Minnehaha Creek Habitat Inventory

The Minnehaha Creek and its tributary, Silver Creek, are surrounded by hundreds of acres of State of Michigan and Little Traverse Conservancy lands, which provides both protection to the stream and public access to the fishery. Because other area streams do not support such a robust brook trout population due to their warm, slow flowing, or low gradient nature. (MDNR fisheries biologist Neal Godby, Personal Communication, 2016), the Minnehaha Creek provides the single closest brook trout angling opportunity to Petoskey.

Monitoring during the grant period yielded better trout habitat, likely due to the Maxwell Rd. crossing improvement.

Habitat

Bedform Units and Diversity

Amongst the vast array of stream conditions that can affect the distribution of aquatic life forms, bedform unit type is the most determinant variable. Bedform unit type is so determinant that in similar studies, it is referred to as simply as "habitat type". Bedform unit type often influences stream conditions related to water velocity, and as a result, influences substrate particle size. Faster waters will carry away small particles, leaving larger particles such as gravel, and cobble. These small particulate tend to settle in areas of slower current, such as pools. Through this natural variability, streams provide living organisms with the different living conditions necessary for biological diversity. Pools, where water slows and deepens, provide trout with cover. They can rest here without expending energy fighting a strong current, and the depth afforded by pools maintains volume over the winter months when runs and riffles may be choked with ice. The riffle just upstream from the pool does not do much to aid in trout overwintering, but provides the necessary turbulence to mix atmospheric oxygen with the water, maintaining dissolved oxygen levels in the stream. Riffles are often the predominate places in streams where fine particulate does not settle. This gives trout an opportunity to spawn, since their eggs cannot survive in the presence of fine particulates. Likewise, the vulnerable, exposed gills of the stonefly require high levels of dissolved oxygen and absence of fine particulate for survival. Stoneflies and certain other sensitive macroinvertebrates are found exclusively in riffles, and serve as an important part of the greater food web of the stream. Through these relationships, and many more, the habitat variability afforded by bedform unit diversity supports a healthy stream ecosystem.

Tip of the Mitt Watershed Council used bedform units as the framework for this habitat inventory. In doing so, four different types of bedform unit were documented. Pool, glide, run, and riffle were present. Each bedform unit is represented by one record in this dataset, with a unique habitat unit number assigned. Data collection procedures were based off a 1993 USFS study by Dolloff et. al. with the addition of spatial data collection using a GPS unit.

At Maxwell Rd. in 2017, the Minnehaha had very few riffles and mostly runs (Figure 5). Its pool:riffle ratio was 36:1, well below the optimal brook trout riverine habitat characterized by the US Fish and Wildlife Habitat Suitability Index as 1:1. After improvement, 2018 results showed a greater variability of pool, run, and riffle upstream of the crossing (Figure 6). Notably, the original pool downstream of the crossing turned into a run and riffle complex. The pool:riffle ratio increased to an optimal 1:1 ratio.

Pickerel Lake Rd., before improvement had a good variability of the bedform units—the least prevalent were glides, while riffles and runs were nearly equally distributed. The pool:riffle ratio was 1:3. (Figure 7)

Glides and runs fall towards the middle of the bedform unit spectrum, and as a result, have less exacting effects on habitat conditions within streams. A deep glide with low water velocity can, to a degree, provide similar resting and overwintering functions as a pools. A shallow glide may not provide the same benefits. Some runs with pockets of gravel may be suitable for trout spawning, while other runs may be predominantly sand. These in-between bedform types are reliant on micro-climate conditions often caused by large woody debris, such as small plunge pools, slow areas, and undercut banks.

Large Woody Debris

Large woody debris (LWD) within a stream system fulfills many important roles related to habitat. For the purposes of this study, TOMWC defined LWD as any piece of wood within the bankfull channel of the stream. To be counted, pieces had to be greater than four inches in diameter, and at least half of the bankfull width of the bedform unit in which it was found. If a piece of LWD failed to meet these conditions based on length, it could still be counted if greater than six inches in diameter.

Numerous studies have shown the importance of LWD in stream systems for both macroinvertebrates and fish. A 2007 study by the MI DNR confirmed a positive relationship between the abundance of age class 0 – 2 brown and brook trout and the amount of LWD found within different reaches of the Au Sable River. Studies of smaller, higher gradient streams in the pacific northwest have also shown the importance of LWD inputs related to sustainable logging practices and their influence on salmonid populations.

LWD provides surface area within the stream channel for macro invertebrates to live on, cling to, and even build cases and nets on (in the case of the caddisfly). Macro invertebrates belonging to the scrapper-shredder functional feeding group often rely on LWD for sustenance, not by eating the wood directly, but by eating the biofilm that forms on LWD. Through additional nutrients resulting from log decomposition and formation of biofilm, the base of the stream food chain is sustained. Macroinvertebrate abundance is a product of this, and is an important food source for fish populations.

LWD in a stream not only acts to augment the food chain, but plays an important role in the morphology of a stream channel. Dave Rosgen, in his 1996 book *Applied River Morphology,* identified that at the watershed scale, streams are shaped by geology, water flow, and sediment deposition. On a local scale of stream morphology, the channel is shaped by slope, bed and bank material, riparian vegetation, and local hydrology. LWD plays a role in these factors as bed and bank material, altering flow patterns of water to create plunge pools, meanders, zones of deposition, and other small-scale channel variations. By altering stream flow, LWD actually increases the amount of time water spends in a given portion of stream, and prevents high water velocities from scouring away banks and bottom substrates.

In 2017, the Minnehaha Creek at Maxwell Rd., before improvement, had amounts of woody debris to put the creek in a reference condition, or over 524 pieces per mile (Figure 8). Some areas of the creek had as little as zero pieces per mile, and the maximum was nearly 8,000. Conversely the maximum in 2018, after the improvement, was 3,520 per mile (Figure 9). It is unknown why this change occurred, but it is possible that woody debris was flushed downstream, as the figures show downstream of the road and in the upstream reaches.

At Pickerel Lake Rd. in 2018, before improvement, there was a high abundance of woody debris throughout the reach (Figure 10). While the lowest amount was zero pieces per mile, the stretch with the most woody debris had 10,000 pieces.

Stream Substrate

Stream substrate is a product of water velocity and how it moves the stream's sediment load down the channel. The sediment load of a channel is determined by the parent material of the stream bed, and also through external inputs such as bank erosion and stormwater. In a stream with stable banks and few sediment inputs, fine particulate is trapped in depositional areas of slow current, and transported away in areas of fast current. This process generates variability in substrate, which is generally desirable and encourages stream biodiversity. Gravel is necessary (as mentioned above) for trout spawning and sensitive macroinvertebrate populations. Depositional areas of organic material provide habitat for burrowing fauna and provide substrate for aquatic vegetation. When this balance is disrupted, biodiversity suffers.

At Maxwell Rd. in 2017, before improvement, reaches well upstream of the crossing were over 50% sand (Figure 11). In 2018, after improvement, upstream reaches had higher variability and sand was correlated with pools. Downstream reaches had less sand overall (Figure 12)

In 2018 at Pickerel Lake Rd., before improvement, some upstream reaches were mostly sand, while reaches nearer the road and downstream were about 50% sand (Figure 13).

Riparian Vegetation

The vegetation growing around a stream widely influences conditions within. Allochthonous inputs (material originating outside of the stream) such as sticks and leaves supplement water with nutrients as they decay. Large allochthonous inputs are considered LWD (covered above), and offer the stream many benefits. Vegetation above the steam provides shade, intercepting the warming energy of direct sunlight. Roots from vegetation prevent erosion to stream banks by holding the soil in place, and can even aid in the formation of undercut banks. Animals that use the stream for water and food benefit from the cover.

The US Fish and Wildlife Service gives the guideline: “A buffer 30 m deep, 80% of which is either well vegetated or has stable rocky stream banks, will provide adequate erosion control and maintain undercut stream banks characteristic of good trout habitat”.

