates (Photo 3-21). It represents approximately 2.4 miles (12,705 feet) of overall mesohabitat in this reach. The transect is approximately 250 feet wide from top of bank and features a relatively trapezoidal cross-section with steep, well defined banks.

PHOTO 3-21 VIEW OF TRANSECT T-2

Wetted width increases from 178 to 226 feet between Trenton station releases of 160 and 1,500 cfs; wetted area increases most rapidly between 160 and 500 cfs where there is an inflection point (Table 3-17, Figure 3-13 and Figure 3-14). Higher flows produce negligible increases in wetted width and area. Depths at a flow release of 160 cfs are predominantly in the 1 to 2 feet range. At 500 cfs most depths are between 1 to 4 feet. At 1,000 cfs, most depths range between 2 to 4 feet, and at 1,500 most depths are greater than 3 feet and range to 5 feet (Figure 3-15).

TABLE 3-17 CHARACTERISTICS OF TRANSECT T-2 RUN-POOL COMPLEX

DISCHARGE (CFS)	WETTED WIDTH (FT)	LINEAR DISTANCE (FT)	WETTED AREA (SQ FT)
160	178	12,705	2,261,490
500	207	12,705	2, 629,935
1,000	224	12,705	2,845,920
1,500	226	12,705	2,871,330

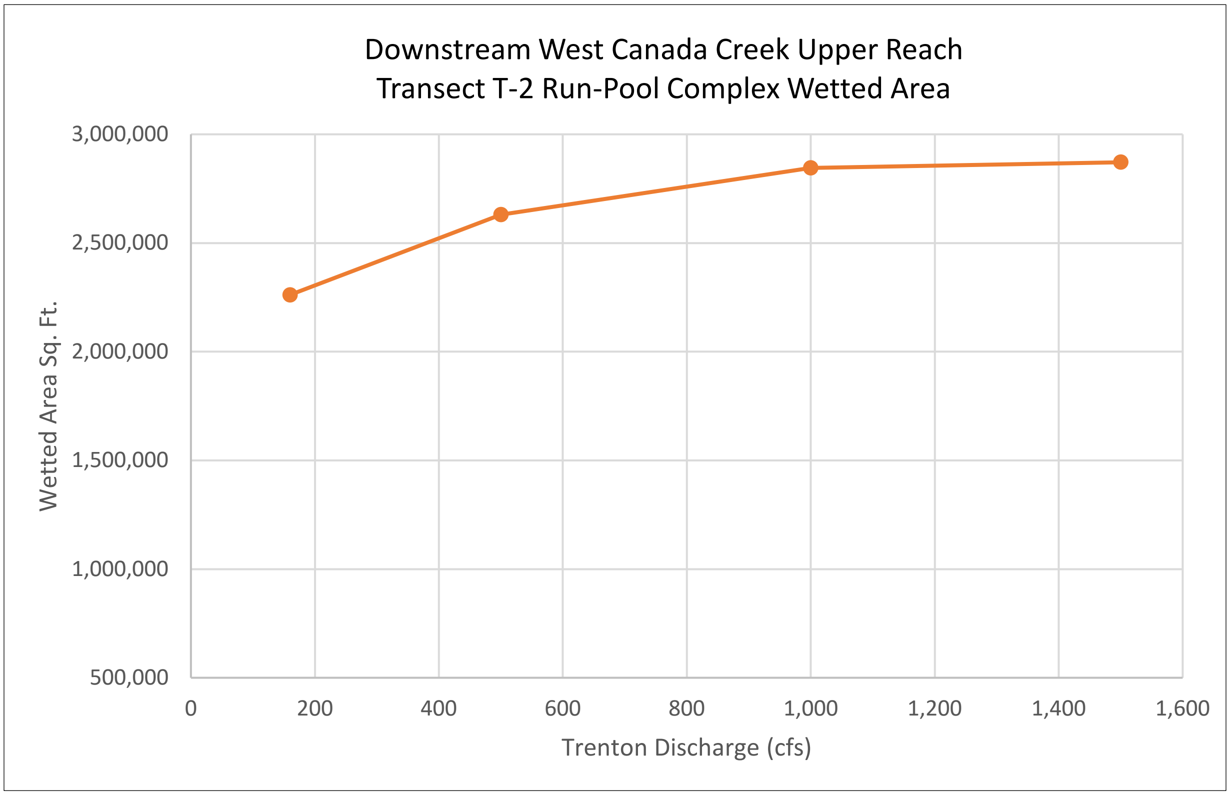


FIGURE 3-13 TRANSECT T-2 RUN-POOL COMPLEX WETTED AREA

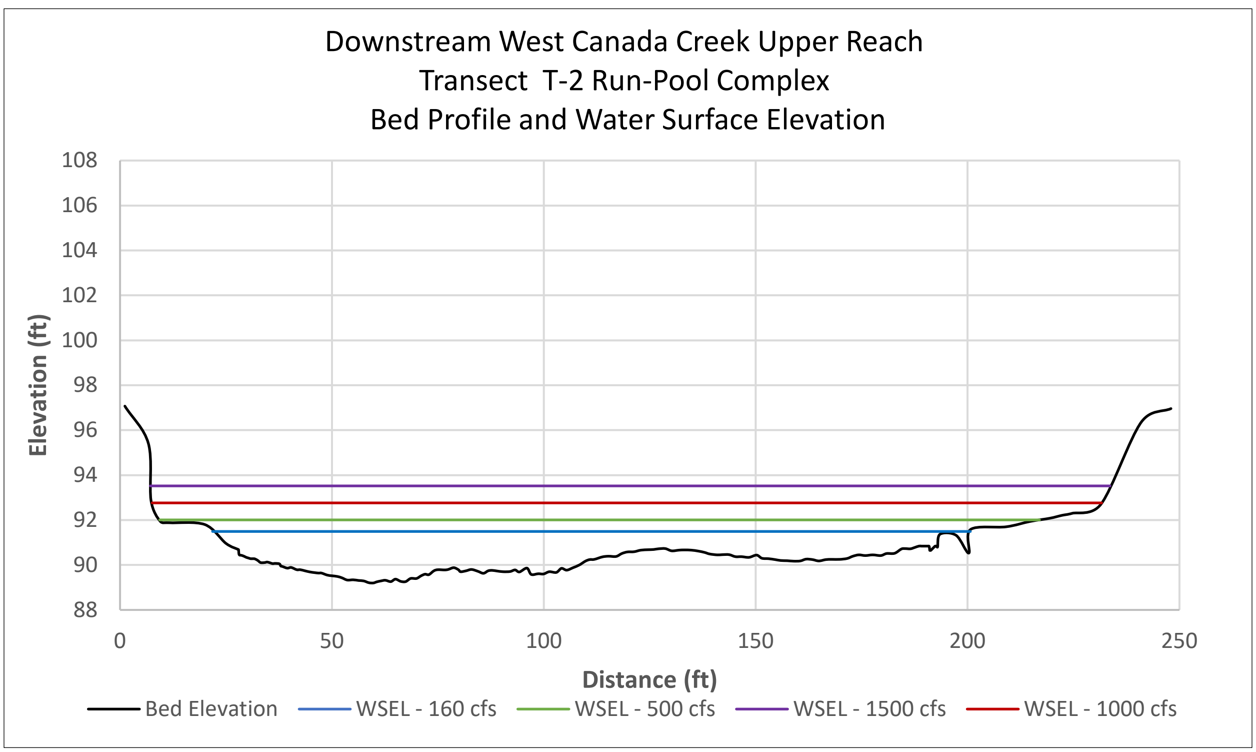


FIGURE 3-14 TRANSECT T-2 RUN-POOL COMPLEX BED PROFILE

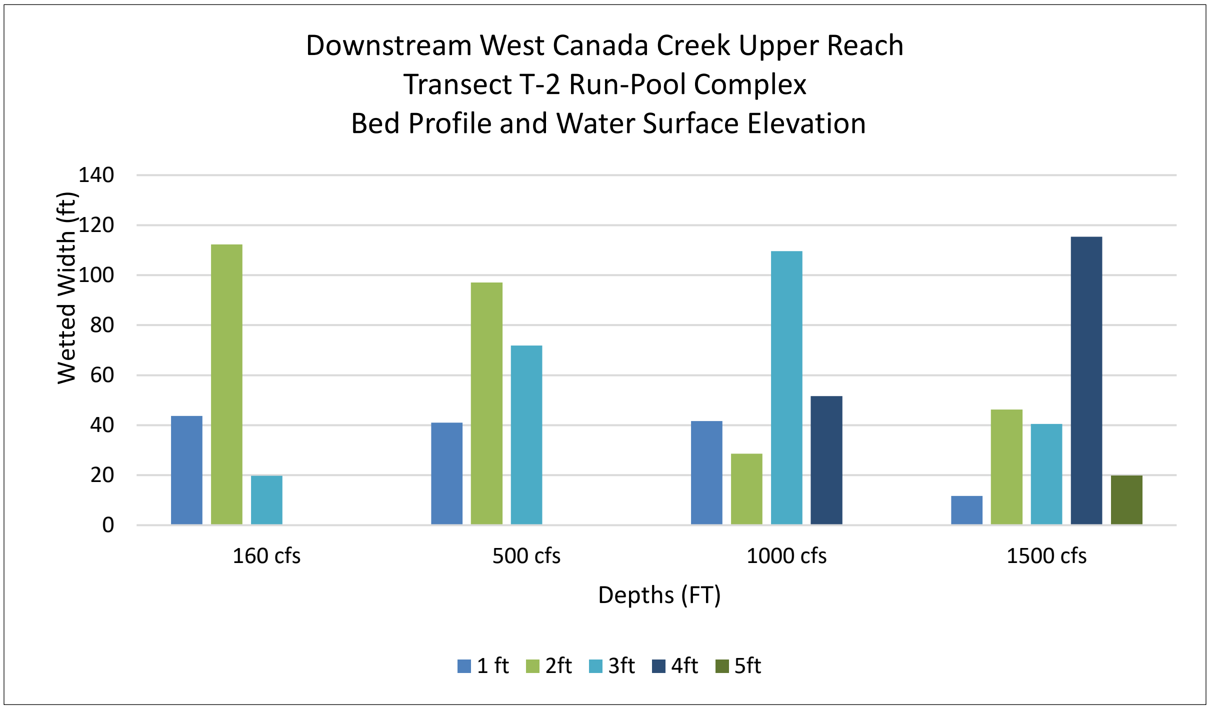


FIGURE 3-15 TRANSECT T-2 RUN-POOL COMPLEX DEPTH DISTRIBUTION

3.2.2.3 TRANSECT T-3 RIFFLE-RAPID

Transect T-3 is in a riffle/rapid approximately one mile upstream from Newport, NY. This area consists of boulder and cobble- dominated substrate (Photo 3-22 and Photo 3-23) with a trapezoidal profile. It represents more than one mile (5,313 feet) of overall riffle/rapid mesohabitat. The transect is 227 feet wide from top of bank.

PHOTO 3-22 VIEW OF TRANSECT T-3

PHOTO 3-23 VIEW OF TRANSECT T-3

Wetted width increases very slightly from 217 to 220 feet between 160 and 1,500 cfs releases; wetted area remains essentially unchanged throughout the flow range as well (Table 3-18, Figure 3-16 and Figure 3-17). Depths at a 160 cfs release are predominantly in the 1 to 2 feet range. At 500 cfs most depths are predominantly between 1 to 2 feet (Figure 3-18). At 1,000 cfs and 1,500 cfs most depths are in the 2 to 3 feet range.

TABLE 3-18 CHARACTERISTICS OF TRANSECT T-3 RIFFLE-RAPID

DISCHARGE (CFS)	WETTED WIDTH (FT)	LINEAR DISTANCE (FT)	WETTED AREA (SQ FT)
160	217	5,313	1,152,921
500	218	5,313	1,158,234
1,000	220	5,313	1,166,860
1,500	220	5,313	1,168,860

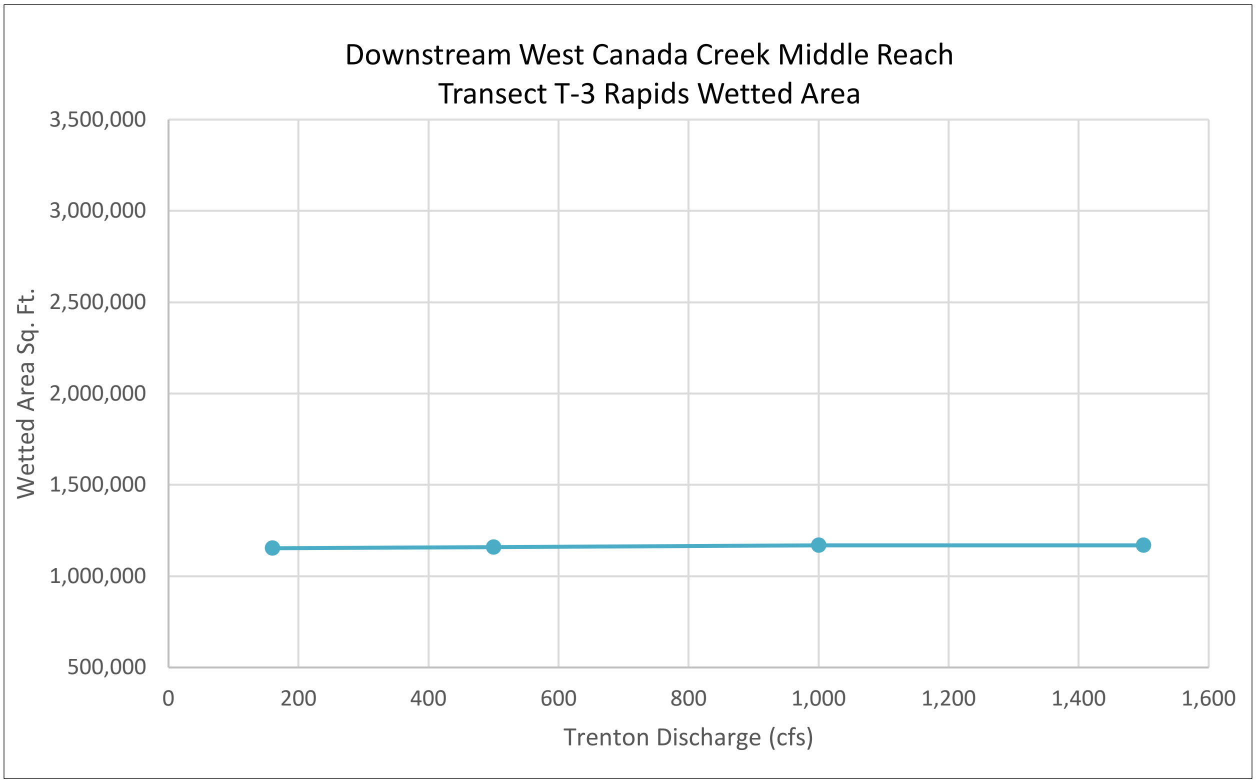


FIGURE 3-16 TRANSECT T-3 RIFFLE-RAPID WETTED AREA

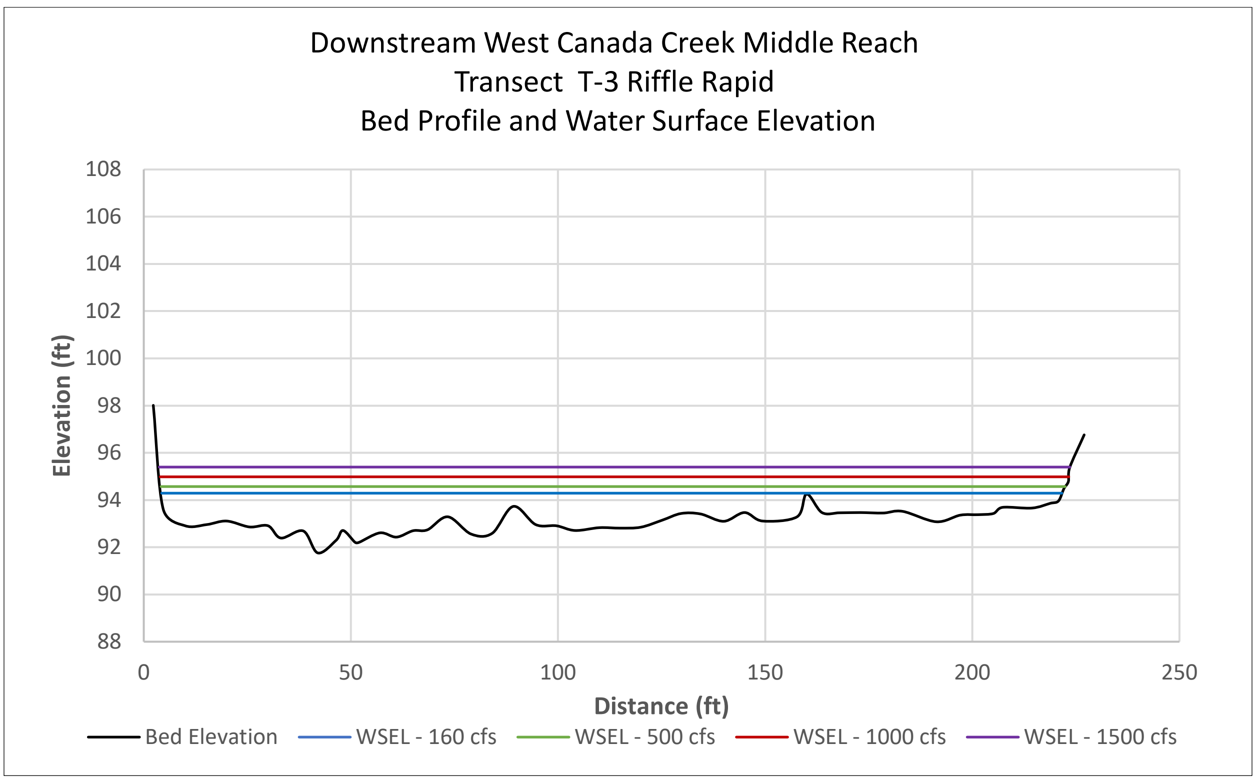


FIGURE 3-17 TRANSECT T-3 RIFFLE-RAPID BED PROFILE

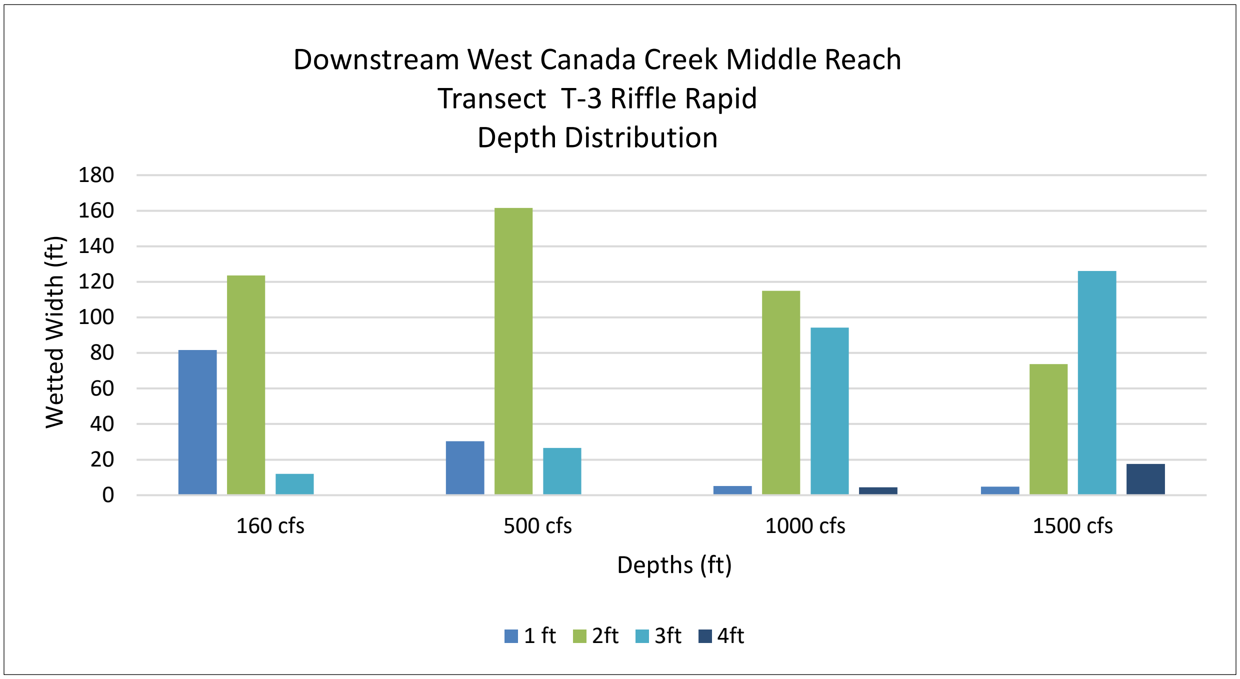


FIGURE 3-18 TRANSECT T-3 RIFFLE-RAPID DEPTH DISTRIBUTION

3.2.2.4 TRANSECT T-4 RIFFLE

Transect T-4 is in a riffle approximately two miles downstream from Newport, NY. This area consists of boulder and cobble- dominated substrate and features a wide gravel/cobble bar on the river-right bank (Photo 3-24). It represents 1.4 miles (9,246 feet) of overall riffle mesohabitat in this reach. The transect is 190 ft wide from top of bank.

