**STREAM GEOMORPHIC ASSESSMENT: PROJECT SUMMARY**

The Town completed a Strategic Watershed Plan in 2021 with the goal of proactively prioritizing water resources on a municipal wide basis. This science-based and data driven report yielded a list of recommendations for future action to protect Falmouth's waterways. One of the top priorities was to complete a *fluvial geomorphic assessment* of five streams in Falmouth: Chenery Brook, Hobbs Brook, Norton Brook, Mill Creek, and Webes Creek.

What is a fluvial geomorphic assessment? *A fluvial geomorphic assessment* studies the interactions between the physical shapes of rivers, their water and sediment transport processes, and the landforms they create. The assessment was completed to determine what restoration actions might be taken to remove Hobbs Brook from the Maine Department of Environmental Protection's (DEP) urban impaired streams list and to ensure the other four streams are not listed in the future.
The findings were used to identify the impacts of urbanization on channel morphology and physical aquatic habitat to develop conceptual restoration options that will address the identified underlying causes for stream degradation. In total, 30 distinct geomorphic sections of uneven lengths were assessed on the five streams with breaks between sections occurring where the character of the valley or channel changes abruptly. Many of the section breaks are at stream crossings where undersized culverts often disrupt the continuity of geomorphic, hydraulic, and ecological processes.

Human activities in the watershed have impacted the five assessed streams to varying degrees and extents. In-stream wood is an important element of high-quality physical aquatic habitat on streams in temperate climates. While the riparian zones on the five streams are well forested in most areas, long sections of even the most densely forested reaches are devoid of wood and may reflect past land clearance activities from decades ago. Streams that have had predominately forested watersheds for decades, such as Chenery Brook, Mill Creek, and Norton Brook, have more wood in the channel than watersheds that have become less forested through time (e.g., Webes Creek) or have only recently become reforested (e.g., Hobbs Brook). Forests take time to mature sufficiently for trees to begin decaying and naturally falling into the stream channel. In-stream wood levels in even the most forested of the five assessed streams are still below levels in pristine watersheds and will take decades to noticeably improve naturally. Therefore, the associated habitat benefits of in-stream wood could be more rapidly restored through "chop and drop" wood addition projects in remote areas or anchored wood additions using log sills, isolated logs, and log jams near stream crossings and other developments. Multiple undersized stream crossings are present along the five assessed streams with at least one such crossing on each stream. Undersized crossings are unable to convey large flow discharges without impounding flow, upsetting the natural hydrological, geomorphological, and ecological continuity of the stream. Large wetland complexes dominated by low growing alders have formed upstream of undersized crossings on all five streams although natural wetlands may have existed in some of these areas prior to the crossings' presence. Since the backwatering upstream of a culvert leads to deposition, flows exiting the culvert outlet are sediment starved and scour downstream of the undersized culverts is sometimes severe, exposing a hardpan clay on the stream bottom and eroding banks. The best restoration measure to Falmouth streams that addresses the impact of the undersized crossings is to replace them with geomorphically compatible structures that have a width at least equivalent to the stream channel and also provide for relief culverts where wide floodplains are present. Larger structures may take years to replace given the high cost, so log crib walls and log sills could be used in the interim to address the impacts of bank and bed scour, respectively, at the undersized culvert outlets.

Past direct human activities on or near the stream channel continue, at least locally, to constrain the stream's adjustment and impact channel morphology. An old dam on Mill Creek blocks the sinuous natural flow path with the stream now flowing through a deep eroding gully around the dam's flank. Artificial fill on the floodplain at two or more locations on Norton Brook constrains channel migration and the development of a more natural sinuous planform. On the most upstream reach of Webes Creek, channel constraints by fill have caused erosion of the opposite bank and exposure of a manhole along the sewer line paralleling the length of the stream. Portions of the five streams were likely straightened in the past and the resulting higher flow velocities tend to be associated with the exposure of a habitat-poor hardpan clay on the stream bottom. Ideally, these various constraints to channel adjustment can be removed as part of restoration efforts (e.g., fill removal), so natural conditions can develop and be sustained over time. Elsewhere, log jams and other restoration structures could be constructed to more immediately improve aquatic habitat and encourage meander redevelopment along straightened reaches.

Human development within the watersheds of the five streams has increased over time, particularly in the Webes Creek watershed. Little evidence was seen on the five streams that excess runoff from impervious surfaces or concentration of runoff was having a direct impact on the stream channels. However, concentration of runoff along Route 1 has resulted in the erosion of a small gully that has led to deposition of a delta into Chenery Brook at the mouth of the gully. The excess runoff from development could, however, be indirectly contributing to erosion of the bed and banks more directly related to other human activities (e.g., undersized crossings). In-stream efforts to address these issues could include reclamation of the floodplain through the removal of artificial fill and the addition of in-stream wood, both of which should reduce flood flow velocities potentially enhanced from excess (and the concentration) of runoff. Despite the human influences on the five streams, natural conditions still exert a strong influence. A great length of all five streams flow through stiff fine-grained glaciomarine clays and silts (i.e., hardpan), leading to channels with a low width:depth ratio (i.e., relatively deep and narrow) and high sinuosity with sometimes very tight meanders developing. Wood in the channel is typically associated with positive habitat attributes such as cover, flow complexity, and the deposition of sediment above the hardpan clay. These natural conditions indicate that restoration efforts focused on removing constraints to natural processes and increasing wood loading in the stream channels will lead to sustainable habitat improvements that will keep the streams from being listed as urban impaired by the State of Maine.