The riparian buffer around the Minnehaha at Maxwell Rd. is optimal for trout habitat (

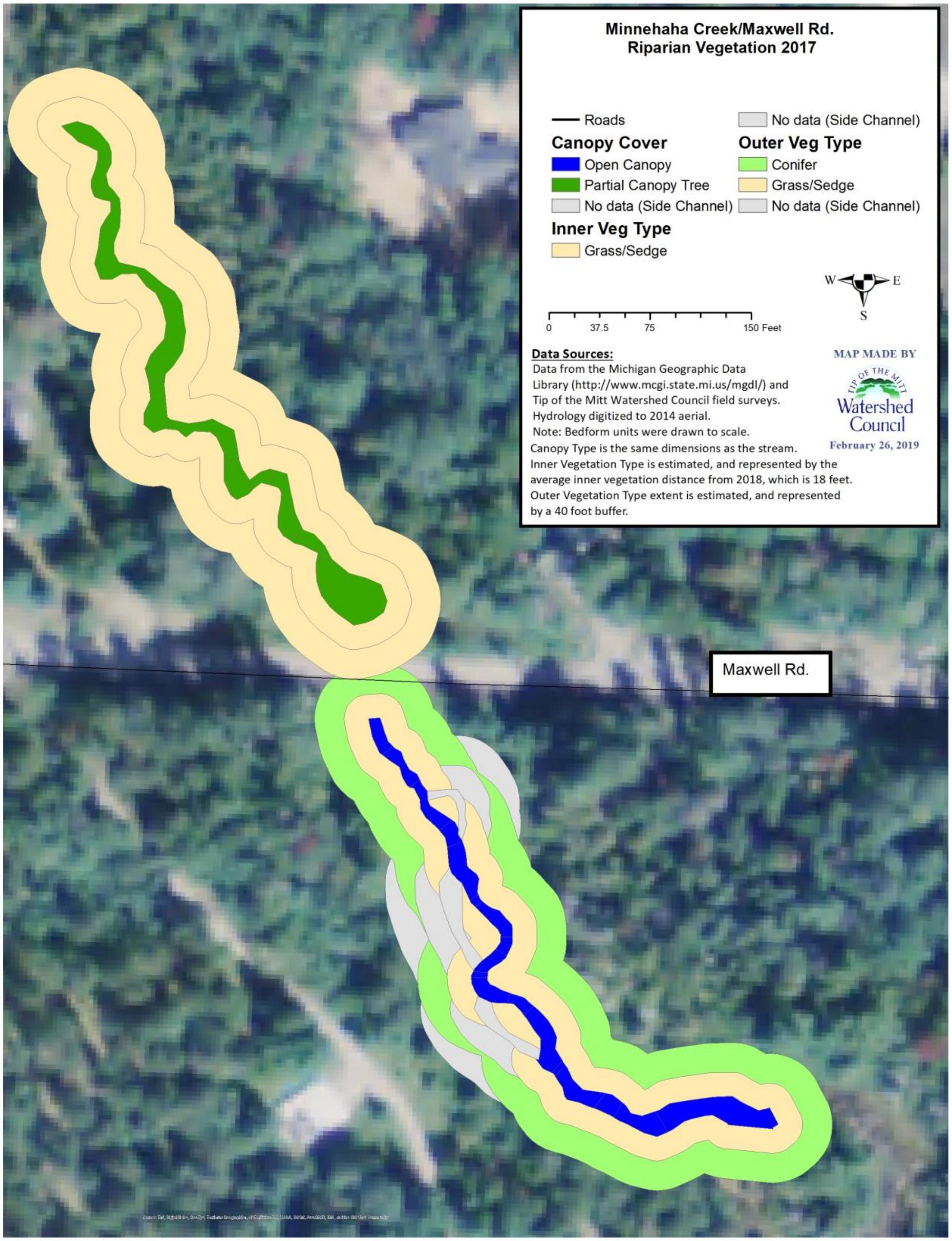

Figure 14 and Figure 15). Some changes occurred between surveying before and after the

Maxwell Rd. improvement. Data shows a change from a grass/sedge outer vegetation type downstream to conifer and an open canopy upstream changing to a partial tree. This could be due to differences in surveyors and is likely not caused by the new culvert.

The riparian buffer around the Minnehaha at Pickerel Lake Rd. is also optimal (Figure 16). The vegetation is different from the upstream Maxwell Rd. crossing in that it is all conifers in the inner and outer vegetation zone. The reach also has no areas of open canopy, allowing for optimal shading and cooling of the creek. 50% - 75% mid-day shading is optimal for cold water fish populations in streams (Anonymous. 1979). This reference condition is captured in survey categories of partial and closed canopies. Open canopy does not provide enough shade to ensure temperatures mid-summer stay within the survival limits of brook trout (<68°F).

Longitudinal Profile

The longitudinal profile was measured at Maxwell Rd. before and after improvement (Figure 1). In 2017, the survey occurred over one day with the help of the U.S. Fish and Wildlife Service. It should be noted that the 2017 survey had very little data points compared to the 2018 survey. More time was taken during the 2018 surveys at Maxwell Rd. and Pickerel Lake Rd., yielding more accurate results. Lessons learned include the need for additional time, more consistent locations for data points for before and after, and the need for Watershed Council staff to be trained in understanding the data.

The 2017 downstream data at Maxwell Rd. is likely inaccurate, in that it shows a steady decline of both water and bed elevation. Likely a reference point was missed during data collection. The plunge pool downstream of the culvert is pronounced in 2017 with a nearly 4 foot drop in elevation. During the 2018 post survey, it was clear that a downcut was more pronounced upstream of the new culvert, and the plunge pool was filled in with more sediment, turning it into a run. Overall, the creek is on its way to consistent variability throughout the reach.

2018 data at Pickerel Lake Rd. was collected prior to improvement (Figure 2). There is also a 4-foot deep plunge pool downstream of the culverts. It is likely that the longitudinal profile would smooth out similar to the Maxwell Rd. crossing after a bridge replaces the culverts.