PHOTO 3-24 VIEW OF TRANSECT T-4

Wetted width increases very slightly from 100 to 135 feet between 160 and 1,500 cfs releases; wetted area also increases only slightly across the flow range and very little between 150 and 500 cfs flow releases (Table 3-19, Figure 3-19 and Figure 3-20), reflecting supercritical flow (i.e., velocity increases more rapidly than depth) Depths are predominantly in the 1 up to 3-foot range; at 500 cfs depths between 3 to 4 feet predominate (Figure 3-21). At 1,000 cfs, depths 2 to 4 feet are predominant, however depths in the 1 to 2 feet range remain relatively unchanged, reflecting gradual inundation of the right-bank gravel bar. At 1,500 cfs most depths are greater than 4 feet with significant areas greater than 6 feet deep.

TABLE 3-19 CHARACTERISTICS OF TRANSECT T-4 RIFFLE

DISCHARGE (CFS)	WETTED WIDTH (FT)	LINEAR DISTANCE (FT)	WETTED AREA (SQ FT)
160	100	9,246	924,600
500	102	9,246	943,092
1,000	122	9,246	1,128,012
1,500	135	9,246	1,248,210

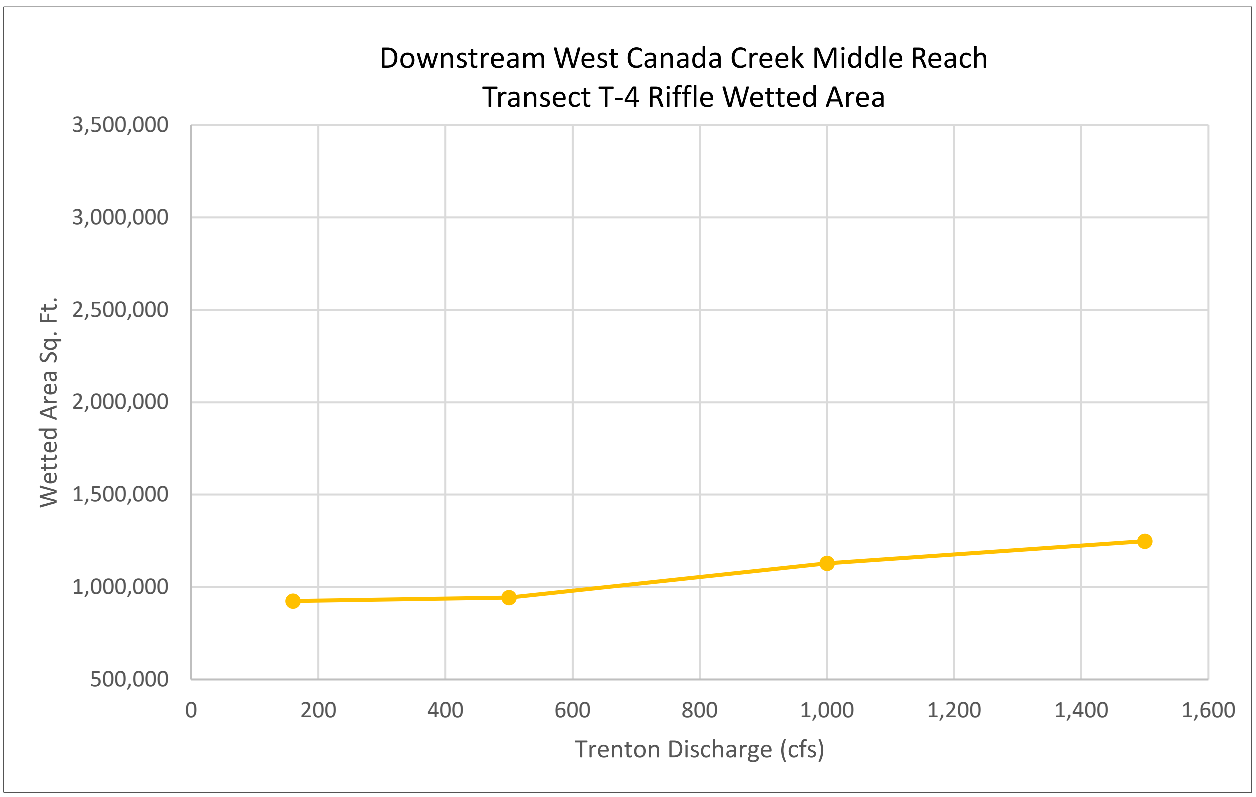


FIGURE 3-19 TRANSECT T-4 RIFFLE WETTED AREA

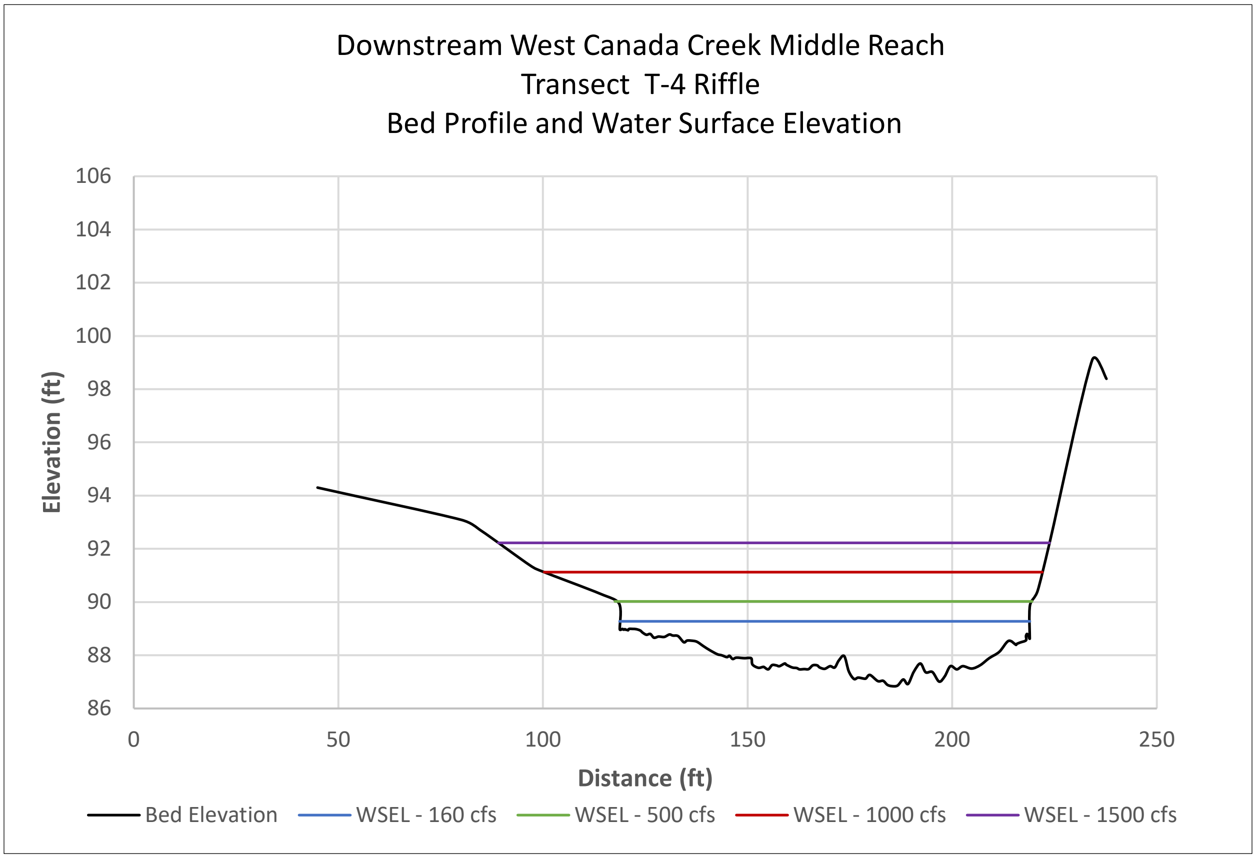


FIGURE 3-20 TRANSECT T-4 RIFFLE BED PROFILE

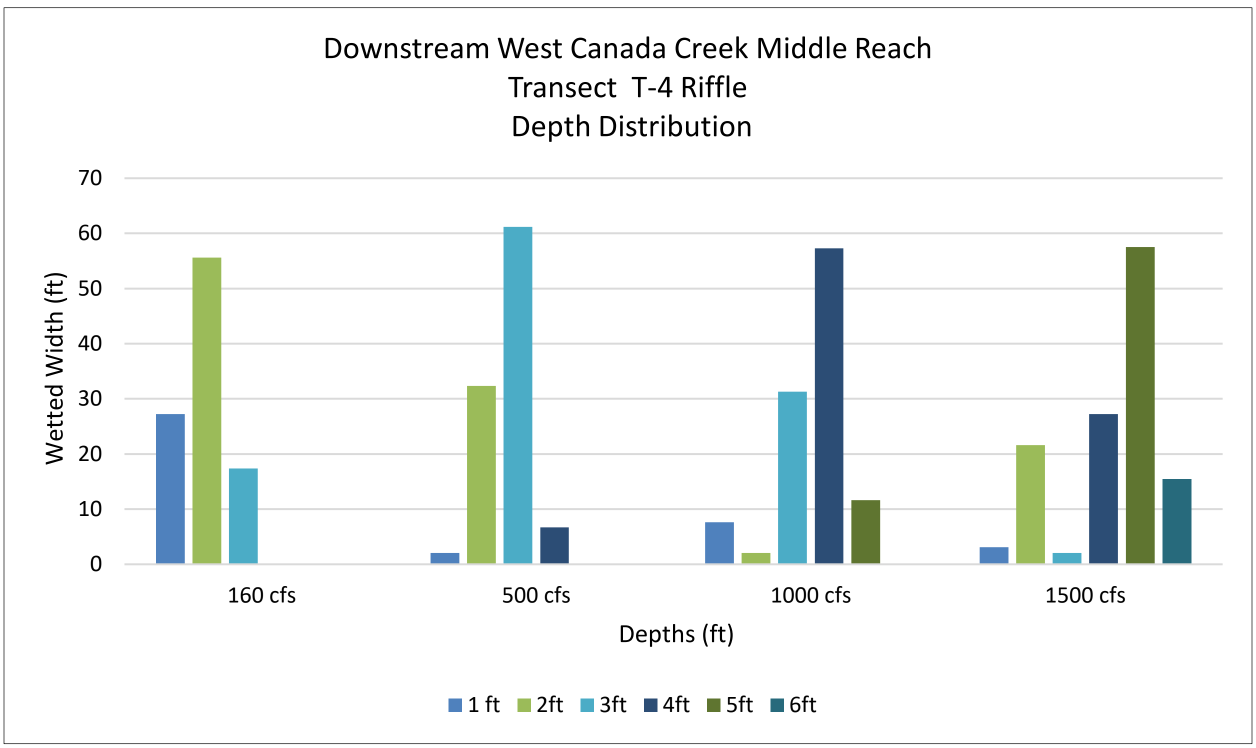


FIGURE 3-21 TRANSECT T-4 RIFFLE DEPTH DISTRIBUTION

3.2.2.5 TRANSECT T-5 RIFFLE-RUN COMPLEX

Transect T-5 is in a riffle- run complex at Kast Bridge above the USGS gage site. This area consists of boulder and cobble-dominated substrate with a coble-gravel bar along the river-left shoreline (Photo 3-25). It represents approximately two miles (10,804 feet) of overall riffle/run mesohabitat. The transect is approximately 220 feet wide from top of bank.

PHOTO 3-25 VIEW OF TRANSECT T-5

Wetted width increases from 109 to 193 feet between 160 and 1,500 cfs releases; most wetted area gains occur across the 160 to 1,000 cfs flow range where there is an inflection point. Additional increases in wetted area up to 1,500 cfs are negligible at higher flows (Table 3-20, Figure 3-22 and Figure 3-23). Depths of 1 foot or less persist throughout the Trenton discharge range of 160 to 1,000 cfs, reflecting the gradual inundation of the left-bank shoal (Figure 3-24). At 500 cfs there is a shift in distribution toward depths between 2 to 5 feet. At 1,000 cfs, depths of 1 foot or less continue to dominate as the gravel bar continues to submerge and depths of 4 to 5 feet also increase as the channel deepens. Depth of 1-2 feet are dominant at 1,500 cfs and most depths are collectively greater than 4 feet.

TABLE 3-20 CHARACTERISTICS OF TRANSECT T-5 RIFFLE- RUN COMPLEX

DISCHARGE (CFS)	WETTED WIDTH (FT)	LINEAR DISTANCE (FT)	WETTED AREA (SQ FT)
160	109	10,804	1,177,636
500	140	10,804	1,512,560
1,000	185	10,804	1,998,740
1,500	193	10,804	2,085,172