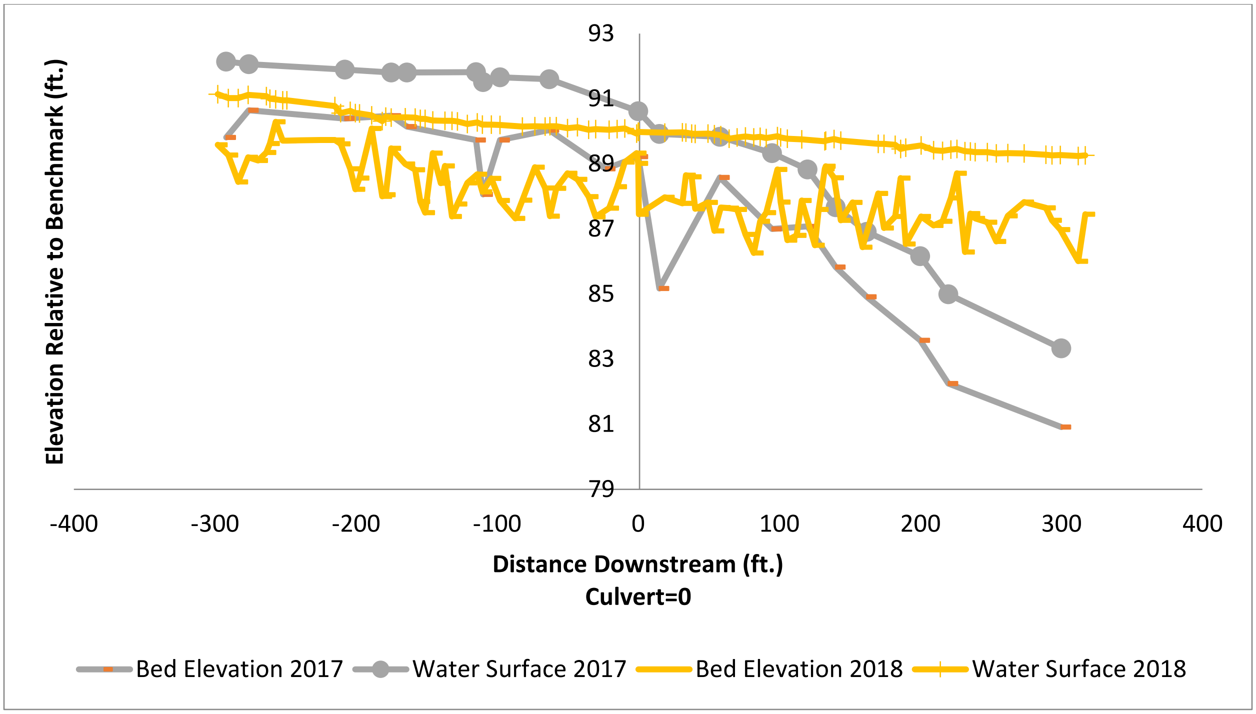

Figure 1. Maxwell Rd. Longitudinal Profile

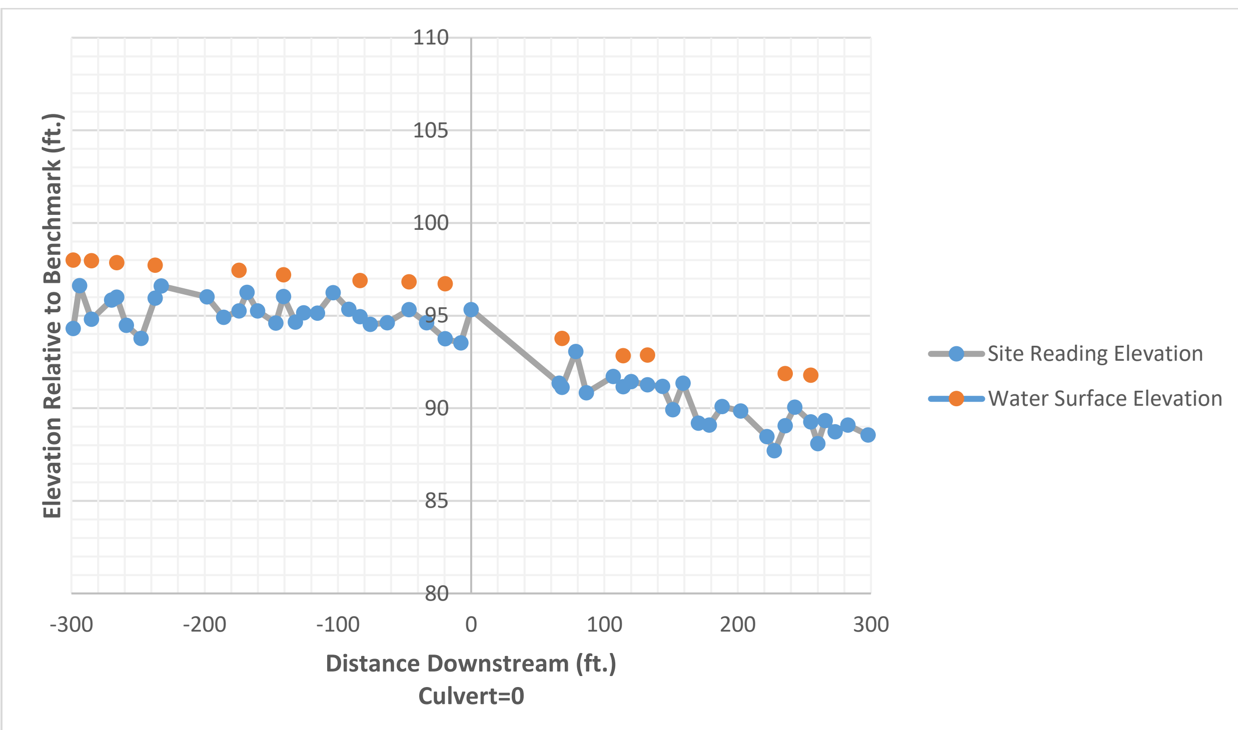

Figure 2. Pickerel Lake Rd. Longitudinal Profile

Macroinvertebrate Assessment

The road/stream crossing improvement did not change the general Hilsenhoff score of the Minnehaha, but some changes were noted in individual parameters (Figure 3). For instance, total taxa and sensitive families increased in spring monitoring events from 2017 to 2018—the overall sensitive families score has increased for this creek due to those changes. Also, in 2017, macroinvertebrate numbers were higher or nearly the same in the fall than the spring at Maxwell Rd. After the improvement, results showed spring numbers to be higher across all categories. While Pickerel Lake Rd. has not been monitored after the improvement, numbers increased after the Maxwell Rd. crossing improvement upstream (Figure 4). It likely that the improvement of the Maxwell Rd. crossing had an effect on both the Maxwell Rd. and Pickerel Lake Rd. crossings.

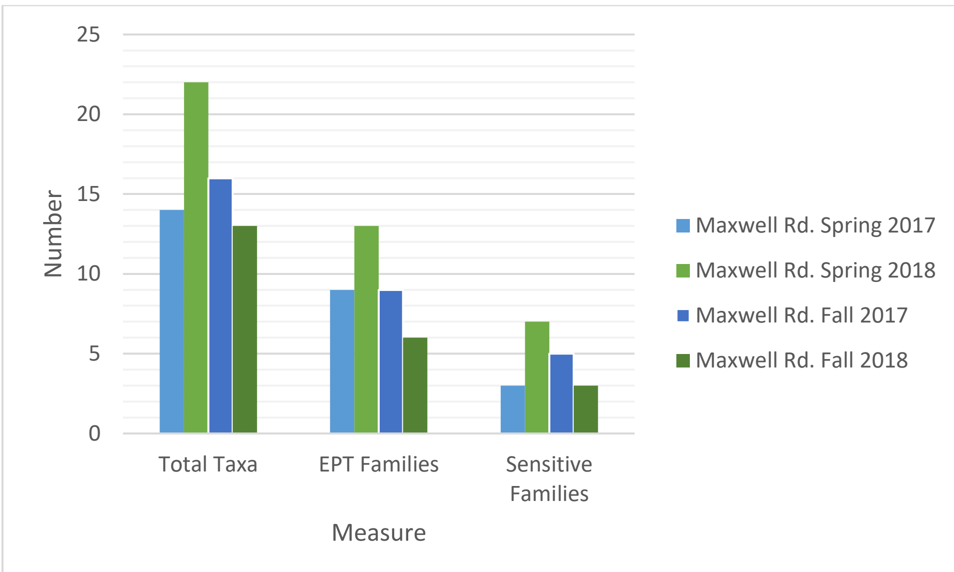

Figure 3. Maxwell Rd. Macroinvertebrates

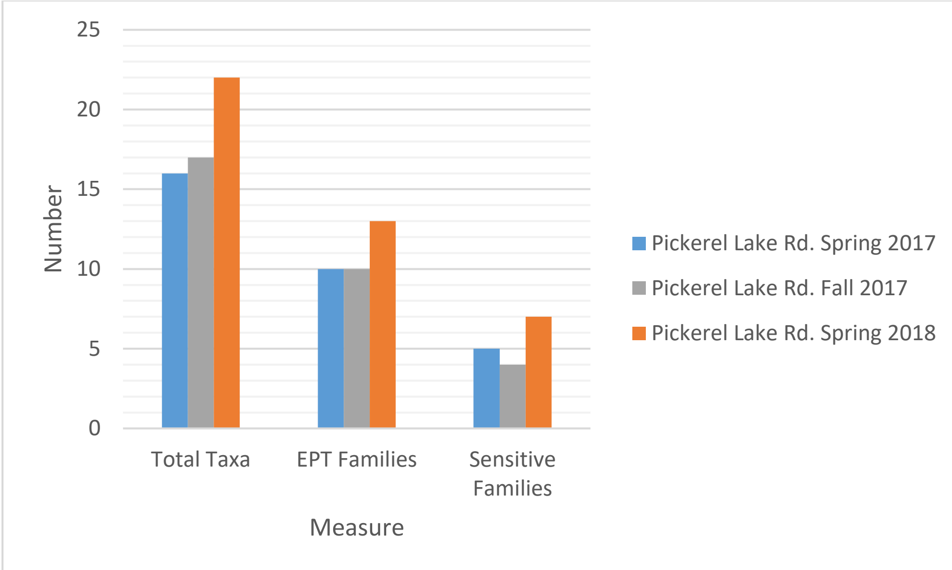

Figure 4. Pickerel Lake Rd. Macroinvertebrates

References

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Dolloff, C. Andrew; Hankin, David G.; Reeves, Gordon H. 1993. Basinwide Estimation of Habitat and Fish Populations in Streams. Gen. Tech. Rep.

Rosgen D. 1996. Applied River Morphology. Wildland Hydrology: Pagosa Springs, CO; 352

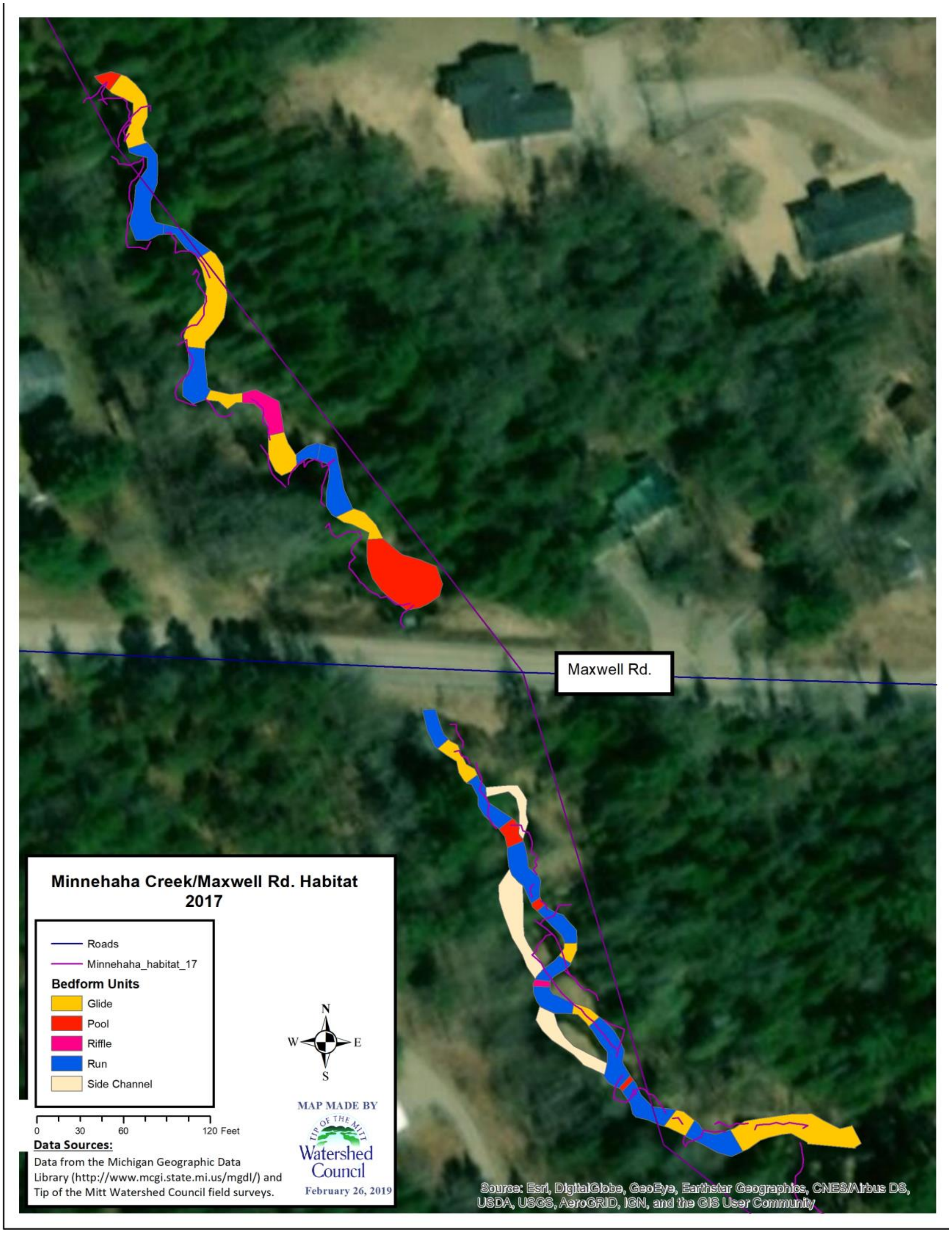

Figure 5. Minnehaha Creek/Maxwell Rd. Habitat 2017

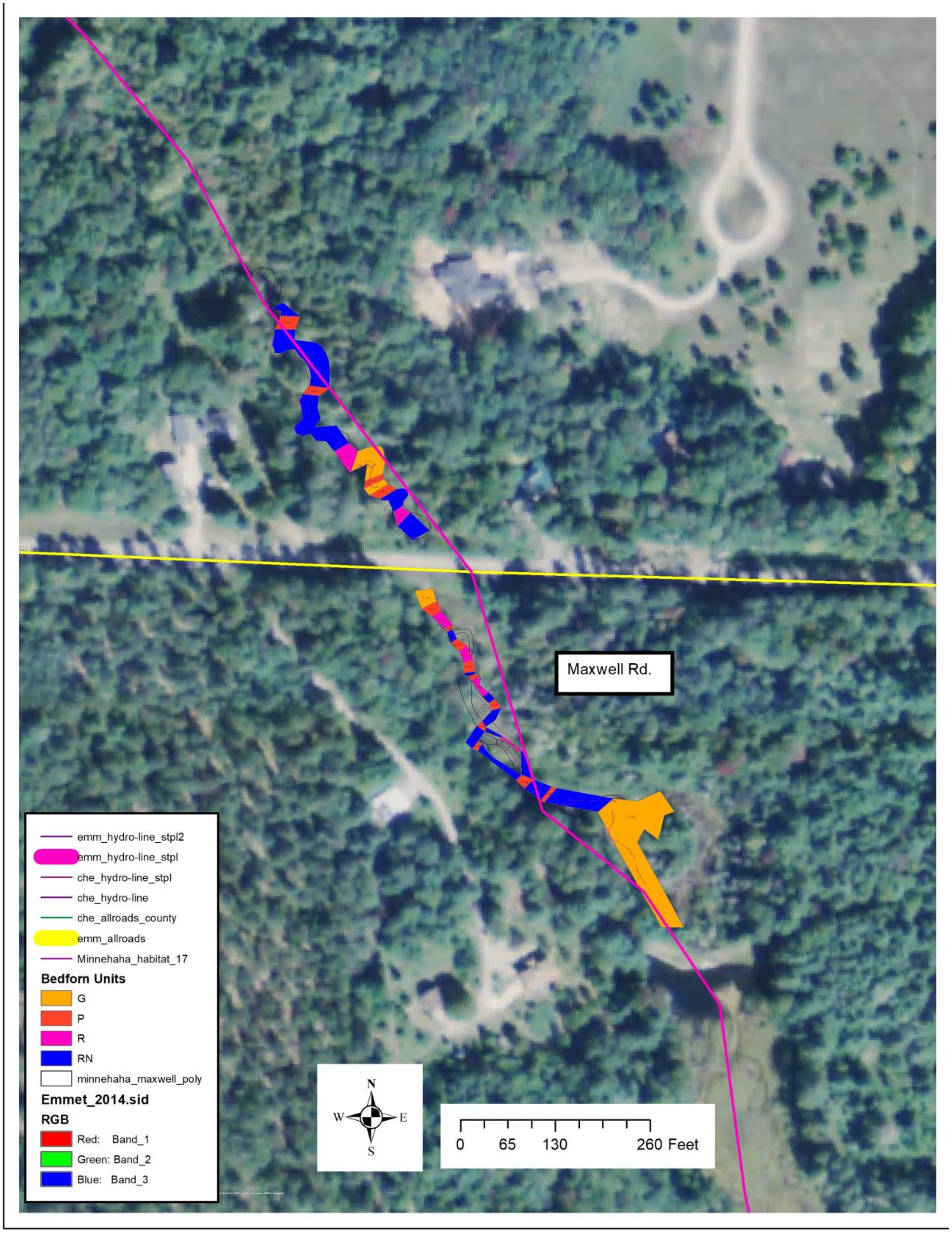

Figure 6. Minnehaha Creek/Maxwell Rd. Habitat 2018

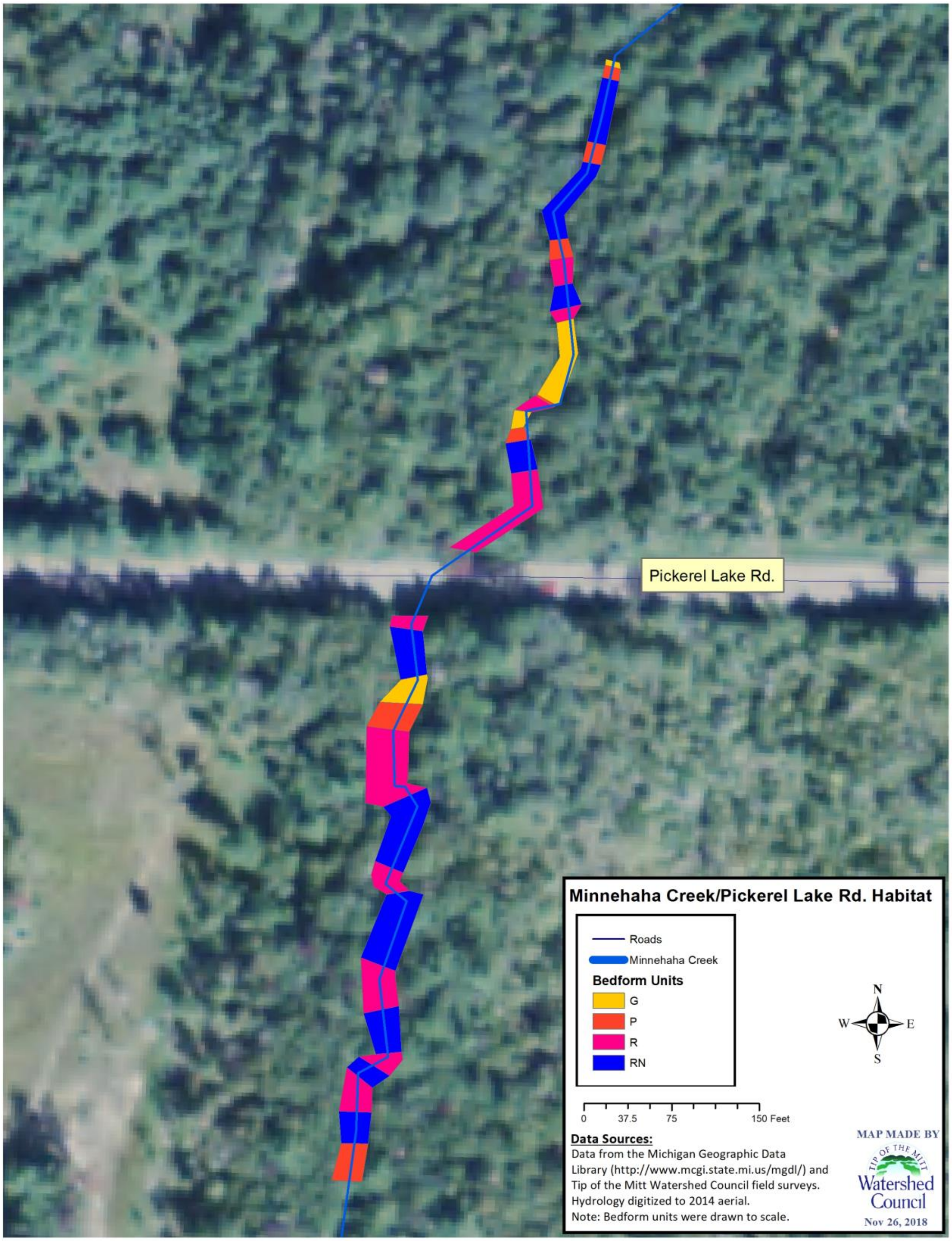