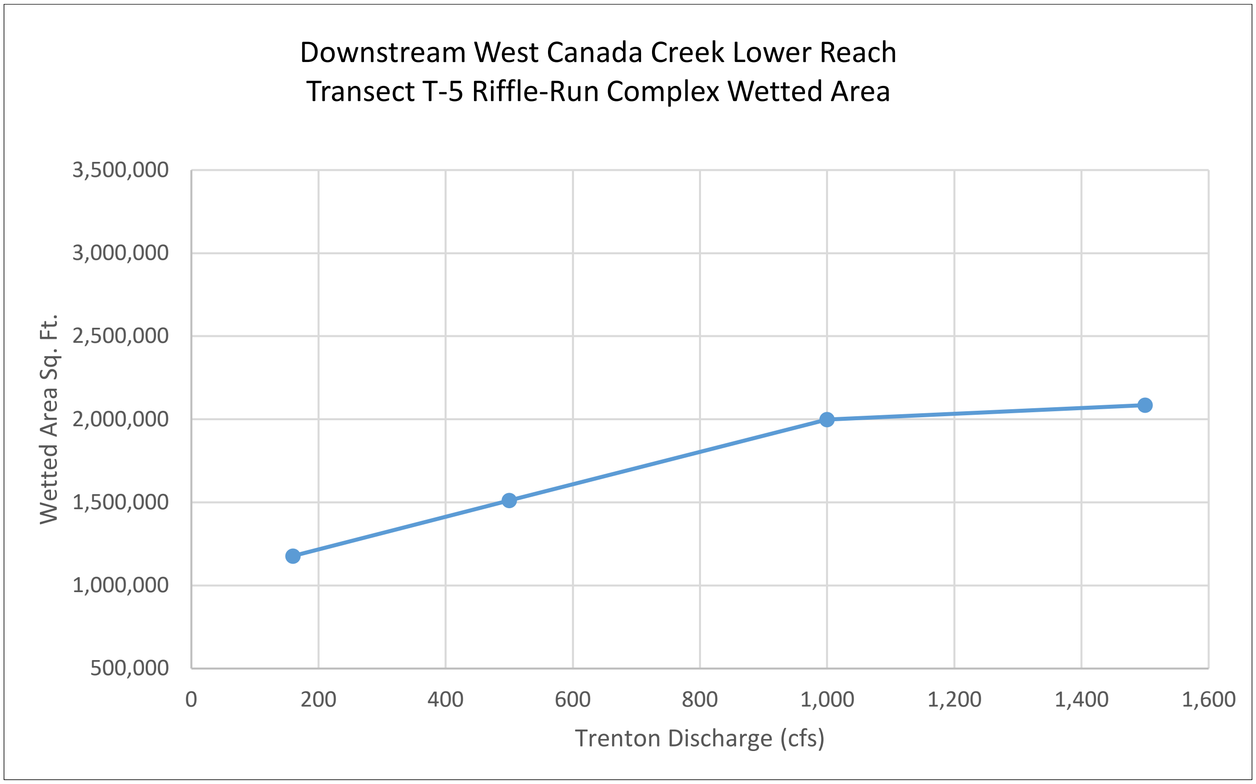


FIGURE 3-22 TRANSECT T-5 RIFFLE-RUN COMPLEX WETTED AREA

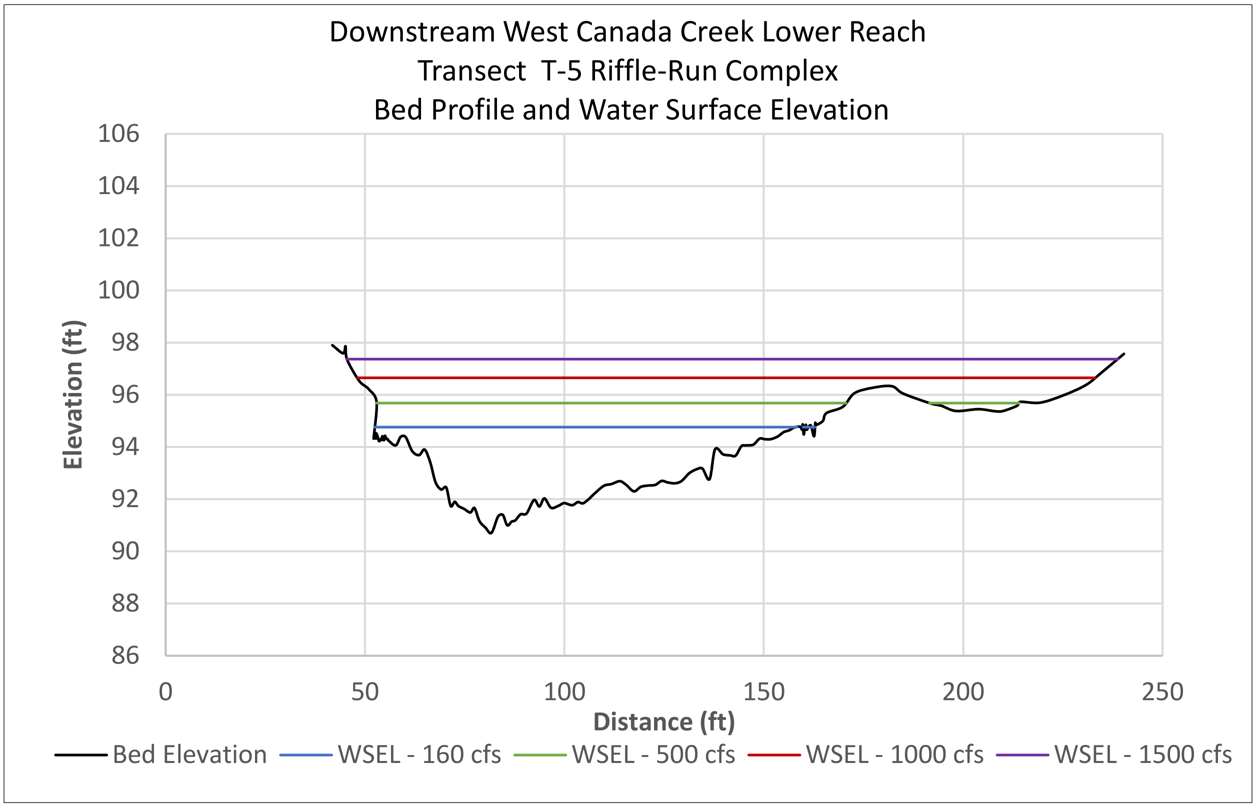


FIGURE 3-23 TRANSECT T-5 RIFFLE-RUN COMPLEX BED PROFILE

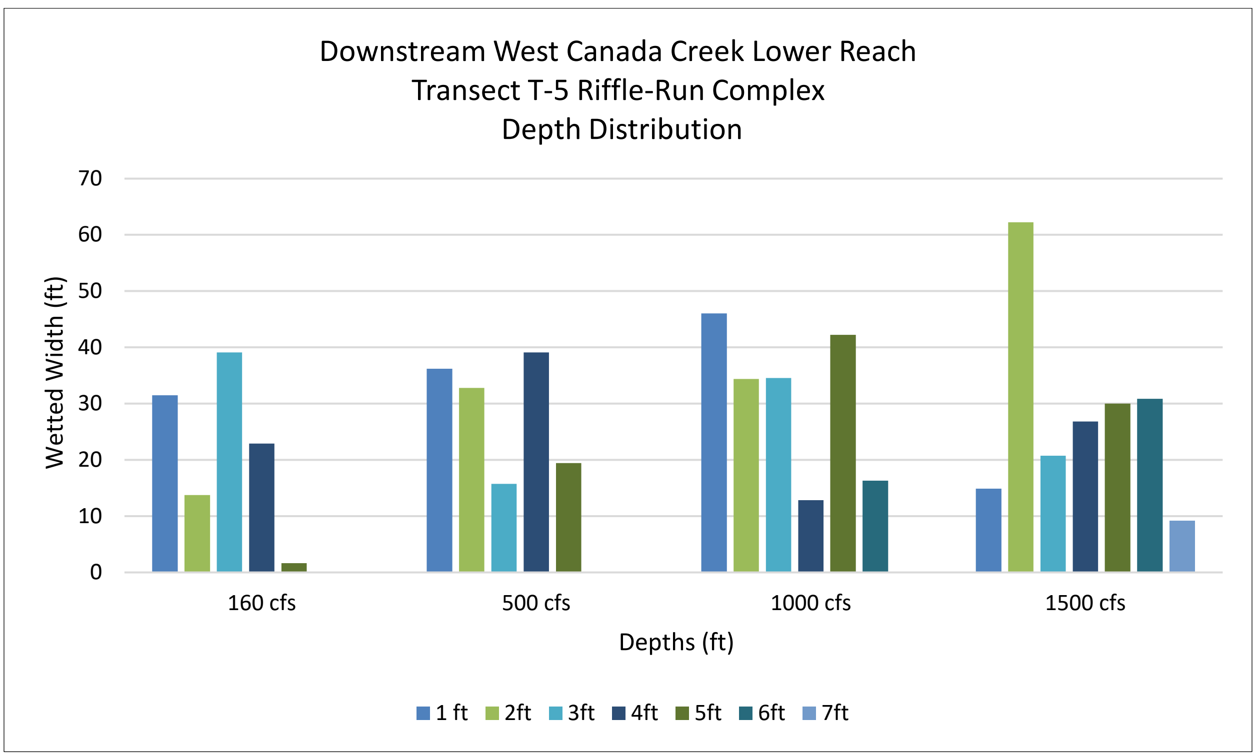


FIGURE 3-24 TRANSECT T-5 RIFFLE-RUN COMPLEX DEPTH DISTRIBUTION

3.2.2.6 TRANSECT T-6 RUN

Transect T-6 is in a low-gradient run upstream from the Herkimer business district. This area consists of gravel and cobble-dominated substrate with occasional large boulders (Photo 3-26). It represents approximately 1.4 miles (7,273 feet) of overall run mesohabitat in this reach. The transect is 308 ft wide from top of bank with steep embankments and no shoals or bars.

PHOTO 3-26 VIEW OF TRANSECT T-6

Wetted width remains relatively unchanged, increasing from 246 to 294 feet between 160 and 500 cfs releases and very little thereafter. Similarly additional increases in wetted area between releases of 500 to 1,500 cfs are negligible (Table 3-21, Figure 3-25 and Figure 3-26). Depths of 1 foot or less 1 to 2 feet, and 2 to 3 feet are almost equally distributed at a Trenton discharge of 160 cfs. Depths steadily shift upward through the flow range, reflecting a deepening rather than widening of this mesohabitat type as flow increases (Figure 3-27). At a 500 cfs Trenton release there is a shift in distribution toward dominant depths between 1 up to 3 feet. At releases of 1,000 cfs or more, depths of 1 foot or less are negligible and depths greater than 3 feet are more pronounced. Depths of one foot or less diminish at 1,500 cfs.

TABLE 3-21 CHARACTERISTICS OF TRANSECT T-6 RUN

DISCHARGE (CFS)	WETTED WIDTH (FT)	LINEAR DISTANCE (FT)	WETTED AREA (SQ FT)
160	246	7,273	1,789,158
500	290	7,273	2,109,170
1,000	294	7,273	2,138,262
1,500	294	7,273	2,138,262

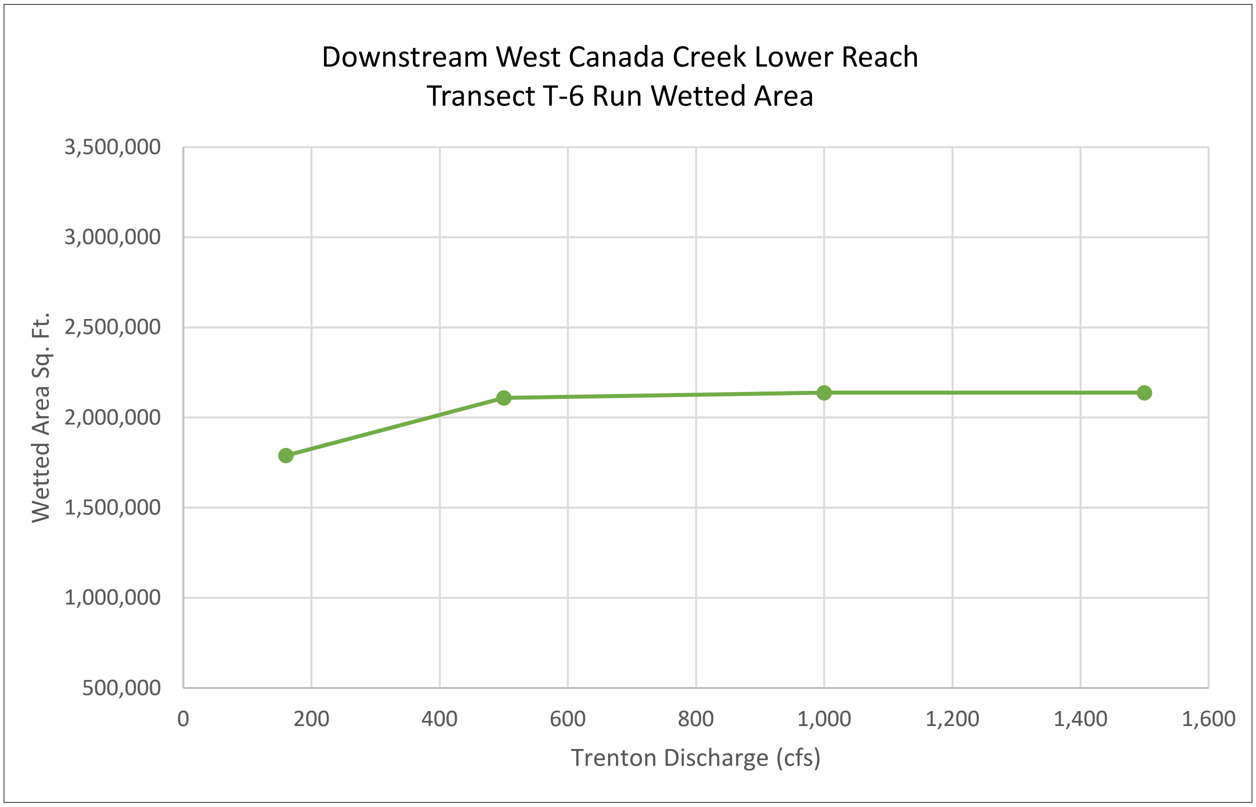


FIGURE 3-25 TRANSECT T-6 RUN WETTED AREA

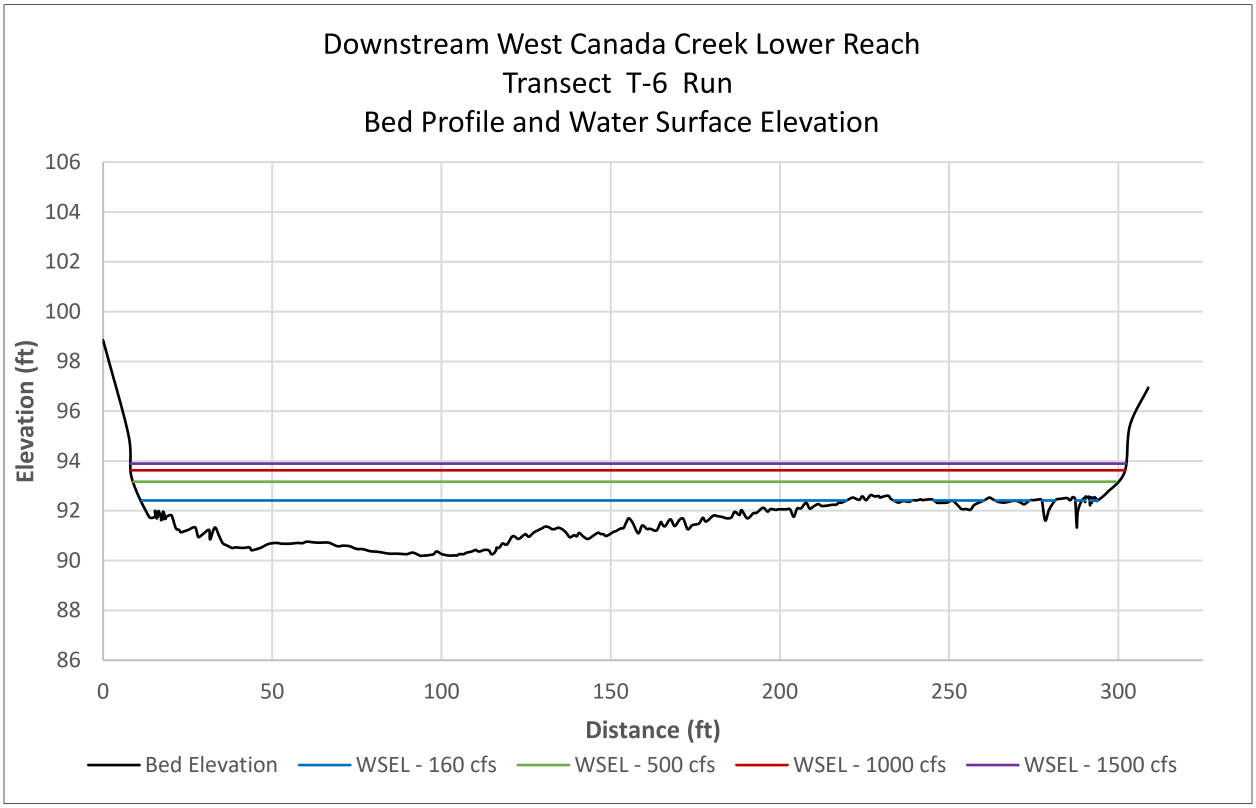


FIGURE 3-26 TRANSECT T-6 RUN BED PROFILE

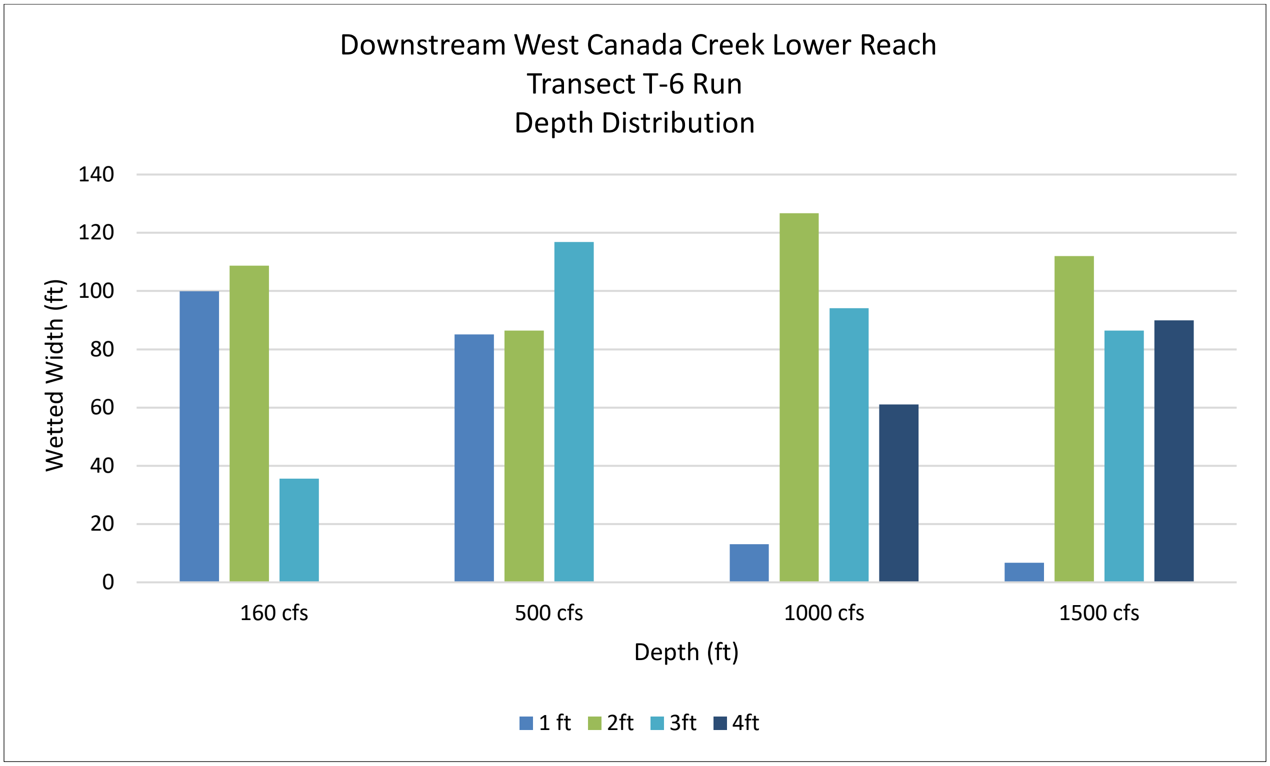


FIGURE 3-27 TRANSECT T-6 RUN DEPTH DISTRIBUTION

3.3 GAGING OF TRENTON MINIMUM FLOW RELEASE VALVE

The USFWS requested a validation of the automated minimum flow release valve discharge at Trenton Station. The automated min flow valve is designed to open should an unexpected outage occur (e.g., unit trip) such that a minimum flow (160 cfs) continues to be released downstream. On August 23, 2019 a gaging validation survey was conducted at Trenton Station. Unit operation was not shut down during the survey to alleviate short-term impacts to aquatic resources downstream during the brief transition between unit discharge and that of the min flow valve. Instead, discharge from the automated minimum flow release valve was determined by subtracting the unit discharge from the combined discharge of the units and the automated min flow valve. This was achieved by measuring the Trenton discharge at 8.5 MW, and then measuring the combined minimum flow valve discharge and Trenton discharge at 8.5 MW. The difference between these two measurements was equal to the minimum flow release valve discharge.

The discharge measurements were collected using an M9 ADCP by Sontek. A transect line was secured across West Canada Creek immediately downstream of the Trenton tailrace (Photo 3-27). The ADCP was connected to the transect line and was pulled across the river using a tethered line from each bank of the river. A series of 4 discharge measurement were conducted along the transect during at each discharge scenario, for a total of 8 measurements. The outlier of each scenario was removed from the data set and the average of the 3 most similar discharge measurements was used to calculate discharge for each scenario. Discharges for each measurement and mean discharges are displayed in (Table 3-22). The discharge measurements were accurate and precise, with all three measurements within the 95% confidence interval around the mean. The measurement furthest away was only 1.15 standard deviations away. The measured automated minimum flow release valve discharge is 269.05 cfs and exceeds the required 160 cfs minimum flow.