Figure 7. Minnehaha Creek/Pickerel Lake Rd. Habitat 2018

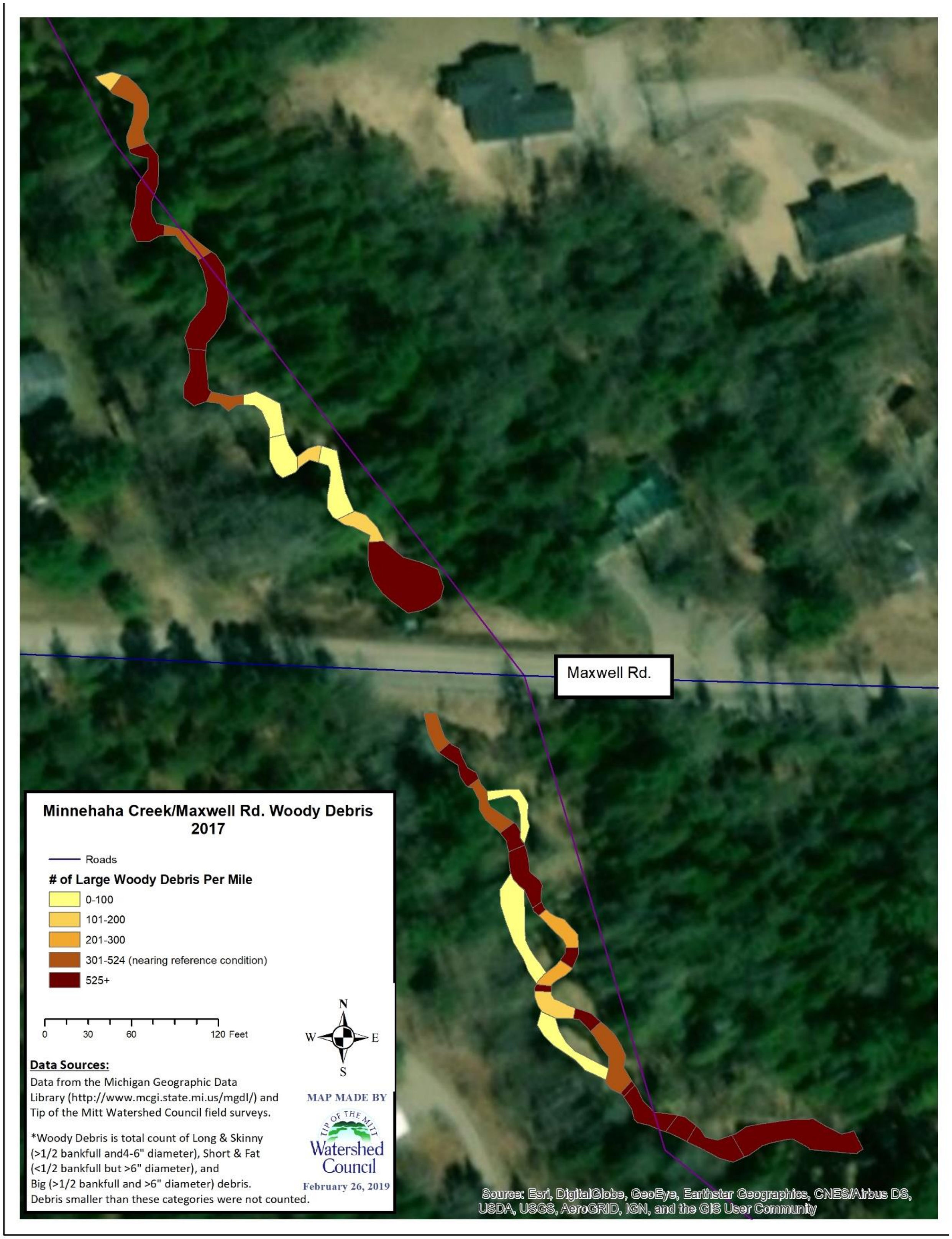

Figure 8. Minnehaha Creek/ Maxwell Rd. Woody Debris 2017

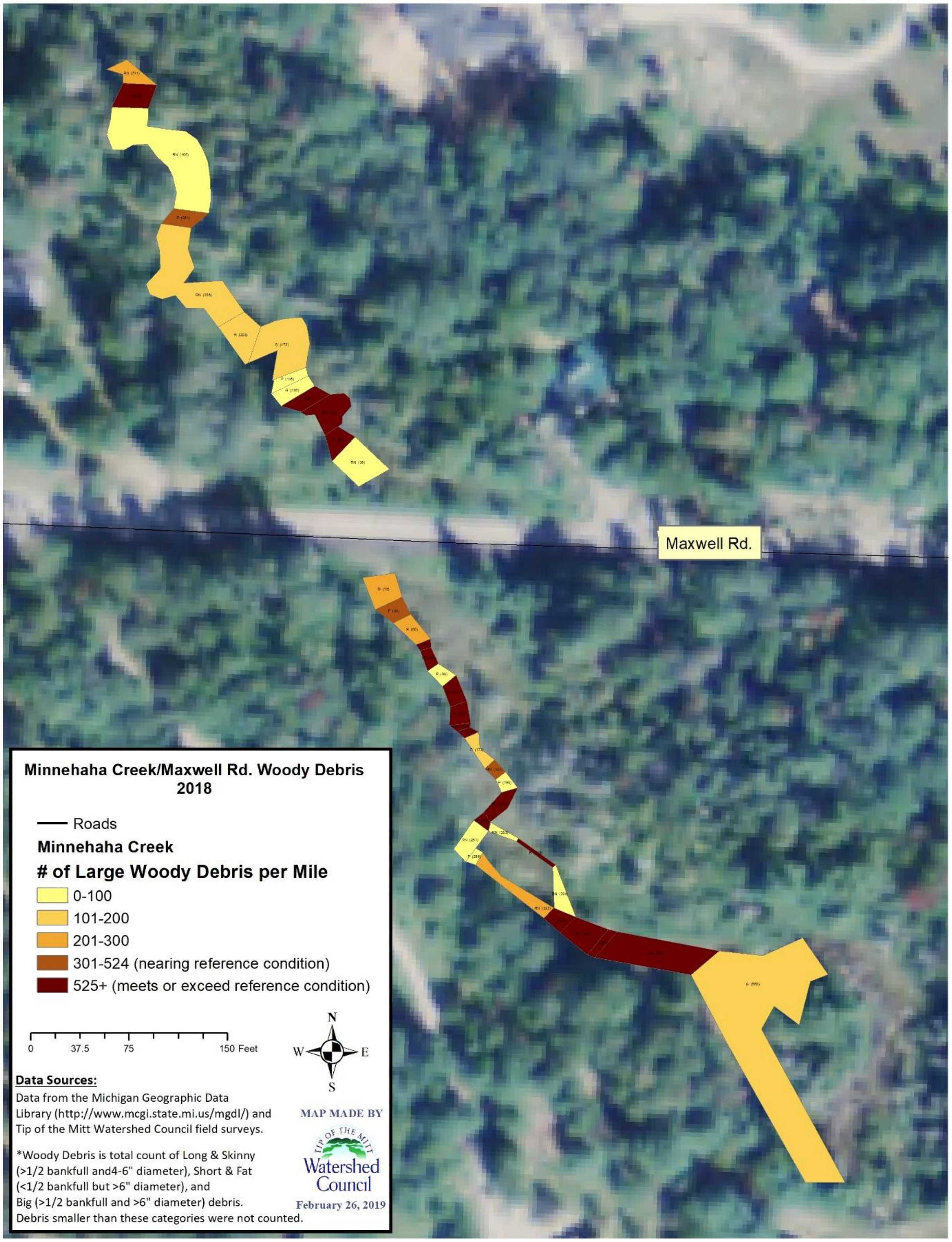

Figure 9. Minnehaha Creek/ Maxwell Rd. Woody Debris 2018

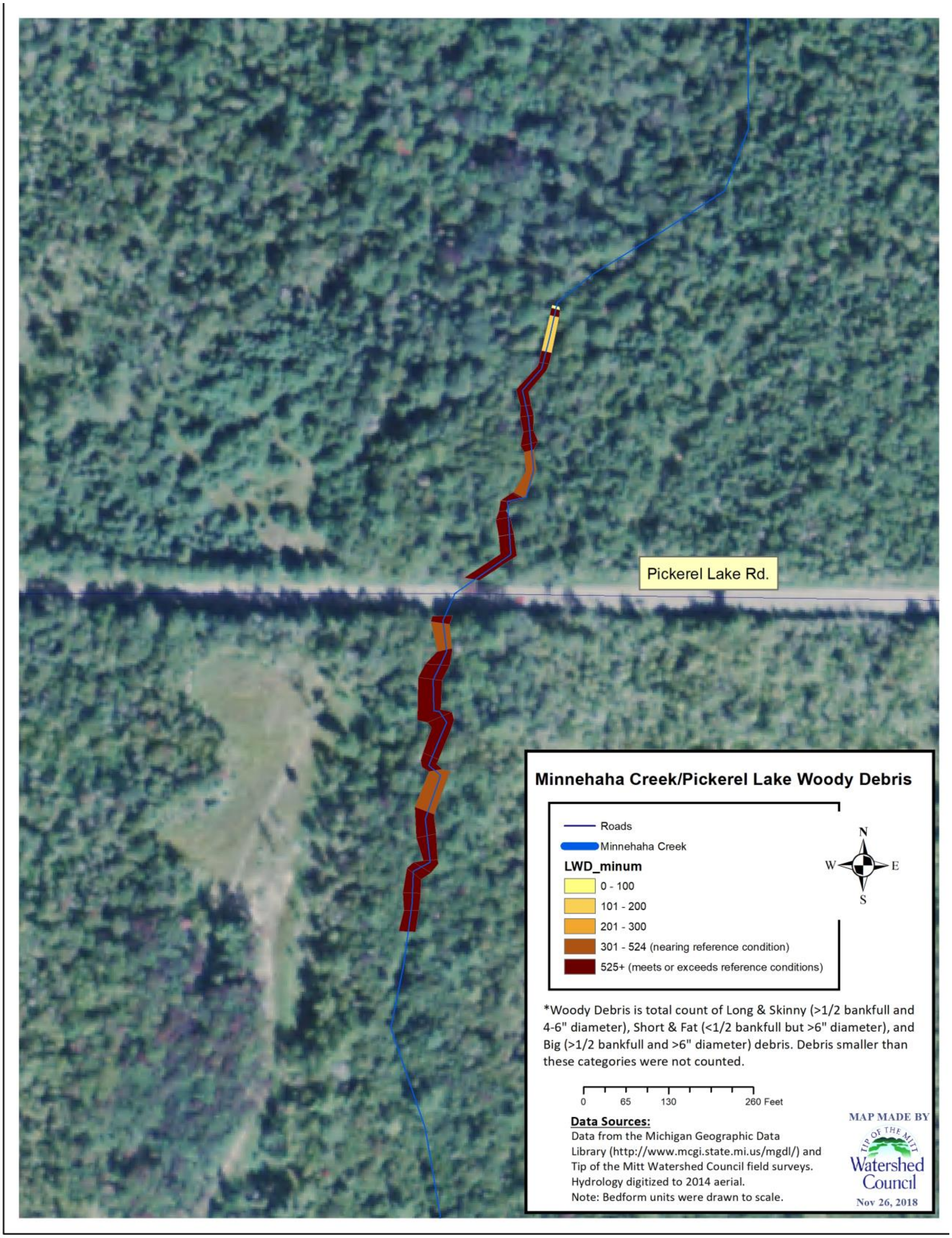

Figure 10. Minnehaha Creek/ Pickerel Lake Rd. Woody Debris 2018

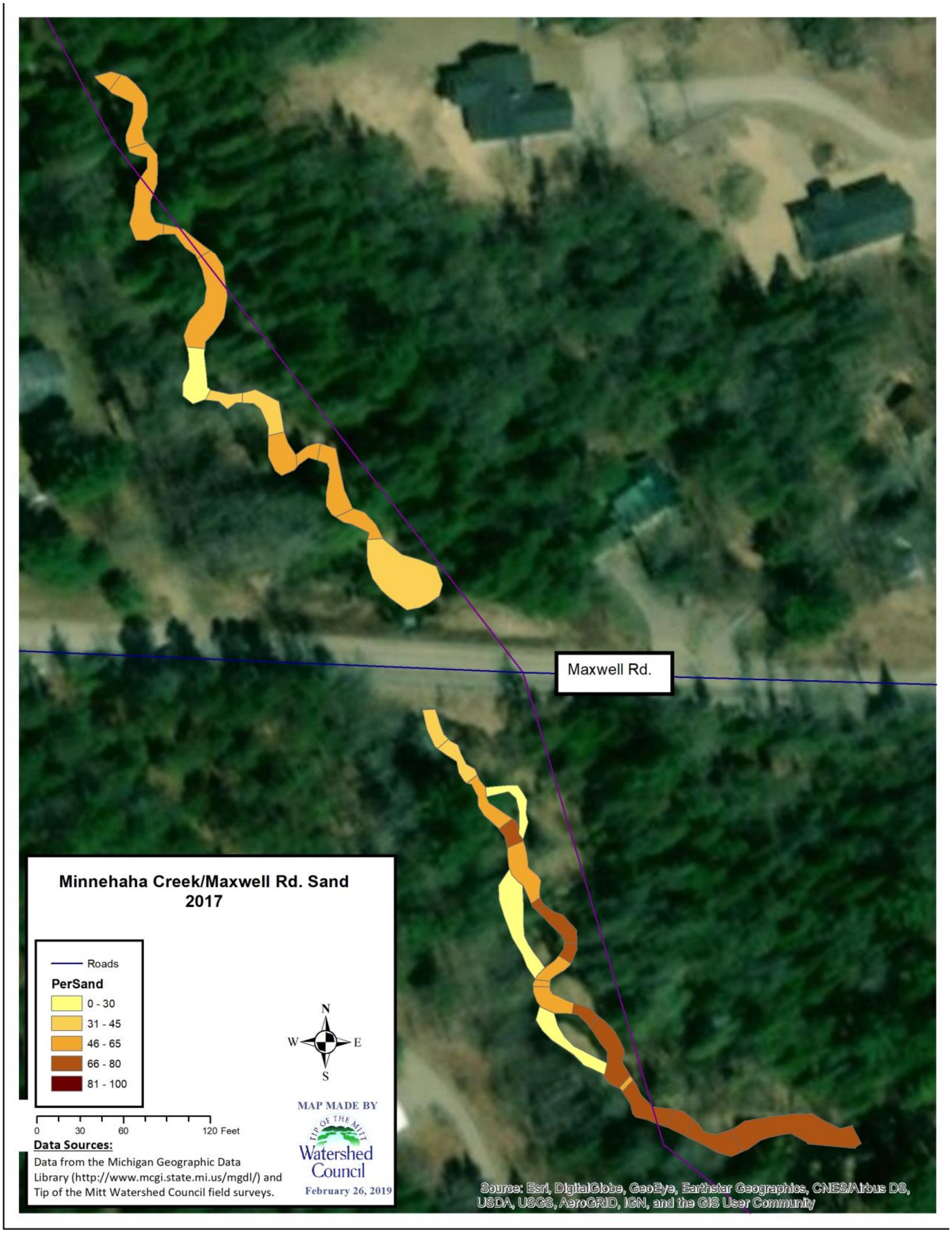

Figure 11. Minnehaha Creek/ Maxwell Rd. Sand 2017

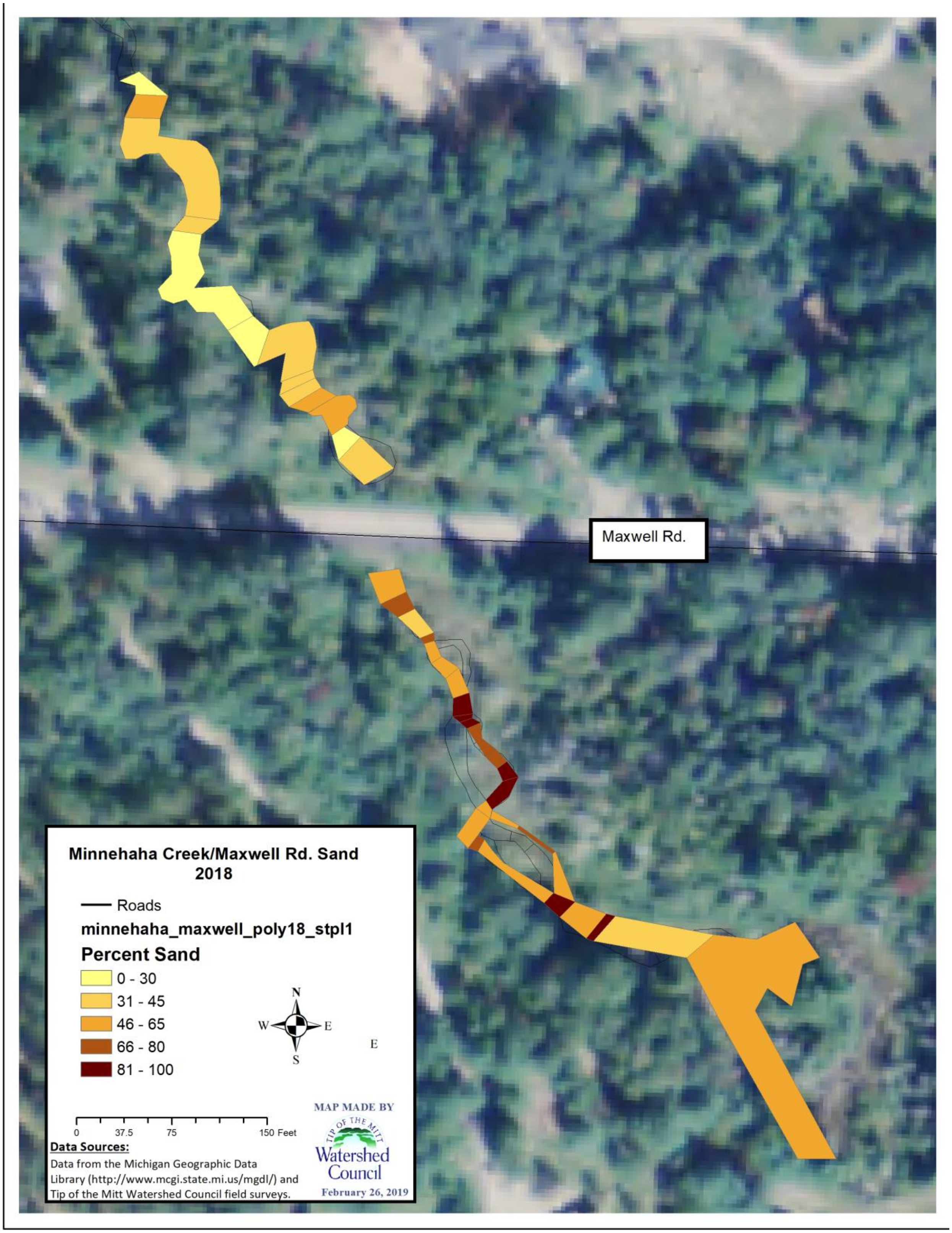