PHOTO 3-27 TRENTON MINIMUM FLOW DISCHARGE VALIDATION TRANSECT

TABLE 3-22 MEASURED DISCHARGE AT TRENTON TAILRACE USING ACOUSTIC DOPPLER CURRENT PROFILER

Measurements	Trenton Discharge at 8.5 MW (cfs)	Combined Discharge (cfs) (Trenton 8.5 MW plus automated minimum flow release valve)	Calculated automated minimum flow release valve (cfs)
1	472	754	
2	486	739	
3	472	744	
Mean	**477**[1]	**746**[2]	**269**

[1] Standard Deviation 7.9

[2] Standard Deviation 7.4

4.0 SUMMARY

The purpose of this study is to evaluate the potential effects of flow releases on the depth and wetted area of mesohabitats in the Prospect bypass reach and downstream reaches of West Canada Creek. During the first phase of the study all mesohabitat units in these areas were surveyed and classified to select reaches and study sites that would represent aquatic habitat of potential interest for flow management. During the second phase of the study transects and level loggers were located at specific locations determined in consultation with the NYSDEC and USFWS based on a review of the initial phase reconnaissance survey.

4.1 PROSPECT BYPASS REACH

The Prospect bypass reach receives leakage flow of approximately 1 cfs in the upper bypass, augmented by approximately 2 cfs of additional inflow in the lower bypass, as well as periodic flow released from the dam as either gate release or spillage. The bypass reach is comprised primarily of flat horizontal bedrock, and scattered small and shallow pools. The upper portion of the Prospect bypass reach appears to have very limited strategic aquatic habitat. The upper bypass reach is heavily scoured and over-widened; over 300 feet wide which is significantly wider than the downstream sections of this bypass reach as well as the mainstem of the West Canada Creek further downriver, and dominated by flat horizontal bedrock (Photo 4-1). Scouring occurs annually during inflow events that exceed Project capacity, such as spring snowmelt runoff. Further, the Prospect bypass reach is separated from contiguous stream reaches by both the dam and Prospect Falls, an approximate 20-foot-high waterfall located in the upper reach. Cover in the Prospect bypass reach is limited to a boulder pile concentration that forms an isolated riffle in the middle section of the bypass reach.

These factors limit recruitment of fish to this reach. There is also a lack of suitable spawning substrates, as most indigenous fluvial fish species in the creek would be expected to be lithophilic spawners that require expanses of gravel and cobble to successfully spawn. Object cover would be required for juvenile and adult life stages, and these are limited in this segment. The hydraulic analysis demonstrates that flows as high as 50 cfs do not significantly change the wetted area of this riffle.

PHOTO 4-1 HORIZONTAL BEDROCK EXPANSE IN UPPER PROSPECT BYPASS REACH

The middle bypass reach channel geometry is controlled by vertical bedrock walls and is composed of small pools and short inter-connecting riffles at low flows. Substrate is dominated by bedrock but there are some cobbles and smaller geologic material. Depths and wetted area do not change significantly across the study flows.

The lower reach contains somewhat larger pools divided by cobble/gravel riffles. The greatest increase in depth and wetted area occurs between leakage and 10 cfs. These riffles potentially provide a zone of passage for fish moving among these pools and/or an area for potential aquatic invertebrate growth which can provide forage for fish residing in the adjacent pools. Given the high torrential seasonal flows that this bypass reach experiences, it is unlikely that there are residential fish populations occurring here. Most are likely individuals that are washed into the reach during high flow events and are transiently occupying the habitat. These seasonally-occurring high flow events are likely a limiting habitat factor for the bypass reach.

4.2 DOWNSTREAM WEST CANADA CREEK

Flow in West Canada Creek downstream of the Trenton Development can be influenced by Project operation at times. Flows ranging from the current Project minimum flow of 160 cfs (released at Trenton) up to 1,500 cfs (approximately station capacity[6]) were evaluated.

Mesohabitat in the downstream West Canada Creek is dominated by runs, riffles and combinations of the two, as well as extensive pools segments where aquatic habitat is less affected by flow changes. These pools in most riverine systems provide refuge for fish when flows rise or fall below a suitable range. Most of the fluvial habitat in the downstream reaches of West Canada Creek is typically at least 200 feet wide and of moderate gradient; however, there are a few sections of higher-gradient rapids with larger substrates. Depths in the rapids, riffles and runs generally contain areas between 1 and 2 feet deep at all flows; however, such depths tended to increase in distribution at Trenton discharge flows of 326 cfs and greater.

Wetted area and depth distributions observed in the flow range studies were affected by channel gradient and cross-sectional morphology characteristic of the various mesohabitats. For example, T-1, located in a high gradient riffle experienced a rapid increase in wetted area between 160 and 326 cfs which became more gradual at higher flows. However, depths did not increase as rapidly at that flow range. High-gradient riffles commonly exhibit *supercritical* flow where the wetted area and velocities tend to be more volatile than depths (Dunn and Leopold, 1998). By contrast T-2, which represents lower gradient run-pool mesohabitat, typically exhibits sub-critical flow, where depth changes more rapidly than does velocity and wetted area. Run-pool is a more widely distributed type of habitat in the West Canada Creek than high gradient rapids and riffles.

Rapid mesohabitat in the middle reach of West Canada Creek did not change in wetted area across the flow range. In this case the channel is fully wetted by the lowest flow, and with steep embankments there is no additional shoreline areas to wet, nor are there any raised shoals or bars in mid channel exposed at low flows. Thus, increases in flow in this reach provide a gradual reduction in shallow nearshore depths, while at the same time depths in the 1 to 2 foot range remain dominant. This likely reflects compensatory increases in channel velocity at higher flows.

[6] Trenton station maximum hydraulic capacity is approximately 1,425 cfs.

The lowermost reach of West Canada Creek is dominated by low gradient riffle-runs and runs. The Kast Bridge riffle-run includes a gravel shoal that increases in wetted area when inundated at a Trenton discharge of approximately 500 cfs after which wetted area increases are relatively modest. The lower West Canada Creek run habitat is fully wetted even at the lowermost flow studied, and thus wetted area does not change at higher flows. This habitat offers a significant distribution of depths of 2 feet or more at all flows evaluated.

Generally, wetted area in low gradient mesohabitats of West Canada Creek appears to only change gradually in response to project operation flows. An inflection point typically occurs at around 300 to 500 cfs depending on the site. Runs and run-pools gain depth rather than wetted area. In addition, some higher gradient habitat have a more pronounced response to changes in discharge at the low flow end of the spectrum, specifically between 160 and 500 cfs releases at Trenton station; however, in some cases wetted area in rapids does not necessarily increase with increased flow as velocities likely increase at a more rapid rate than depth and wetted area.

5.0 REFERENCES

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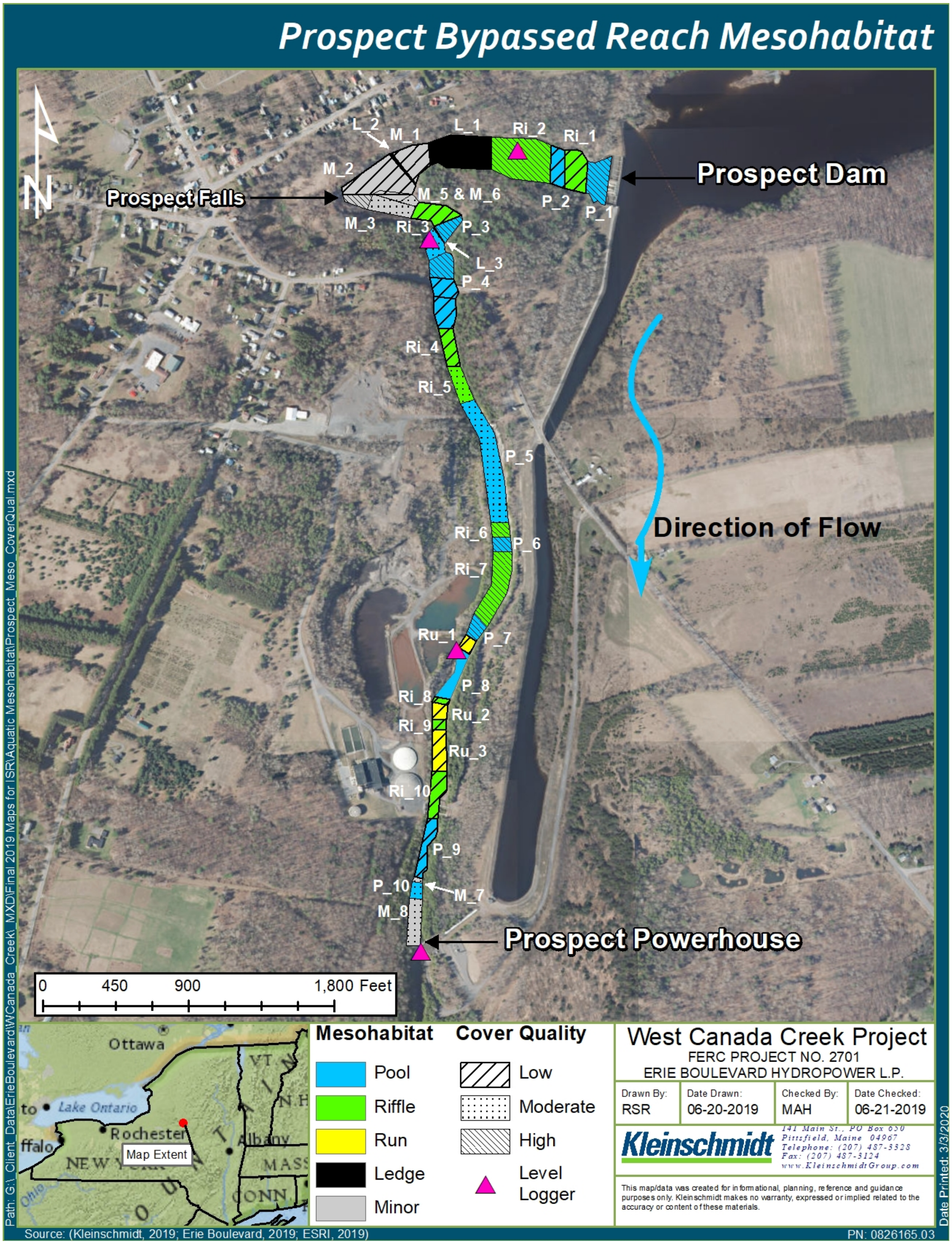
APPENDIX A

PROSPECT BYPASS REACH
MESOHABITAT, SUBSTRATE AND COVER MAPS


Prospect Bypassed Reach Mesohabitat
L_2
M_1
L_1
Ri_2
Ri_1
M_2
Prospect Dam
Prospect Falls
M_5 & M_6
P_2
P_1
M_3
Ri_3
P_3
L_3
P_4
Ri_4
Ri_5
P_5
Direction of Flow
Ri_6
P_6
Ri_7
Ru_1
P_7
P_8
Ri_8
Ru_2
Ri_9
Ru_3
Ri_10
P_9
P_10
M_7
M_8
Prospect Powerhouse
0 450 900 1,800 Feet
Ottawa
Lake Ontario
Rochester
Albany
Map Extent
Mesohabitat
Pool
Riffle
Run
Ledge
Minor
Cover Quality
Low
Moderate
High
Level Logger
West Canada Creek Project
FERC PROJECT NO. 2701
ERIE BOULEVARD HYDROPOWER L.P.
Drawn By: RSR
Date Drawn: 06-20-2019
Checked By: MAH
Date Checked: 06-21-2019
Kleinschmidt
This map/data was created for informational, planning, reference and guidance purposes only. Kleinschmidt makes no warranty, expressed or implied related to the accuracy or content of these materials.
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Date Printed: 3/3/2020
Source: (Kleinschmidt, 2019; Erie Boulevard, 2019; ESRI, 2019)
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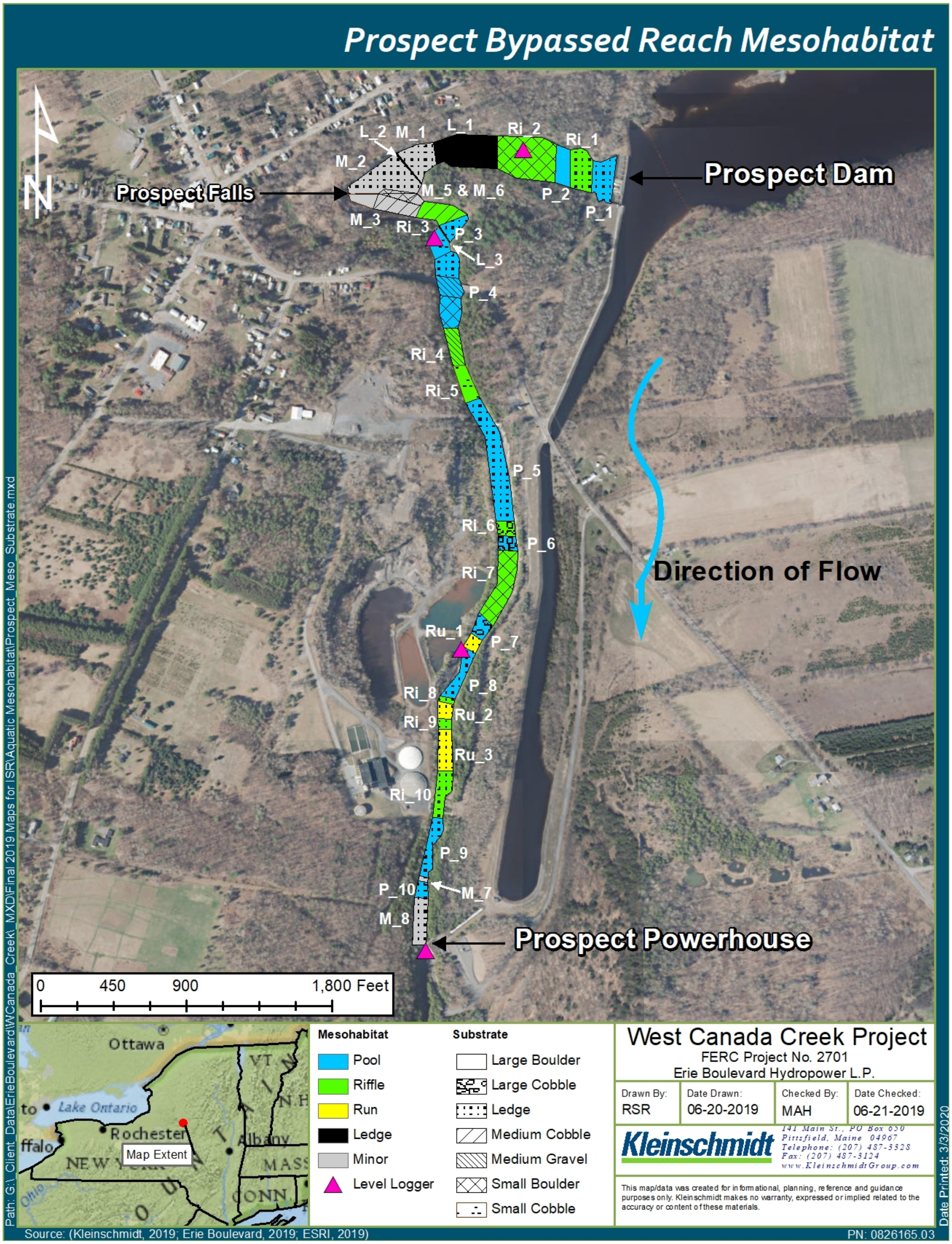
Prospect Bypassed Reach Mesohabitat
Prospect Dam
Prospect Falls
Prospect Powerhouse
Direction of Flow
L_2 M_1 L_1 Ri_2 Ri_1
M_2
M_5 & M_6
P_2 P_1
M_3 Ri_3 P_3
L_3
P_4
Ri_4
Ri_5
P_5
Ri_6
P_6
Ri_7
Ru_1
P_7
P_8
Ri_8
Ri_9 Ru_2
Ru_3
Ri_10
P_9
P_10
M_7
M_8
0 450 900 1,800 Feet
Ottawa
Lake Ontario
Rochester
Map Extent
NEW YORK
Albany
MASS
CONN
VT
N.H.
Mesohabitat
Pool
Riffle
Run
Ledge
Minor
Level Logger
Substrate
Large Boulder
Large Cobble
Ledge
Medium Cobble
Medium Gravel
Small Boulder
Small Cobble
West Canada Creek Project
FERC Project No. 2701
Erie Boulevard Hydropower L.P.
Drawn By: RSR
Date Drawn: 06-20-2019
Checked By: MAH
Date Checked: 06-21-2019
Kleinschmidt
141 Main St., PO Box 650
Pittsfield, Maine 04967
Telephone: (207) 487-3328
Fax: (207) 487-3124
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Date Printed: 3/3/2020
Source: (Kleinschmidt, 2019; Erie Boulevard, 2019; ESRI, 2019)
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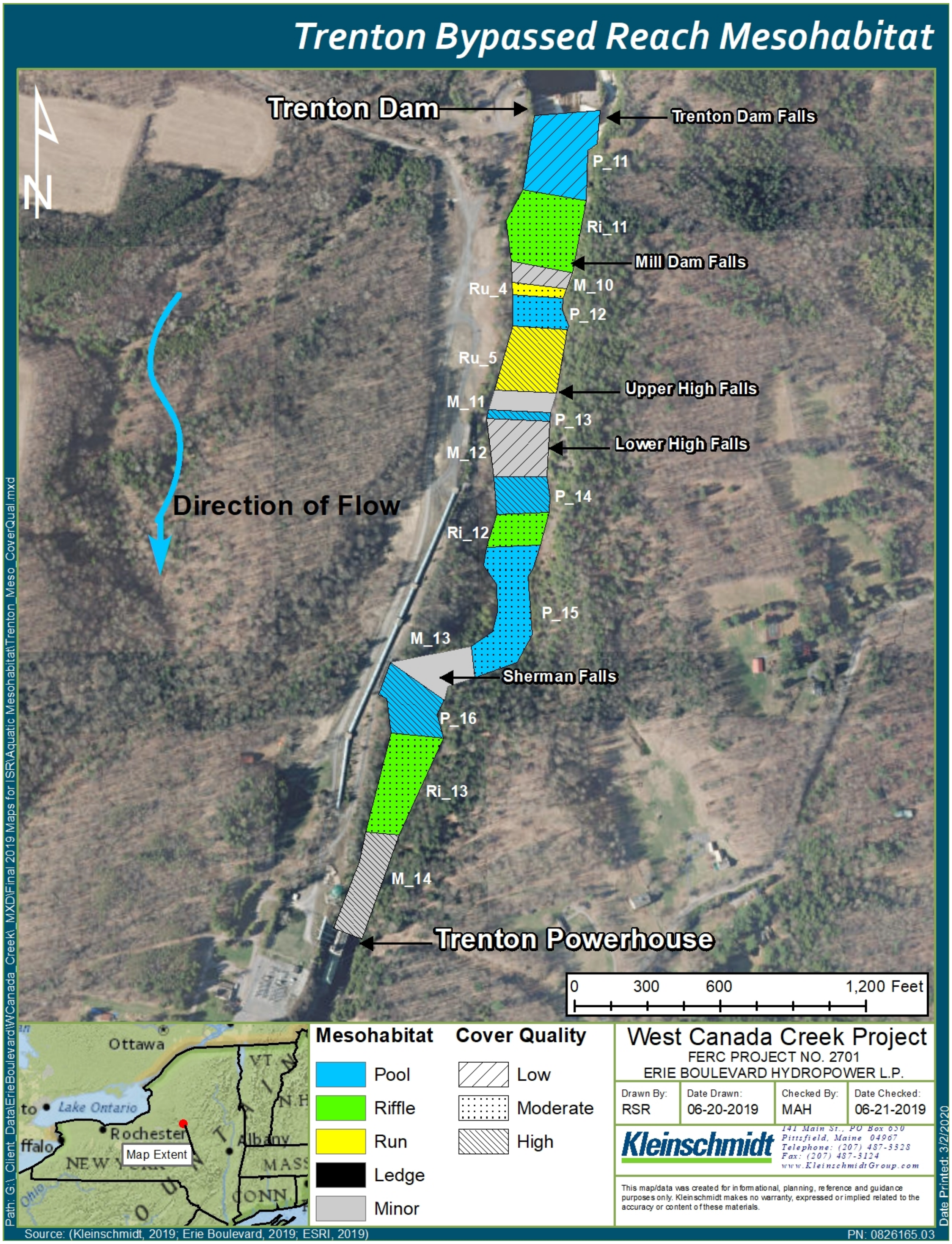
APPENDIX B

TRENTON BYPASS REACH
MESOHABITAT, SUBSTRATE AND COVER MAPS


Trenton Bypassed Reach Mesohabitat
Trenton Dam
Trenton Dam Falls
P_11
Ri_11
Mill Dam Falls
Ru_4
M_10
P_12
Ru_5
Upper High Falls
M_11
P_13
Lower High Falls
M_12
P_14
Direction of Flow
Ri_12
P_15
M_13
Sherman Falls
P_16
Ri_13
M_14
Trenton Powerhouse
N
0
300
600
1,200 Feet
Ottawa
Lake Ontario
Rochester
Map Extent
Albany
NEW YORK
VT
N.H
MASS
CONN
Mesohabitat
Pool
Riffle
Run
Ledge
Minor
Cover Quality
Low
Moderate
High
West Canada Creek Project
FERC PROJECT NO. 2701
ERIE BOULEVARD HYDROPOWER L.P.
Drawn By: RSR
Date Drawn: 06-20-2019
Checked By: MAH
Date Checked: 06-21-2019
Kleinschmidt
141 Main St., PO Box 650
Pittsfield, Maine 04967
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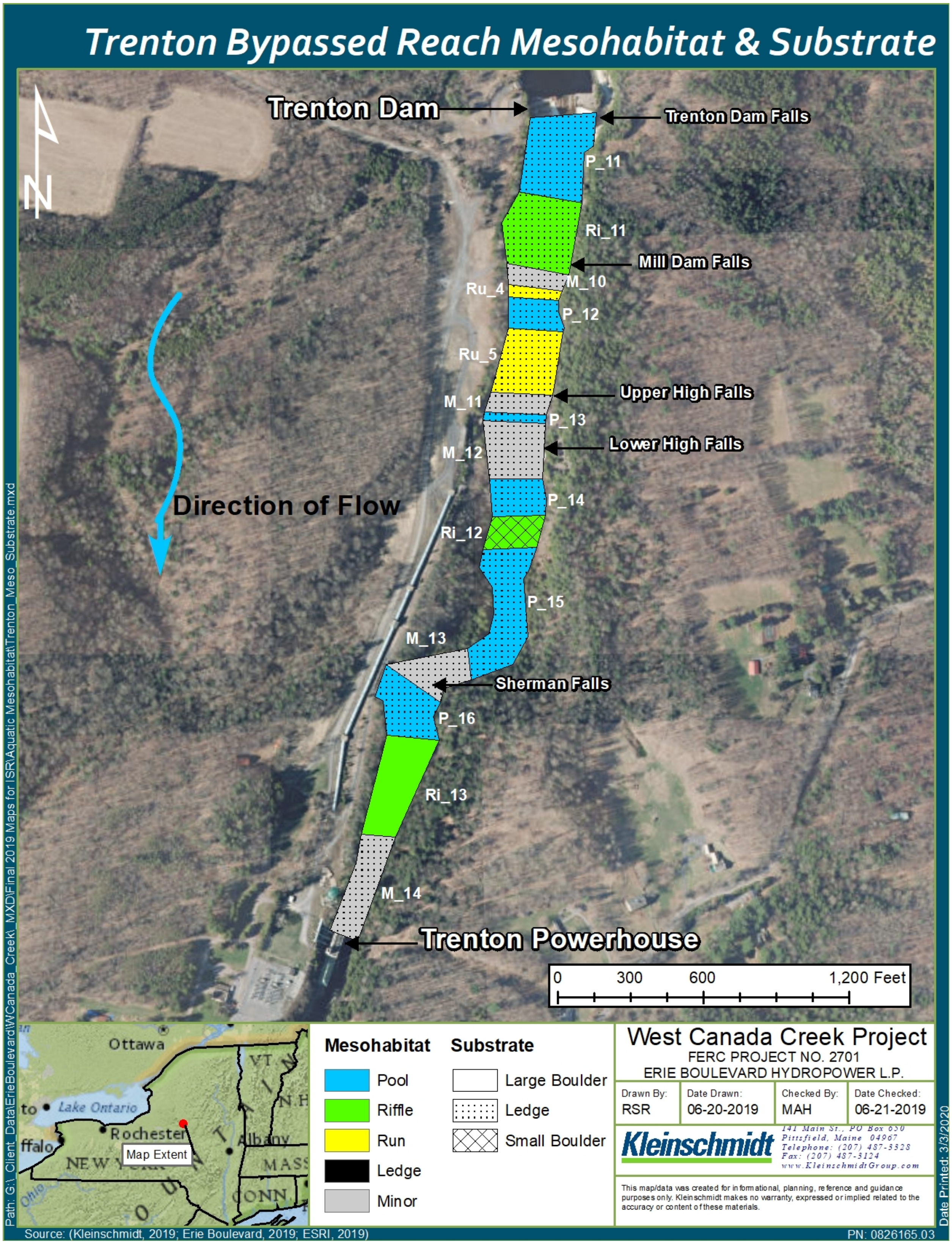
Source: (Kleinschmidt, 2019; Erie Boulevard, 2019; ESRI, 2019)
PN: 0826165.03


Trenton Bypassed Reach Mesohabitat & Substrate
Trenton Dam
Trenton Dam Falls
P_11
Ri_11
Mill Dam Falls
M_10
Ru_4
P_12
Ru_5
Upper High Falls
M_11
P_13
Lower High Falls
M_12
P_14
Direction of Flow
Ri_12
P_15
M_13
Sherman Falls
P_16
Ri_13
M_14
Trenton Powerhouse
N
0 300 600 1,200 Feet
Ottawa
Lake Ontario
Rochester
Map Extent
Albany
NEW YORK
VT
N.H.
MASS
CONN
Mesohabitat
Pool
Riffle
Run
Ledge
Minor
Substrate
Large Boulder
Ledge
Small Boulder
West Canada Creek Project
FERC PROJECT NO. 2701
ERIE BOULEVARD HYDROPOWER L.P.
Drawn By: RSR
Date Drawn: 06-20-2019
Checked By: MAH
Date Checked: 06-21-2019
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Date Printed: 3/3/2020
Source: (Kleinschmidt, 2019; Erie Boulevard, 2019; ESRI, 2019)
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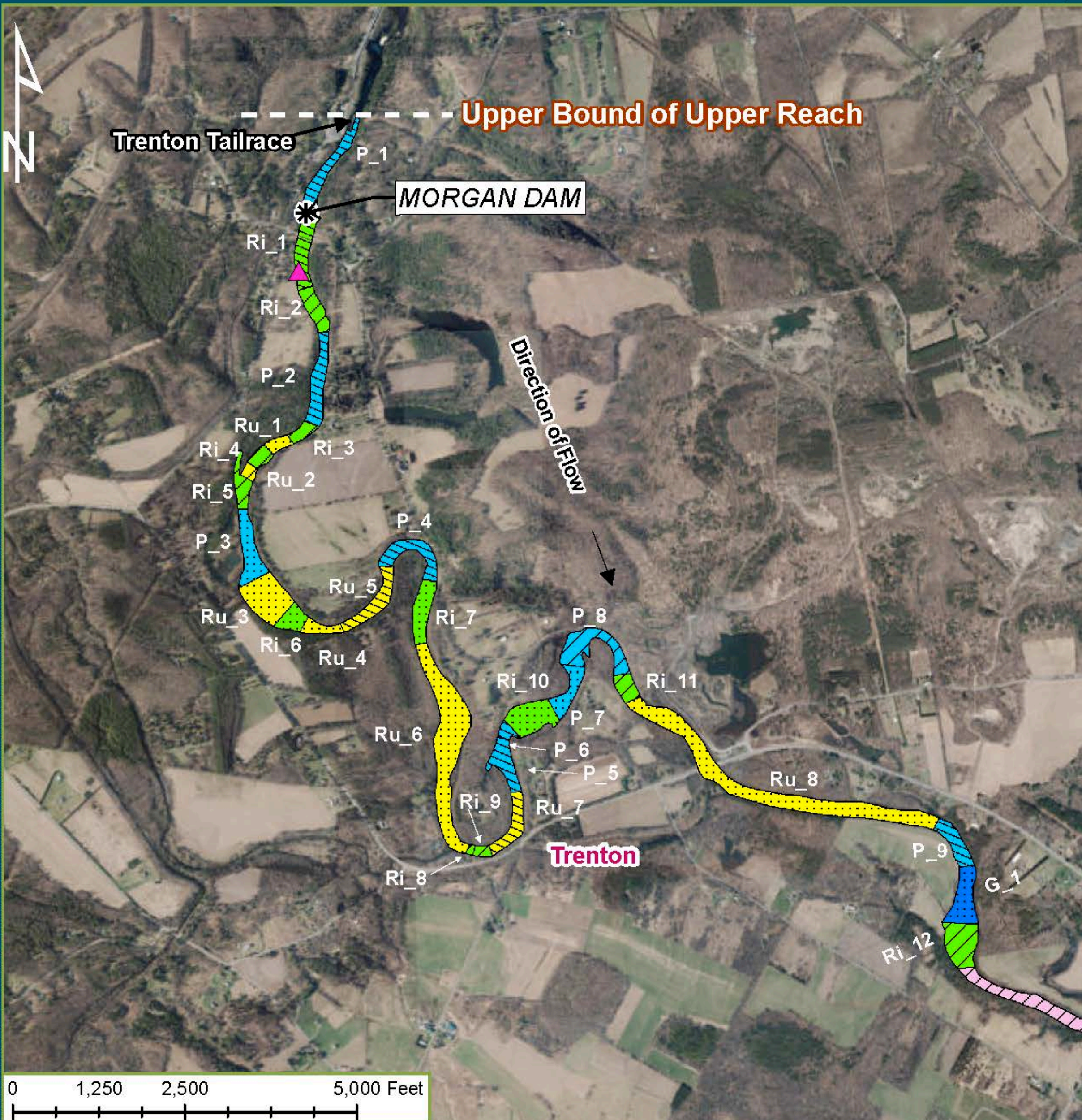
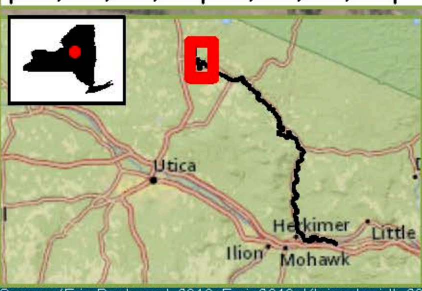
APPENDIX C

DOWNSTREAM REACH
MESOHABITAT, SUBSTRATE AND COVER MAPS

West Canada Creek Mesohabitat & Cover Quality





Level Logger

Mesohabitat

- Backwater
- Glide
- Pool
- Rapids
- Riffle
- Riffle-Run Complex
- Run
- Run-Pool Complex

Cover Quality

- Low
- Moderate
- High

West Canada Creek Project
FERC Project No. 2701
Erie Bouelvard Hydropower L.P.

Drawn By:	Date Drawn:	Checked By:	Date Checked:
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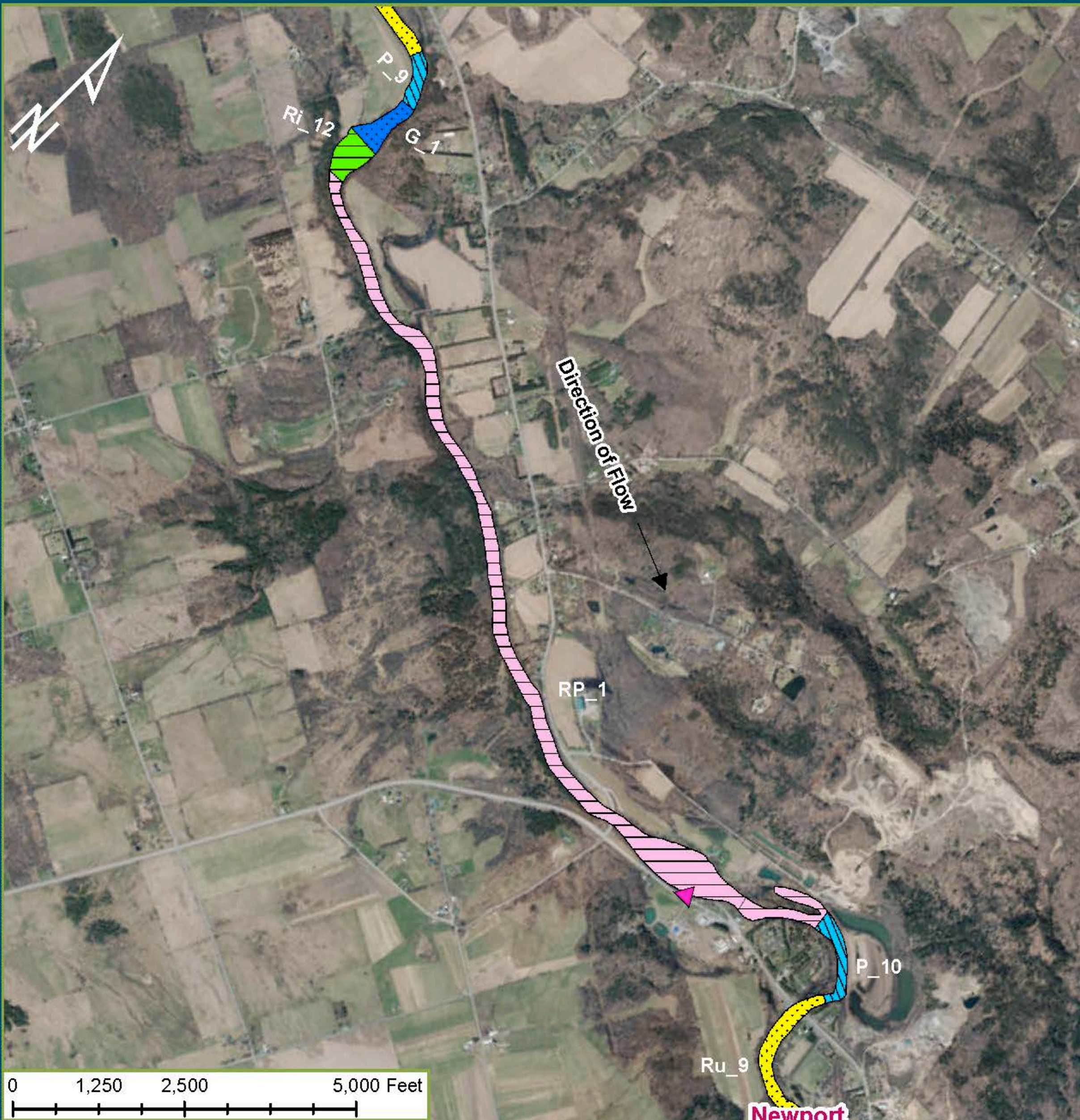
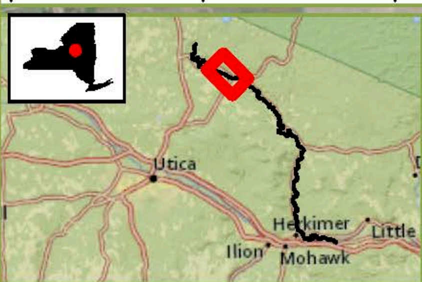
Date Printed: 3/3/2020

PN:0826165.03

West Canada Creek Mesohabitat & Cover Quality





Level Logger

Mesohabitat
- Backwater
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- Rapids
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Source: (Erie Boulevard, 2019; Esri, 2019; Kleinschmidt, 2019)