Figure 12. Minnehaha Creek/Maxwell Rd. Sand 2018

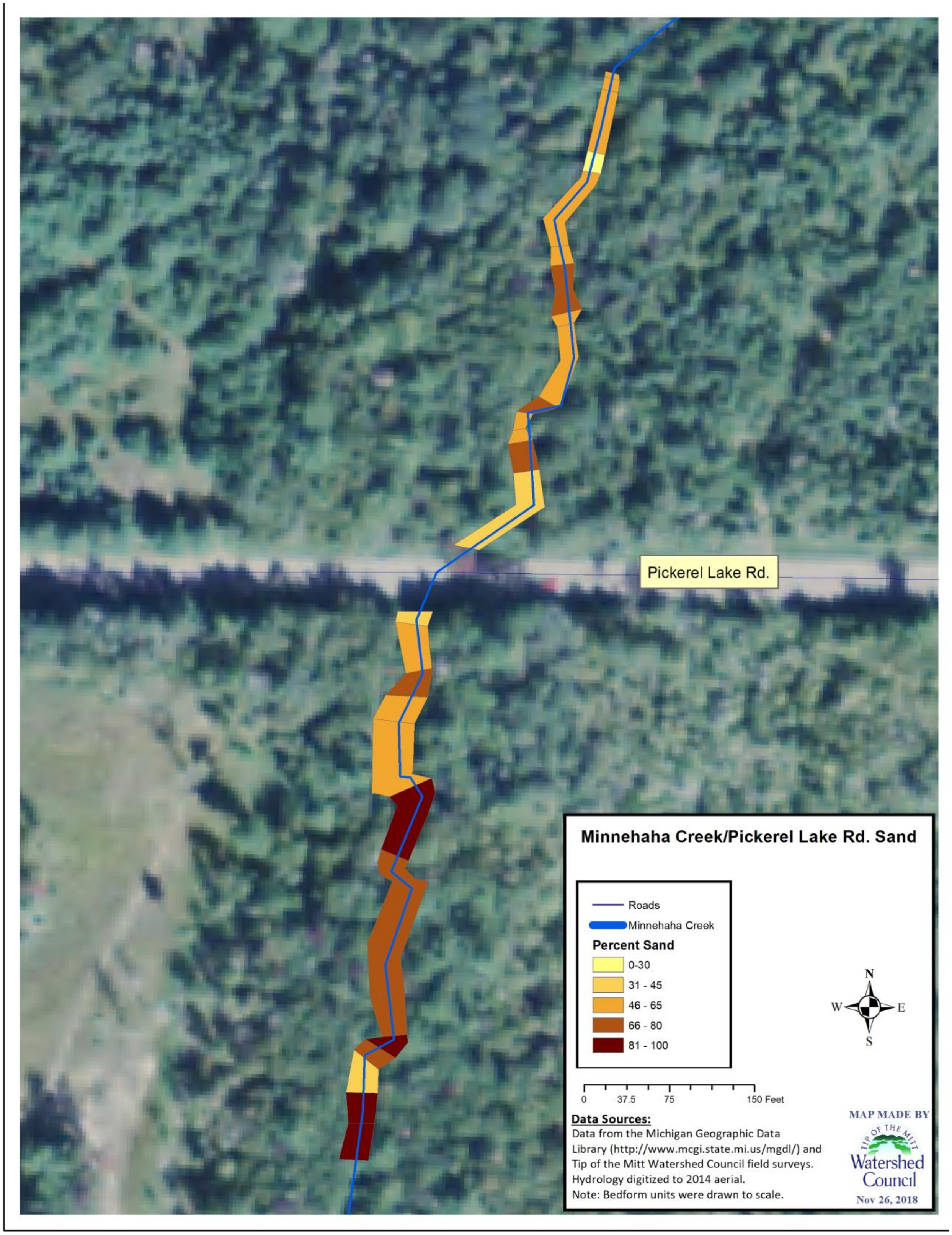

Figure 13. Minnehaha Creek/ Pickerel Lake Rd. Sand 2018

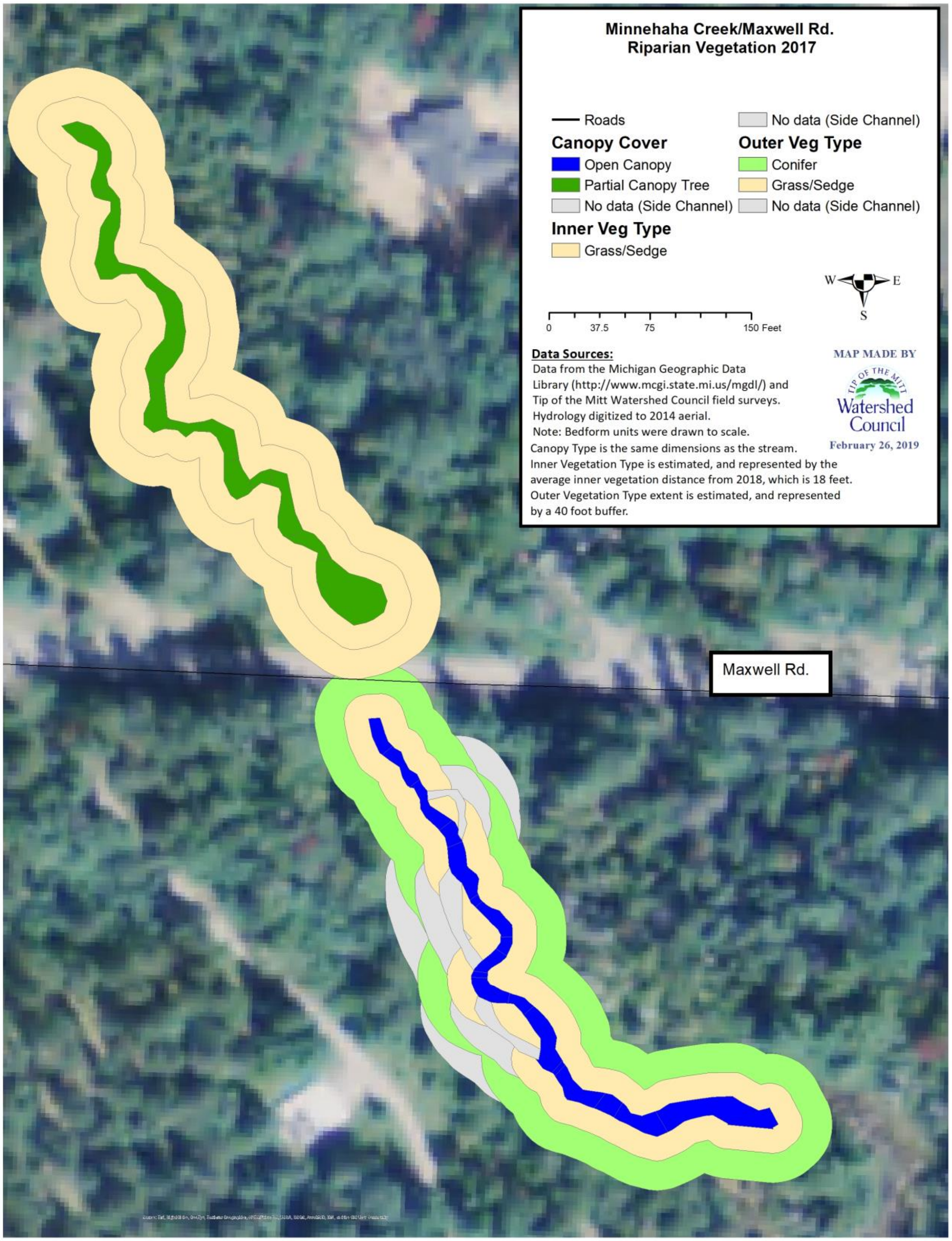

Figure 14. Minnehaha Creek/ Maxwell Rd. Riparian Vegetation 2017