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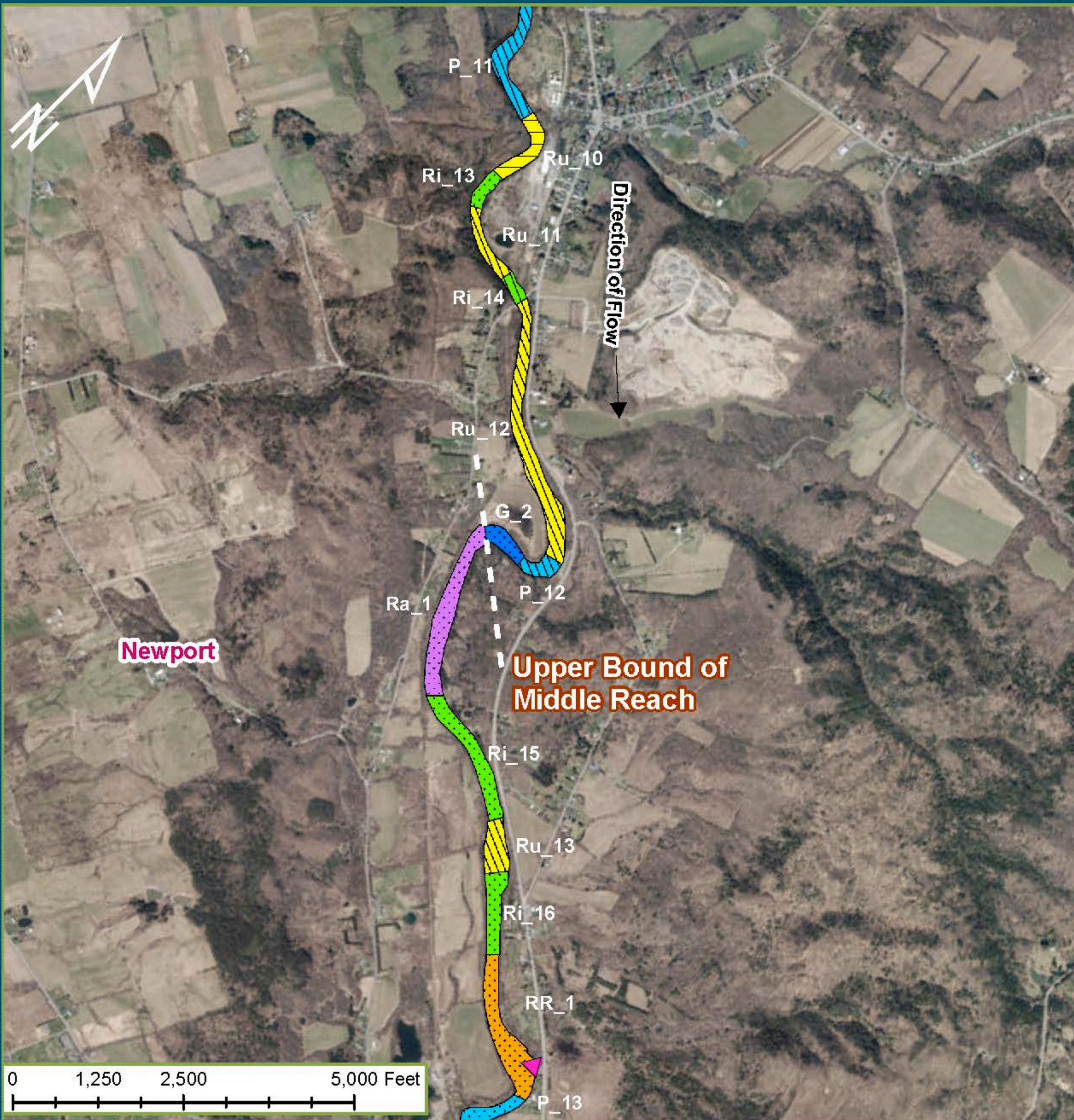
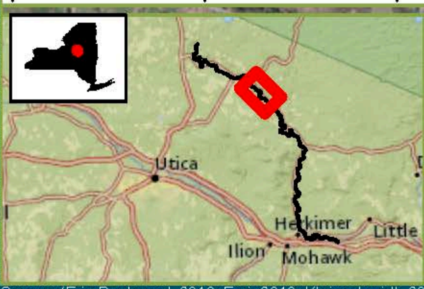
West Canada Creek Mesohabitat & Cover Quality





Level Logger

Mesohabitat
- Backwater
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- Run-Pool Complex

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West Canada Creek Project
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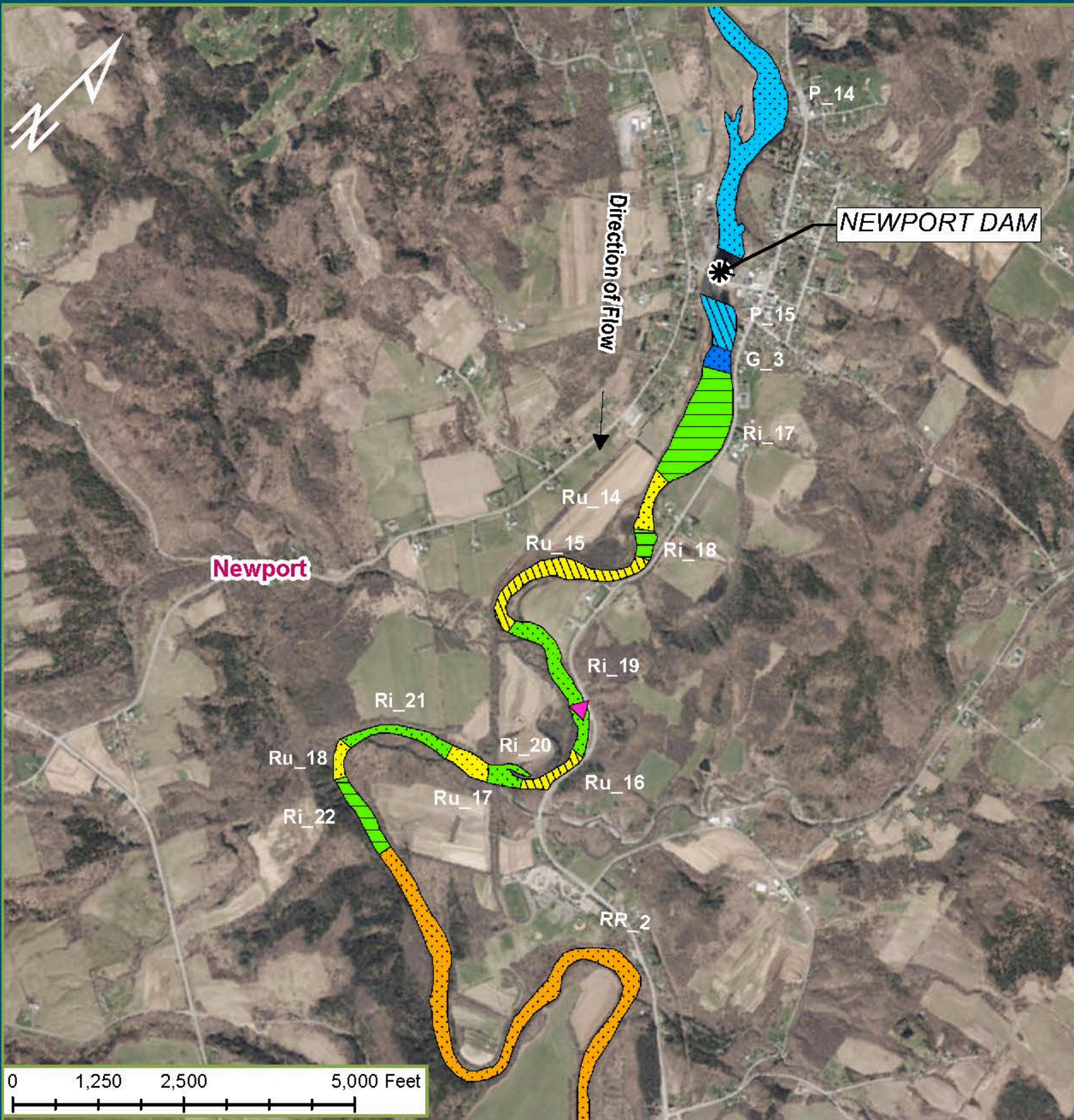
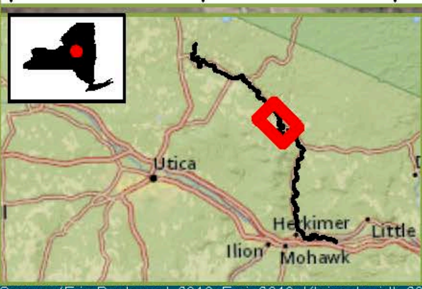
West Canada Creek Mesohabitat & Cover Quality





Level Logger

Mesohabitat

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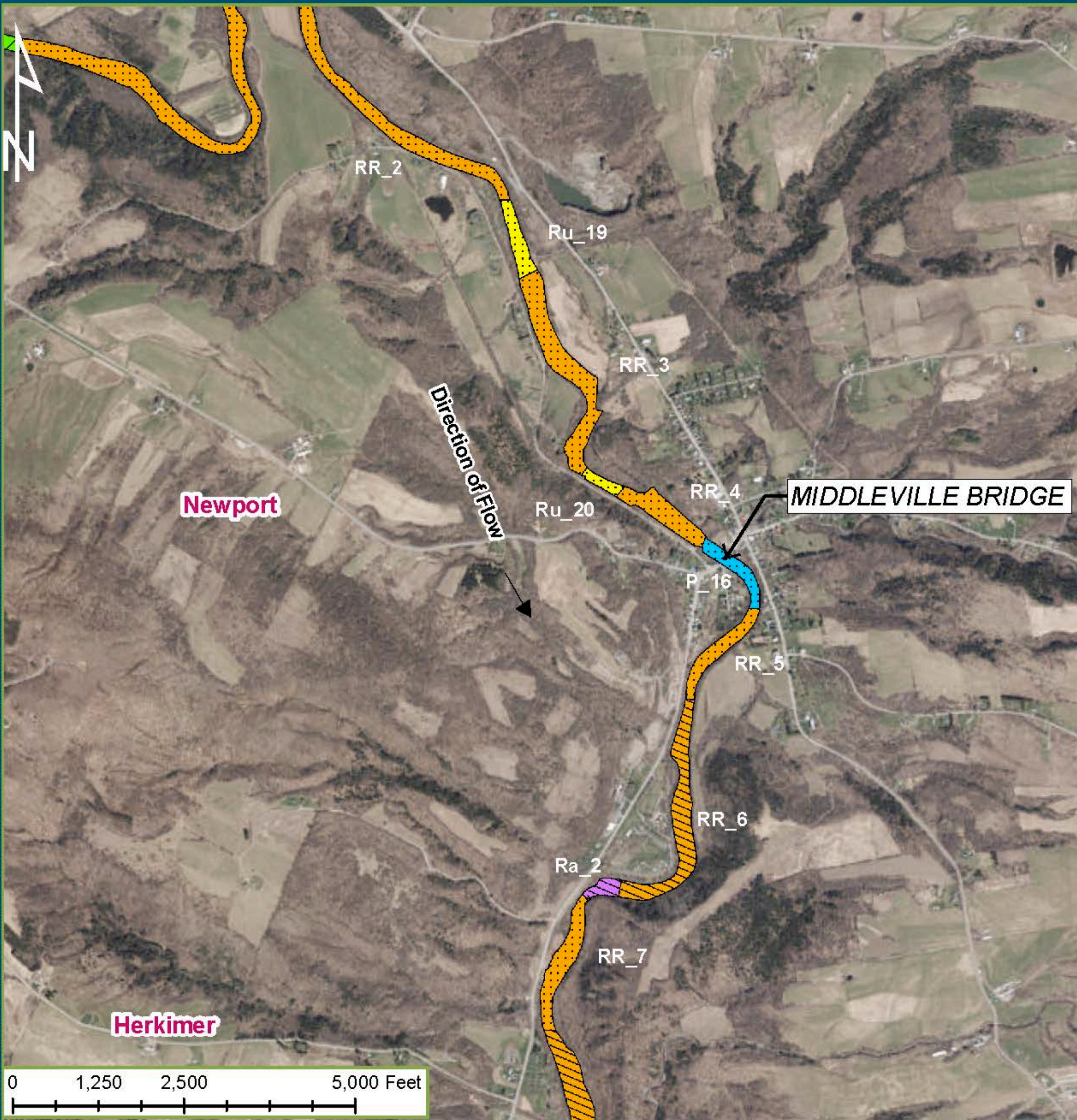
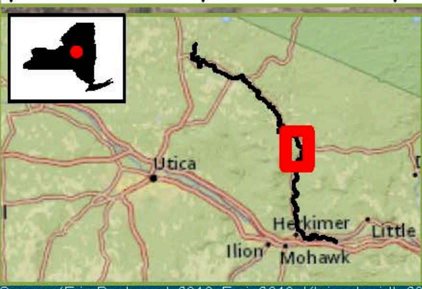
West Canada Creek Mesohabitat & Cover Quality





Level Logger

Mesohabitat
- Backwater
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- Rapids
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- Riffle-Run Complex
- Run
- Run-Pool Complex

Cover Quality
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West Canada Creek Project
FERC Project No. 2701
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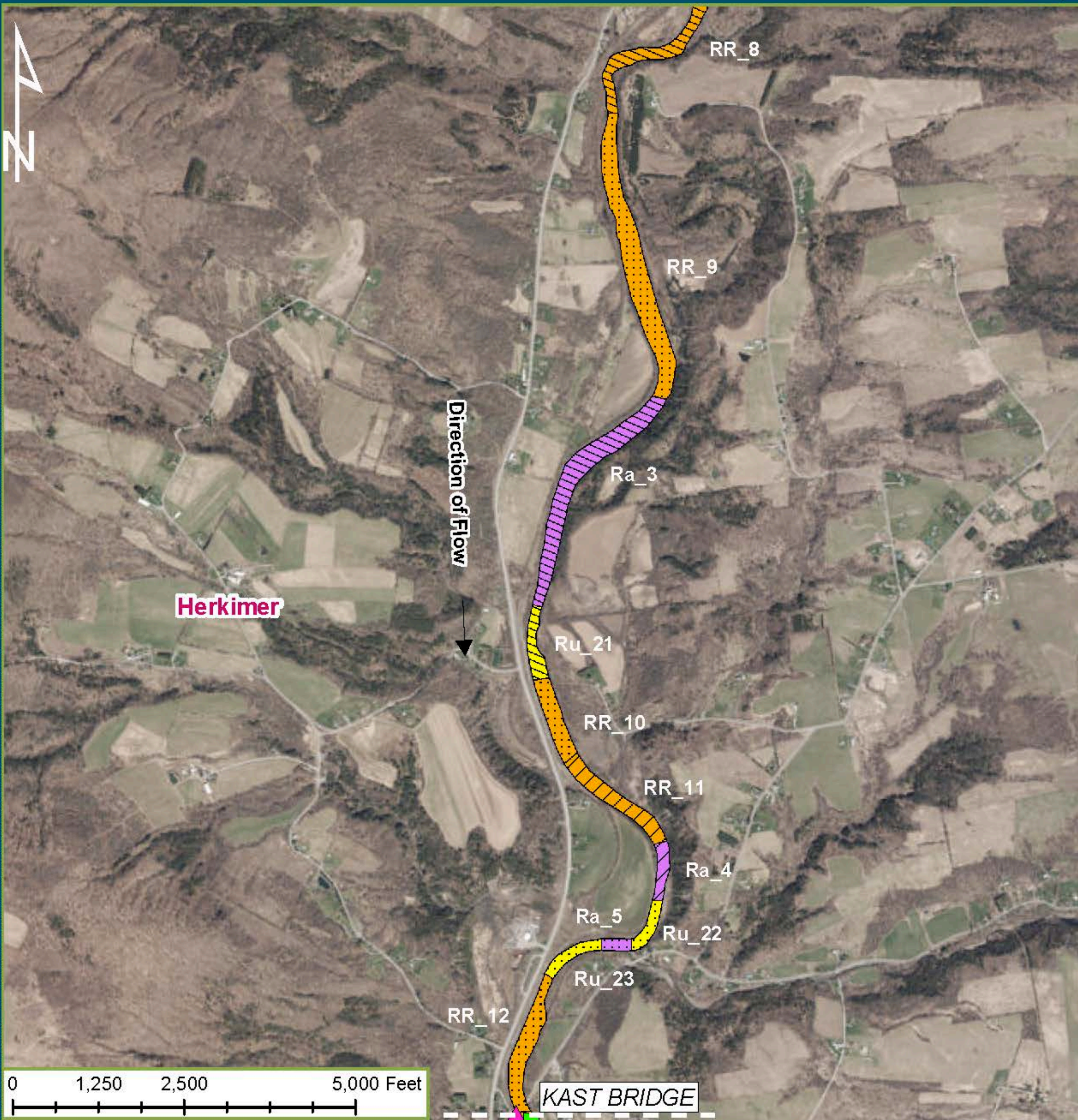
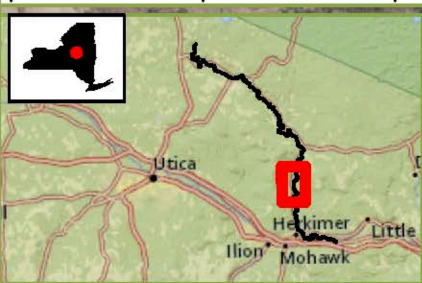
West Canada Creek Mesohabitat & Cover Quality





Level Logger

Mesohabitat
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West Canada Creek Project
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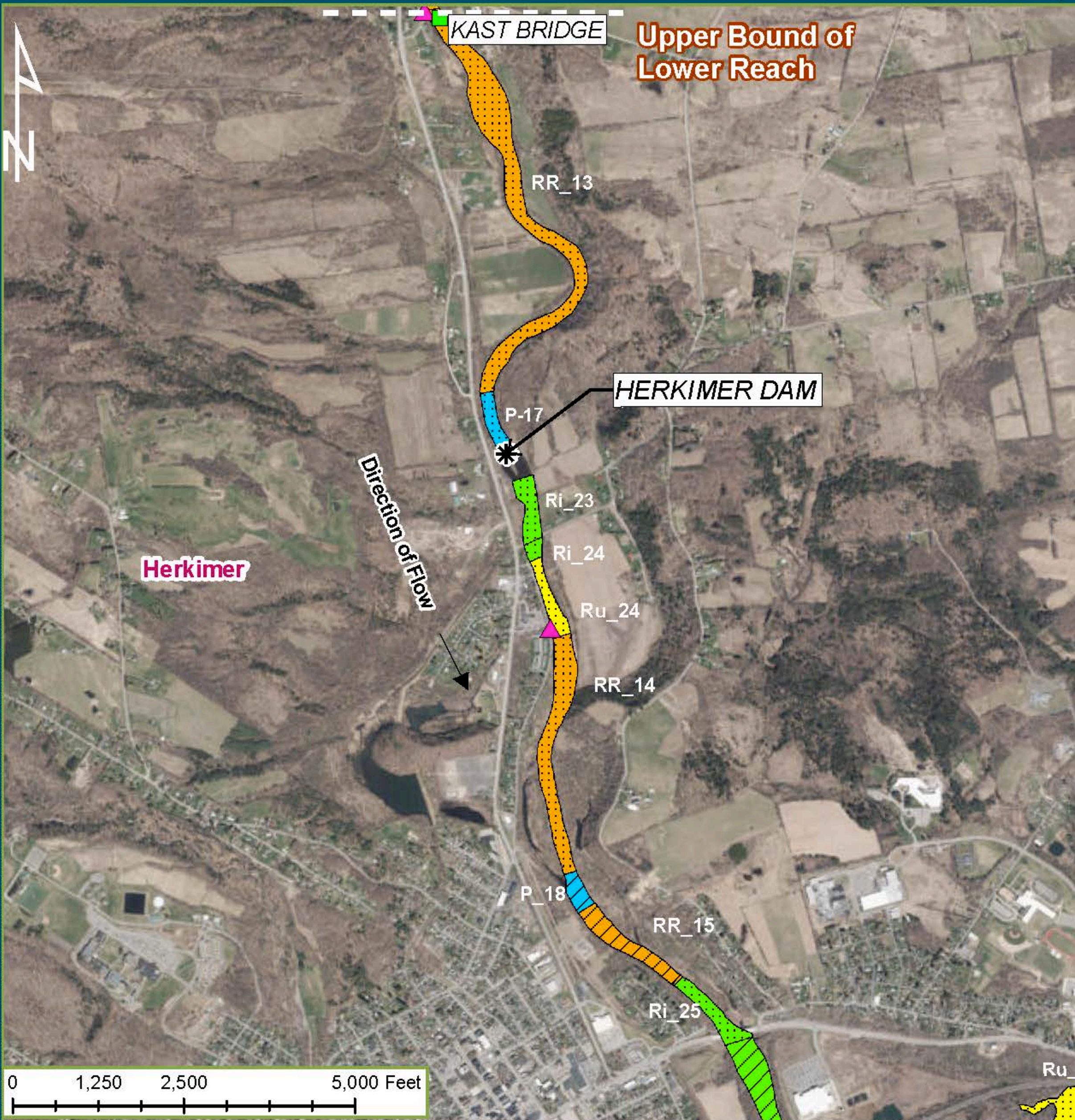

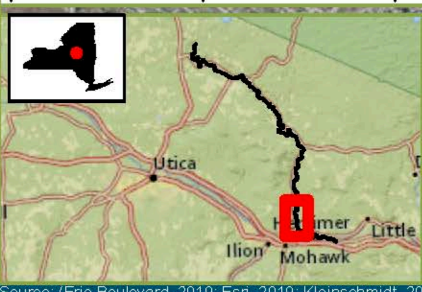

Level Logger

Mesohabitat
- Backwater
- Glide
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- Rapids
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- Riffle-Run Complex
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Cover Quality
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West Canada Creek Project
FERC Project No. 2701
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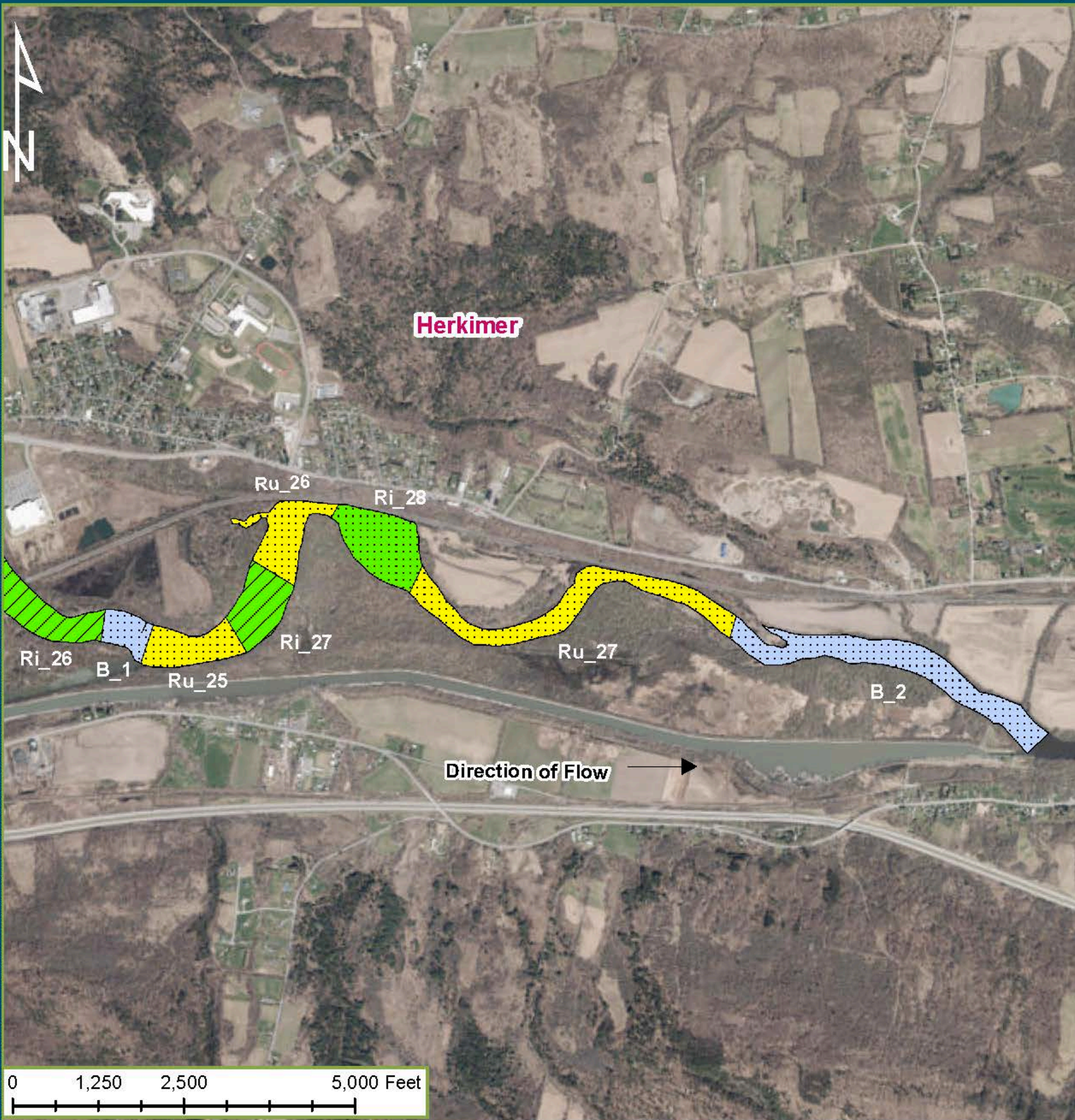

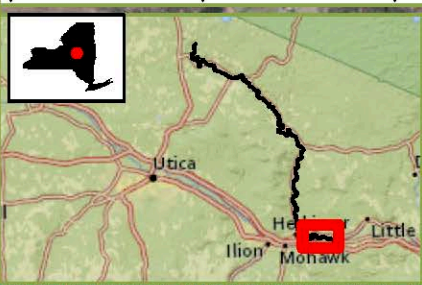

Level Logger

Mesohabitat

- Backwater
- Glide
- Pool
- Rapids
- Riffle
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- Run
- Run-Pool Complex

Cover Quality

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West Canada Creek Project
FERC Project No. 2701
Erie Bouelvard Hydropower L.P.

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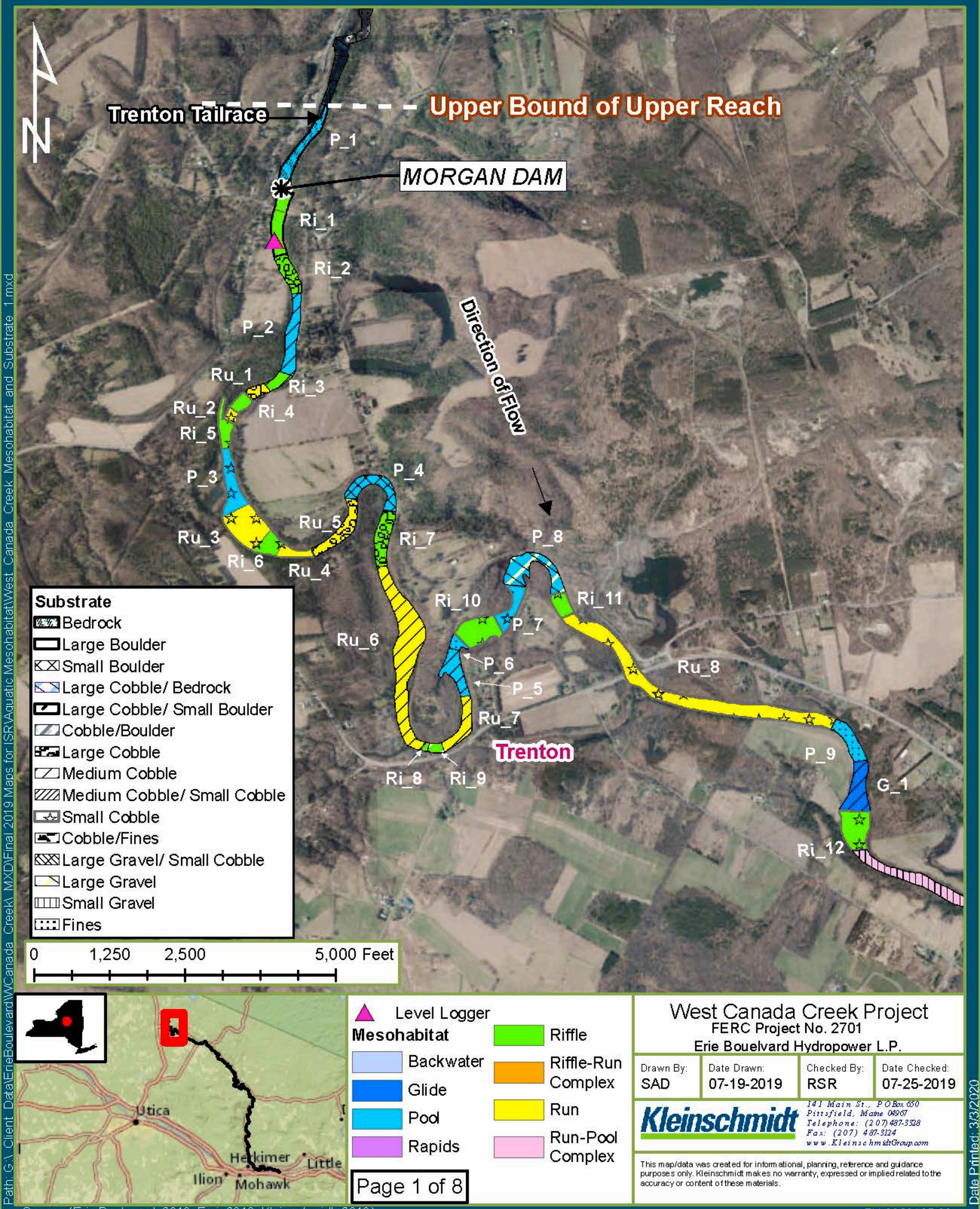
West Canada Creek Mesohabitat & Substrate



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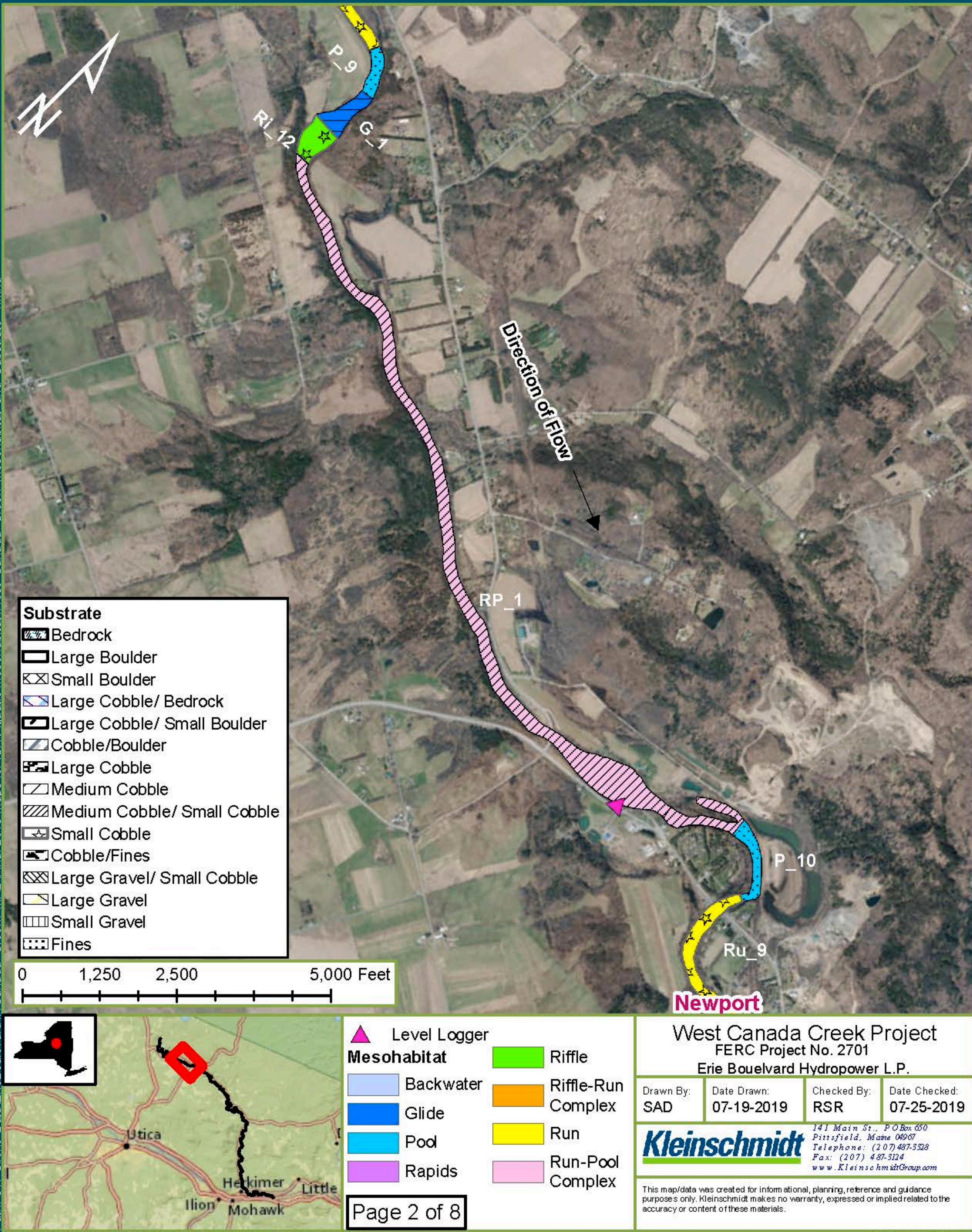
West Canada Creek Mesohabitat & Substrate



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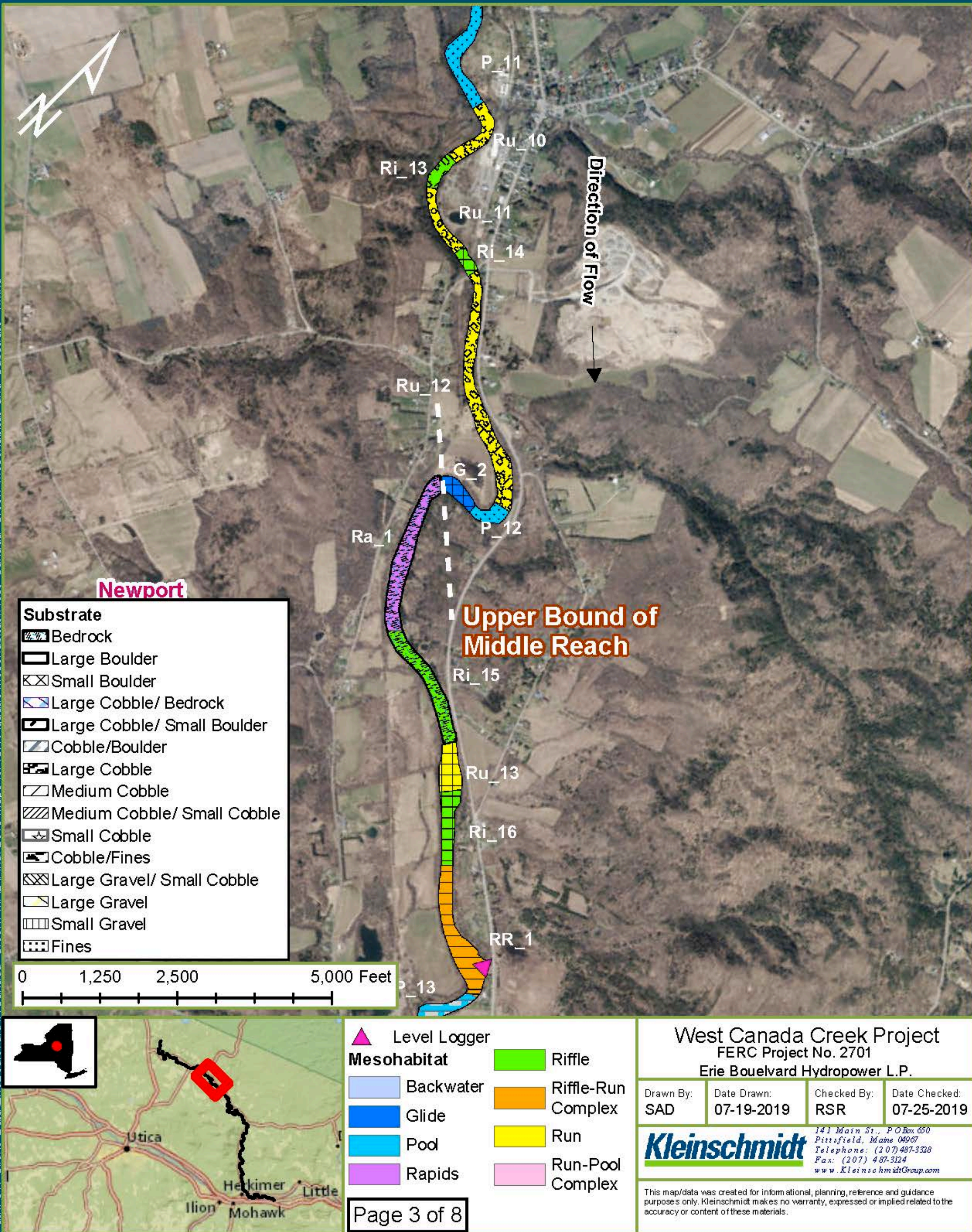

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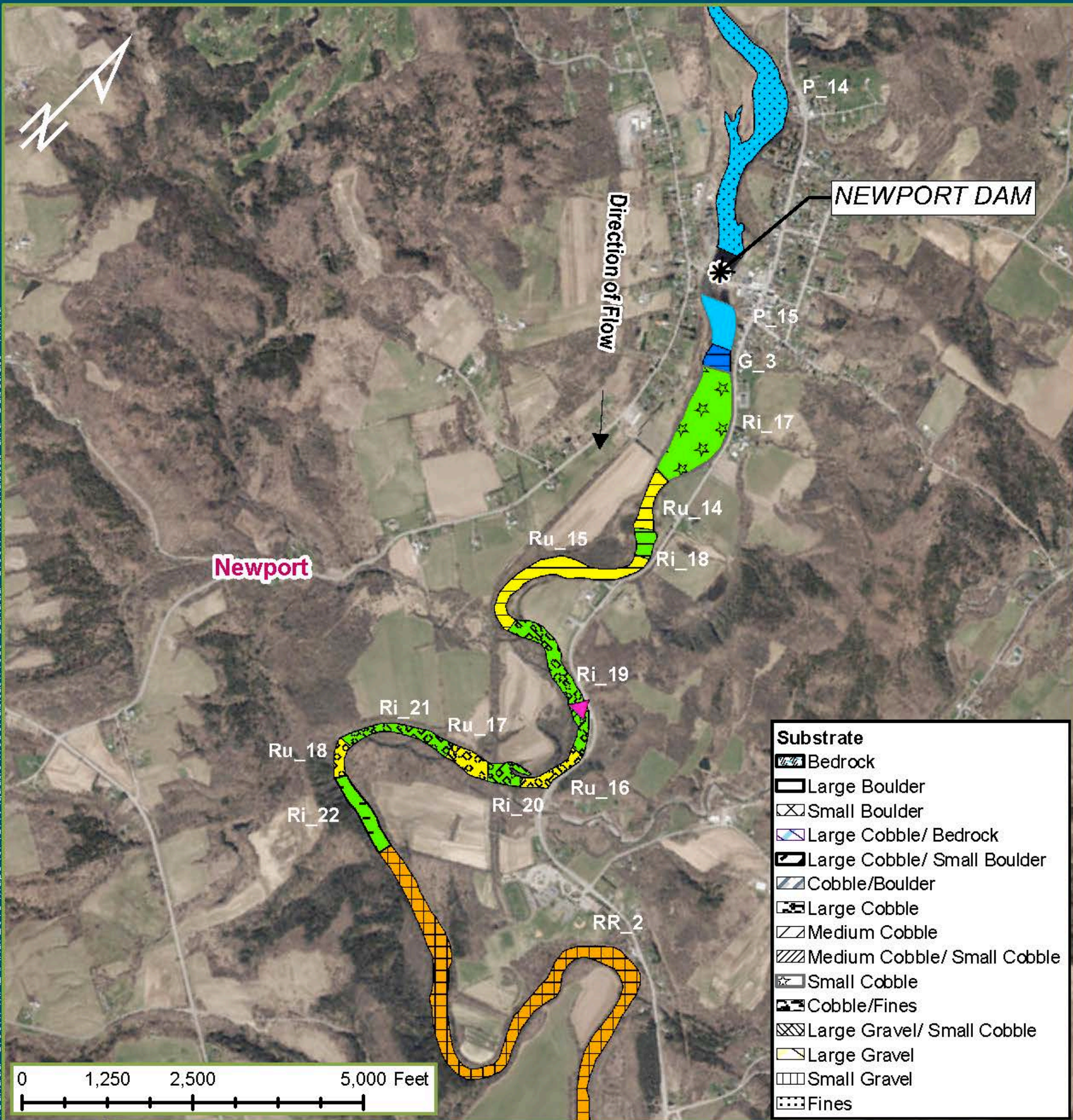