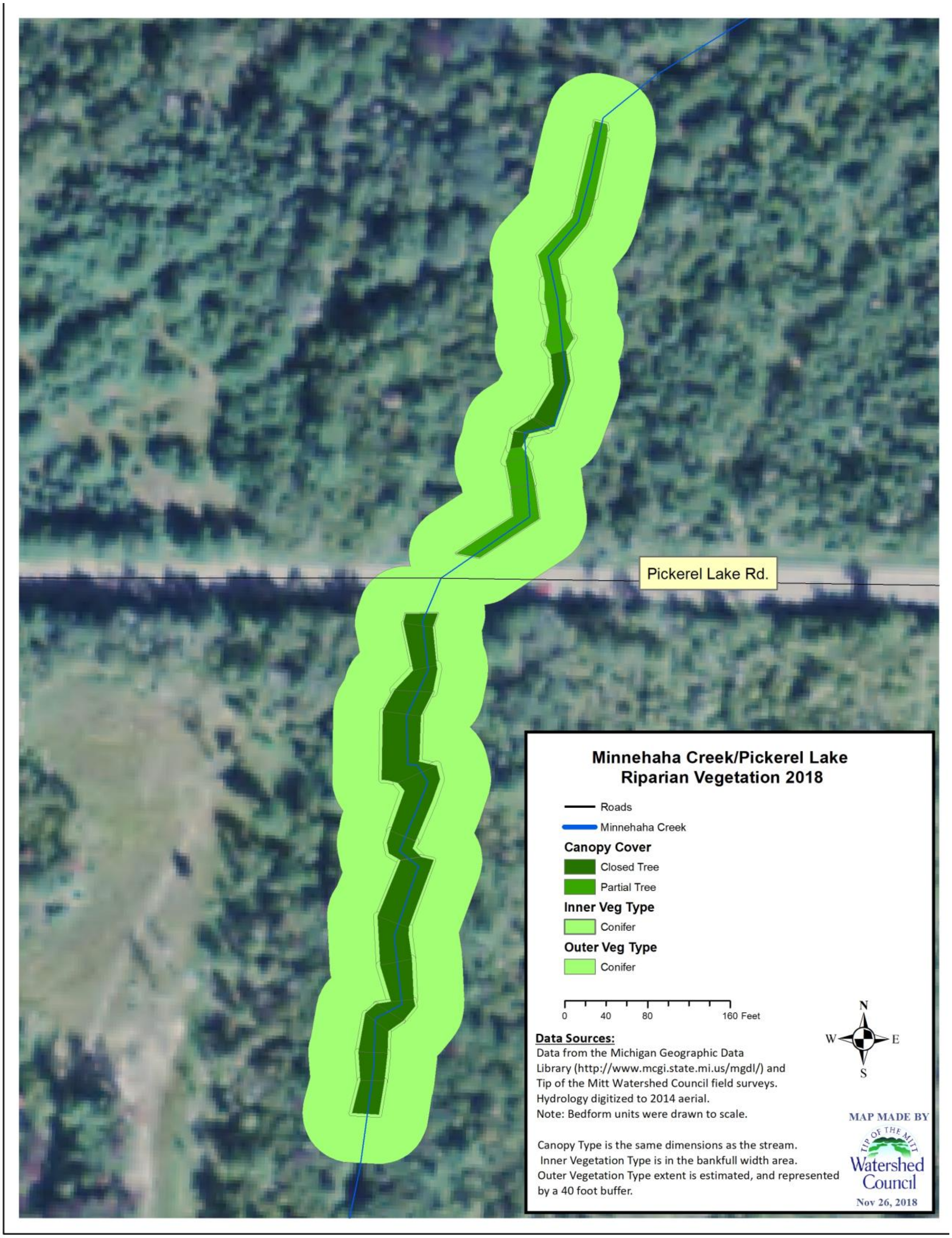

Figure 15. Minnehaha Creek/ Maxwell Rd. Riparian Vegetation 2018

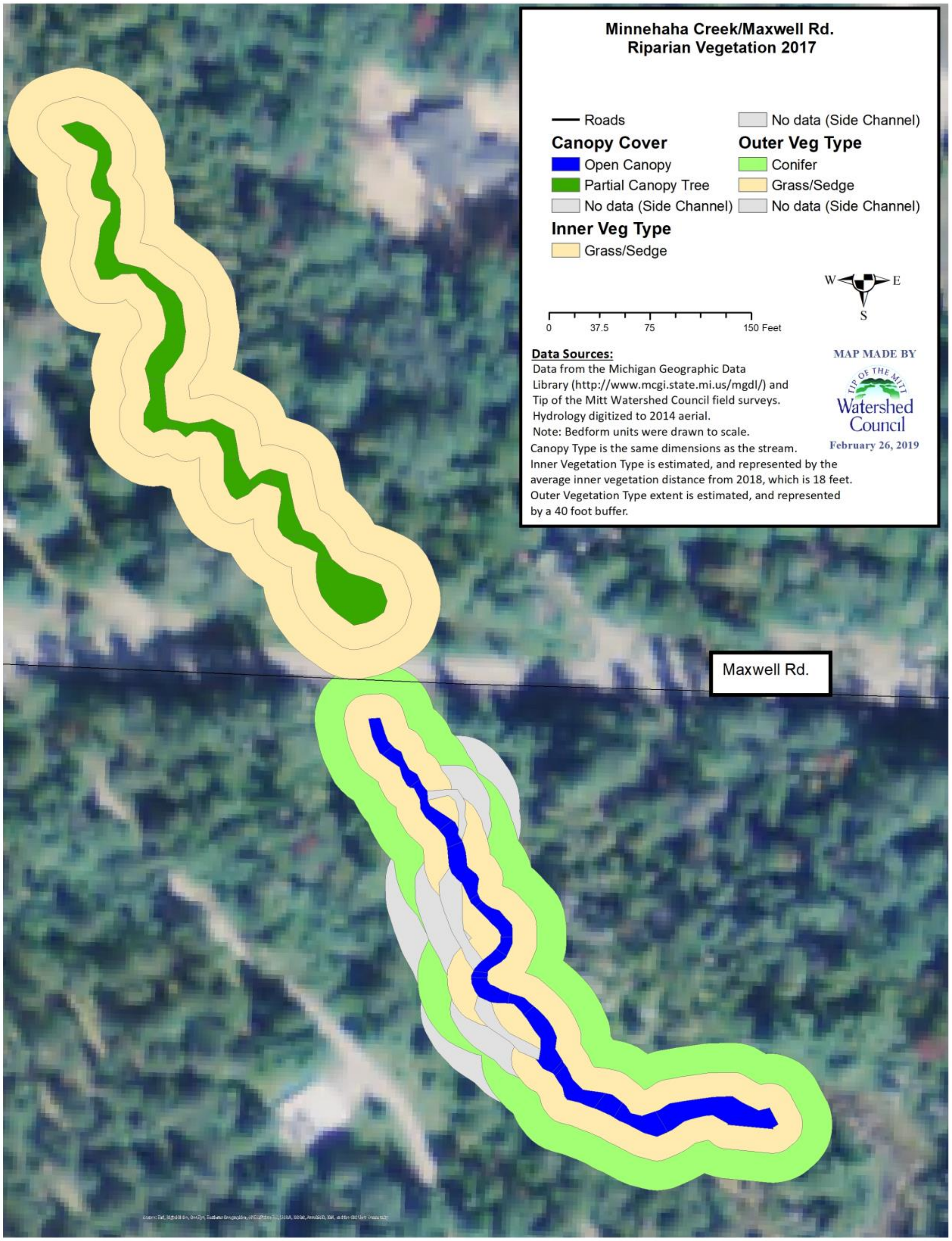

Figure 16. Minnehaha Creek/ Pickerel Lake Rd. Riparian Vegetation 2018