Substrate

- Bedrock
- Large Boulder
- Small Boulder
- Large Cobble/ Bedrock
- Large Cobble/ Small Boulder
- Cobble/Boulder
- Large Cobble
- Medium Cobble
- Medium Cobble/ Small Cobble
- Small Cobble
- Cobble/Fines
- Large Gravel/ Small Cobble
- Large Gravel
- Small Gravel
- Fines

Level Logger

Mesohabitat

- Backwater
- Glide
- Pool
- Rapids
- Riffle
- Riffle-Run Complex
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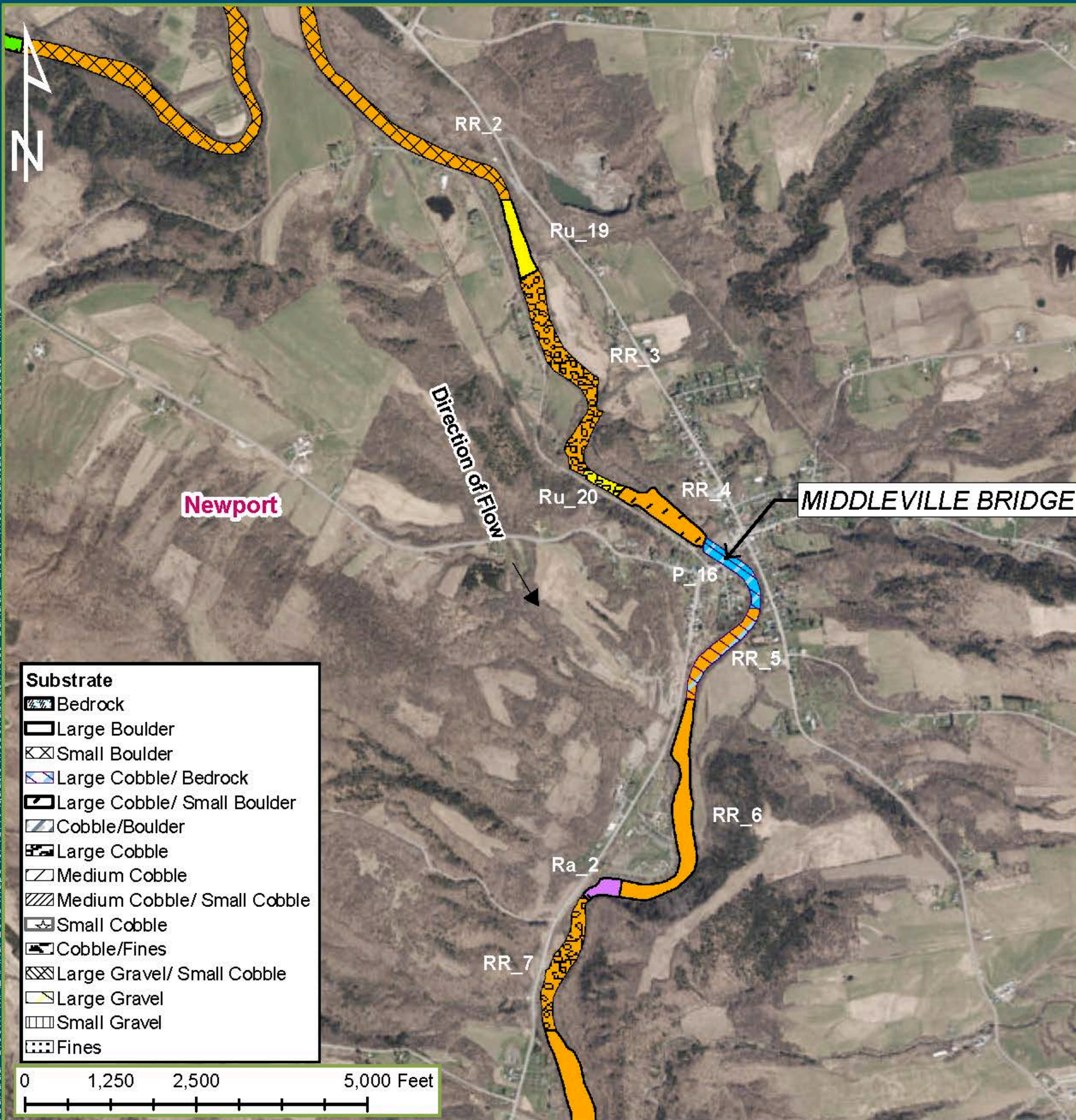

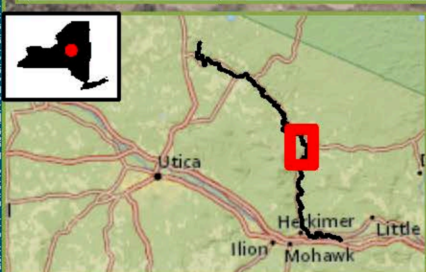

Level Logger

Mesohabitat

Backwater

Glide

Pool

Rapids

Riffle

Riffle-Run Complex

Run

Run-Pool Complex

Page 5 of 8

West Canada Creek Project
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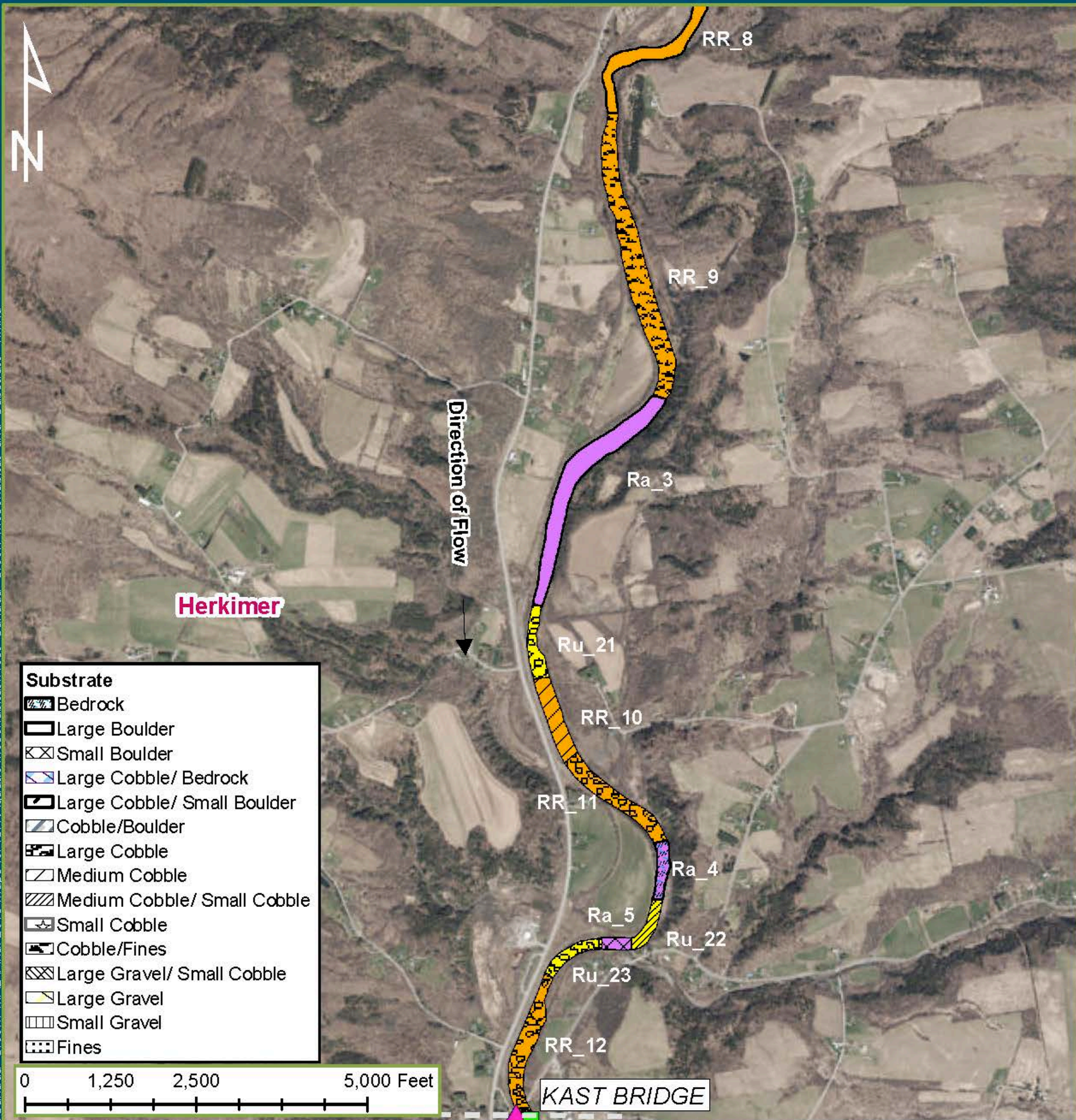

Level Logger

Mesohabitat

Backwater
Glide
Pool
Rapids
Riffle
Riffle-Run Complex
Run
Run-Pool Complex

Page 6 of 8

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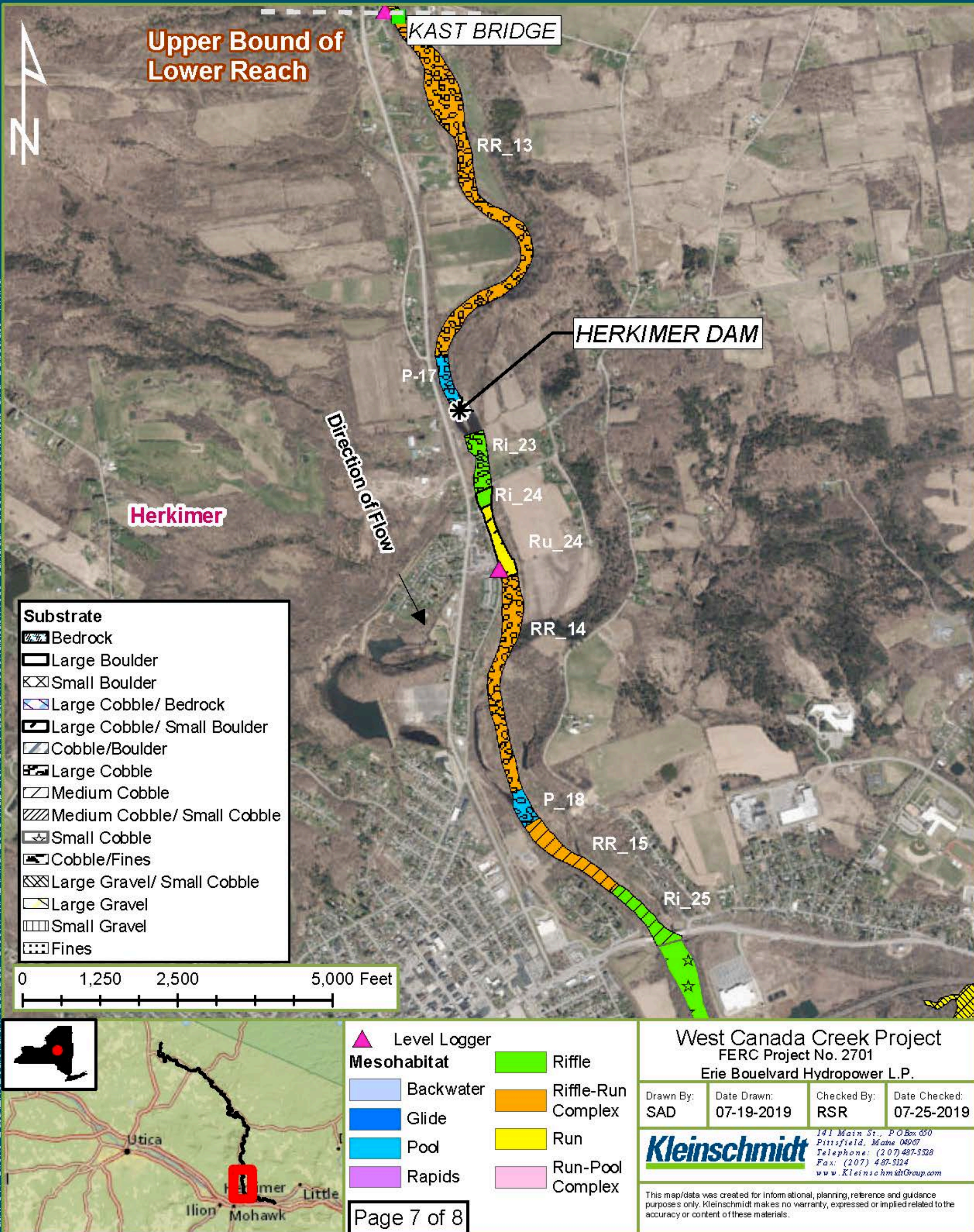

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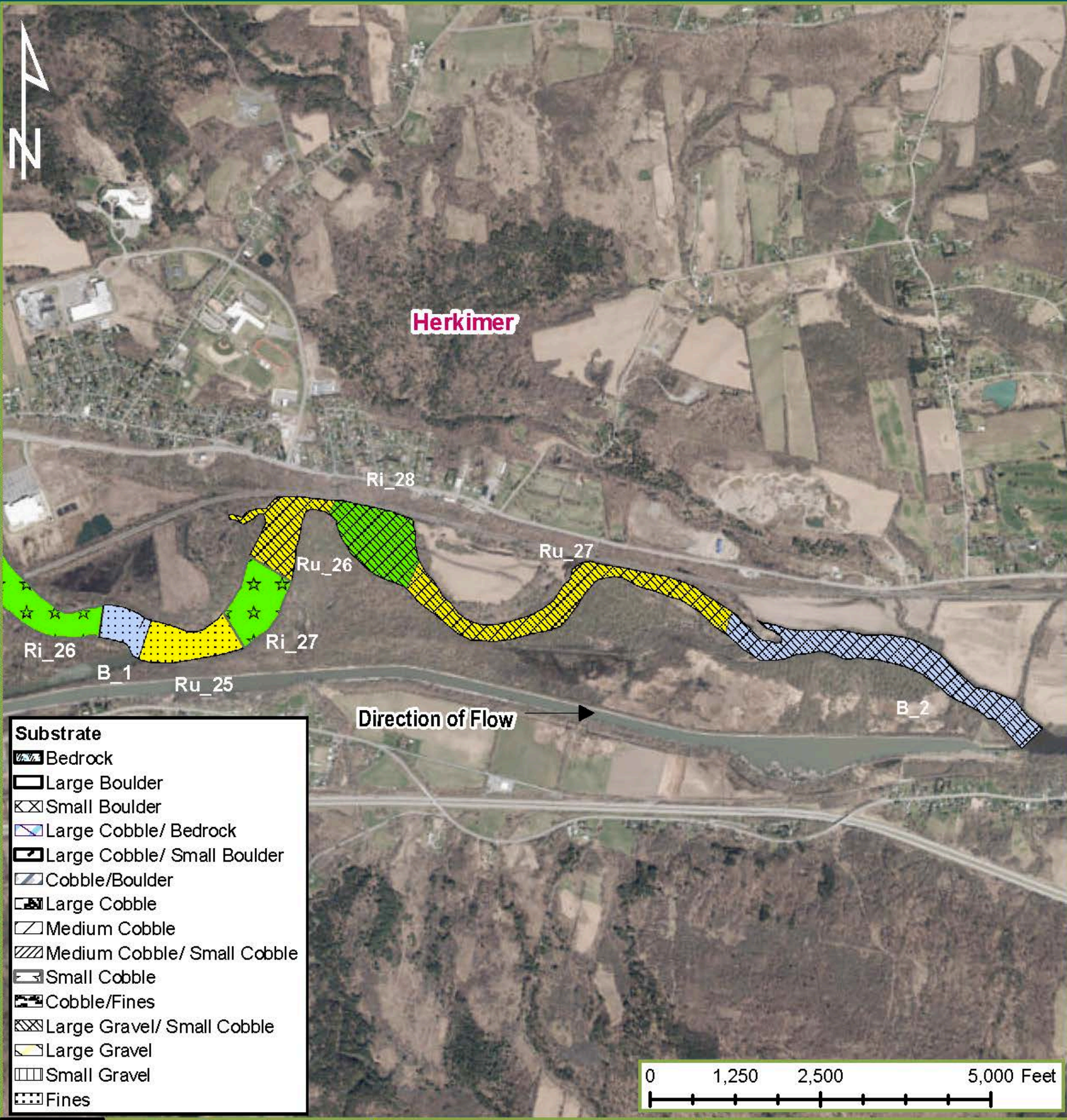

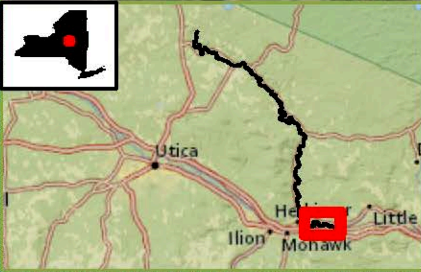

Level Logger

Mesohabitat

Backwater	Riffle
Glide	Riffle-Run Complex
Pool	Run
Rapids	Run-Pool Complex

West Canada Creek Project
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